Proceedings of the
5th International Olympiad on Astronomy and Astrophysics (IOAA)
Silesia, Poland

5th IOAA
SILESIA POLAND 2011

Katowice, 25.08-04.09. 2011

5th International Olympiad on Astronomy and Astrophysics under the auspices of the President of the Republic of Poland

Edited by: J. Juszkiewicz

Editorial team:

L. Motyka, B. Zakrzewski, W. Ogłoza, H. Chrupała,

J. Szczepanik, G. Stachowski, S. Janta,

Translation: K. Kowalska – Kiera

Photos: A. Ślązok, G. Sowa, D. Jabłeka

Illustrations come from the book by Johannes Hevelius
entitled *SELENOGRAPHIA SIVE LUNAE DESCRIPTIO* dating back to 1647

Printed by: www.drukarnia-tom.pl

LIST OF CONTENTS

Słowo wstępne

Szanowni uczestnicy V Międzynarodowej Olimpiady z Astronomii i Astrofizyki, liderzy grup i obserwatorzy, współorganizatorzy 5th IOAA z Chorzowa, Katowic i Krakowa, sprzymierzeńcy 5th IOAA, wolontariusze, drodzy Państwo!

Jedenaście dni pomiędzy 25 sierpnia a 4 września 2011 r. przejdzie do historii Planetarium i Obserwatorium Astronomicznego im. Mikołaja Kopernika w Chorzowie, jako czas zmagań olimpijczyków. Zmagań, które tworzą nową kartę dziejów naszej placówki. Chociaż na co dzień przyzwyczajeni jesteśmy do odwiedzin naszej śląskiej świątyni nauki i popularyzacji wiedzy o Wszechświecie przez rzesze młodych sympatyków astronomii, jednak obecność poszukiwaczy odpowiedzi na najtrudniejsze pytania z astronomii i astrofizyki – uczestników V IOAA – to prawdziwe święto Planetarium i Województwa Śląskiego.

Oczekiwaliśmy uczestników z niecierpliwością, przygotowując od wielu miesięcy zadania i program pobytu Gości w Polsce, pokonując wspólnie mniejsze i większe problemy organizacyjne. Pod koniec przygotowań - w ostatniej dekadzie lipca 2011 roku - odwiedził Śląsk i Kraków, żeby przyjrzeć się postępowi prac, poznać i ostatecznie ustalić tematykę zadań olimpijskich, ocenić stan przygotowań do tego międzynarodowego przedsięwzięcia, ówczesny Sekretarz Generalny Międzynarodowej Olimpiady z Astronomii i Astrofizyki (dziś jej Przewodniczący) – Pan dr Chatief Kunjaya z Indonezji, który udzielił nam swych cennych rad. Serdecznie Mu za to dziękuję.

W trakcie olimpijskich zmagań nad całością ich przebiegu czuwał Pan profesor Boonrucksar Soonthomthum z Tajlandii – ówczesny Przewodniczący IOAA, a dr Greg Stachowski, aktualny Sekretarz Generalny, koordynował poczynania sędziów i liderów w Krakowie. Składam Panom tą drogą wyrazy wdzięczności.

Dziś, kiedy nadszedł czas podsumowań i symbolicznego pożegnania z V IOAA niniejszą publikacją, mam zaszczyt - w imieniu wszystkich współorganizatorów – Wam, drodzy uczestnicy z Bangladeszu, Białorusi, Brazylii, Bułgarii, Chin, Chorwacji, Czech, Grecji, Węgier, Indii, Indonezji, Iranu, Kazachstanu, Kolumbii, Korei Południowej, Litwy, Portugalii, Rumunii, Rosji, Serbii, Singapuru, Słowacji, Sri Lanki, Tajlandii, Ukrainy i Polski – serdecznie podziękować. Dziękuję Wam za stworzenie wspaniałej atmosfery naukowej, za epatowanie ciepłem i serdecznością wzajemną. Dziękuję za pokazanie światu, że przyjaźń nie zna granic państwowych, religijnych, kulturowych i obyczajowych.

Choć wynik olimpijskich zmagań był dla wszystkich uczestników rzeczą najważniejszą, to swoją postawą udowodnili, że dla każdego z nich wartością samą w sobie były wzajemne relacje międzyludzkie - cenniejsze niż pozycje, punkty i medale.

Gratuluję wszystkim, życzę dalszych sukcesów, odkrywania nieznanego i spełnienia marzenia każdego naukowca – Nagrody Nobla.

Liderzy i obserwatorzy V IOAA, niczym trenerzy sportowych teamów przeżywali z boku, często bardziej emocjonalnie niż sami uczestnicy, naukowe zmagania podopiecznych.

Myślę, że każdy z liderów i obserwatorów ma swą cząstkę w sukcesie grup i pojedynczych zawodników. Wśród tych wyjątkowych miłośników nauk ścisłych nie może nie być pasjonatów, którzy swoją pozytywną energią, pracowitością i zapałem naukowym zarazili następców sięganiem po najwyższe laury świata astronomii i astrofizyki. Wsparli oni także swoich podopiecznych doskonałym tłumaczeniem zadań V IOAA z języka angielskiego na języki ojczyste.

Szanowni Państwo! Nigdy wcześniej przedsięwzięcia Planetarium Śląskiego nie objął swoim patronatem Prezydent Rzeczypospolitej Polskiej. Chylę czoło i z serca dziękuję Panu Prezydentowi Rzeczypospolitej Polskiej Bronisławowi Komorowskiemu, że uczynił zaszczyt objęcia V Międzynarodowej Olimpiady z Astronomii i Astrofizyki patronatem honorowym.

Za pomoc i przychylność dziękuję także Panu prof. dr. hab. Stefanowi Niesiołowskiemu – Wicemarszałkowi Sejmu Rzeczypospolitej Polskiej VI kadencji.

Chciałbym też, w tej szczególnej publikacji, podziękować wszystkim, którzy przyczynili się do organizacji V IOAA.

Nawet najlepsze pomysły i chęci zorganizowania tak prestiżowego przedsięwzięcia nie byłyby możliwe, gdyby nie finansowe i decyzyjne zagwarantowanie realizacji projektu.

Wyrazy szacunku i wdzięczności składam Ministerstwu Edukacji Narodowej za zaufanie dla chorzowskiego centrum olimpijsko – astronomicznego jakim jest organizator pięćdziesięciu pięciu krajowych Olimpiad Astronomicznych – Planetarium Śląskie. Dziękuję za wsparcie i obecność w Chorzowie Panu Jackowi Krawczykowi - Dyrektorowi Departamentu Zwiększania Szans Edukacyjnych w Ministerstwie Edukacji Narodowej oraz Panu Arturowi Matejkowskiemu – starszemu specjaliście tegoż Departamentu.

Człowiekiem, który podjął odważną i – w jak najbardziej pozytywnym znaczeniu tego słowa – brzemienną w skutkach decyzję o organizacji V IOAA na Śląsku był ówczesny marszałek województwa a obecnie Senator Rzeczypospolitej Polskiej Pan Bogusław Śmigielski.

Z równie fantastycznym zaangażowaniem kontynuował dzieło Pan Adam Matusiewicz – Marszałek Województwa Śląskiego i odpowiedzialny za sektor oświaty Województwa Śląskiego – Członek Zarządu Pan Jerzy Gorzelik.

Dziękuję Panom Marszałkom bez zaangażowania których Śląsk i Planetarium Śląskie nie dostąpiliby zaszczytu organizowania tej największej astronomiczno – astrofizycznej imprezy na świecie.

Dziękuję za uświetnienie swoją obecnością uroczystości inauguracji i podsumowania V IOAA Panu Marszałkowi Adamowi Matusiewiczowi, Panu Jerzemu Gorzelikowi – Członkowi Zarządu, Pani Dyrektor Wydziału Edukacji i Nauki – Ewie Baran, Pani Zastępczyni Dyrektora Wydziału Edukacji i Nauki – Grażynie Marasek i wszystkim osobom reprezentującym Urząd Marszałkowski oraz wszystkim dyrektorom placówek oświatowych, dla których organem prowadzącym jest Województwo Śląskie.

Panu Adamowi Matusiewiczowi i Panu Jerzemu Gorzelikowi dodatkowo dziękuję za podniosłe słowa skierowane do zebranych na uroczystości rozpoczęcia i zakończenia V IOAA w Teatrze Rozrywki w Chorzowie.

Na ręce Pani Dyrektor Wydziału Edukacji i Nauki składam podziękowanie Pani Gabrieli Paletko i Panu Sławomirowi Setlakowi za niezastąpioną pomoc w organizacji V IOAA.

Za wszelką przychylność dziękuję władzom miasta Chorzowa: uczestnikom Olimpiady zaszczyt uczynili swoją obecnością Prezydent Miasta Chorzów – mgr inż. Andrzej Kotala, Zastępca Prezydenta Miasta Chorzowa – mgr Wiesław Ciężkowski oraz dyrektorzy liceów ogólnokształcących Chorzowa.

Program Olimpiady realizowany był nie tylko w Śląskim Planetarium, organizacyjnie wspomagały nas władze Wojewódzkiego Parku Kultury i Wypoczynku: Pan Arkadiusz Godlewski – Prezes Zarządu WPKiW S.A. oraz Pan Tomasz Kaczmarek – Wiceprezes Zarządu WPKiW S.A.

Dla biegu na orientację uczestników V IOAA przestrzeń Ogrodu Zoologicznego uprzejmie udostępniła pani dyrektor Jolanta Kopiec, natomiast Muzeum Górnośląski Park Etnograficzny „Skansen" z panem dyrektorem Bogdanem Kuboszkiem na czele gościł zawodników, liderów, wolontariuszy i wszystkich współorganizatorów V IOAA.

Podczas jedenastodniowych zmagań olimpijskich i duchem i ciałem były z nami władze Komitetu Głównego Olimpiady astronomicznej: prof. dr hab. Jerzy Kreiner – przewodniczący, prof. dr hab. Andrzej Pigulski, prof. dr hab. Bartłomiej Pokrzywka, prof. dr hab. Andrzej Sołtan, prof. dr hab. Edwin Wnuk (prezes Polskiego Towarzystwa Astronomicznego), dr Henryk Brancewicz - prezes Polskiego Towarzystwa Miłośników Astronomii), dr Henryk Chrupała - wiceprzewodniczący, dr Grzegorz Kondrat, dr Waldemar Ogłoza, dr Krzysztof Ziołkowski, mgr Jacek Szczepanik - sekretarz naukowy, mgr Marek Szczepański.

Cenny swój czas uczestnikom i organizatorom wspaniałomyślnie ofiarował prawdziwy autorytet, nie tylko w dziedzinie astronomii, prezes Polskiego Towarzystwa Miłośników Astronomii – dr Henryk Brancewicz.

Szczególne wyrazy uznania kieruję do wszystkich autorów zadań, którymi byli: prof. dr hab. Jerzy Kreiner, prof. dr hab. Andrzej Sołtan, dr Jerzy Kuczyński, dr Waldemar Ogłoza, dr Greg Stachowski, mgr Marek Szczepański i mgr Stefan Janta. Nie tylko trudność, ale i atrakcyjność zadań podkreślali zawodnicy, liderzy i obserwatorzy V Międzynarodowej Olimpiady z Astronomii i Astrofizyki.

Dziękuję sędziom V IOAA (prof. Jerzy Kreiner, prof. Bartłomiej Pokrzywka, Waldemar Ogłoza. Jerzy Kuczyński, Jacek Czakański, Janusz Nicewicz, Karolina Zawada, Zbigniew Głownia, Agata Pepiak, Błażej Nikiel-Wroczyński, Jerzy Krzesiński, Michał Ochman, Robert Szafron, Agata Rożek, Piotr Guzik, Dorota Kozieł-Wierzbowska, Alicja Konieczny, Tadeusz Firszt, Stefan Janta, Tomasz Kisiel, Marek Szczepański, Jacek Szczepanik, Jan Desselberger) oraz pomocnikom sędziów (Bartłomiej Zakrzewski, Marek Dróżdż, Beata Dyduch, Urszula Lewczuk, Paweł Stopa, Ewa Kosturkiewicz, Elżbieta Dudek, Damian Jabłeka), którzy niezwykle sprawnie uporali się z dyskusją nad zadaniami, ich sprawdzeniem i ocenieniem.

V Międzynarodowa Olimpiada z Astronomii i Astrofizyki była świętem nie tylko Śląskiego Planetarium, ale całego regionu, a nawet kraju, dzięki rzetelnemu i obiektywnemu przekazowi medialnemu. Dziękuję TVP 3, TV Silesia, regionalnym i miejskim telewizjom kablowym i internetowym, Polskiemu Radiu Katowice, Radiu Piekary i innym stacjom radiowym, redakcji Dziennika Zachodniego, Gazety Wyborczej, Gazety Parkowej, Chorzowianina, Magazynu Wspólnota Europejska Euro 25 (szczególne podziękowanie dla Pani Ilony Saft – redaktor naczelnej), który przez swój zasięg rozsławił Olimpiadę i województwo śląskie na całym świecie. W tym samym miejscu pragnę podkreślić rolę wszystkich redagujących codziennie wydawany "Newsletter" informujący i obrazujący najważniejsze wydarzenia dnia poprzedniego oraz publikacji: „Welcome booklet" (pod redakcją Jarosława Juszkiewicza) – anglojęzycznego informatora i przewodnika dla każdego uczestnika, gościa i wszystkich ludzi związanych z V IOAA. Swoje artykuły zamieścili w nim: Henryk Chrupała, Jan Desselberger, Lech Motyka, Sławomir Setlak, Magdalena Sekuła, Katarzyna Głuch – Juszkiewicz, a tłumaczyła je Katarzyna Kowalska. Skorzystano ze zdjęć zrobionych przez: Gabrielę Sowę, Tomasza Piwka, Stefana Jantę, Michała Żołnowskiego i Andrzeja Szczygła.

Niezwykła atmosfera życzliwości i wzajemnej sympatii towarzysząca imprezie to wielka zasługa, co jeszcze raz podkreślam, uczestników, ale w sposób szczególny do jej tworzenia przyczyniła się liczna grupa młodych wolontariuszy – opiekunów każdego z 29 olimpijskich zespołów, przede wszystkim studentów różnych kierunków i uczelni. Językowo i organizacyjnie pomagali uczestnikom, organizatorom, opiekunom, sędziom i mediom, wręcz na swój sposób wszystkich scalali: Katarzyna Kowalska i Tomasz Kisiel.

Dziękuję serdecznie wszystkim zaangażowanym w organizację V IOAA pracownikom Śląskiego Planetarium: Barbarze Osiejuk, Agacie Spruś, Bogusławie Zagole, Rafałowi Bączkowiczowi, Henrykowi Chrupale, Jackowi Czakańskiemu, Krzysztofowi Dwornikowi, Tadeuszowi Firsztowi, Damianowi Jabłece, Stefanowi Jancie, Jerzemu Kuczyńskiemu, Jackowi Szczepanikowi, Markowi Szczepańskiemu, Krystynie Dybek, Krystynie Perek, Katarzynie Połońskiej, Katarzynie Prusak, Grażynie Salamon, Elżbiecie Tkacz, Annie Gamon, Bożenie Gąsce, Marioli Jurkowskiej, Marii Kandzi, Monice Minkowskiej, Mariannie Tymorek, Zbigniewowi Dmowskiemu, Jerzemu Palidze, Krystianowi Plonie.

Każda z wymienionych przeze mnie osób jest znaczącym ogniwem wielkiego wspólnego sukcesu – organizacji V Międzynarodowej Olimpiady z Astronomii i Astrofizyki, ale pozwolą Państwo, że w sposób szczególny podziękuję osobom, które wspierały mnie tak, że bez nich nie wyobrażam sobie przygotowań Olimpiady. Trudno zliczyć godziny, które poświęcili Olimpiadzie i Planetarium oraz obrazowi Śląska i naszego kraju w oczach gości z 26 państw świata: pani Gabriela Paletko, pan Stefan Janta, pan Sławomir Setlak. Serdecznie Państwu dziękuję!

Cieszę się, że uczestnicy V IOAA stając w szranki o miano najlepszego astronoma-astrofizyka mogli też zobaczyć najpiękniejsze zakątki naszego regionu. Mam nadzieję, że wizyta w Kopalni Guido w Zabrzu, w Pszczynie, w Muzeum Chleba w Radzionkowie czy w Pławniowicach pozostanie w pamięci przedstawicieli wszystkich kontynentów.

W imieniu wszystkich współorganizatorów życzę Brazylii – kolejnemu organizatorowi Olimpiady z Astronomii i Astrofizyki równie wspaniałych przeżyć, które dane były uczestnikom i sprzymierzeńcom V IOAA w Chorzowie.

Lech Motyka

Preface

Dear participants of 5^{th} International Olympiad on Astronomy and Astrophysics, group leaders and observers, co-organisers of 5^{th} IOAA from Chorzów, Katowice and Kraków, the supporters of 5th IOAA, volunteers, Ladies and Gentlemen!

Those eleven days between 25^{th} August and 4th September 2011 will go down in the history of the Nicolaus Copernicus Planetarium and Astronomical Observatory in Chorzów as the time of Olympic struggles - the struggles creating a new chapter in the history of this institution. Though we are accustomed to the visits of young enthusiasts of astronomy in our Silesian temple of science, the presence of those seeking answers for the most difficult questions in the field of astronomy and astrophysics – the participants of 5^{th} IOAA – was a real feast for both the Planetarium and the Silesian Voivodship.

We awaited participants impatiently, preparing the tasks and the programme of their visit in Poland for a few months and overcoming smaller and bigger organisational problems together. At the end of the preparation period – in the last decade of July 2011 – Silesia and Kraków were visited by the then Secretary General of the International Olympiad on Astronomy and Astrophysics (now its Head) – Mr Chatief Kunjaya from Indonesia – who came to evaluate the preparations for this international event and provided us with valuable advice. I thank him for that.

During olympic struggles, professor Boonrucksar Soonthomthum from Thailand – the then Chairman of IOAA – oversaw their course and Dr. Greg Stachowski, the present-day Secretary General, coordinated the actions of judges and leaders in Kraków. On this occasion, I express my gratitude to you, Gentlemen.

Today, when the time of summaries and the symbolic farewell to 5^{th} IOAA came, in the form of this publication I have the honour – on behalf of all co-organisers – to thank you, dear participants from Bangladesh, Belarus, Brazil, Bulgaria, China, Columbia, Croatia, Czech Republic, Greece, Hungary, India, Iran, Kazakhstan, South Korea, Lithuania, Portugal, Romania, Russia, Serbia, Singapore, Slovakia, Sri Lanka, Thailand, Ukraine and Poland. I thank you for creating wonderful scientific atmosphere, warmth and mutual cordiality. I thank you for showing the world that friendship respects no national, religious, cultural and lifestyle boundaries.

Though the result of Olympic struggles was the most important thing for all participants, they proved with their attitude that for all of them the mutual interpersonal relations were themselves more precious than positions, points and medals.

I congratulate you all, I wish you further successes, discovering the unknown and fulfilling the dreams of all scientists – being granted the Nobel Prize.

Leaders and observers of 5th IOAA, just like the sport teams coaches, experienced the scientific battles of their wards sometimes even more emotionally than the participants did themselves.

I think that all leaders and observers contributed to the success of the groups and individuals. Among those unique science enthusiasts, there were those who pass their positive energy, diligence and zeal for studying on successors and urge them to reach for the top prizes of the world of astronomy and astrophysics. They also supported their wards with outstanding translation of the tasks of 5th IOAA from English into mother tongues.

Ladies and Gentlemen! Never before have the undertakings of the Planetarium been taken under the patronage of the President of the Republic of Poland. I take my hat off to Bronisław Komorowski who graced us with taking honorary patronage over the 5th International Olympiad on Astronomy and Astrophysics.

For the help and favour I also thank professor Dr. Stefan Niesiołowski – Deputy Speaker of the Sejm of the Republic of Poland.

I would also like, on the cards of this publication, thank all who contributed to the organisation of 5th IOAA.

Even the best ideas and wish to organise such a prestigious event would not be possible without the financial aid and the guarantee of fulfilling the project.

I am paying respect to the Ministry of National Education for the trust for Planetarium in Chorzów – the organiser of fifty-five national Astronomy Olympiads. I thank Mr Jacek Krawczyk, the Director of the Department of Improving the Educational Opportunities in the Ministry of National Education for the support and the presence and Mr Artur Matejkowski, the senior specialist of this Department.

A man who took a brave – and rich in consequences – decision about organising 5th IOAA in Silesia was Mr Bogusław Śmigielski, the then Marshall of the voivodship and the present-day Senator of the Republic of Poland.

Mr Adam Matusiewicz, the Marshall of the Silesian Voivodship and a person responsible for the Department of Education of the Silesian Voivodship – Mr Jerzy Gorzelik, the member of the board, continued this work with equally fantastic commitment.

I thank the Marshalls, without the commitment of whom Silesia and the Silesian Planetarium would not have been granted the honour of organising this largest astronomical-astrophysical event in the world.

I thank Marshall Mr Adam Matusiewicz, Mr Jerzy Gorzelik -the member of the board, Mrs Ewa Baran – the Director of the Department of Science and Education, Mrs Grażyna Marasek – the deputy Director of the Department of Science and Education and all people representing the Marshal's office and all directors of the educational establishments for whom the Silesian Voivodship was the supervising body for honouring the opening ceremony and the summary of the 5th IOAA.

I give additional thanks to Mr Adam Matusiewicz and Mr Jerzy Gorzelik for the lofty words aimed at all the people gathered at the opening and closing ceremony of 5th IOAA in the Entertainment Theatre in Chorzów.

I also express thanks to the Director of the Department of Science and Education, Mrs Gabriela Paletko and Mr Sławomir Setlak for the indispensable help while organising the 5th IOAA.

I express my gratitude towards the authorities of the city of Chorzów for their goodwill and for delighting us with their presence: the President of the city of Chorzów - M.Sc. Eng. Andrzej Kotala, Vice President – M.Sc. Wiesław Ciężkowski and the directors of the schools of secondary education in Chorzów.

The programme of the Olympiad was realised not only in the Silesian Planetarium. When it comes to organisational issues, we were supported by the authorities of the Silesian Culture and Recreation Park, the chairmen of the Silesian Culture and Recreation Park JSC – Mr Arkadiusz Godlewski and Mr Tomasz Kaczmarek – Vice-President of the board of the Silesian Culture and Recreation Park JSC.

The territory of the zoo was made accessible for the participants of the 5th IOAA thanks to the Director, Mrs Jolanta Kopiec. Upper Silesian Ethnographic Park "Skansen" with the Director, Mr Bogdan Kuboszek in the vanguard hosted the competitors, leaders, volunteers and all co-organisers of 5th IOAA.

During 11-day-olympic struggles, the authorities of the Head Committee of the Astronomical Olympiad: professor Dr. Jerzy Kreiner – the chairman of the jury, professor Dr. Andrzej Pigulski, professor Dr. Bartłomiej Pokrzywka, professor Dr. Andrzej Sołtan, professor Dr. Erdwin Wnuk (the chairman of the Polish Astronomical Society), Dr. Henryk Brancewicz – the chairman of Polish Amateur Astronomers Society, Dr. Henryk Chrupała – Vice President, Dr. Grzegorz Kondrat, Dr. Waldemar Ogłoza, Dr. Krzysztof Ziołkowski, M.Sc. Jacek Szczepanik – scientific secretary, M.Sc. Marek Szczepański.

Dr. Henryk Brancewicz, a real authority not only in the field of astronomy, the chairman of the Polish Amateur Astronomers Society generously devoted his precious time.

Exceptional expressions of gratitude are directed to all authors of the tasks, these are: professor Dr. Jerzy Keiner, professor Dr. Andrzej Sołtan, Dr. Jerzy Kuczyński, Dr. Waldemar Ogłoza, Dr. Greg Stachowski, M.Sc. Marek Szczepański and M.Sc. Stefan Janta. Not only difficulty but also attractiveness of the tasks were emphasised by the participants, leaders and observers of the 5th International Olympiad on Astronomy and Astrophysics.

I thank all judges of 5th IOAA (Jerzy Kreiner, Bartłomiej Pokrzywka, Waldemar Ogłoza, Jerzy Kuczyński, Jacek Czakański, Janusz Nicewicz, Karolina Zawada, Zbigniew Głownia, Agata Pepiak, Błażej Nikiel-Wroczyńki, Jerzy Krzesiński, Michał Ochman, Robert Szafron, Agata Rożek, Piotr Guzik, Dorota Kozieł-Wierzbowska, Alicja Konieczny, Tadeusz Firszt, Stefan Janta, Tomasz Kisiel, Marek Szczepański, Jacek Szczepanik, Jan Desselberger) and their assistants (Bartłomiej Zakrzewski, Marek Dróżdż, Beata Dyduch, Urszula Lewczuk, Paweł Stopa, Ewa Kosturkiewicz, Elżbieta Dudek, Damian Jabłeka), who efficiently dealt with the discussion over the problems, their proofreading and evaluation.

5th International Olympiad on astronomy and Astrophysics was a festival not only for a Silesian Planetarium but also for the whole region, and even a country thanks to a reliable and objective media covering. I thank TVP3, TV Silesia, regional and city cable and Internet television stations, Polish Radio Katowice, Radio Piekary and other radio stations, the editorial offices of Dziennik Zachodni, Gazeta Wyborcza, Gazeta Parkowa, Gazeta Chorzowianin, Wspólnota Europejska Euro 25 Magazine (special thanks for Mrs Ilona Saft – editor-in-chief), which, thanks to its spread, popularized the Silesian Voivodship in the whole world. At this point I would also like to emphasise the role of all people who, day by day, edited the "Newsletter" informing about and presenting the most important events of the previous day and the "Welcome booklet" (edited by Jarosław Juszkiewicz) – an English directory and guide for each participant, guest and all people connected with 5th IOAA. Those who placed their articles inside are Henryk Chrupała, Jan Desselberger, Lech Motyka, Sławomir Setlak, Magdalena Sekuła, Katarzyna Głuch-Juszkiewicz; Katarzyna Kowalska translated them. Photos that illustrated the publication were taken by Gabriel Sowa, Tomasz Piwek, Stefan Janta, Michał Żołnowski and Andrzej Szczygieł.

Unique atmosphere of friendliness and mutual fondness accompanying the event is a great merit of - I will emphasize this once again – participants. However, a numerous group of young volunteers – guides of each of 29 olympic teams, mostly students of various faculties and universities, contributed to its creation in a very special way. Katarzyna Kowalska and Tomasz Kisiel supported the participants, organisers, guides, jury and media with linguistic and organisational help – they integrated everyone.

I give thanks to all employees of the Silesian Planetarium engaged in organising 5th IOAA: Barbara Osiejuk, Agata Spruś, Bogusława Zagoła, Rafał Bączkowicz, Henryk Chrupała, Jacek Czakański, Krzysztof Dwornik, Tadeusz Firszt, Damian Jabłeka, Stefan Janta, Jerzy Kuczyński, Jacek Szczepanik, Marek Szczepański, Krystyna Dybek, Krystyna Perek, Katarzyna Połońska, Katarzyna Prusak, Grażyna Salamon, Elżbieta Tkacz, Anna Gamon, Bożena Gąska, Mariola Jurkowska, Maria Kandzia, Monika Minkowska, Marianna Tymorek, Zbigniew Dmowski, Jerzy Paliga and Krystian Plona.

Each of the enumerated people is a significant element of great common success – the organisation of the 5th Olympiad on Astronomy and Astrophysics. But let me thank in a special way those who supported me so much that I cannot even imagine the preparations for the Olympiad without them. It is difficult to count the hours they devoted to the Olympiad, the Planetarium and the image of Silesia and our country in the eyes of the guests from 26 countries: Mrs Gabriela Paletko, Mr Stefan Janta and Mr Sławomir Setlak. I cordially thank you!

I am glad that the participants of 5th IOAA competing to achieve the title of the best astrophysics could also see the most beautiful places of our region. I hope that the visit to the Coal Mine Guido in Zabrze, to Pszczyna, the Museum of Bread in Radzionków or in Pławniowice will remain in the memory of the representatives of all continents.

On behalf of all co-organisers I wish Brasil – the next organiser of the Olympiad on Astronomy and Astrophysics – equally wonderful moments that the participants and friends of the 5th IOAA experienced in Chorzów.

Lech Motyka

Message from the President of IOAA

Let me start by congratulating Poland and the Organizing Committee, both scientific and local, of this IOAA. Really, all of you have done a wonderful work to make the 5th IOAA a success.

I would also like to take this opportunity to pay remembrance to one of our friends who is not here today, Dr Waldemar Gorzkowski, who passed away in Isfahan, Iran on July 15, 2007,was one of the very first group to shape the existence of the International Olympiads in Astronomy and Astrophysics from its very start. His willingness to found the venue for promoting interest and excellence in the field of Astronomy and Astrophysics, just like in other lines of science, is a great principal to the Astro-Olympiads.

Each host country for the IOAA brings a distinctive flavor to her running of the Olympiads. Each builds further on the achievements and ideas of the past. I think we are now in a uniquely strong position. My experience over the past few years has shown me how immensely rich a resource we have in our member countries. To have attracted many candidates teams of so high a calibre, is a testament to the strength and value of IOAA.

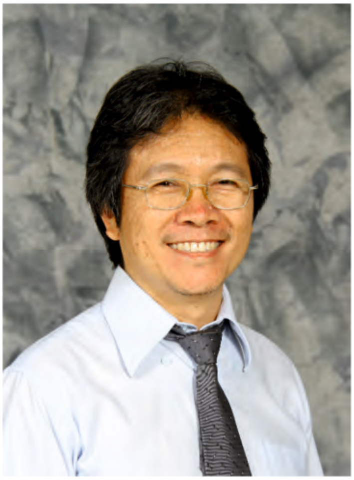
Though there is still much to be done, I believe that we have made quite a progress and that there is potential for important continuing advances in every aspect of IOAA.

I am deeply grateful for all the support I have had during my days as the President of the IOAA. From yourselves, from governments, from my colleagues, team members and friends in the community and outside. Last, but not least, I fully hope that the IOAA will continue to be global and sustainable platform for students interested in the field of Astronomy and Astrophysics. The competition will expose participants to enriching learning experiences, thereby, motivating them to strive for excellence in the international arena. Only in this way can our primary goal of the sustainable development of Astronomy and Astrophysics and personnel in this subject area be achieved.

Thank you,

Professor Boonrucksar Soonthornthum

Message from the Secretary General of IOAA



My term as the IOAA General Secretary started in the first IOAA in Chiang Mai, Thailand, in 2007. It was quite surprising for me when few colleagues, especially from Thailand, told me that they considered to nominate me as the Secretary of IOAA. I did not have any idea whether to accept or refuse the nomination. Why me? Many other team leaders have also the competency for the position. I had no clear idea about the detail of the job, no experience in the management of any international olympiad. Is it wise to accept a job when I do not know well about it? Then I consulted my colleagues in the ministry of education and also the other Indonesian colleagues.

Then I realize that possibly all other colleagues will have the similar level of knowledge of the job. Anybody who fill the position will have to learn, figure out what to do and define the detail of the job by themselves for fulfilling the purpose and mission of the organization. IOAA was a new organization, perhaps, nobody know exactly what kind of challenge to be faced. The support from my Indonesian colleagues, made me decide to accept the nomination and finally the IBM approved Prof Boonrucksar Soonthornthum as the president and me as the Secretary.

I felt honored that the leaders trusted me to become the Secretary and I should not disappoint them. Some of the main jobs, I think, is to make IOAA develop well, more participating countries in the future, and to make sure that the event is held every year with good quality. Then I figure out what to do to fulfill the purpose. The president also did the same things and we work together to formulate the plan to be proposed to the IBM.

Since the establishment of IOAA in 2006, during the preparatory meeting in Thailand, Indonesia had been appointed to be the host of the second IOAA, while Iran was nominated to be the third host. However it was not clearly decided for Iran because we had not gotten the formal approval from the Government of Iranian. Later, in the mid of the first IOAA, Brazil proposed to become the host of the third IOAA, and then we had two candidates. It was the first challenging task for me as the IOAA Secretary and Boonrucksar as the President to negotiate with Iranian and Brazilian team leaders to decide the host of the third IOAA.

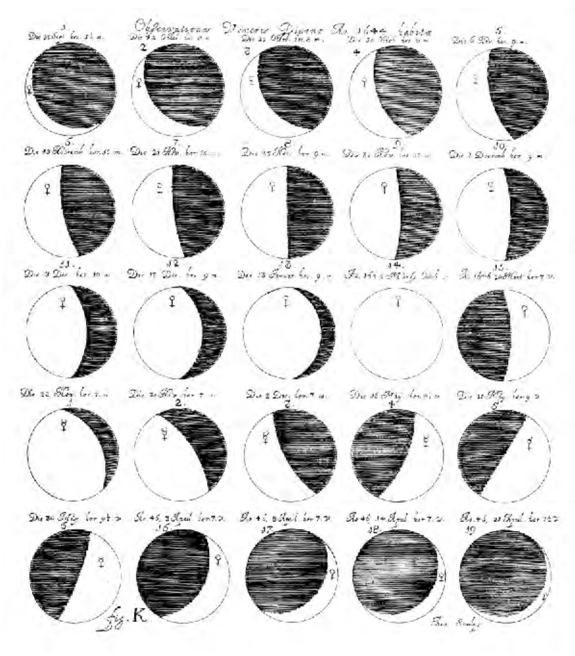
The other memorable moment in the effort to build IOAA was the contact with IAU. Everybody agree that support from the other scientific, especially astronomical organization is important to attract more participants of IOAA. Therefore I made an effort to participate in the IAU General Assembly in Brazil in 2009 so that I can have a chance to talk with the leaders of IAU, especially the IAU president, General Secretary, the president of commission 46 etc. Supported by the IOAA president and several team leaders who also attend the IAU GA, we could get the support from the IAU. Such supports open more possibilities for IAU members to know the IOAA and increase the hope for more participants in the future.

The first until the fifth IOAA provide us a lot of experiences, and based on the experiences we made some improvements. For example, in the beginning, there was no preparatory visit by the President and Secretary of IOAA to the host country. The experiences showed the necessity of such visit to assist the host country to improve the preparation. In the beginning we don't know exactly the items to be checked, discussed and improve during the preparatory visit. Now the procedure for the work during the visit is possible to be standardized, to make the IOAA become better and better in the future.

The fifth IOAA was organized very well, the program going on well. Academically it was also very good, many team leaders appreciate the hard work of the academic team to yield high quality tasks. More countries participated in the fifth IOAA, reflecting the good promotion of the IOAA. We hope such increasing trend of the number of participants will continue next year in Rio de Janeiro. Participants from Latin America is expected to increase because of the shorter distance to the venue. I also have informed a South African member of IAU about the sixth IOAA, and we hope to see the participants from Africa for the first time next year. The preparatory visit by the president and secretary has also been planned one or two months before the D-day, to make the better organization of the IOAA.

In the end of my term as Secretary, several team leaders nominate me as the candidate of the president of IOAA. For me, it indicates that I did not disappoint my IOAA colleagues in doing the job as Secretary. When finally the IBM approved me to fill the position as president, I felt honored and grateful for the trust, but great responsibility is seen ahead and I cannot do my job well without the support and cooperation from all members of IOAA. From January 2012, my job as president will be started and I hope we can work together, in friendly and democratic atmosphere for the astronomy education and bright future of IOAA.

Chatief Kunjaya



Speech by the coordinator of IOAA

5th International Olympiad on Astronomy and Astrophysics (5th IOAA) was organized in three cities: Katowice, Chorzów and Kraków. This decision was dictated by both experience gained at previous editions of international olympiads and logistic needs. In Katowice, there was proper hotel accommodation available. As for Chorzów, there was a hall suitable to host 140 Participants and the largest planetarium in Poland which hosted the practical part of the astronomical competition.

Both the hall and the Planetarium are located on the territory of one of the largest city parks in Europe, the surface of which amounts to over 500 ha. It is placed within the administrative boundaries of the city of Chorzów. The hotel where the Students lived is situated on the outskirts of the above mentioned Park, but officially in Katowice. Though the hotel and the hall are located on the territories of two cities, in fact they are only 200 metres away from each other. Planetarium is situated on the territory of Chorzów, only 500 metres from the hotel. Such agreed boundaries between the cities are characteristic for the Upper Silesia where the 5th IOAA was held.

Kraków was a place where Leaders and Jury were debating. They were far from the Participants what prevented their mutual contacts. Moreover, the Participants were also obliged to submit their telephones and all Internet-connected devices to the depository. Additionally, the place where Students lived was cut off from the access to the Internet during the Olympiad time. 29 teams took part in the competition. Each had its own volunteer guide spending 24 hours a day with their wards, beginning their work with the very moment the team landed in Poland and finishing only after they left the country.

The 5th International Olympiad on Astronomy and Astrophysics comprised team and individual competitions. Each team was confronted with 5 tasks. Each individual was to solve 15 short problems, 3 long ones and 2 data analysis tasks. Due to bad weather, it was impossible to organise night astronomical observations. Nevertheless, they were held under the artificial Planetarium sky. The competence level of the 5th IOAA was guaranteed by the Head Committee of the Polish astronomical olympiad.

Each task solved by the students was copied twice and brought to Kraków in order to be evaluated. What is the evidence of the scale of this enterprise is the number of copies done by our copiers. The number of copied tasks, solutions and different materials altogether exceeded 24 000.

The Olympiad began with team tasks that were broadcast live via Internet.

On days free from olympic struggles, the Participants and the Leaders could sightsee the region and take part in trips organised for them.

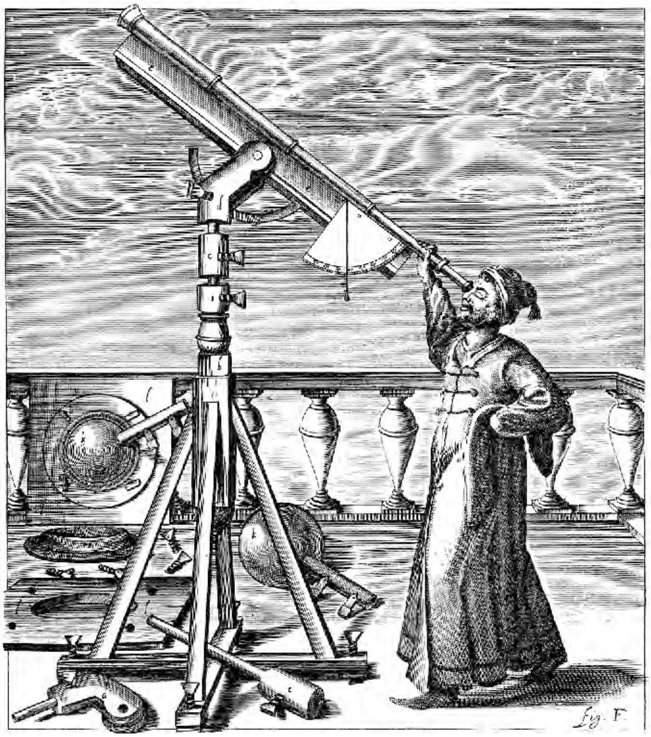
They also joined various games such as karaoke, football matches or orienteering. Each team was given a map of the park with the marked route and the stations where Participants were expected to do certain tasks. It was a great chance for the Students to get acquainted with the neighbourhood in which 5th IOAA took place.

The Leaders, on the other hand, sightsaw Kraków. They also had the opportunity to visit the Tychy brewery.

After the competitions came to an end, the Students and Leaders finally met on the grounds of the ethnographic park that belongs to the Park in Chorzów.

The opening and the closing ceremony of 5th IOAA took place in the Entertainment Theatre in Chorzów. Apart from Leaders and Students, the opening and the closing ceremony of 5th IOAA was also participated by the representatives of the Ministry of National Education, the authorities of the Silesian Voivodship and Chorzów as well as the representatives of the world of science.

Stefan Janta



Organising Committee

Supervising Committee

1.	Lech Motyka	LOC Chorzów	Planetarium director
2.	Stefan Janta	LOC Chorzów	IOAA coordinator + judge
3.	Gabriela Paletko	LOC Chorzów	LOC office Kraków
4.	Sławomir Setlak	LOC Chorzów	IOAA supervisor, Marshall's office

Organising Committee

5.	Henryk Chrupała	LOC Chorzów	copying the solutions, tasks review
6.	Marek Szczepański	LOC Chorzów	practical and team competition + judge
7.	Jacek Szczepanik	LOC Chorzów	tasks transportation (Kraków-Katowice) + judge
8.	Jerzy Kreiner	LOC Kraków	+ judge
9.	Bartłomiej Pokrzywka	LOC Kraków	+ judge
10.	Waldemar Ogłoza	LOC Kraków	the chairman of judges
11.	Greg Stachowski	LOC Kraków	the chairman of leaders

People cooperating with LOC

12.	Jacek Spyt	information technology services, Kraków
13.	Piotr Matuszczyk	information technology services
14.	Katarzyna Kowalska	LOC Office in Chorzów + translator and interpreter + booklet
15.	Tomasz Kisiel	interpreter + judge
16.	Rafał Bączkowicz	information technology services in Chorzów
17.	Damian Jabłeka	tasks transportation (reserve)+ judge
18.	Jarosław Juszkiewicz	newsletter and booklet editor
19.	Tadeusz Firszt	cooperation (practical part)+ judge
20.	Kamil Witor	trips organising
21.	Anna Drenda	logistics
22.	Krystyna Gołąbek	logistics
23.	Bartłomiej Zakrzewski	supporting LOC Kraków + judge
24.	Piotr Hamera	LOC office Kraków + translator

Planetarium staff supporting LOC

1. Barbara Osiejuk
2. Agata Spruś
3. Bogusława Zagoła
4. Krystyna Perek
5. Krystyna Dybek
6. Grażyna Salamon
7. Katarzyna Prusak
8. Anna Gamon
9. Katarzyna Połońska
10. Krzysztof Dwornik
11. Bożena Gąska
12. Jerzy Paliga
13. Zbigniew Dmowski
14. Elżbieta Tkacz
15. Krystian Plona
16. Marianna Tymorek
17. Monika Minkowska
18. Maria Kandzia
19. Mariola Jurkowska

Head Committee of the Polish Astronomy Olympiad

1. Professor, Dr. Jerzy Kreiner – chairman
2. Professor, Dr. Andrzej Pigulski
3. Professor, Dr. Bartłomiej Pokrzywka
4. Professor, Dr. Andrzej Sołtan
5. Professor, Dr. Edwin Wnuk
6. Dr. Henryk Brancewicz
7. Dr. Henryk Chrupała – vice chairman
8. Dr. Grzegorz Kondrat
9. Dr. Waldemar Ogłoza
10. Dr. Krzysztof Ziołkowski
11. M.Sc. Jacek Szczepanik – scientific secretary
12. M.Sc. Marek Szczepański

The list of the tasks authors

1. Waldemar Ogłoza
2. Andrzej Sołtan
3. Greg Stachowski
4. Jerzy Kuczyński
5. Marek Szczepański
6. Jerzy Kreiner
7. Stefan Janta

The list of judges

1. Jerzy Kreiner
2. Bartłomiej Pokrzywka
3. Waldemar Ogłoza
4. Janusz Nicewicz
5. Karolina Zawada
6. Zbigniew Głownia
7. Agata Pepiak
8. Błażej Nikiel – Wroczyńki
9. Piotr Guzik
10. Dorota Kozieł-Wierzbowska
11. Jacek Czakański
12. Jerzy Krzesiński
13. Alicja Konieczny
14. Michał Ochman
15. Robert Szafron
16. Agata Rożek
17. Jerzy Kuczyński
18. Jan Desselberger
19. Jacek Szczepanik
20. Marek Szczepański
21. Tadeusz Firszt
22. Tomasz Kisiel
23. Stefan Janta

Supporting judges

1. Beata Dyduch
2. Bartłomiej Zakrzewski
3. Damian Jabłeka
4. Urszula Lewczuk
5. Paweł Stopa
6. Ewa Kosturkiewicz
7. Elżbieta Dudek
8. Marek Dróżdż

The list of volunteers

1.	Chief guide	Jakub Bartas
2.	Kazakhstan & Bolivia	Marta Klekowska
3.	Iran	Piotr Woda
4.	Czech Republic	Marta Berek
5.	Greece	Michał Życiński
6.	Russia	Jacek Janta
7.	Korea	Rafał Graca
8.	Bangladesh	Dagmara Kazalska
9.	Portugal & Colombia	Karolina Zagoła
10.	Indonesia	Anna Marzec
11.	India	Magdalena Lupa
12.	Slovakia	Sabina Bułka
13.	Hungary	Karolina Gołąbek
14.	Serbia	Kamila Iwańska
15.	Thailand	Damian Olma
16.	Ukraine	Magda Kalarus
17.	Belarus	Helena Szyłko
18.	Brasil	Alicja Motyka
19.	Bulgaria	Michał Kalinowski
20.	Lithuania	Katarzyna Gaweł
21.	China	Aleksandra Mastalska
22.	China guest team	Martyna Czogalik
23.	Croatia	Kinga Janicka
24.	Sri Lanka	Małgorzata Matyjasek
25.	Singapor	Martyna Zapała
26.	Romania	Agnieszka Mrowiec
27.	Poland	Mateusz Zalewski
28.	Poland guest team	Piotr Kosz
29.	Iran guest team	Dominika Błonkała

The list of volunteers helping during practical competitions

1. Robert Klimczak
2. Paweł Żurek
3. Michał Kusiak
4. Marek Ledwoń
5. Jarosław Bugaj
6. Jan Kierski
7. Damian Jabłeka
8. Cezary Filipiuk
9. Andrzej Wojciechowski
10. Krystian Kurka
11. Tomasz Piwek
12. Antoni Skowron
13. Marian Legutko
14. Wojciech Kulesza
15. Bogusław Lanuszny
16. Henryk Zachłod

Medical service

Doctor of medicine Ewa Sobczyk – Chorzów, Katowice
Doctor of medicine Beata Belowska - Kraków

Medical support at the time of competitions and trips was provided by the ambulance personnel of Będzin Rescue Team of the Polish Red Cross.

FINIS SELENOGRAPHIÆ.

Participants

no.	Country	First Name	Family name	
1	Kazakhstan	Bekzat	Abdulla	KAZ-1
2	Kazakhstan	Diana	Askhatova	KAZ-2
3	Iran	Ali	Fahimniya	IRN-1
4	Iran	Aslan	Noorghasemi	IRN-2
5	Iran	Ehsan	Abedi	IRN-3
6	Iran	Parham	Porsandeh Khial	IRN-4
7	Iran	Ramtin	Keramati	IRN-5
8	Czech Republic	Jakub	Vosmera	CZE-1
9	Czech Republic	Lukáš	Timko	CZE-2
10	Czech Republic	Filip	Murár	CZE-3
11	Czech Republic	Eva	Miklušová	CZE-4
12	Czech Republic	Stanislav	Fort	CZE-5
13	Greece	Georgios	Lioutas	GRC-1
14	Greece	Despoina	Pazouli	GRC-2
15	Greece	Stefanos	Tyros	GRC-3
16	Greece	Paraskevas	Tzitzimpasis	GRC-4
17	Greece	Emmanouil	Vourliotis	GRC-5
18	Russia	Darya	Turichina	RUS-1
19	Russia	Alexey	Akinshchikov	RUS-2
20	Russia	Arina	Apetyan	RUS-3
21	Russia	Ilkham	Galiullin	RUS-4
22	Korea	Gilhyun	Ryou	KOR-1
23	Korea	Heungsik	Park	KOR-2
24	Korea	Yunseo	Jang	KOR-3
25	Korea	Sangwoon	Kim	KOR-4
26	Korea	Seungeon	Lee	KOR-5
27	Bangladesh	Tazkera	Haque	BGD-1
28	Bangladesh	Md.Sams	Afif Nirjhor	BGD-2
29	Bangladesh	Md. Moshiur	Rahman	BGD-3
30	Bangladesh	Paritosh Chandra	Roy	BGD-4
31	Portugal	Carolina	Almeida Duarte	PRT-1
32	Indonesia	Miftahul	Hilmi	INA-1
33	Indonesia	Raymond	Djajalaksana	INA-2
34	Indonesia	James	Lim	INA-3
35	Indonesia	Ko Matias Adrian	Kosasih	INA-4
36	Indonesia	Muhammad Wildan	Gifari	INA-5
37	India	Akhil	Kedia	IND-1
38	India	Akshay	Krishna	IND-2
39	India	Jeevana Priya	Inala	IND-3
40	India	Bharadwaj	Rallabandi	IND-4
41	India	Sharad	Mirani	IND-5
42	Slovakia	Machal	Račko	SVK-1
43	Slovakia	Peter	Kosec	SVK-2
44	Slovakia	Miroslav	Gašpárek	SVK-3
45	Slovakia	Matúš	Kulich	SVK-4
46	Slovakia	Dominik	Imrich	SVK-5

Participants

no.	Country	First Name	Family name	
47	Hungary	Gergely	Dálya	HUN-1
48	Hungary	Gábor	Galgóczi	HUN-2
49	Hungary	Otto	Hanyecz	HUN-3
50	Hungary	Bela	Hegyesi	HUN-4
51	Hungary	Zoltán	Jäger	HUN-5
52	Serbia	Stefan	Badza	SRB-1
53	Serbia	Stefan	Andjelkovic	SRB-2
54	Serbia	Ognjen	Markovic	SRB-3
55	Serbia	Filip	Zivanovic	SRB-4
56	Serbia	Ivan	Tanasijevic	SRB-5
57	Thailand	Pongpichit	Chuanraksasat	THA-1
58	Thailand	Thippayawis	Cheunchitra	THA-2
59	Thailand	Nondh	Panithanpaisal	THA-3
60	Thailand	Krittanon	Sirorattanakul	THA-4
61	Thailand	Kittipoj	Ngernyuang	THA-5
62	Ukraine	Ievgenii	Kuriatnikov	UKR-1
63	Ukraine	Arkadiy	Kossakovs`ky	UKR-2
64	Ukraine	Oleksandr	Kayda	UKR-3
65	Ukraine	Anton	Dmytriyev	UKR-4
66	Ukraine	Yuriy	Denysenko	UKR-5
67	Belarus	Artsiom	Kopats	BLR-1
68	Belarus	Hanna	Fakanava	BLR-2
69	Belarus	Svetlana	Komar	BLR-3
70	Belarus	Valery	Zharabitski	BLR-4
71	Belarus	Zakhar	Plodunov	BLR-5
72	Brasil	Rafael	de Lima Bordoni	BRA-1
73	Brasil	Ivan Tadeu	Ferreira Antunes	BRA-2
74	Brasil	Tabata Claudia	Amaral de Pontes	BRA-3
75	Brasil	Pedro	Rangel Caetano	BRA-4
76	Brasil	Gustavo	Haddad F. e S.Braga	BRA-5
77	Bulgaria	Miroslav	Radomirov	BGR-1
78	Bulgaria	Momchil	Molnar	BGR-2
79	Bulgaria	Miroslav	Zhekov	BGR-3
80	Bulgaria	Konstantin	Gundev	BGR-4
81	Bulgaria	Vasil	Todorinov	BGR-5
82	Lithuania	Arturas	Zukovskij	LTV-1
83	Lithuania	Dainius	Kilda	LTV-2
84	Lithuania	Gabija	Marsalkaite	LTV-3
85	Lithuania	Justas	Tamasauskas	LTV-4
86	Lithuania	Motiejus	Valiunas	LTV-5
87	China	Geng	Zhao	CHN-1
88	China	Jianyang	Fu	CHN-2
89	China	Simiao	Cheng	CHN-3
90	China	Sihao	Cheng	CHN-4
91	China	Mingjie	Jian	CHN-5

Participants

no.	Country	First Name	Family name	
92	Croatia	Anna-Khrystyna	Andreikanich	HRV-1
93	Croatia	Leonardo	Pierobon	HRV-2
94	Croatia	Julio	Car	HRV-3
95	Croatia	Kresimir	Tisanic	HRV-4
96	Croatia	Drago	Plecko	HRV-5
97	Sri Lanka	Jude Vijayanga	Wijesekera	LKA-1
98	Sri Lanka	Chiranthaka Sandun Bandara	Palugaswewa	LKA-2
99	Sri Lanka	Lakmal Buddika	Meegahapola	LKA-3
100	Sri Lanka	Banuka Dimuthu Kularatne	Munaweera Kankanamge	LKA-4
101	Sri Lanka	Ashen Chaturanga	Bellana Vithanage	LKA-5
102	Singapor	Ye	Wang	SGP-1
103	Singapor	Timothy	Tay	SGP-2
104	Singapor	Rion	You	SGP-3
105	Singapor	Jue Hang	Qin	SGP-4
106	Singapor	Yu Jian	Ang	SGP-5
107	China G	Qixi	Chen	CHG-1
108	China G	Jingyu	Qian	CHG-2
109	China G	Luya	Wang	CHG-3
110	China G	Ye	Wang	CHG-4
111	China G	Zhixuan	Lai	CHG-5
112	Poland	Maksymilian	Sokołowski	POL-1
113	Poland	Jakub	Klencki	POL-2
114	Poland	Eryk	Lipka	POL-3
115	Poland	Michał	Glanowski	POL-4
116	Poland	Miłosz	Jakubek	POL-5
117	Poland G	Dominik	Suszalski	PLG-1
118	Poland G	Filip	Ficek	PLG-2
119	Poland G	Michał Kamil	Siłkowski	PLG-3
120	Poland G	Krzysztof	Będkowski	PLG-4
121	Poland G	Przemysław	Kuta	PLG-5
122	Colombia	Logan Fernando	Pérez Monsalve	COL-1
123	Colombia	Sergio David Lobo	Bolaño	COL-2
124	Colombia	Juan Sebatián	Valbuena Bermúdez	COL-3
125	Iran G	Mehdi	Soleimanifar	IRG-1
126	Iran G	Behnam	Pourghassemi Najafabadi	IRG-2
127	Iran G	Aryan	Hashemi Talkhooncheh	IRG-3
128	Iran G	Ali Akbar	Kavei	IRG-4
129	Iran G	Mohammad	Bayazi	IRG-5
130	Romania	Bogdan Cristian	Marchis	ROM-1
131	Romania	Ana Maria	Constantin	ROM-2
132	Romania	Andrei Alexandru	Cuceu	ROM-3
133	Romania	Mihai	Răcoreanu	ROM-4
134	Romania	Roberta	Raileanu	ROM-5

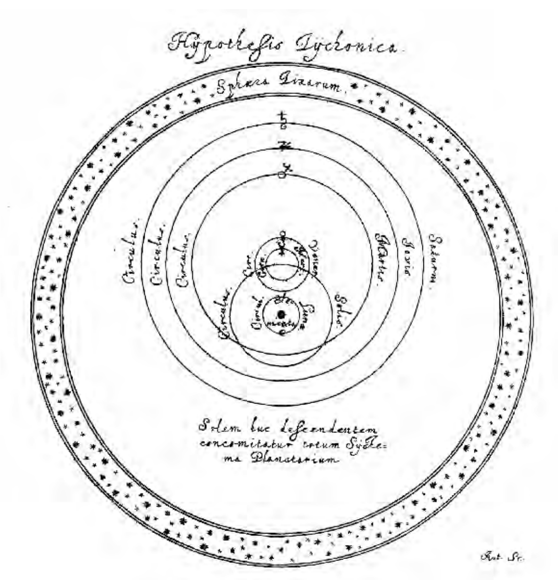
Leader's List

	Thailand	President professor Soonthornthum Boonrucksar
	Indonesia	General Secretary Dr. Chatief Kunjaya
1.	Kazakhstan	Baranovskaya Svetlana
2.	Iran	Hakimi Pajouh Hossein
3.	Iran	Movahed Seyed Mohammad Sadegh
4.	Czech Republic	Kožuško Jan
5.	Czech Republic	Gráf Tomáš
6.	Greece	Seiradakis John Hugh
7.	Greece	Zachilas Loukas
8.	Russia	Eskin Boris
9.	Russia	Zhabrunowa Elena
10.	Korea	Ann Hong Bae
11.	Korea	Kim Yoojea
12.	Bangladesh	Cruz Ronald
13.	Bangladesh	Amin Moshurl
14.	Indonesia	Malasan Hakim L.
15.	Indonesia	Arifyanto M. Ikbal
16.	India	Mazumdar Anwesh
17.	India	Aniket Sule
18.	Slovakia	Hric Ladislav
19.	Slovakia	Hricová Bartolomejowá Mária
20.	Hungary	Hegedüs Tibor
21.	Hungary	Szakáts Róbert
22.	Serbia	Vasiljković Aleksandar
23.	Serbia	Ninković Slobodan
24.	Thailand	Sathanon Umnart
25.	Thailand	Muanwong Orrarujee
26.	Ukraine	Reshetnyk Volodymyr
27.	Ukraine	Mykhailyk Kateryna
28.	Belarus	Sekerzhitsky Stanislaw
29.	Belarus	Poplavsky Alexander
30.	Sri Lanka	K.P.S. Chandana Jayaratne
31.	Portugal	Brescansin de Amores Eduardo
32.	Bulgaria	Stoev Alexey
33.	Bulgaria	Karavasilev Nicola
34.	Lithuania	Sūdžius Jokūbas
35.	Lithuania	Bridžius Audrius
36.	China	Zuo Daihui
37.	China	Chen Dongni
38.	Croatia	Hržina Damir
39.	Croatia	Romštajn Ivan

40.	Brasil	Gonçalves Assis Felipe
41.	Brasil	Mothé Diniz Thais
42.	Poland	Kondrat Grzegorz
43.	Poland	Mróz Przemysław
44.	Columbia	Goez Theran Cristian Alberto
45.	Singapor	Yuen Xiang Hao
46.	Romania	Trocaru Sorin
47.	Romania	Petrică Crăciun
48.	China guest	Li Xin
49.	China guest	Yao Chuansen
50.	Iran guest	Arbabi Bidgoli Sepehr
51.	Iran guest	Kookaram Kazem
52.	Poland guest	Pjanka Patryk

The list of observers

1.	Iran	Seyed Amir Sadat Moosavi
2.	Greece	Maria Kontaxi
3.	Indonesia	Rizal Alfian
4.	India	Anand Ghaisas
5.	Slovakia	Marian Vidovenec
6.	Thailand	Siramas Komonjinda
7.	Ukraine	Mariia Hloba
8.	Lithuania	Gediminas Beresnevicius



Framework programme of 5th International Olympiad on Astronomy and Astrophysics

Day 1 25th August 2011 Thursday

Students Katowice & Leaders Kraków

Arrival to Poland – transfer from the airport\train station to the appropriate hotel.
The registration of participants at the hotel; issuing identifiers, conference and advertising materials (all day long).

18^{00} - 23^{00}	dinner at the hotel

Day 2 26th August 2011 Friday

Students Katowice

7^{00} - 9^{00}	breakfast at the hotel
10^{00}	meeting on the buses in front of the hotel
10^{05} - 10^{30}	transfer to the Entertainment Theatre in Chorzów
11^{00} - 14^{00}	5th IOAA Opening Ceremony
14^{15}	return to the hotel
15^{00} - 16^{30}	lunch at the hotel
16^{30} - 19^{00}	free time and group activities at the hotel
19^{30} - 20^{00}	briefing
20^{00} - 21^{00}	dinner at the hotel
21^{00} - 22^{00}	visit to the competition hall

Leaders Kraków

7^{00} - 8^{00}	breakfast at the hotel
8^{15}	meeting on the buses in front of the hotel
8^{20} - 10^{00}	transfer to the Entertainment Theatre in Chorzów
11^{00} - 14^{00}	5th IOAA Opening Ceremony
14^{00} - 14^{45}	banquet in the hotel foyer
15^{00}	meeting on the buses in front of the Theatre
15^{05} - 15^{30}	transfer to Planetarium
15^{30} - 17^{00}	choosing places (drawing lots), problem presentation in the Planetarium hall
17^{15} - 19^{00}	return to the hotel
19^{00} - 20^{00}	dinner at the hotel
20^{00} - 20^{30}	IBM #1 introduction
20^{30} - 21^{30}	the discussion of team tasks
21^{30} - 23^{30}	the translation of team tasks

Day 3 27th August 2011 Saturday

Students Katowice

7^{00} - 9^{00}	breakfast at the hotel
9^{15}	meeting on the buses in front of the hotel
10^{00}	"Hubble 3D" film show in IMAX cinema
12^{30} - 14^{00}	lunch at the hotel
15^{00} - 16^{30}	team tasks
19^{00} - 20^{00}	dinner at the hotel
20^{00} - 20^{30}	briefing
20^{30} - 22^{00}	getting acquainted with the observational apparatus

Leaders Kraków

7^{00} - 8^{00}	breakfast at the hotel
8^{00} - 9^{00}	the translation and printing of team tasks
9^{30} - 13^{00}	the discussion of theoretical problems
13^{00} - 14^{00}	lunch at the hotel
14^{30} - 15^{30}	the discussion of theoretical problems
15^{30} – 16^{30}	the broadcasting of the team tasks in Katowice
16^{30} - 19^{00}	the discussion and translation of theoretical problems
19^{00} - 20^{00}	dinner at the hotel
20^{00} - 23^{00}	the translation of theoretical problems

Day 4 28th August 2011 Sunday

Students Katowice

7^{00} - 9^{00}	breakfast at the hotel
9^{00} - 12^{30}	free time and group activities at the hotel
12^{30} - 14^{00}	lunch at the hotel
14^{30} - 20^{00}	theoretical problems
20^{30} - 21^{30}	dinner at the hotel
22^{00} - 23^{00}	getting acquainted with the Planetarium hall

Leaders Kraków

6^{30} - 7^{30}	breakfast at the hotel
8^{00} - 16^{00}	trip (lunch during the trip)
17^{00} - 19^{00}	the discussion of observational tasks and Planetarium tasks
19^{00} - 20^{00}	dinner at the hotel
20^{00} - 23^{00}	further discussions; the translation of observational problems and Planetarium tasks

Day 5 29th August 2011 Monday

Students Katowice

6^{30} - 8^{00}	breakfast at the hotel
8^{15}	meeting on the buses in front of the hotel
8^{20} - 18^{30}	scheduled trip (lunch during the trip)
19^{00} - 20^{00}	dinner at the hotel
20^{00} - 20^{30}	briefing
21^{00}	the first term of night observations or Planetarium observations

Leaders Kraków

7^{00} - 8^{00}	breakfast at the hotel
8^{00} - 9^{00}	the translation of observational tasks and Planetarium tasks
9^{00} - 11^{00}	IBM #2 (elections)
11^{30} - 14^{00}	the discussion of data analysis tasks
14^{00} - 15^{00}	lunch at the hotel
15^{30} - 19^{00}	the discussion and translation of data analysis tasks
19^{00} - 20^{00}	dinner at the hotel
20^{00} - 23^{00}	the translation of data analysis tasks or free time

Day 6 30th August 2011 Tuesday

Students Katowice

8^{30} - 10^{00}	breakfast at the hotel
10^{00} - 12^{30}	free time and group activities at the hotel
12^{30} - 14^{00}	lunch at the hotel
15^{00} - 18^{00}	data analysis tasks
19^{00} - 20^{00}	dinner at the hotel
20^{00} - 20^{30}	briefing
21^{00}	the second term of the night observations or Planetarium tasks

Leaders Kraków

7^{00} - 8^{00}	breakfast at the hotel
9^{00} - 17^{00}	sightseeing trip to Kraków
18^{00} - 20^{00}	dinner at the hotel
20^{00} - 23^{00}	consultations and marking

Day 7 31^{st} August 2011 Wednesday

Students Katowice

8^{30} - 10^{00}	breakfast at the hotel
10^{00} - 12^{30}	free time and group activities at the hotel
12^{30} - 14^{30}	lunch at the hotel
15^{00} - 18^{30}	outdoor games in the Park
19^{00} - 20^{00}	dinner at the hotel
20^{00} - 20^{30}	briefing
20^{30} - 22^{00}	recreation

Leaders Kraków

7^{00} - 8^{00}	breakfast at the hotel
9^{00} - 11^{00}	IBM #3 (elections)
11^{00} - 14^{00}	consultations, marking and classification
14^{00} - 15^{00}	lunch at the hotel
15^{00} - 19^{00}	consultations, marking and classification
19^{00} - 20^{00}	dinner at the hotel
20^{00} - 23^{00}	consultations, marking and classification

Day 8 1^{st} September 2011 Thursday

Students Katowice

6^{30} - 8^{00}	breakfast at the hotel
8^{15}	meeting on the buses in front of the hotel
8^{20} - 18^{30}	scheduled trips (lunch during the trip)
19^{00} - 20^{00}	dinner at the hotel
20^{00} - 20^{30}	briefing
20^{30} - 22^{00}	recreation

Leaders Kraków

7^{00} - 8^{00}	breakfast at the hotel
8^{00} - 14^{00}	moderation on theoretical tasks
14^{00} - 15^{00}	lunch at the hotel
15^{00} - 19^{00}	moderation on observational and data analysis tasks, moderation on group tasks
19^{00} - 20^{00}	dinner at the hotel
20^{00} - 21^{00}	IBM #4
21^{00} - 23^{00}	final classification

Day 9 2nd September 2011 Friday

Students Katowice

7^{00} - 9^{00}	breakfast at the hotel
9^{00} - 12^{00}	free time (shopping – Silesia City Centre)
12^{30} - 14^{30}	lunch at the hotel
16^{00} - 22^{00}	party in Upper Silesian Ethnographic Park in Chorzów

Leaders Kraków

7^{00} - 8^{00}	breakfast at the hotel
9^{00} - 13^{00}	IBM #5 syllabus discussion, elections for the next IOAA
13^{00} - 14^{00}	lunch at the hotel
14^{30} - 16^{00}	transfer to Chorzów
16^{00} - 22^{00}	party in Upper Silesian Ethnographic Park in Chorzów
22^{00}	return to the hotel in Kraków

Day 10 3rd September 2011 Saturday

Students Katowice

7^{00} - 9^{00}	breakfast at the hotel
10^{00}	meeting on the buses in front of the hotel
10^{05} - 10^{30}	transfer to the Entertainment Theatre in Chorzów
11^{00} - 14^{30}	5th IOAA Closing Ceremony
14^{45}	meeting on the buses in front of the theatre
14^{50} - 15^{15}	transfer to the hotel
15^{30} - 17^{00}	lunch at the hotel
17^{00} - 20^{00}	free time and group activities at the hotel
20^{00} - 21^{00}	dinner at the hotel

First departures from Poland

Leaders Kraków

7^{00} - 8^{00}	breakfast at the hotel
8^{15}	meeting on the buses in front of the hotel
8^{20} - 10^{00}	transfer to the Entertainment Theatre in Chorzów
11^{00} - 14^{30}	5th IOAA Closing Ceremony
14^{30} - 15^{30}	banquet at the Theatre foyer
15^{35}	meeting on the buses in front of theatre
15^{40} - 17^{00}	transfer to Kraków
19^{00} - 20^{00}	dinner at the hotel

First departures from Poland

Day 11 4th September 2011 Sunday

Students Katowice & Leaders Kraków

6^{00} - 8^{00}	breakfast at the hotel

Departures from Poland - transfer to the airport/train station

Students Katowice

Day 1 Thursday 25.08.11	Day 2 Friday 26.08.11	Day 3 Saturday 27.08.11	Day 4 Sunday 28.08.11	Day 5 Monday 29.08.11	Day 6 Tuesday 30.08.11
arrival	breakfast 7:00 - 9:00 11:00 5th IOAA opening ceremony	7:00 - 9:00 IMAX	7:00 - 9:00 free time and group activities	6:30 - 8:00	8:30 - 10:00 recreation 12:30 - 14:00
	Lunch 15:00 - 16:30	12:30 - 14:00	12:30 - 14:00	Trip (lunch during the trip)	
	free time and group activities 19:30 - 20:00 briefing	15:00 - 16:30 team competition	14:30 - 20:00 theoretical competition		15:00 - 18:00 data analysis competition
18:00 - 23:00 dinner	20:00 - 21:00 21:00 - 22:00 getting acquainted with the place of theoretical competition	19:00 - 20:00 20:00 - 20:30 briefing 20:30 - 22:00 getting acquainted with the observational instruments at the hotel	20:30 - 21:30 22:00 - 23:00 getting acquainted with the Planetarium hall	19:00 - 20:00 20:00 - 20:30	19:00 - 20:00 20:00 - 20:30
				21:00 first date of night observations or observations in Planetarium	21:00 second date of night observations or observations in Planetarium

Day 7 Wednesday 31.08.11	Day 8 Thursday 01.09.11	Day 9 Friday 02.09.11	Day 10 Saturday 03.09.11	Day 11 Sunday 04.09.11
8:30 - 10:00 free time and group activities 12:30 - 14:30 outdoor games	6:30 - 8:00	7:00 - 9:00 free time, shopping	7:00 - 9:00 11:00 closing ceremony 15:30 - 17:00	6:00 - 8:00 departure
	trip (lunch during the trip)	12:30 - 14:30		
		16:00 meeting with Leaders and banquet in the ethnographic park		
19:00 - 20:00 20:00 - 20:30 20:30 - 22:00 recreation	19:00 - 20:00 20:00 - 20:30 20:30 - 22:00 recreation		20:00 - 21:00	

Leaders Kraków

Day 1 Thursday 25.08.11	Day 2 Friday 26.08.11	Day 3 Saturday 27.08.11	Day 4 Sunday 28.08.11	Day 5 Monday 29.08.11	Day 6 Tuesday 30.08.11
arrival	breakfast 7:00 - 8:00 11:00 5th IOAA opening ceremony	7:00 - 8:00 8:00-9:00 translation of group tasks (printing and photocopying, transport to Chorzow) 9:30-13:00 discussion over theoretical tasks	6:30 - 7:30	7:00 - 8:00 8:00-9:00 translation of observation and Planetarium tasks 9:00-11:00 IBM #2 elections 11:30-14:00 discussion over data analysis tasks	7:00 - 8:00
	14:00 - 14:45 lunch at the Theatre	13:00 - 14:00	8:00 - 16:00 trip (lunch during the trip)	14:00 - 15:00	trip (lunch during the trip)
	travel to Planetarium, getting aquainted with the Planetarium hall, choosing the tables (drawing lots), travel to International Fair Hall and getting aquainted with it 17:15 - 19:00 travel to Krakow	14:30-15:30 discussion over theoretical tasks 15:30 transmission from the competition in Katowice 16:30-19:00 discussion and translation theoretical tasks	17:00 - 19:00 discussion over observation and planetarium tasks	15:30-19:00 discussion over data analysis tasks and translation	
18:00 - 23:00 dinner	19:00 - 20:00	19:00 - 20:00	19:00 - 20:00	19:00 - 20:00	18:00 - 20:00
	20:00-20:30 IBM #1 introduction 20:30-21:30 the discussion over group tasks 21:30-23:30 tranlation of group tasks	20:00-23:00 translation of theoretical tasks or free time	20:00-23:00 further discussionon about observation and planetarium tasks; translation	20:00-23:00 translation of data analysis tasks or free time	20:00-23:00 assessment, marking, consultation and classification or free time

Day 7 Wednesday 31.08.11	Day 8 Thursday 01.09.11	Day 9 Friday 02.09.11	Day 10 Saturday 03.09.11	Day 11 Sunday 04.09.11
7:00 - 8:00 9:00-11:00 IBM #3 elections 11:00- 14:00 assessment, marking, consultation and classification	7:00 - 8:00 8:00-14:00 moderation on theoretical tasks	7:00 - 8:00 9:00-13:00 IBM #5 discussion over syllabus and other matters, elections for next IOAA, discussion over other problems	7:00 - 8:00 8:15 travel to Chorzow 11:00 closing ceremony	6:00 - 8:00
14:00 - 15:00	14:00 - 15:00	13:00 - 14:00	14:30 - 15:30 lunch at the Theatre	departure
15:00-19:00 assessment, marking, consultation and classification or free time	15:00-19:00 moderation on observational and data analysis tasks and moderation on observation and Planetarium tasks	14:30-16:00 travel to Chorzow 16:00 meeting with Students and banquet in the ethnographic park		
19:00 - 20:00	19:00 - 20:00		19:00 - 20:00	
20:00-23:00 assessment, marking, consultation and classification or free time	20:00 21:00 IBM #4 21:00-23:00 final classification			

LOC Kraków

Day 1 Thursday 25.08.11	Day 2 Friday 26.08.11	Day 3 Saturday 27.08.11	Day 4 Sunday 28.08.11	Day 5 Monday 29.08.11	Day 6 Tuesday 30.08.11
arrival	breakfast 7:00 - 8:00	7:00 - 8:00	6:30 - 7:30	7:00 - 8:00	7:00 - 8:00
	8.30 departure of coaches to Chorzów 11.00 5th IOAA opening ceremony	9.00-10.00 printing team tasks, packing them to envelopes (Leaders) 10.00 picking up team tasks, transport to Chorzów	7.00-9.00 copying theoretical tasks, packing them to envelopes 8.00 sending Leaders on a trip 10.00 picking up theoretical tasks, transport to Chorzów	8.00-9.00 copying observation and Planetarium tasks, packing them to envelopes (Leaders) 10.00 picking up observation and Planetarium tasks, transport to Chorzów	8.00 -9.00 packing tasks to envelopes 9.00 sending Leaders on a trip 10.00 picking up data analysis tasks, transport to Chorzów
		13:00 - 14:00	13:00 - 14:00		14:00 - 15:00
		15.30 team tasks transmission from Katowice (IT specialists)			
Dinner 18:00 - 23:00	19:00 - 20:00	19:00 - 20:00	19:00 - 20:00	19:00 - 20:00	19:00 - 20:00
	23.00 distributing theoretical tasks			23.00 copying data analysis tasks	

Day 7 Wednesday 31.08.11	Day 8 Thursday 01.09.11	Day 9 Friday 02.09.11	Day 10 Saturday 03.09.11	Day 11 Sunday 04.09.11
7:00 - 8:00	7:00 - 8:00	7:00 - 8:00	7:00 - 8:00	7:00 - 8:00
	9.00 inserting data into the score table (IT technicians) and projecting it on the screen		11.00 closing ceremony	departure
14:00 - 15:00		14:00 - 15:00	14:00 - 15:00	
19:00 - 20:00	19:00 - 20:00	19:00 - 20:00	19:00 - 20:00	

LOC Katowice

Day 1 Thursday 25.08.11	Day 2 Friday 26.08.11	Day 3 Saturday 27.08.11	Day 4 Sunday 28.08.11	Day 5 Monday 29.08.11	Day 6 Tuesday 30.08.11
	breakfast 7:00 - 9:00	7:00 - 9:00	7:00 - 9:00	6:30 - 8:00	8:30 - 10:00
The transport of copiers, printers, computers, ethernet, stationery and promotional materials for Leaders to Kraków	8.00 organisers come to the the theatre 10.15 coaches with students leave for the opening ceremony 11:00 ceremony opening 5thioaa	Preparing the hall for the team tasks: the tables are joined together in the groups of four; telescopes are standing beside the tables; on the tables there are visit cards, equipment and envelopes with the tasks inside	Preparing the hall for the theoretical part. There are 150 tables standing separate. On the tables there are visit cards, equipment and envelopes with tasks inside. 9.00-12.00 activities at the hotel (games and plays)	8.00 preparing the students for the trip	9.00 Preparing the hall of the International Fairs for the data analysis tasks. The are150 tables arranged separately. On the tables there are visit cards, equipment and envelopes with the tasks inside. 9.00-12.00 activities at the hotel
		13:00 - 14:00	13:00 - 14:00		14:00 - 15:00
arrival	17.00-19.00 activities at the hotel (games and plays)	15.30-16.30 keeping an eye for the students	14.30-18.30 keeping an eye on the participants	18.00 Preparing the International Fair hall for the observation tasks, preparing the observatory posts (arranging telescopes, chairs and a 42" plasma screen with the clock)	18.00 Preparing the International Fair hall for the observation tasks, preparing the observatory posts (arranging telescopes, chairs and a 42" plasma screen with the clock)
	Briefing	18:30 - 19:00	18:30 - 19:00	18:30 - 19:00	18:30 - 19:00
Dinner 18:00 - 23:00	19:00 - 20:00	19:00 - 20:00	19:00 - 20:00	19:00 - 20:00	19:00 - 20:00
	Briefing	20:00 - 20:30	20:00 - 20:30	20:00 - 20:30	20:00 - 20:30
	The presentation of the International Fairs hall and the the presentation of the equipment of each desk	Copying the solutions twice, securing the originals, transporting the copies to Kraków The presentation of the telescopes to all participants at the hotel	Copying the solutions twice, securing the originals; the transport of copies to Kraków The presentation of the Planetarium hall and the way each post is equipped	Presenting the Planetarium hall and the way each post is equipped After first observations, the solutions are copied twice, the originals are secured, the copies are transported to Kraków.	Copying the data analysis solutions twice, securing the originals, transport of copies to Kraków. After first observations, the solutions are copied twice, the originals are secured, the copies are transported to Kraków.
				Reinforced protection of the park during the competition	Reinforced protection of the park during the competition

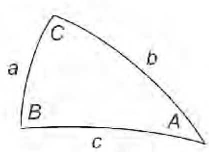
Day 7 Wednesday 31.08.11	Day 8 Thursday 01.09.11	Day 9 Friday 02.09.11	Day 10 Saturday 03.09.11	Day 11 Sunday 04.09.11
8:30 - 10:00	6:30 - 8:00	7:00 - 9:00	7:00 - 9:00	6:00 - 8:00
10.00-12.00 activities at the hotel (games and plays)	9.00 sending the students on a trip (1st group) 9.00-11.00 activities at the hotel (the groups that are setting off later)	Printing diplomas	7.00 preparing medals, diplomas and statuettes (at the theatre) 11:00 closing ceremony	
14:00 - 15:00		14:00 - 15:00	14:00 - 15:00	departure
Supervising the orienteering Reinforced protection of the park during orienteering		Signing the diplomas in the open-air ethnographic museum		
18:30 - 19:00	18:30 - 19:00			Copiers, printers, computers and ethernet are tansported to Chorzów
19:00 - 20:00	19:00 - 20:00		19:00 - 20:00	
20:00 - 20:30	20:00 - 20:30			
20.00-22.00 activities at the hotel (plays and games)	20.00-22.00 karaoke at the hotel			

5th IOAA SILESIA POLAND 2011 v1

Astronomical and physical constants

Astronomical unit (AU)	1.4960×10^{11} m
Light year (ly)	9.4605×10^{15} m = 63 240 AU
Parsec (pc)	3.0860×10^{16} m = 206 265 AU
1 Sidereal year	365.2564 solar days
1 Tropical year	365.2422 solar days
1 Calendar year	365.2425 solar days
1 Sidereal day	$23^{h}\,56^{m}\,04^{s}.091$
1 Solar day	$24^{h}\,03^{m}\,56^{s}.555$ units of sidereal time
Mass of Earth	5.9736×10^{24} kg
Mean radius of Earth	6.371×10^{6} m
Equatorial radius of Earth	6.378×10^{6} m
Mean velocity of Earth on its orbit	29.783 km s^{-1}
Mass of Moon	7.3490×10^{22} kg
Radius of Moon	1.737×10^{6} m
Mean Earth – Moon distance	3.844×10^{8} m
Mass of Sun	1.98892×10^{30} kg
Radius of Sun	6.96×10^{8} m
Effective temperature of the Sun	5 780 K
Luminosity of the Sun	3.96×10^{26} J s^{-1}
Solar constant	1366 W m^{-2}
Brightness of the Sun in V-band	–26.8 mag.
Absolute brightness of the Sun in V-band	4.75 mag.
Absolute bolometric brightness of Sun	4.72 mag.
Angular diameter of the Sun	30′
Speed of light in vacuum (c)	2.9979×10^{8} m s^{-1}
Gravitational constant (G)	6.6738×10^{-11} N m^{2} kg^{-2}
Boltzmann constant (k)	1.381×10^{-23} m kg s^{-2} K^{-1}
Stefan–Boltzmann constant (σ)	5.6704×10^{-8} kg s^{-3} K^{-4}
Planck constant (h)	6.6261×10^{-34} J s
Wien's constant (b)	2.8978×10^{-3} m K
Hubble constant (H_0)	70 km s^{-1} Mpc^{-1}
electron charge (e)	1.602×10^{-19} C
Current inclination of the ecliptic (ε)	23° 26.3′
Coordinates of the northern ecliptic pole for epoch 2000.0 (α_E, δ_E)	$18^{h}\,00^{m}\,00^{s}$, +66° 33.6′
Coordinates of the northern galactic pole for epoch 2000.0 (α_G, δ_G)	$12^{h}\,51^{m}$, +27° 08′

You can try to solve an equation $x = f(x)$ using iteration: $x_{n+1} = f(x_n)$.



Basic equations of spherical trigonometry

$$\sin a \sin B = \sin b \sin A \ ,$$
$$\sin a \cos B = \cos b \sin c - \sin b \cos c \cos A \ ,$$
$$\cos a = \cos b \cos c - \sin b \sin c \cos A \ .$$

Short theoretical questions

Each question max 10 points

1. Most single-appearance comets enter the inner Solar System directly from the Oort Cloud. Estimate how long it takes a comet to make this journey. Assume that in the Oort Cloud, 35 000 AU from the Sun, the comet was at aphelion.

2. Estimate the number of stars in a globular cluster of diameter 40 pc, if the escape velocity at the edge of the cluster is 6 km s^{-1} and most of the stars are similar to the Sun.

3. On 9 March 2011 the Voyager probe was 116. 406 AU from the Sun and moving at 17.062 km s^{-1}. Determine the type of orbit the probe is on: (a) elliptical, (b) parabolic, or (c) hyperbolic. What is the apparent magnitude of the Sun as seen from Voyager?

4. Assuming that Phobos moves around Mars on a perfectly circular orbit in the equatorial plane of the planet, give the length of time Phobos is above the horizon for a point on the Martian equator. Use the following data:
   Radius of Mars R_{Mars} = 3 393 km Rotational period of Mars T_{Mars} = 24.623 h. Mass of Mars M_{Mars} = 6.421 × 10^{23}kg. Orbital radius of Phobos R_P = 9 380 km.

5. What would be the diameter of a radiotelescope working at a wavelngth of λ = 1 cm with the same resolution as an optical telescope of diameter D = 10 cm?

6. Tidal forces result in a torque on the Earth. Assuming that, during the last several hundred million years, both this torque and the length of the sidereal year were constant and had values of 6.0 × 10^{16} N m and 3.15 × 10^{7} s respectively, calculate how many days there were in a year 6.0 x 10^{8} years ago. Moment of inertia of a homogeneous filled sphere of radius R and mass m is $I = \frac{2}{5} m R^2$.

7. A satellite orbits the Earth on a circular orbit. The initial momentum of the satellite is given by the vector **p**. At a certain time, an explosive charge is set off which gives the satellite an additional impulse $\Delta\mathbf{p}$, equal in magnitude to $|\mathbf{p}|$. Let α be the angle between the vectors **p** and $\Delta\mathbf{p}$, and β between the radius vector of the satellite and the vector $\Delta\mathbf{p}$. By thinking about the direction of the additional impulse $\Delta\mathbf{p}$, consider if it is possible to change the orbit to each of the cases given below. If it is possible mark YES on the answer sheet and give values of α and β for which it is possible. If the orbit is not possible, mark NO.

   (a) a hyperbola with perigee at the location of the explosion.

(b) a parabola with perigee at the location of the explosion.

(c) an ellipse with perigee at the location of the explosion.

(d) a circle.

(e) an ellipse with apogee at the location of the explosion.

Note that for $\alpha = 180^\circ$ and $\beta = 90^\circ$ the new orbit will be a line along which the satellite will free fall vertically towards the centre of the Earth.

8. Assuming that dust grains are black bodies, determine the diameter of a spherical dust grain which can remain at 1 AU from the Sun in equilibrium between the radiation pressure and gravitational attraction of the Sun. Take the density of the dust grain to be $\rho = 10^3$ kg m^{-3}.

9. Interstellar distances are large compared to the sizes of stars. Thus, stellar clusters and galaxies which do not contain diffuse matter essentially do not obscure objects behind them. Estimate what proportion of the sky is obscured by stars when we look in the direction of a galaxy of surface brightness $\mu = 18.0$ mag arcsec^{-2}. Assume that the galaxy consists of stars similar to the Sun.

10. Estimate the minimum energy a proton would need to penetrate the Earth's magnetosphere. Assume that the initial penetration is perpendicular to a belt of constant magnetic field 30 μT and thickness 1.0×10^4 km. Prepare the sketch of the particle trajectory. (Note that at such high energies the momentum can be replaced by the expression E/c. Ignore any radiative effects).

11. Based on the spectrum of a galaxy with redshift $z = 6.03$ it was determined that the age of the stars in the galaxy is from 560 to 600 million years. At what z did the epoch of star formation occur in this galaxy? Assume that the current age of the Universe is $t_0 = 13.7 \times 10^9$ years and that the rate of expansion of the Universe is given by a flat cosmological model with cosmological constant $\Lambda = 0$. (In such a model the scale factor $R \propto t^{2/3}$, where t is the time since the Big Bang.)

12. Due to the precession of the Earth's axis, the region of sky visible from a location with fixed geographical coordinates changes with time. Is it possible that, at some point in time, Sirius will not rise as seen from Krakow, while Canopus will rise and set? Assume that the Earth's axis traces out a cone of angle 47°. Krakow is at latitude 50.1° N; the current equatorial coordinates (right ascension and declination) of these stars are:
Sirius (α CMa) : $6^h 45^m$, $-16^\circ 43'$
Canopus (α Car) : $6^h 24^m$, $-52^\circ 42'$

13. The equation of the ecliptic in equatorial coordinates (α, δ) has the form:
$\delta = \arctan(\sin\alpha \tan\varepsilon)$,
where ε is the angle of the celestial equator to the ecliptic plane. Find an analogous relation $h = f(A)$ for the galactic equator in horizontal coordinates (A, h) for an observer at latitude $\varphi = 49^\circ 34'$ at local sidereal time $\theta = 0^h 51^m$.

14. Estimate the number of solar neutrinos which should pass through a 1 m^2 area of the Earth's surface perpendicular to the Sun every second. Use the fact that each fusion reaction in the Sun produces 26.8 MeV of energy and 2 neutrinos.

15. Given that the cosmic background radiation has the spectrum of a black body throughout the evolution of the Universe, determine how its temperature changes with redshift z. In particular, give the temperature of the background radiation at the epoch $z \approx 10$ (that of the farthest currently observed objects). The current temperature of the cosmic background radiation is 2.73 K .

Long theoretical questions

Instructions

1. You will receive in your envelope an English and native language version of the questions.
2. You have 5 hours to solve 15 short (tasks 1-15) and 3 long tasks.
3. You can use only the pen given on the desk.
4. The solutions of each task should be written on the answer sheets, starting each question on a new page. Only the answer sheets will be assessed.
5. You may use the blank sheets for additional working. These work sheets will not be assessed
6. At the top of each page you should put down your code and task number.
7. If solution exceeds one page, please number the pages for each task.
8. Draw a box around your final answer.
9. Numerical results should be given with appropriate number of significant digits with units.
10. You should use SI or units commonly used in astronomy. Points will be deducted if there is a lack of units or inappropriate number of significant digits.
11. At the end of test, all sheets of papers should be put into the envelope and left on the desk.
12. In your solution please write down each step and partial result.

Long theoretical questions (max 30 points each)

1. A transit of duration 180 minutes was observed for a planet which orbits the star HD209458 with a period of 84 hours. The Doppler shift of absorption lines arising in the planet's atmosphere was also measured, corresponding to a difference in radial velocity of 30 km/s (with respect to observer) between the beginning and the end of the transit. Assuming a circular orbit exactly edge-on to the observer, find the approximate radius and mass of the star and the radius of the orbit of the planet.

2. Within the field of a galaxy cluster at a redshift of $z = 0.500$, a galaxy which looks like a normal elliptical is observed, with an apparent magnitude in the B filter $m_B = 20.40$ mag.

   The luminosity distance corresponding to a redshift of $z = 0.500$ is $d_L = 2754$ Mpc.

   The spectral energy distribution (SED) of elliptical galaxies in the wavelength range 250 nm to 500 nm is adequately approximated by the formula:

   $$L_\lambda(\lambda) \propto \lambda^4$$

   (i.e., the spectral density of the object's luminosity, known also as the monochromatic luminosity, is proportional to λ^4.)

   a) What is the absolute magnitude of this galaxy in the B filter ?

   b) Can it be a member of this cluster? (write YES or NO alongside your final calculation)

   Hints: Try to establish a relation that describe the dependence of the spectral density of flux on distance for small wavelength interval. Normal elliptical galaxies have maximum absolute magnitude equal to -22 mag.

3. The planetarium program 'Guide' gives the following data for two solar mass stars:

Star	1	2
Right Ascension	$14^h\,29^m\,44.95^s$	$14^h\,39^m\,39.39^s$
Declination	$-62°\,40'\,46.14''$	$-60\,50'\,22.10''$
Distance	1.2953 pc	1.3475 pc
Proper motion in R.A.	−3.776 arcsec / year	−3.600 arcsec / year
Proper motion in Dec.	0.95 arcsec / year	0.77 arcsec / year

   Based on these data, determine whether these stars form a gravitationally bound system. Assume the stars are on the main sequence. Write YES of bound or NO if not bound alongside your final calculation.

   Note: the proper motion in R.A. has been corrected for the declination of the stars.

1. In your envelope you will receive an English and native language versions of the questions.
2. You have 2.5 hours to solve 2 tasks.
3. You can get maximum 25 points for each task.
4. You can use only the pen and tools given on the desk.
5. The solutions of each task should be written on the answer sheets, starting each question on a new page. Only the answer sheets will be assessed.
6. You may use the blank sheets for additional working. These work sheets will not be assessed
7. At the top of each page you should put down your code and task number.
8. If solution exceeds one page, please number the pages for each task.
9. Draw a box around your final answer.
10. Numerical results should be given with appropriate number of significant digits with units.
11. You should use SI or units commonly used in astronomy. Points will be deducted if there is a lack of units or inappropriate number of significant digits.
12. At the end of the test, all sheets of paper should be put into the envelope and left on the desk.
13. In your solution please write down each step and partial results.
14. Graphs for tasks number 1 and 2 should be prepared on the plotting paper.

Data Analysis questions

1. Analysis of times of minima

Figure 1 shows the light curve of the eclipsing binary V1107 Cas, classified as a W Ursae Majoris type.

Table 1 contains a list of observed minima of the light variation. The columns contain: the number of the minimum, the date on which the minimum was observed, the heliocentric time of minimum expressed in Julian days and an error (in fractions of a day).

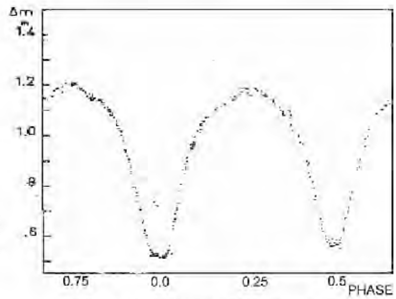


Fig. 1: Light curve of V1107 Cas.

Using these data:

(a) Determine an initial period of V1107 Cas, assuming that the period of the star is constant during the interval of observations. Assume that observations during one night are continuous. Duration of the transit is negligible.

(b) Make what is known as an (O–C) diagram (for "observed – calculated") of the times of minima, as follows: on the x-axis put the number of periods elapsed (the "epoch") since a chosen initial moment M_o; on the y-axis the difference between the observed moment of minimum M_{obs} and the moment of minimum calculated using the formula ("ephemeris"):

$$M_{calc} = M_o + P \times E$$

where E, the epoch, is exactly an integer or half-integer, and P is the period in days.

(c) Using this (O–C) diagram, improve the determination of the initial moment M_o and the period P, and estimate the errors in their values.

(d) Calculate the predicted times of minima of V1107 Cas given in heliocentric JD occurring between 19h, 1 September 2011 UT and 02h, 2 September 2011 UT.

No.	Date of minimum (UT)	Time of minimum (Heliocentric JD)	Error
1	22 December 2006	2 454 092.4111	0.0004
2	23 December 2006	2 454 092.5478	0.0002
3	23 September 2007	2 454 367.3284	0.0005
4	23 September 2007	2 454 367.4656	0.0005
5	15 October 2007	2 454 388.5175	0.0009
6	15 October 2007	2 454 388.6539	0.0011
7	26 August 2008	2 454 704.8561	0.0002
8	5 November 2008	2 454 776.4901	0.0007
9	3 January 2009	2 454 835.2734	0.0007
10	15 January 2009	2 454 847.3039	0.0004
11	15 January 2009	2 454 847.4412	0.0001
12	16 January 2009	2 454 847.5771	0.0004

Table 1: Observed times of minima of V1107 Cassiopeae

2. Weighing a galaxy

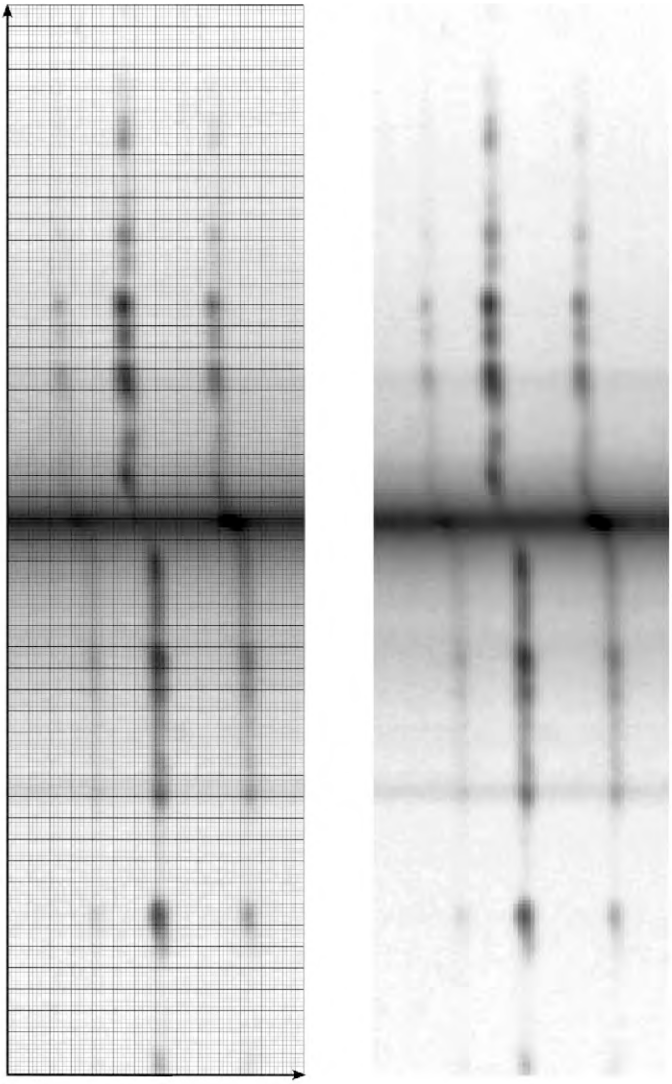
The attached images show a photograph of the spiral galaxy NGC 7083, which lies at a distance of 40 Mpc, and a fragment of its spectrum. The slit of the spectrograph was aligned with the major axis of the image of the galaxy. The x-axis of the spectrum represents wavelength, and the y-axis represents the angular distance of the emitting region from the core of the galaxy, where 1 pixel = 0.82 arcsec. Two bright emission lines are visible, with rest wavelengths of $\lambda_1 = 6564$ Å, $\lambda_2 = 6584$ Å.

Use the spectrum to plot the rotation curve of the galaxy and estimate the mass of the central bulge.

Assumption: central bulge is spherical.

The photograph of the galaxy has the correct proportions.

NGC 7083



Spectrum of NGC 7083. Grid marks pixels

Observing competition – planetarium round

General instructions

1. There are 2 questions, each worth 25 points. You have **80** minutes to solve them, of which :
   (a) **20** minutes for reading the question and preparing for the observations,
   (b) **40** minutes to perform all the observations in the planetarium (20 minutes for each questions),
   (c) **20** minutes for calculations and finishing your work.
2. Additional time is allowed to move to and from the planetarium.
3. Along with the questions you will be given a map of the sky, for use with both questions. The map is for epoch J 2000.0, using a polar projection with a linear scale in declination, and covers stars down to about 5^{th} magnitude. You will also be given paper for working and notes, writing implements, a pencil sharpener and an eraser.

   Please take everything from the desk in the first room with you to the planetarium dome, as you will be going to a different room afterwards to finish your work.
4. At your place in the dome you will find a torch and clipboard. Please leave these two items behind for the next contestant.
5. Only answers <u>given in the appropriate places on the question sheet and on the map</u> of the sky will be assessed. The additional worksheets will not be assessed.
6. Clearly mark every page with your code number.

About the questions

In Question 1 :

1. The sky is stationary, the observer is on the surface of the Earth.
2. Visible on the sky are: a comet, the Moon and a nova of about 2^{nd} magnitude.
3. From the 11^{th} minute, a grid representing horizontal coordinates will be projected on the sky, and will remain on until the end of the question.

In Question 2 :

1. Four consecutive days on the surface of Mars will be shown.
2. There is a Martian base visible on the horizon.
3. During the Martian daytime the sky will be slightly brightened.
4. The moons of Mars and the other planets will <u>not</u> be displayed.
5. The local meridian will be continuously visible on the sky.

<u>Note:</u> Azimuth is counted from 0° to 360° starting at S through W, N, E.

Observing competition – planetarium round

1. Earth

A) On the map of the sky, mark (with a cross) and label the nova (mark it "N") and the Moon (mark it with a Moon symbol) and draw the shape and position of the comet.

B) In the table below, circle only those objects which are above the astronomical horizon. <u>Note:</u> you will lose 1 point for every incorrect answer.

M20 – Triffid Nebula	o Cet – Mira	δ CMa – Wezen
α Cyg – Deneb	M57 – Ring Nebula	β Per – Algol
δ Cep – Alrediph	α Boo – Arcturus	M44 – Praesepe (Beehive Cluster)

C) When the coordinate grid is visible, mark on the map the northern part of the local meridian (from the zenith to the horizon) and the ecliptic north pole (with a cross and marked "P").

D) For the displayed sky, give the :

geographical latitude of the observer : $\varphi =$ . . . .

Local Sidereal Time : $\theta =$ . . . .

time of year, by circling the calendar month :

Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec.

E) Give the names of the objects, whose approximate horizontal coordinates are :

azimuth $A_1 = 45°$ and altitude $h_1 = 58°$: . . . . ;

azimuth $A_2 = 278°$ and altitude $h_2 = 20°$: . . . .

(If you can, use Bayer designations, IAU abbreviations and Messier numbers or English or Latin names.)

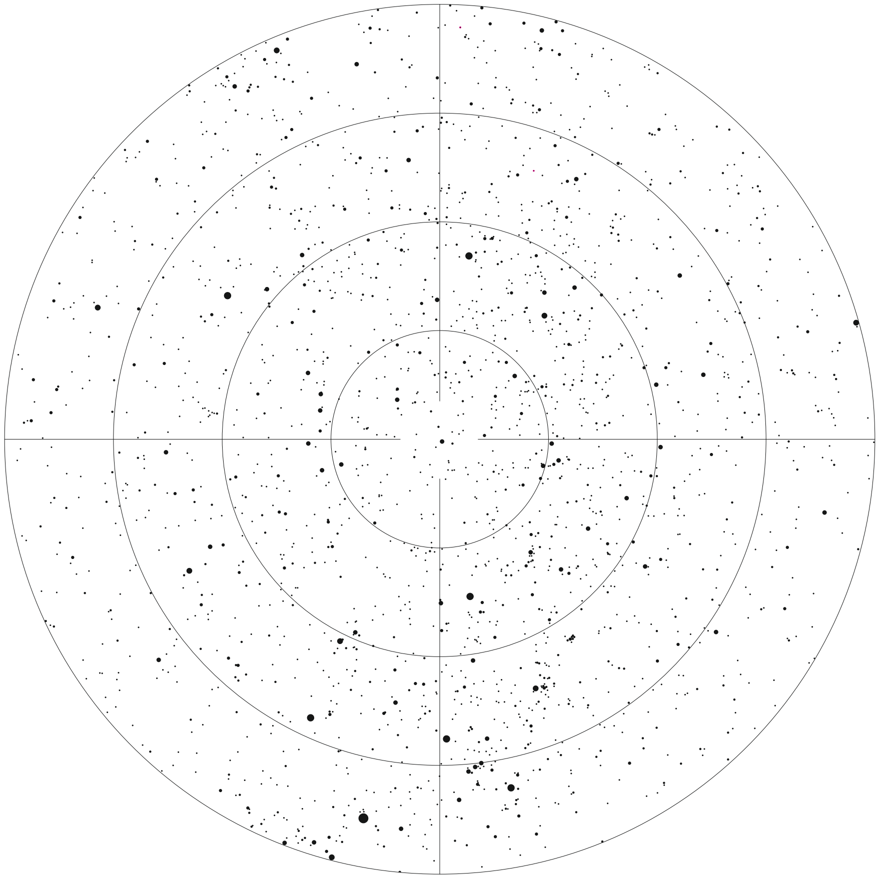
F) Give the horizontal coordinates (azimuth, altitude) of :

Sirius (α CMa) : $A_3 =$ . . . . ; $h_3 =$ . . . .

The Andromeda Galaxy (M31) : $A_4 =$ . . . . ; $h_4 =$ . . . .

G) Give the equatorial coordinates of the star marked on the sky with a red arrow :

$\alpha =$ . . . . ; $\delta =$ . . . .



2. Mars

H) Give the areographic (Martian) latitude of the observer : φ = ...

I) Give the altitudes of upper (h_u) and lower (h_l) culmination of :

Pollux (β Gem) : h_u = ... ; h_l = ... ,

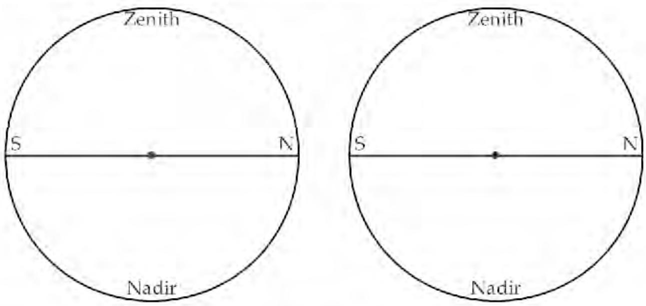
Deneb (α Cyg) h_u = ... ; h_l = ... ,

J) Give the areocentric (Martian) declination of :

Regulus (α Leo) δ = ...

Toliman (α Cen) δ = ...

K) Sketch diagrams to illustrate your working in questions (I) and (J) above :



L) on the map of the sky, mark (with a cross) and label ("M") the Martian celestial North Pole.

M) Give the azimuth of the observer as seen from the Martian base :

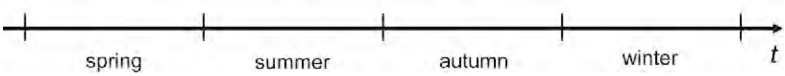
A = ...

N) Estimate the location of the base on Mars, and circle the appropriate description :

a. near the Equator *b.* near the northern Tropic circle

c. near the northern Arctic circle *d.* near the North Pole

O) The time axis below shows the Martian year and the seasons in the northern hemisphere. Mark the date represented by the planetarium display on the axis.



Observing competition – night round

Instructions

1. There are 2 questions, each worth 25 points. You have **80** minutes to solve them, of which :
   (a) **25** minutes for reading the question and preparing for the observations,
   (b) **30** minutes to perform all the observations at the telescope (for both questions),
   (c) **25** minutes for calculations and finishing your work.
2. Additional time is allowed to move to and from the observing site.
3. Along with the questions you will receive a map of the sky, for use with both questions.
4. At the observing site you will find ready :
   (a) a refracting telescope with a right-angle mirror and an eyepiece with an illuminated reticle, which can be rotated about the optical axis,
   (b) a red torch, stopwatch, pencil, eraser and clipboard,
   (c) a chair.

   Note: the telscope is already aligned – do not change the position of the tripod!

   The brightness of the reticle can be adjusted by turning the on-off switch.
5. You are allowed to take only the questions, answer sheet and blank paper for additional work with you to the telescope.
6. Only the answer sheet will be assessed. The additional worksheets will not be assessed.
7. Clearly mark every page of the answer sheet with your code number.
8. If you have difficulty with the equipment (not related to the question) or disturb the alignment of the telescope, call an assistant.

Observing competition – night round

1. The Little Dolphin

An asterism known as the Little Dolphin lies near a line connecting the stars α Peg (Markab) and β Peg (Scheat). It is marked with a cicle on the large-scale map.

The map also shows the constellation of Delfinus, the Dolphin, with the brightest stars labelled with their Bayer designations (α, β, γ, δ and ε).

The coordinates of α and β Peg and the Little Dolphin (in right ascension order) are:

	Right Ascension α	Declination δ
Little Dolphin	$23^{h}\,02^{m}$	$+23.0°$
β Peg	$23^{h}\,04^{m}$	$+28.1°$
α Peg	$23^{h}\,05^{m}$	$+15.2°$

Based on your observations, make two drawings on the answer sheet :

On Drawing 1 :

Draw the view of the constellation **Delphinus** (Del) as seen through the finder scope. Include as many stars as you can see in the field of view.

With an arrow, mark the apparent direction of motion of the stars across the field of view of the finder scope caused by the rotation of the Earth.

Label the stars with the Bayer designations given on the map (α, β, γ, δ and ε).

Also label the brightest of these 5 stars "m_{max}".

Also label the faintest of these 5 stars "m_{min}".

On Drawing 2 :

Draw the view of the **Little Dolphin** as seen through the larger telescope. Include as many stars as you can see in the field of view.

With an arrow, mark the apparent direction of motion of the stars across the field of view of the telescope caused by the rotation of the Earth.

Label the stars of the Little Dolphin α', β', γ', δ' and ε' such that they match the labels of the stars in the constellation Delphinus as given on the map.

Label the brightest of these 5 stars "m_{max}".

DOLPHIN

Little Dolphin

2. Determining declination

The two pictures on the next page show a small asterism, as seen directly on the sky and as a mirror image. Three stars are labelled: S1, S2 and S*x*. The position of the asterism is also marked with a rectangle on the larger-scale map of the sky.

Find this asterism and point your telescope to it.

Using the illuminated reticle as a fixed reference point, and the stopwatch, measure the time taken for the stars S1, S2 and *Sx* to move across the field. You may rotate the eyepiece so that the cross-hairs of the reticle are in the most convenient position for your measurement.

Use your measurements and the known declinations of stars S1 and S2 as given below to determine the declination of star *Sx*.

On the answer sheet, give your measurements and working, and estimate the random error in your result.

For each set of measurements you make, draw the view through the eyepiece on the answer sheet. (Use the blank circular field on the answer sheet.)

Mark the drawing with the compass directions N and E. Draw the reticle and the tracks of the stars to show the motion which you timed using the stopwatch.

Mark the ends of each timed track and show which time measurement refers to which track – for example, for measurement "T1" marking the ends "Start T1" and "End T1".

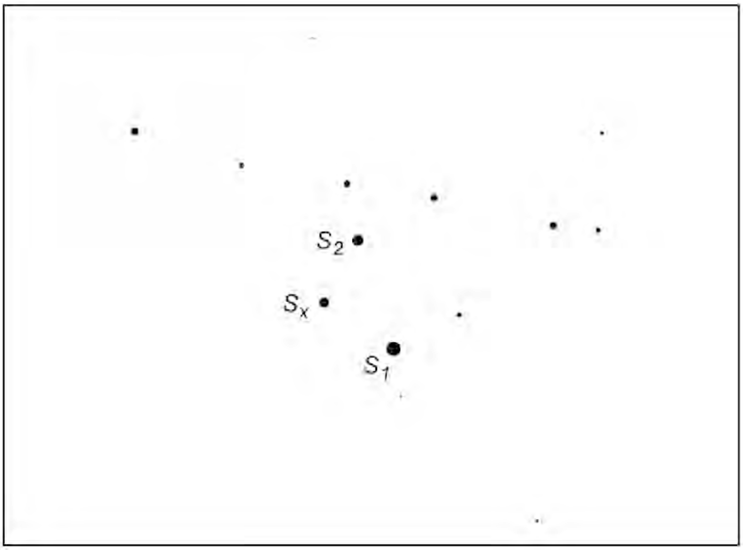
The angle of the reticle can be easily adjusted by rotating the eyepiece around its optical axis. If you change the angle of the reticle for a new measurement, draw a new diagram.

The declinations of the field stars S1 and S2 are :

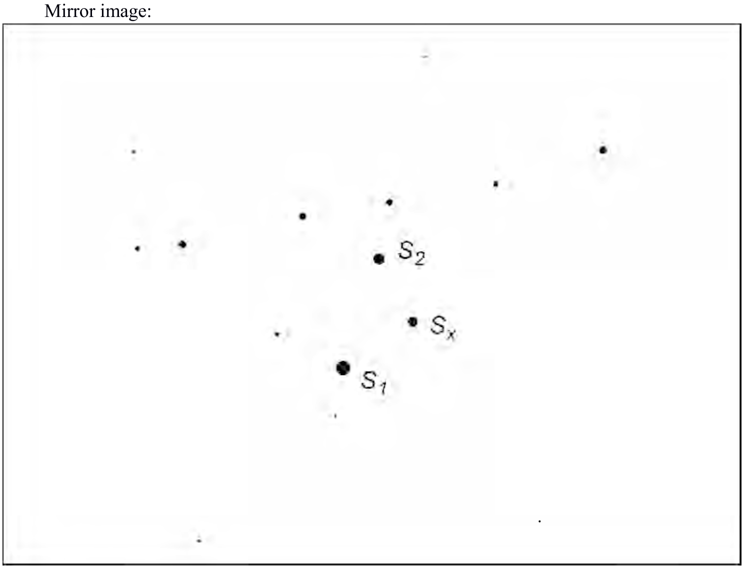
S_1 : $\delta = +19°\,48'\,18''$ S_2 : $\delta = +20°\,06'\,10''$

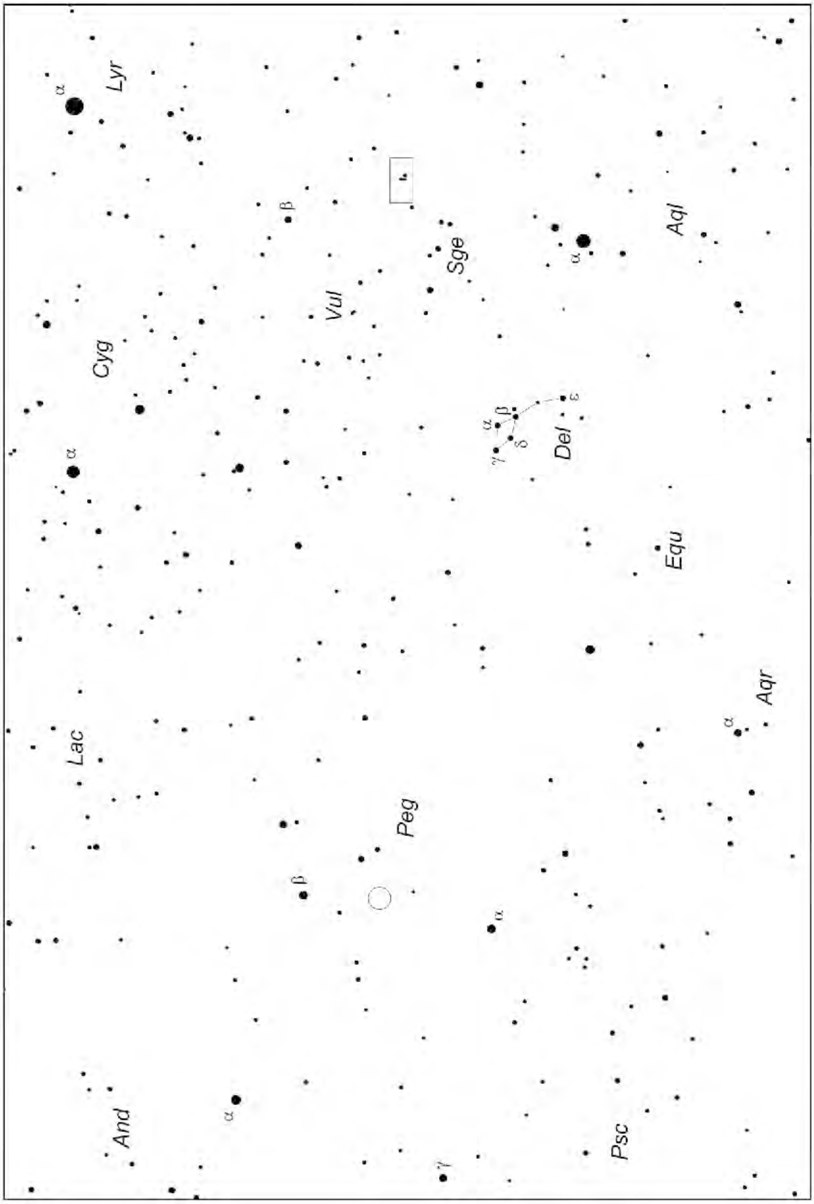
Assume that: $\delta(S_2) > \delta(Sx) > \delta(S_1)$.

Direct view:



Mirror image:




Lyr
Aql
Sge
Vul
Cyg
Del
Equ
Aqr
Lac
Peg
And
Psc

Group competition rules

1. Teams consisting of three or more students can participate in the group competition.
2. The team will be given a set of 5 problems to solve in 60 minutes.
3. The team's result is decided by the sum total of the points obtained for all 5 problems. Up to 20 points can be obtained for each problem. The team can gain extra points by handing in their solutions to all 5 problems before the end of the allotted 60 minutes, and will lose points for time taken beyond the 60 minutes, as follows:
4. If, at the moment the team's solutions are handed in, n full minutes are left before the allotted time, then the sum total of the points obtained by the team for their solutions will be multiplied by a factor

$$k = 1 + n/100,$$

   thus the team gets an extra 1% of their total result for every minute saved.

5. If the team hand in their solutions n full minutes after the allotted 60 minutes have passed, the sum total of the points obtained by the team of the team will be multiplied by the factor

$$k = 1 - n/100,$$

   thus the team will lose 1% of their result for every minute used beyond the allotted time.

6. The team with the most points after adjustment for time wins.
7. Every student of the winning team will be given a prize and gold medal of the group competition.

Additional Instructions

1. You may complete the questions in any order and using any combination of team members working individually or together.
2. Hand your answers in when you have finished working on <u>all</u> of the problems.
3. A team combined from two countries will receive all of the questions in both languages, but should complete and hand in no more than <u>one</u> version of each question.
4. For question 1, mark your answers on the maps provided. For question 3, mark your answers on the question sheet in the appropriate places. For questions 2 and 4 please use the attached answer sheets. For question 5 mark the card.

Group competition

1. Constellations

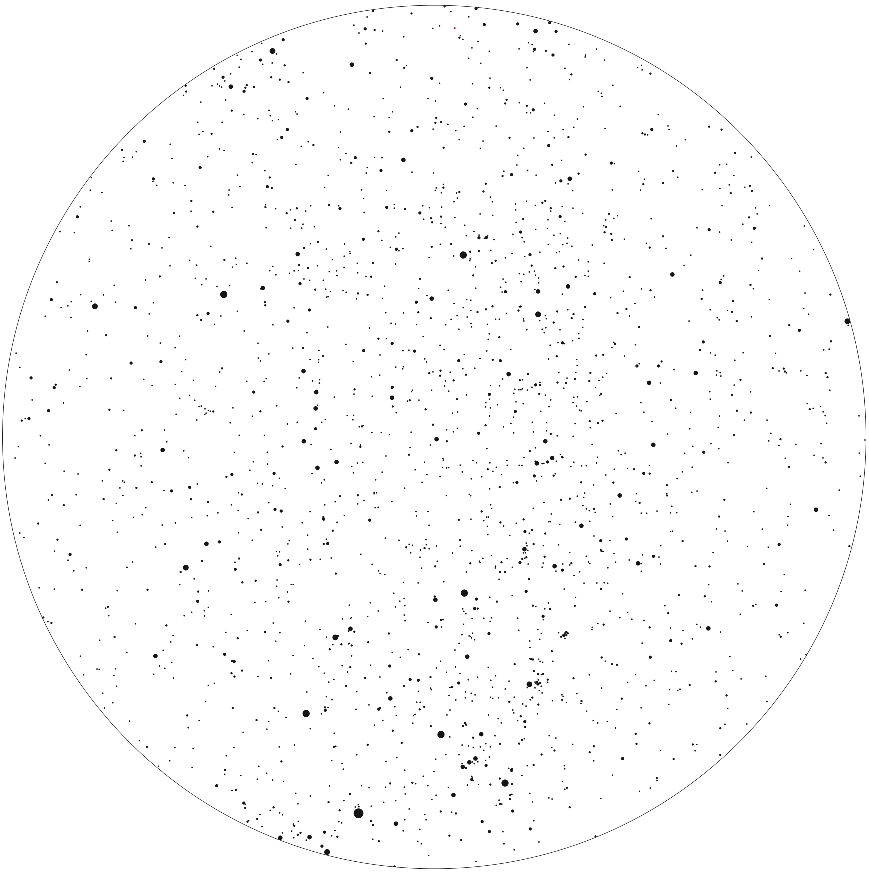
Jan Hevelius (1611–1687) introduced 11 new constellations onto the sky. The International Astronomical Union confirmed 7 of those in 1928:

	IAU Abbreviation	Latin name	Translation	Equatorial coordinates of the centre of the constellation	
				Right ascension α	Declination δ
1	CVn	Canes Venatici	Hunting dogs	$13^h\,00^m$	$+40°$
2	Lac	Lacerta	Lizard	$22^h\,30^m$	$+46°$
3	LMi	Leo Minor	Smaller Lion	$10^h\,10^m$	$+32°$
4	Lyn	Lynx	Lynx	$8^h\,00^m$	$+48°$
5	Sct	Scutum	Shield	$18^h\,40^m$	$-10°$
6	Sex	Sextans	Sextant	$10^h\,15^m$	$-3°$
7	Vul	Vulpecula	(Little) Fox	$20^h\,15^m$	$+24°$

(a) For each of the above constellations, clearly mark on the attached map a point lying within the constellation, using the appropriate number or IAU name.

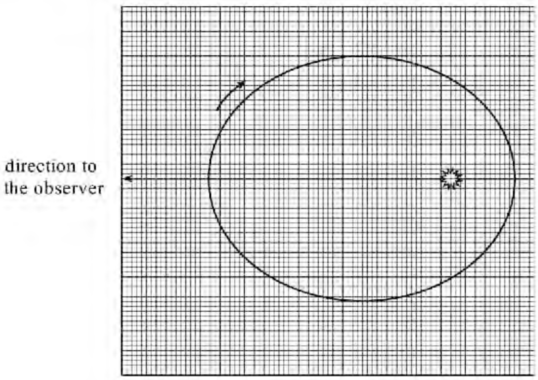
(b) On the same map, clearly mark (using a cross or arrow) the positions of any 13 objects from the Messier Catalogue, giving the Messier number ("M *xx*") for each.

The map is prepared for epoch J 2000.0 and uses a polar projection with a linear scale in declination. It includes stars brighter than about 5th magnitude.



2. Orbital motion

The scale diagram below represents the relative orbit of a physically double star:



A star of mass m moves around a star of mass M in the indicated direction, where $m \ll M$. The major axis of the ellipse is aligned with the direction to the observer, and the motion of the star is in the plane of the diagram.

Find the part of the ellipse where the angular velocity ω of star m is less than its mean angular velocity $\langle\omega\rangle$, and indicate this as accurately as possible on the scale diagram on the answer sheet. Also mark those places on the ellipse for which the observer will see:

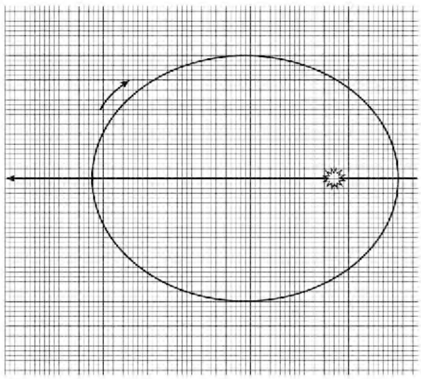
(a) extreme values of the tangential speed: $v_{t\,max}$ and $v_{t\,min}$,

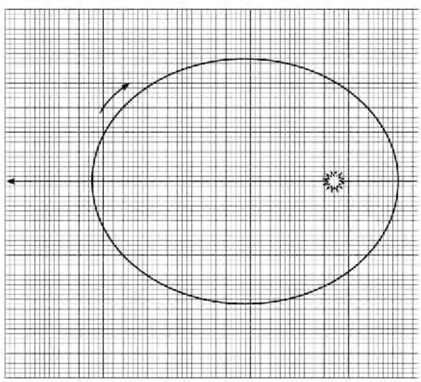
(b) extreme values of the radial speed: $v_{r\,max}$ and $v_{r\,min}$.

Note: The momentary angular velocity ω of star m is equal to the mean angular velocity $\langle\omega\rangle$ when the distance between stars $r = \sqrt{(ab)}$, where a and b are the semi-axes of the orbit.

(You may use one or both of the diagrams on the answer sheet to show your answer.)

Answer sheet for Question 2





3. Identifying telescope components

(a) Look at the pictures of the telescope and match the names of the items with the corresponding letters. Write your answers in the table below:

Item name	Letter	Points
(example) Tripod	**M**	0
1. Counterweight		
2. Right Ascension Setting Circle (R.A. Scale)		
3. Declination Setting Circle (Declination Scale)		
4. Right Ascension locking knob		
5. Declination locking knob		
6. Geographical latitude scale		
7. Finder scope		
8. Focuser tube		
9. Focuser knob		
10. Eyepiece		
11. Declination Axis		
12. Right Ascension Axis (Polar Axis)		
13. Right Ascension slow motion adjustment		
14. Declination flexible slow motion adjustment		
15. 90° diagonal mirror		
16. Azimuth adjustment knobs		
17. Altitude adjustment screws		
18. Lock screw		
19. Spirit level bubble		
20. Eyepiece reticle light – on/off switch & brightness control		

(b) Select and circle the correct answer for each of the questions below:

21. Mount type :

a. Fork *b*. English Equatorial *c*. Dobsonian *d*. German Equatorial

22. Optical type :

a. Newtonian *b*. Cassegrain *c*. Keplerian *d*. Galilean

23. Entrance aperture :

a. 60 mm *b*. 80 mm *c*. 90 mm *d*. 100 mm

and objective lens focal length :

a. 400 mm *b*. 500 mm *c*. 600 mm *d*. 800 mm

24. Eyepiece focal length :

a. 4 mm *b*. 6 mm *c*. 12.5 mm *d*. 25 mm

25. Used for visual observations of the sky, the finder scope gives a picture which is :

a. normal *b*. rotated by 180° *c*. reflected in one axis *d*. rotated by 90°

26. Used for visual observations **with** the diagonal mirror, the instrument gives a picture which is :

a. normal *b*. rotated by 180° *c*. reflected in one axis *d*. rotated by 90°

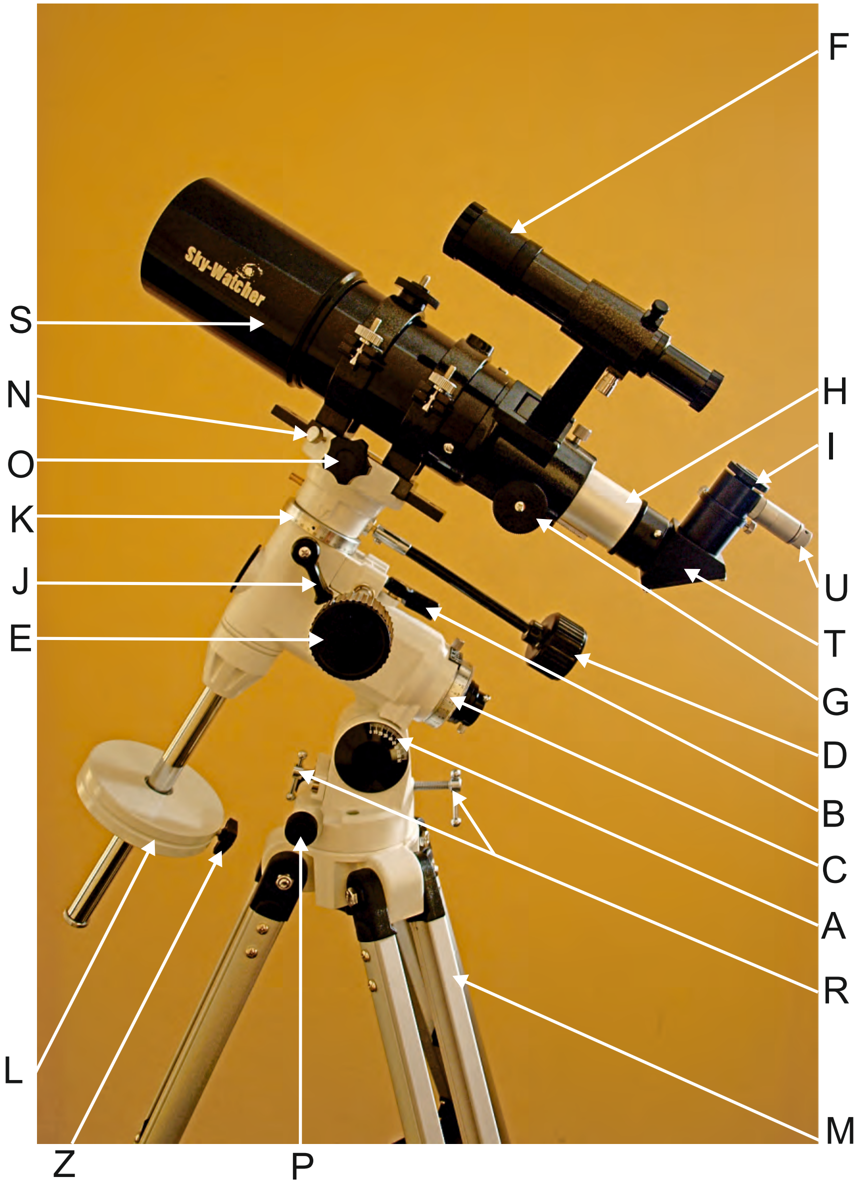
(c) Determine the following theoretical instrument parameters

27. Magnification : ____________________________

28. Focal ratio : ____________________________

29. Resolution : ____________________________
(in arcseconds)

30. Limiting magnitude:


Sky-Watcher
F
S
N
H
O
I
K
J
U
E
T
G
D
B
C
A
R
L
M
Z
P


X
Sky-Watcher
Y
Y
W
X

4. Minimum of an eclipsing binary

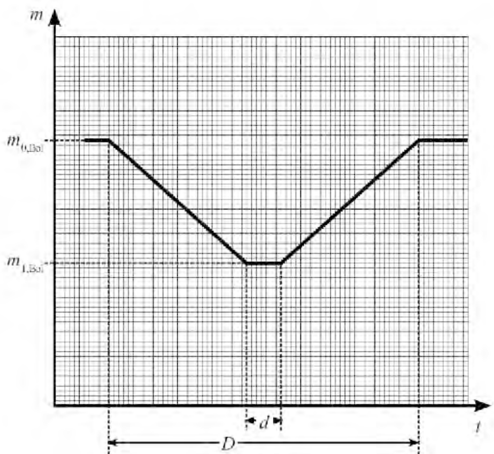
The figure shows the secondary (shallower) minimum of the light curve of an eclipsing binary star. The difference between bolometric magnitudes $m_{1,Bol} - m_{0,Bol} = 0.33$ magnitude.

We also know from simultaneous spectroscopy that the star with the smaller radius was eclipsed by the larger star during the secondary minimum (since only one spectrum was observable during the minimum).

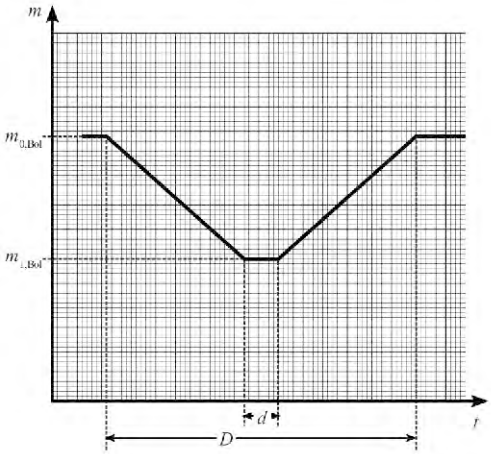
Determine the change of brightness of this binary during the primary minimum and draw the shape of the primary minimum using the same scale as the secondary minimum. Label the graph with all appropriate parameters.

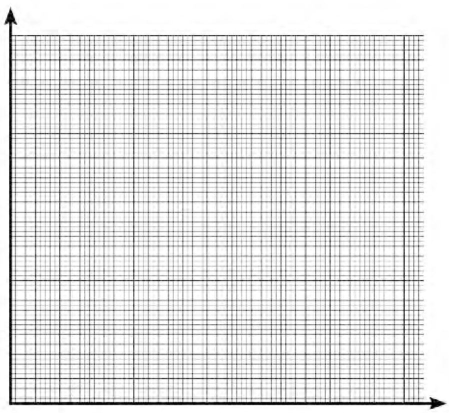
Use the answer sheets (one blank, one with the light curve plots) for your final answers.

You may assume that the eclipses are central, that the stars are spheres of constant surface brightness, and that the distance between the stars does not change.



Answer sheet for Question 4

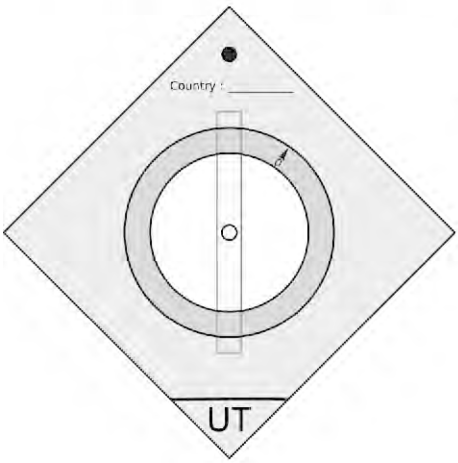


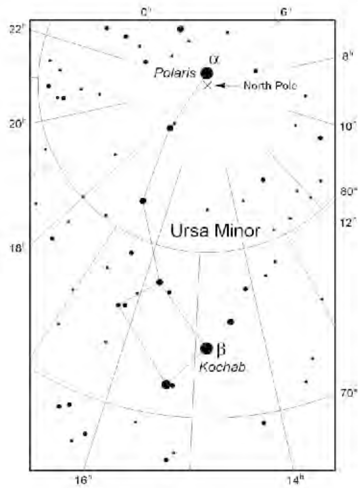


5. Nocturnal

Circumpolar stars describe a full circle around the Celestial Pole over 24 hours. This can be used to make a simple clock.

You are given a blank card with a movable ring, along with a clear strip with a centre circle. If the card has a suitable scale, the clear strip is attached as in the diagram below and the Pole Star is visible through the centre circle, then the position of the star Kochab (β UMi) on the inner edge of the ring will give the current time.





Design and mark on the card and ring suitable inner and outer scales (as required) such that, in Katowice for any night of the year, the side of the clock marked "UT" can be used to show current Universal Time, and the other side (marked "ST") can be used to show current Local Sidereal Time.

For 27 August in Katowice, the lower culmination of Kochab is at 05:15 Central European Summer Time (UT−2). The coordinates of Kochab (β UMi) are : α: $14^h\ 51^m$, δ: $+74.2°$.

Notes: – The blank card is marked with a line which should be held horizontally when the device is used.

– The clear strip will be attached later, after you have finished and handed in the card. For now it is left off so that it does not get in your way when making the scale.

V1

Short theoretical questions – solutions

Each question max 10 points

Question 1

Perihelium distance is much smaller than aphelium distance.
Thus, semimajor axis of the comet orbit $a \approx 17500$ AU. **[1]**
Application of the III Kepler's Law to get the comet orbital period **[4]**
Actual calculations: $T = a^{2/3} \approx 2.32 \cdot 10^6$ (T in years) **[4]**
The sought solution is equal to one half of T, i.e. approx. $1.16 \cdot 10^6$ years **[1]**

Question 2

$v_e = \sqrt{(2GM_{sol}\, n/R)}$, **[5]**
solve for n. (~ 100 000). **[5]**

Question 3

Sum of potential and kinetic energy of Voyager is $E = -G\, m\, M_\odot / r + mv^2 / 2$ **[3]**
Where m – mass of Voyager, $r = 116.406$ AU, $v = 17.062$ km/s.

Substituting numerical values into energy equation, **[3]**
we get $E > 0$, therefore the orbit is hyperbolic **[1]**

Brightness of the Sun is $m(r) = m_\odot + 5 \log(r)$ **[2]**
≈ -16.5 mag. **[1]**

Question 4

The orbit of Phobos and the rotation of the planet are in the same direction, so the angular velocity of the moon relative to Mars, $\omega_{P/M}$, is equal to the difference

$\omega_{P/M} = \omega_M - \omega_P$ **[2]**

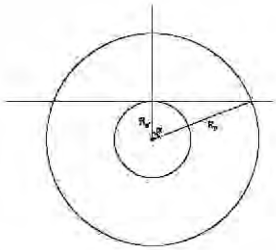
where ω_M and ω_P are the angular rotation velocity of Mars and the angular orbital velocity of Phobos respectively.

For ω_M we have $\omega_M = 2\pi / T_M$ where T_M is the period **[1]**

The time above the horizon, t, is found from the relation (see drawing):

$t = 2\alpha / \omega_{P/M}$ **[2]**

where $\alpha = R_M / R_P$. **[1]**



Find the angular velocity of Phobos ω_P assuming gravity is equal to the centripetal force:

$$\omega_P = \mathrm{sqrt}(\,GM_M / R^{3/2}{}_P)$$ **[2]**

Substituting:

$\omega_M = 7.0882 \cdot 10^{-5}\ \mathrm{s}^{-1}$,

$\omega_P = 2.2784 \cdot 10^{-4}\ \mathrm{s}^{-1}$,

$\omega_{P/M} = -1.5696 \cdot 10^{-4}\ \mathrm{s}^{-1}$

where "–" means that the moon "leads" the rotation of the planet; substitute the absolute value into the equation,

thus

$\alpha = 68^{\circ}.794 = 1.2007$ rad.

and $t \approx 15300\ \mathrm{s} = 4h\ 15m$. **[2]**

Question 5

Angular resolution: $\sin(\lambda) = 1.22\,\lambda/D$ **[2]**

$D_{radio}[m] = (\lambda_{radio} \cdot D_{optic})/\lambda_{optic} =$ (1cm· 10cm)/550nm = (0.01 m · 0.1 m) / 0.00000055 m= 1820 m

equation of angular resolution as a function of λ and D **[2]**

proportion of $\lambda_{radio}/D_{radio} = \lambda_{optic}/D_{optic}$ **[2]**

proper calculation **[2]**

and result assuming λ_{optic} in proper range: 500 – 600 nm **[2]**
400 – 900 nm
out of range

Question 6

Calculation of the moment of inertia of Earth **[2]**

The moment of inertia is $I = \frac{2}{5} m_E R_E^2$

Equation of motion for this case $K = I \cdot \varepsilon$ **[2]**

where ε is angular acceleration and K is moment of force.

Calculation of angular acceleration **[1]**

Acceleration is equal to $\varepsilon = K/I$. From the assumption, the acceleration ε is constant and we find its numerical value equal to $6\cdot 10^{22}\ s^{2}$.

Calculation of the change of ε during assumed period of time **[1]**

Multiplying this value by $1.9\cdot 10^{16}$ s [600 My] we obtain $\Delta\omega = 1.14\cdot 10^{-5}\ s^{-1}$.

Calculation of the angular frequency in the past **[2]**

Using the definition of the angular frequency one can calculate its recent value $2\pi/86164\ s^{-1} = 7.29\cdot 10^{-5}\ s^{-1}$. Subtracting from it calculated above $\Delta\omega$ one gets $\omega_{past} = 6.15\cdot 10^{-5}\ s^{-1}$

Calculation of the day length in the past and number of days in the ancient year **[2]**

Having angular frequency one can get ancient period of Earth rotation . Dividing sidereal year length by the obtained period one gets number of days in the ancient year equal to about 420 days.

Question 7

Limiting ourself to the orbits with peri and apogeum in the explosion point, the angle β should be equal to 90° or 270°, while the angle α should be:

1). $\alpha \in <0°; 90°)$ or $\alpha \in (270°; 360°>$, **[2]**
2). $\alpha = 90°$ or $\alpha = 270°$, **[2]**
3). $\alpha \in (90°; 120°)$ or $\alpha \in (240°; 270°)$, **[2]**
4). $\alpha = 120°$ or $\alpha = 240°$, **[2]**
5). $\alpha \in (120°; 180°)$ or $\alpha \in (180°; 240°)$, **[2]**

respectively.

Taking into account other kind of orbits (without peri and apogeum) one has to make the angle β free (unfixed).

Question 8

Gravitational force can be expressed in the form: $F_g = \frac{4}{3}\pi \cdot r^3 \cdot \rho \cdot G \cdot \frac{M}{R^2}$ **[2]**

The force of radiation reads $F_r = \pi \cdot r^2 \cdot C_0/c$ **[2]**
where r, ρ, R, G, M, C_0 are a radius and density of dust, distance form the Sun, gravitational constant, Solar mass and Solar constant respectively.
Comparing these forces one obtains $F_g = F_r$ **[2]**

and finally one gets the dust grain radius $r = \frac{3}{4}\frac{C_0 \cdot R^2}{c \cdot \rho \cdot G \cdot M}$ **[2]**

Substituting numerical values one obtains $r \approx 5 \cdot 10^{-7}$ m **[2]**

Question 9

Finding that surface brightness is independent of distance **[2]**

Relationship between m and the Sun surface brightness:
$m - \mu_{\odot} = -2.5 \log\ ((\pi \cdot \theta^2/4)\ /\ 1\ \mathrm{arcsec}^2)$. **[2]**

Calculations of $\mu_{\odot} = -10.79$ **[1]**

Galaxy vs. Sun surface brightness (in magnitudes$\cdot$arcsec^{-2})
$\mu - \mu_{\odot} = 18.0 + 10.79 = 28.79$ **[1]**

Relationship between the sought sky fraction covered by stars, x, and the surface brightness ratio: $\mu - \mu_{\odot} = -2.5 \log x$ **[3]**

Calculations $x = 10^{-0.4(\mu - \mu_{\odot})} = 3.1 \cdot 10^{-12}$ **[1]**

Question 10

Formulation of a penetration conditions **[2]**

From the conditions specified in the exercise text the particle should be pass in the belt of magnetic field around quarter of the circle. If this particle leaves the belt the particle path should be a little longer. It means that the radius of this circle should be larger then the belt thickness.

Determination of the forces (centrifugal and magnetic) acting upon the particle, writing of the appropriate formulae **[4]**

Comparison of the forces and calculations **[3]**

Comparing centrifugal and magnetic force one obtains

$e \cdot v \cdot B = M \cdot v^2 / r$

So $e \cdot r \cdot B = p$, where p denotes the momentum. From the assumed approximation $e \cdot r \cdot B = E / c$

Thus definitively particle energy is described by $E = c \cdot e \cdot r \cdot B$.

Substituting numerical values one obtains $E \approx 3 \cdot 10^{-8}$ J it means $2 \cdot 10^2$ GeV

Answer and conclusion: **[1]**

Question 11

Within assumed cosmological model the following relation is valid:

$(1+z) = \frac{R_0}{R(z)} = \left(\frac{t_0}{t(z)}\right)^{2/3}$, where R_0 and $R(z)$ denote the current value of the scale factor and that for the redshift equal to z respectively, while t_0 and $t(z)$ stands for the time that passed from the Big Bang. **[5]**

For z=6.03 the appropriate time $t(z) = 7.35\ 10^8$ years. Subtracting from $t(z)$ the interval equal to 560 My and 600 My one obtains $t_1 = 1.75 \cdot 10^8$ y and $t_2 = 1.35 \cdot 10^8$ y **[3]**

what is equivalent to $z_1 = 17.3$ and $z_2 = 20.8$. **[2]**

Question 12

At Northern Hemisphere declination of the non-rising stars $\delta < \varphi - 90°$, where φ stands for latitude. So in Krakow $\delta < -39.9°$. **[2]**

Within assumed precession model declination of the star can differ from ecliptic latitude β not more than ε = +23.5°. So the ecliptic latitude β of the stars at the study should be determined. **[2]**

Solving spherical triangle

$\sin\beta = \cos\varepsilon \cdot \sin\delta - \sin\varepsilon \cdot \cos\delta \cdot \sin\alpha$ **[3]**

Substituting by numerical values for the stars at the study one obtains:

Sirius $\beta = -39°.7$

Canopus $\beta = -75°.9$ **[1]**

Due to the precession, declination of Sirius can reach -63.2° so it will become non rising star.

As far as Canopus is concern its declination never exceed -52.4°, so it will never be visible. **[2]**

Question 13

From the attached table it can be read that northern galactic pole has the following coordinates:

$$\alpha_G = 12^h 51^m;\ \delta_G = +27°08'.$$

It means that at the sidereal time $\theta = 0^h 51^m$ this pole is in lower culmination at the northern side and below the horizon. **[2]**

The angle between galactic equatorial plane and the horizon is equal to

$90° - \delta_G + 90° - \varphi = 103°18'$ and this angle is an analogue of ε in the equation of the ecliptic.

Analogue of R.A. in the equation of the ecliptic is $90° - A$ because A is clockwise while R.A. is counterclockwise and at the intersection of the horizon plane and galactic equatorial azimuth is equal to 90°. **[2]**

So we get $\text{tg}(h) = \sin(90° - A)\,\text{tg}(180° - \varphi - \delta_G)$. So,
$h = \text{arc tg}\,(\cos A \cdot \text{tg}\,(-\varphi - \delta_G) = \text{arc tg}\,(-\cos A \cdot \text{tg}\, 76°42')$. **[4]**

Checking:

$A = 0,\qquad h = -76°42'$,

$A = 90,\qquad h = 0°$. **[2]**

Question 14

Solar constant (from table) is 1366 W m^{-2}

Each reaction gives 26.8 MeV = $26.8 \cdot 1.602 \cdot 10^{-13}$ J = $4.3 \cdot 10^{-12}$ J **[4]**

Thus there must be $1366 / 4.3 \cdot 10^{-12} = 3.2 \cdot 10^{14}$ reactions per second to produce this energy flux **[4]**

Each reaction produces 2 neutrinos, so there must be $6.4 \cdot 10^{14}$ neutrinos $m^{-2} \cdot s^{-1}$. **[2]**

Question 15

Correct choice of the wavelength: **[2]**

If the nature of the spectrum does not change, it is sufficient to perform the calculation for one wavelength. The simplest choice is for the wavelength of the maximum (Wien's law)

$\lambda = b/T$

Understanding definition of redshift **[2]**

From this

$z = (\lambda_a - \lambda_e) / \lambda_e$

where λ_a is the wavelength received at the Earth and λ_e is the emitted wavelength

thus $\lambda_e = \lambda_a / (z+1)$

Substituting into Wien's law, we find

$T = b \cdot (z+1) / \lambda_a$ **[4]**

Substituting the current value of the temperature we find the result **[2]**

5th IOAA

Long theoretical questions – solutions and points

Question 1 – Transit of an exoplanet

Max 30 points

Calculation of the angular distance on the orbit which the planet travels during the transit **[6]**
Since the orbit is circular,

$$\sin\frac{\alpha}{2}=\frac{\pi t}{T}$$

where t and T are, respectively, the duration of the transit and the orbital period of the planet.

We can leave the angle as $\sin\frac{\alpha}{2}$ as this will be useful later; the numerical value of this expressiob is about 0.112.

Calculation of the velocity of the planet **[10]**
The velocity v at the beginning and end of the transit and the measured difference in velocities Δv form an isosceles triangle, with the angle between the equal sides = 2α.
Thus

$$2v\cdot\sin\frac{\alpha}{2}=\Delta v$$

from which we get a velocity equal to about 134 km/h. **[2]**

Calculation of the radius of the orbit **[2]**
since we know the velocity on a circular orbit, this is trivial:

$$2\pi r=vT\Rightarrow r=\frac{vT}{2\pi}$$

Substituting we get about $6.4\cdot10^6$ km. **[2]**

Calculation of the radius of the star **[2]**
With the velocity on the orbit and the transit duration, we get the radius of the star:

$2R=tv\Rightarrow R=\frac{tv}{2}$ $=7.5\cdot10^5$ km . The star is thus similar to the Sun in size. **[2]**

Calculation of the mass of the :

Given the orbital speed and radius, do this in the usual way:

$$\frac{v^2}{r}=\frac{GM}{r^2}$$ **[2]**

thus

$$M=\frac{v^2r}{G}$$

The mass is therefore about $1{,}8\cdot10^{30}$ kg, so again similar to the mass of the Sun. **[2]**

5th IOAA

Question 2 – Brightness of an elliptical galaxy

Max 30 points

1)
The luminosity distance is defined to satisfy a canonical inverse square law of the bolometric luminosity L (total emitted radiation power) and observed flux F (flux-luminosity relationship)

$$F = \frac{L}{4\pi d_L^2} \qquad (1)$$

Units of the flux and luminosity are expressed in SI ($W \cdot m^{-2}$ and W respectively), or CGS ($erg \cdot s^{-1} \cdot cm^{-2}$, $erg \cdot s^{-1}$ respectively).

[3]

2)
Only the part of the spectrum (namely B-band) is observed, but the inverse square law is applicable also to the monochromatic luminosity $L_\lambda(\lambda)$ and monochromatic flux $S(\lambda)$ [1], taking into account that observed wavelengths are not equal to emitted ones. (Observers frame is not the same as a frame of galaxy). For a small wavelength interval

$$S(\lambda_o) \cdot \Delta\lambda_o = \frac{L_\lambda(\lambda_e)}{4\pi d_L^2} \cdot \Delta\lambda_e,$$

Observed fraction of the total spectrum is redshifted into the frame of the observer, and a relationship between the observed and emitted wavelengths, λ_o and λ_e, can be expressed as

$$\lambda_e = \lambda_o/(1+z).$$

So,

$$S(\lambda)\Delta\lambda = \frac{1}{4\pi d_L^2} \cdot L_\lambda\left(\frac{\lambda}{1+z}\right) \cdot \frac{1}{1+z}\Delta\lambda. \qquad (2)$$

[9]

3)
The absolute luminosity is defined as the flux would be observed at a distance of 10 pc from the compact source at rest (not redshifted). It means that the frame would be the same as for the object.

$$S_{10}(\lambda) = \frac{L_\lambda(\lambda)}{4\pi d_{10}^2}, \qquad (3)$$

where d_{10} is the distance equal to 10 pc, $S_{10}(\lambda)$ denotes a monochromatic flux in the wavelength of λ measured at 10 pc from the object.

[3]

[1] *Monochromatic flux is sometimes called as spectral density of flux (energy per unit time per unit area per unit wavelength) while monochromatic luminosity as spectral density of the luminosity (energy per unit time per unit wavelength). Their form is described by SED and thus spectral index.*

4)
Dividing eq. (2) by (3) we get

$$\frac{S(\lambda)}{S_{10}(\lambda)}=\left(\frac{d_{10}}{d_L}\right)^2\cdot\frac{L_\lambda\left(\frac{\lambda}{1+z}\right)}{L_\lambda(\lambda)}\cdot\frac{1}{1+z} \qquad (4)$$

for all the wavelengths.
The lower edge of validity of SED approximation is equal to 250nm. This corresponds to 1.5·250 nm=375 nm what is below the blue cut-off of the B filter[2], so SED approximation is applicable. Using the SED of the galaxy, we get

$$\frac{L_\lambda\left(\frac{\lambda}{1+z}\right)}{L_\lambda(\lambda)}\cdot\frac{1}{1+z}=\left(\frac{1}{1+z}\right)^4\frac{1}{1+z}=(1+z)^{-5} \qquad (5)$$

$$\frac{S(\lambda)}{S_{10}(\lambda)}=\left(\frac{d_{10}}{d_L}\right)^2\cdot(1+z)^{-5} \qquad (6)$$

The fraction of the monochromatic fluxes $S(\lambda)/S_{10}(\lambda)$ does not depend on the wavelength! So the relation (6) is valid also for blue band fluxes.

[9]

5)
The blue fluxes F and F_{10} have to be replaced by the corresponding magnitudes.
Using Pogson's Ratio it can be obtained:

$$m_B-M_B=-2.5\log\left(\frac{F}{F_{10}}\right)=5\log\left(\frac{d_L}{d_{10}}\right)+12.5\log(1+z)$$

$$M_B=m_B-5\log\left(\frac{d_L}{d_{10}}\right)+12.5\log(1+z) \qquad (7)$$

Substituting numerical data one can obtain:

$$M_B=20.40^{\mathrm{mag}}-5\log\left(2754\cdot10^5\right)-12.5\log(1.5)=-24.00^{\mathrm{mag}}$$

$$M_B=-24.00^{\mathrm{mag}} \qquad (8)$$

Please note, that precision is determined by m_B !

[3]

6)
Only the cD galaxies are so luminous, while the normal elliptical galaxies are substantially weaker. Accordingly, the galaxy is not a member of the cluster, but is a foreground object.

[3]

---
[2] *Blue band : Effective Wavelength Midpoint λeff=445nm, FWHM=94nm [398nm÷492nm]*

Question 3 – Proper motion

Max 30 points

Difference in radial distance is about $1.58 \cdot 10^{15}\,m$ **[2]**
Difference in right ascension is about 2.4767° **[2]**
Difference in declination is about 1.84° **[2]**

Thus the angular distance on the sky is about 3.09° **[3]**

Calculating the linear distance perpendicular to the line of sight
Using trigonometric functions and the distance from the Sun, we obtain a distance of $2{,}1 \cdot 10^{15}\,m$ **[2]**

The distance between the stars is thus $2{,}63 \cdot 10^{15}\,m$ **[3]**

Calculate the difference in angulare velocity in R.A. and Dec. Calculations (same method) for R.A. and Dec give a difference of 0.18 arcsec/year in both. **[4]**

Conversion of angular velocity on the sky to transverse linear velocity. (works out aroud 15) **[4]**

Note that transverse velocity is a lower limit to total velocity **[2]**

Compare obtained velocity to velocity expected for the distances between stars.
At distances of tens of thousands of AU the velocity is too great for the stars to form a bound system even with very massive stars. Even for a pair of one light and one heavy star, the heavy one would have a mass of thousands of Solar masses. **[4]**

Final answer and conclusion: **[2]**

5th IOAA

SILESIA POLAND 2011

Data Analysis Question 1 - solution

1) The star is a W UMa type, so both primary and secondary minima were observed. If the depth of the minimum isn't given, there is no way of decifing which (primary or secondary it is).

2) From the data, the can be seen that on four nights more than one minimum was observed. This allows us to estimate half the period based on the difference between pairs of observations:

minima	Δ T	average
2-1	.1367	Σ/5=.1367 Period P = obtained average x 2 = **0.2734**
4-3	.1372	
10-9	.1364	
11-10	.1373	
12-11	.1359	

3) For a first approximation of the elements, we chose an initial epoch (M_0), for example the first observed minimum 2454092.4111 The approximate elements are then:
M_{calc} = 2454092.4111 + 0.2734 · E

4) For an exact determination of the the elements we draw an O-C diagram. The data for making the O-C diagram are calculates as follows:

No	(M_{obs}) 2454000 –	E = (M_{obs} - M_0)/P	E (rounded to the nearest whole or half integer)	M_{calc} 2454000.0+	O-C = M_{obs}-M_{calc}
1	092.4111	0	0,0	092,4111	0,0000
2	092.5478	0,5	0,5	092,5478	0,0000
3	367.3284	1005,5497	1005,5	367,3148	0,0136
4	367.4656	1006,0516	1006,0	367,4515	0,0141
5	388.5175	1083,0519	1083,0	388,5033	0,0142
6	388.6539	1083,5508	1083,5	388,6400	0,0139
7	704.8561	2240,1061	2240,0	704,8271	0,0290
8	776.4901	2502,1178	2502,0	776,4579	0,0322
9	835.2734	2717,1262	2717,0	835,2389	0,0345
10	847.3039	2761,1295	2761,0	847,2685	0,0354
11	847.4412	2761,6316	2761,5	847,4052	0,0360
12	847.5771	2762,1287	2762,0	847,5419	0,0352

5) The O-C diagram should be plotted on graph paper

6) From the diagram, it can be seen that over 2762 epochs the value of (O-C) increased by 0.0355 days, therefore over one cycle (one epoch) the period was too short by:

0.0355/2762 = 0.0000129

and the estimated period P should be increased by this value.Taking into account that the graph can be read to 3 significant figures, the correction should also be to 3 significant figures.
P' = 0,2734 + 0,0000129 = 0,2734129
thus the corrected light elements of V1107 Cas are:

M_{calc} = 2454092.4111 + 0.2734129·E

7) The correction of the period could also be determined directly from the table, using the mean value of O-C for the initial epoch (E=0; 0,5) and the final epochs (E=2761; 2761,5; 2762)

8) To calculate the ephemeris, we need to know the JD of a given day. Since dates and JD numbers are given in the observations, we can calculate that, for example on 1 January 2008 r. at 12:00 the JD was 2454467.0, while on 1 January 2011 at 12:00 it was 2455563.0.
Since 1 September 2011 is the 243-rd day of the year, thus at 12:00 on that day JD 2455806.0 begins.

9) On 1 September 2011 at 18:00 (JD 2455806.25) there have been 1713.8389 days or 6268.3176 epochs since the inital epoch M_0 (2454092.4111). Thus the nearest (secondary) minimum which agrees with these elements will be:

JD 2454092.4111 + 0,2734129 · 6268,5 =2455806,2999 = **$19^h\,12^m$ UT**

The next (primary) minimum will be :

JD 2454092.4111 + 0.2734129 · 6269 = 2455806.4366 = **$22^h\,29^m$ UT**

The next (secondary) minimum will be on the same night, at:

JD 2455806.4111 + 0,2734129 · 6269,5 = 2457520.5733
that is on 2 September at **$1^h\,46^m$ UT**

Earlier and later minima can be determined by adding or subtracting half a period, or 3^h17^m

Data Analysis questions - points

1. Minima

Max 25 points

Correct determination of the approximate elements by

using double the difference of successive minima	[2]
using the average of several pairs of minima	[2]
correct calculation	[1]

Correct calculation of the points for the O-C diagram

correct calculation of epochs	[3]
correct calculation of (O-C)	[3]

either Correctly drawn diagram

Each correct axis	[1+1]
Correctly and carefully drawn points	[2]

Correct calculation of the period correction and giving the corrected elements

Using cumulative error / no. of epochs to correct period	[1]
correct cumulative O-C error	[1]
correct no. of epochs	[1]
correct period correction result	[1]

or calculation of period correction from the table of O-C without drawing O-C diagram **[4]**

corrected elements	[1]
error estimate for elements	[1]

Incorrect significant figures in final ephemeris: **[-2]**

Calculation of JD for 1 Sept 2011	[1]
Correct calculation of the ephemeris for the given night	[3]

Missing the second and third minima of the night **[-1 each]**

Data Analysis Question 2 - solution

Solution:

$\Delta\lambda = \lambda_1 - \lambda_2 = 20$ Å

distance on picture =22 pixels ± 2 $>$ horizontal scale 20/22= 0.9091 Å/pixel

Doppler shift from spectrum between upper and lower arm: $\Delta\lambda =$ 7 pixels ± 1 = 6.3636 Å

$2V_{radial} = c \cdot \Delta\lambda/\lambda$ ($c \approx 300\,000$ km/s) = 290.8 km/s

Inclination problem: (i – angle between line of sight and galactic disc)

Size of galaxy image: a = 11.5 ± 0.5 cm, b = 6.5 ± 0.5 cm $>$ i=arc sin (b/a) ≈ 35°

$\cos(i) = V_{radial} / V_{rotation}$ $>$ $V_{rotation} = V_{radial}/2 \cdot \cos(35^o) = 216.7$ km/s

Vertical scale (pixel to distance-from-centre conversion)

For 1 pixel: angle 0.82” corresponds to 2 ·40 Mpc·tg(0.82”/2) = 159 pc in galactic distance

Mass determination:

From Kepler’s law: $M = V^2 \cdot R / G$

$R \approx 10$ pixel = 1590 pc$\cdot 3.09\cdot 10^{16}$ m/pc = $4.9\cdot 10^{19}$ m

$M = 3.4 \cdot 10^{40}$ kg $> 1.7\cdot 10^{10} M_\odot$ ($M_\odot \approx 2\cdot 10^{30}$ kg)

2. Weighing a galaxy

Max 25 points

estimation of horizontal scale (pixel/Å)	**[1]**
calculation of $\Delta\lambda$ distance between lines	**[1]**
calculation of scale in Å/pixel	**[1]**
estimation of scale error	**[1]**

Vertical scale

Calculation of distance from galactic centre or rescaling from "/pixel to pc/pixel	**[2]**

Estimation of disc inclination based on pictures of galaxy :

measuring the vertical and horizontal size of galaxy image	**[2]**
calculating the inclination of galactic disc	**[1]**
calculating the error of inclination estimation	**[1]**

estimations of position of line in pixels	**[1]**
calculations of Doppler shift in Å	**[1]**
calculations of radial velocity using proper formula and constants	**[1]**
calculations of velocity for inclination	**[1]**

proper draw the rotation curve:

if picture will show:	-'solid body' rotation in bulge	**[1]**
	- two arms (blue and read shifted)	**[1]**
	- symmetry between arms	**[1]**
	- more then 10 point per arm	**[1]**
	- fluctuation of "constant level"	**[1]**

calculation of mass of bulge of galaxy based on Kepler's law

- using the proper formula	**[2]**
- using the proper place (end of the bulge) for bulge mass determination	**[2]**
- estimation of error base of scale and inclination error	**[2]**

Observing competition – planetarium round

Solutions and points

Note: For questions requiring giving a position, correct to 1° gets full marks (usually **1 point**), correct to 2° gets half marks (usually **0.5 point**).

1. **Earth** Max 25 points

A) On the map of the sky, mark and label the nova and the Moon and draw the shape and position of the comet. **[2+1+3]**

B) In the table below, circle only those objects which are above the astronomical horizon. **[+0.5 for each correct, -1 for each incorrect]**

~~M20 – Triffid Nebula~~	ο Cet – Mira	δ CMa – Wezen
α Cyg – Deneb	~~M57 – Ring Nebula~~	β Per – Algol
δ Cep – Alrediph	~~α Boo – Arcturus~~	M44 – Praesepe (Beehive Cluster)

C) When the coordinate grid is visible, mark on the map the northern part of the local meridian and the ecliptic north pole. **[3+2]**

D) For the displayed sky, give the :

geographical latitude of the observer : φ = **50° ± 1°** **[1]**

Local Sidereal Time : θ = **$5^h 25^m \pm 8^m$** **[2]**

time of year, by circling the calendar month :

Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec. **[2]**

E) Give the names of the objects, whose approximate horizontal coordinates are :

azimuth A_1 = 45° and altitude h_1 = 58° : . . .**M 45** . . . . **[1]**

azimuth A_2 = 278° and altitude h_2 = 20° : . . . **α Leo** . . . . **[1]**

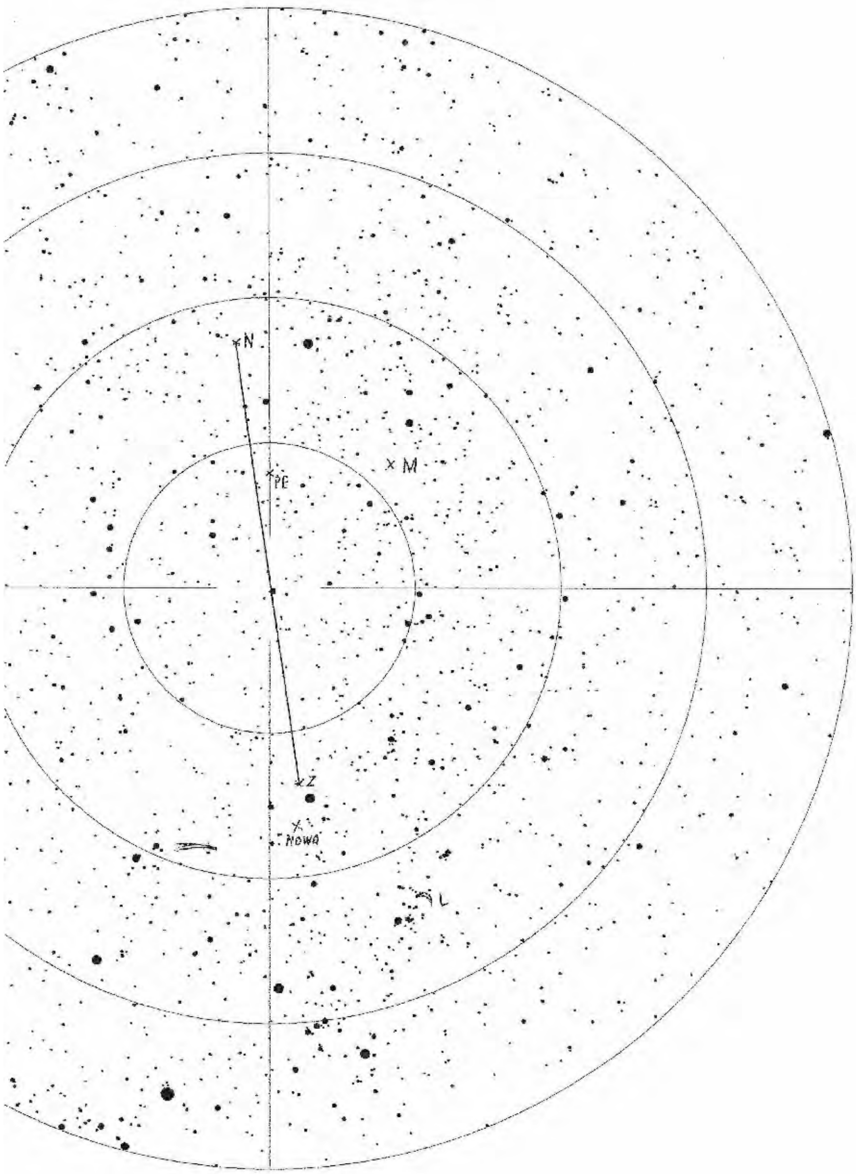
F) Give the horizontal coordinates (azimuth, altitude) of :

Sirius (α CMa) : A_3 = **340° ± 2°**; h_3 = **20° ± 1°** **[0.5+0.5]**

The Andromeda Galaxy (M 31) : A_4 = **108° ± 2°** ; h_4 = **41° ± 2°** **[0.5+0.5]**

G) Give the equatorial coordinates of the star marked on the sky with a red arrow :

α = **$3^h 24^m \pm 15^m$**; δ = **49° ± 3°** **[1+1]**


N
M
PE
Z
NOWA
L

2. Mars Max 25 points

H) Give the areographic (Martian) latitude of the observer : φ = **22.5 °** **[2]**

I) Give the altitudes of upper h_u and lower h_l culmination of :

Pollux (β Gem) : h_u = **61° ± 0.5°**; h_l = **-50° ± 1° (calculated)** **[1+2]**

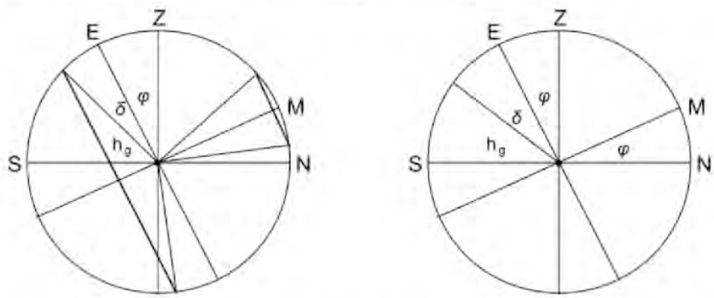
Deneb (α Cyg) h_u = **32° ± 0.5°** ; h_l = **13° ± 0.5°** **[1+1]**

J) Give the areocentric (Martian) right ascension and declination of :

Regulus (α Leo) δ = **-22.5° ± 0.5°** , from culmination: h_u = **45° ± 0.5°** **[2]**

Toliman (α Cen) δ = **-48° ± 0.5°**, from culmination: h_u = **19.5° ± 0.5°** **[2]**

K) Sketch diagrams to illustrate your working in questions (I) and (J) above : **[2+2]**



L) On the map of the sky, mark (with a cross) and label ("M") the Martian North Pole **[2]**

M) Give the azimuth of the direction in which the observer moved away from the Martian base :

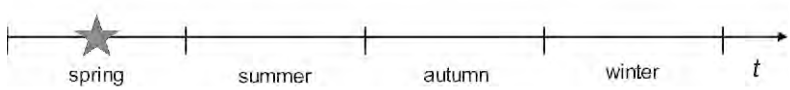
A = **330°-180° = 150 °.** **[2]**

N) Estimate the location of the base on Mars, and circle the appropriate description :

a. near the Equator *b.* **<u>near the northern Tropic circle</u>** **[3]**

c. near the northern Arctic circle *d.* near the North Pole

O) The time axis below shows the Martian year and the seasons in the northern hemisphere. Mark the date represented by the planetarium display on the axis. **[3]**

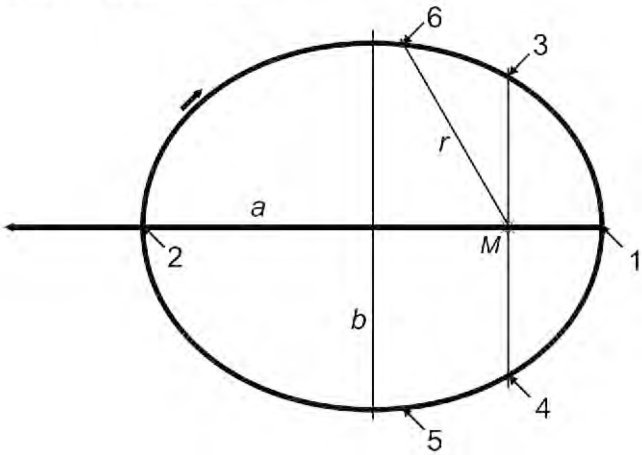


Group competition - solutions

Question 1 Constellations

20 elements to assess (7 constellations and 13 Messier Objects). For each full and correct answer **1 point**. For each partial or less accurate answer **0.5 point.**

Question 2 Orbital motion



$v_{t\,max}$ is at point 1 or 2, 2 points

$v_{t\,min}$ is at point 2 or 1, 2 points

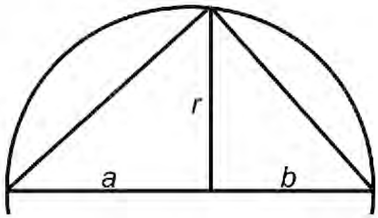
$v_{r\,max}$ is at point 3, 5 points
(or at point 4 4 points)

$v_{r\,min}$ is at point 4, 5 points
(or at point 3 4 points)

The momentary angular velocity of star m is jest than the mean angular velocity along the arc from point 5 through 2 to 6.

The value of the radius $r = \sqrt{ab}$ can be determined geometrically:

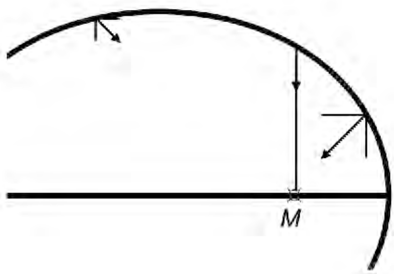
It is a right-angled triangle inscribed within a circle of radius $a+b$, of height r.

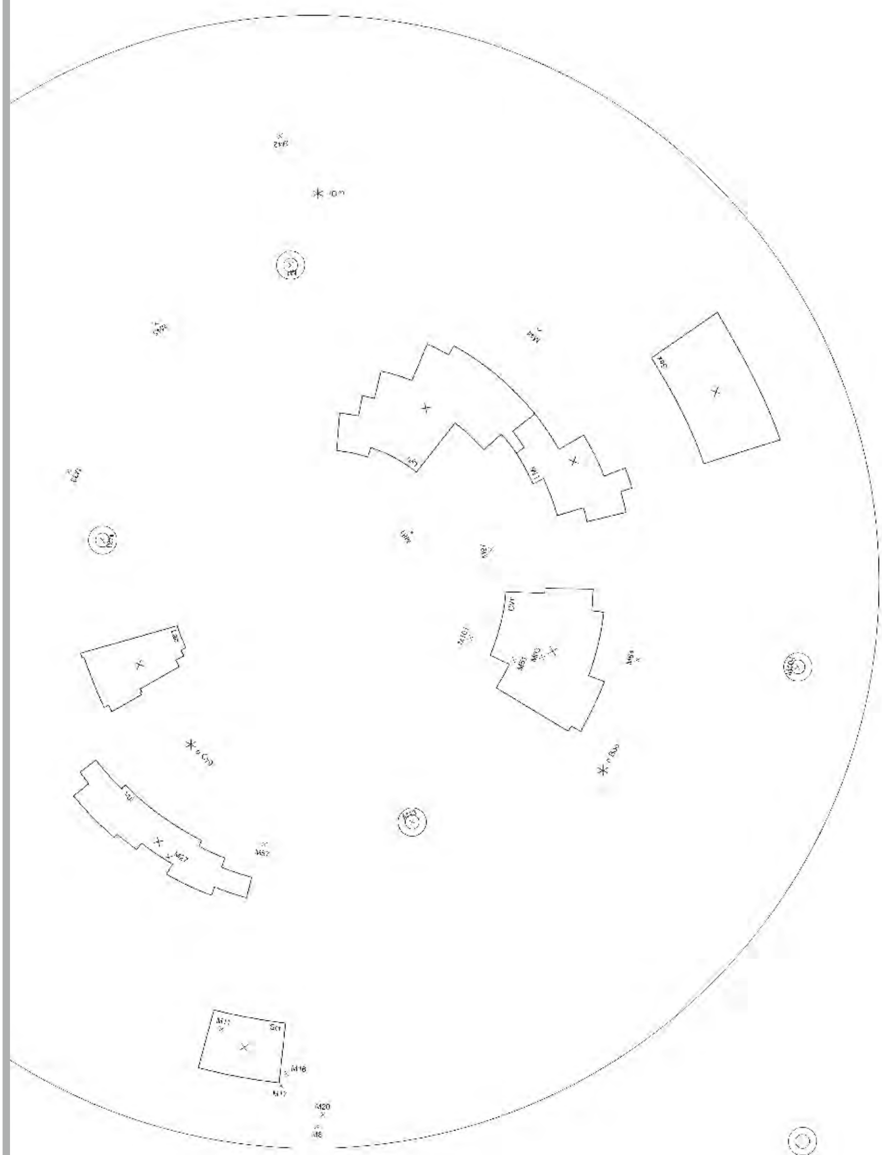


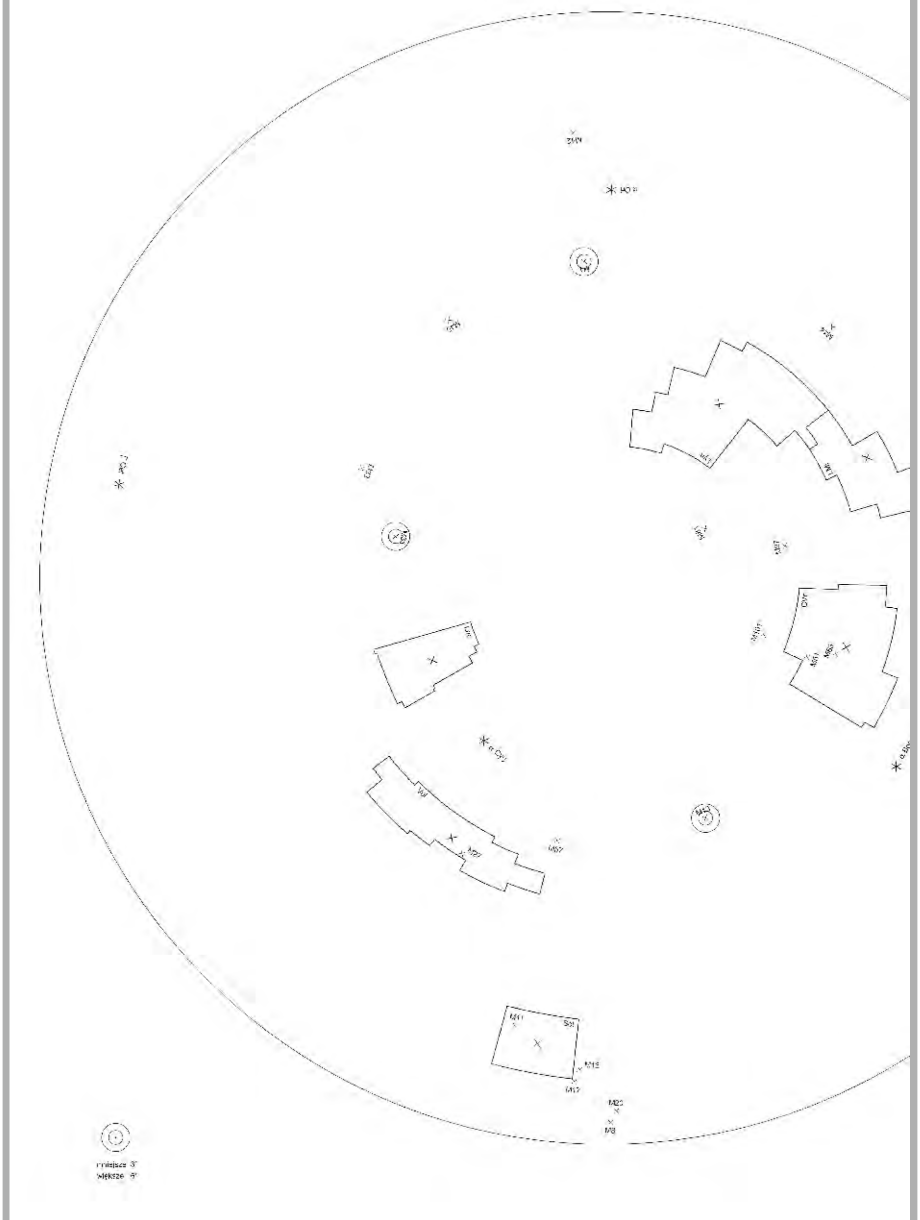
[6]

Reasoning:

The central acceleration due to the central gravitational force can be decomposed into radial and tangential coordinates. Only the radial component changes the radial velocity. The radial velocity has an extreme value when the acceleration changes sign.






M11
M17
M8
mniejsze 3°
większe 5°

Question 3 Identifying telescope components

Look at the pictures of the telescope and match the names of the items with the corresponding letters. Write your answers in the table below:

Item name	Letter	Points
(example) Tripod	**M**	0
1. Counterweight	L	**0,5**
2. Right Ascension Setting Circle (R.A. Scale)	C	**0,5**
3. Declination Setting Circle (Declination Scale)	K	**0,5**
4. Right Ascension locking knob	B	**0,5**
5. Declination locking knob	J	**0,5**
6. Geographical latitude scale	A	**0,5**
7. Finder scope	F	**0,5**
8. Focuser tube	H	**0,5**
9. Focuser knob	G	**0,5**
10. Eyepiece	I	**0,5**
11. Declination Axis	XX	**0,5**
12. Right Ascension Axis (Polar Axis)	XY	**0,5**
13. Right Ascension slow motion adjustment	E	**0,5**
14. Declination flexible slow motion adjustment	D	**0,5**
15. 90 ° diagonal mirror	T	**0,5**
16. Azimuth adjustment knobs	P	**0,5**
17. Altitude adjustment screws	R	**0,5**
18. Lock screw	O	**0,5**
19. Spirit level bubble	W	**0,5**
20. Eyepiece reticle light on/off switch & brightness control	U	**0,5**

Select and circle the correct answer for each of the questions below:

21. Mount type :
a. Fork *b.* Transit *c.* Dobsonian Alt-Azimuth *d.* **German Equatorial** **[1]**

22. Optical type :
a. Newtonian *b.* Cassegrain *c.* **Keplerian** *d.* Galilean **[1]**

23. Objective aperture :
a. 60 mm *b.* **80 mm** *c.* 90 mm *d.* 100 mm **[0.5]**

and objective lens focal length :
a. **400 mm** *b.* 500 mm *c.* 600 mm *d.* 800 mm **[0.5]**

24. Eyepiece focal length :
a. 4 mm *b.* 6 mm *c.* **12.5 mm** *d.* 25 mm **[1]**

25. Used for visual observations of the sky, the finder scope gives a picture which is :

a. normal *b.* **rotated by 180°** *c.* reflected in one axis *d.* rotated by 90° **[1]**

26. Used for visual observations **with** the diagonal mirror, the instrument gives a picture which is :

a. normal *b.* rotated by 180° *c.* **reflected in one axis** *d.* rotated by 90° **[1]**

Determine the following theoretical instrument parameters

27. Magnification : $M = f / f_{eyepiece} = 32x$, or by measurement of image at eyepiece **[1]**
for 40x **[0.5]**

28. Focal ratio : 5 or f /5 or 1/5 (reverse convention) **[1]**

29. Resolution : (in arcseconds) r = 14/(D [cm]) = 1.75 arcsec or 1.22 lambda/D = 1.73 arcsec **[1]**

30. Limiting magnitude: z = 5.5 + 5 log (D) + 2.5 log (M) for M = 32x gives z = 11.5 mag
for M = 40x gives 11.8 mag
z = 7.5 + 5 log (D) gives 12 mag
z = 5 log (80/6) + 6 gives 11.6 mag

accept 11.5 mag to 12 mag **[1]**

Question 4 Minimum of an eclipsing binary

Outline:

During the secondary minimum, the star with the higher effective temperature is closer to the observer. We also know that it is larger. During the primary minimum we therefore have an annular eclipse – the cooler and smaller component is visible against the larger one, only obscuring it partially.

We use subscript:
0 – data concerning the sum of both components (outside eclipse),
1 – data concerning the hotter component,
2 – data concerning the cooler component,
g – data concerning the primary minimum,
R_1 and R_2 – radii of the stars, where $R_1 > R_2$,
T_1 and T_2 – effective temperatures of the stars, where $T_1 > T_2$,

Data from the plot:	looking for:
$m_1 - m_0 = 0{,}33$ mag.	$m_g = ?$
$d/D = 1/9$,	plot of the primary minimum

Since both components are at the same distance from the observer, we can use the difference of the absolute magnitudes rather than the difference of the observered magnitudes:

$$m_g - m_1 = M_g - M_1 = -2{,}5\log\frac{L_g}{L_1},$$

where L_g and L_1 are the appropriate luminosities.

For star 1: $L_1 = \pi R_1^2 \cdot \sigma T_1^4$.

For the annular eclipse, the situation is more complicated:

$$L_g = \pi R_2^2 \cdot \sigma T_2^4 + \pi\left(R_1^2 - R_2^2\right)\cdot \sigma T_1^4.$$

Rearranging:

$$m_g - m_1 = -2.5\log\left(\frac{R_2^2}{R_1^2}\left(\frac{T_2^4}{T_1^4} - 1\right) + 1\right).$$

m_g can be determined by finding the ratios: R_2/R_1 i T_2/T_1. The ratio of the radii is derived from the light curve, whereas the ratio of temperatures from photometric considerations.

If D is the duration of the primary minimum, while d is the duration of the 'flat bottom' during the eclipse, we get:

$$\frac{d}{D}=\frac{2\cdot(R_1-R_2)}{2\cdot(R_1+R_2)}=\frac{1-\dfrac{R_2}{R_1}}{1+\dfrac{R_2}{R_1}} \quad\Rightarrow\quad \frac{R_2}{R_1}=\frac{D-d}{D+d}=\frac{1-\dfrac{d}{D}}{1+\dfrac{d}{D}}=0{,}8$$

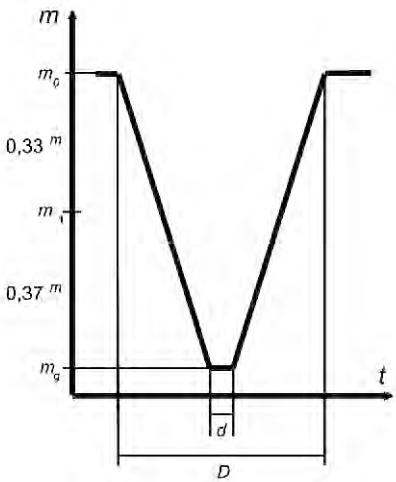
To obtain the ratio of temperatures, we need the observed brightness of star 2, or rather I_2/I_1. Thus using Pogson's formula again:

$$m_1-m_0=2{,}5\log\frac{I_0}{I_1}=2{,}5\log\frac{I_1+I_2}{I_1}=2{,}5\log\left(1+\frac{I_2}{I_1}\right)$$

$$\Rightarrow \quad \frac{I_2}{I_1}=10^{0{,}4(m_1-m_0)}-1, \text{ but } \frac{I_2}{I_1}=\frac{L_2}{L_1}=\left(\frac{R_2}{R_1}\right)^2\left(\frac{T_2}{T_1}\right)^4 \text{ and thus:}$$

$$\left(\frac{T_2}{T_1}\right)^4=\left(\frac{R_1}{R_2}\right)^2\left(10^{0{,}4(m_1-m_0)}-1\right) \quad\Rightarrow\quad \frac{T_2}{T_1}=0{,}86\ .$$

Subsituting numerical values we obtain $m_g - m_1 = 0{,}37^m$.



Points

$R_2/R_1=$	**[5]**
$T_2/T_1=$	**[5]**
$m_g-m_0=$	**[5]**
drawing	**[5]**

Question 5 Nocturnal

Outline:

The inner edge of the movable ring, next to which the star will be visible, should be a clock face, and the inner edge of the card body should be a calendar scale.

The hour (and down to quarter-hour) scale should be marked in the direction of motion of the stars (i.e. anti-clockwise) – it should be in Sidereal Time units, i.e. with an error increasing to 4 minutes over the day.

[4]

The dates should also increase in the same direction (anticlockwise).

[4]

Both scales should be aligned, which should be aided by the mark at 0^h.

Practical notes: with the time 3^h15^m UT should be positioned at the lowest point (vertically) of the device, then the mark at 0^h00^m UT should show the current calendar date, 27 August.

[4]

As regards Sidereal Time,

the right ascension of β *UMi* from the atatched map is: $\alpha = 14^h 50^m$,
since this is at lower culmination, then Sidereal Time is: $\theta = 2^h 50^m$,

Practical notes: the time 2^h10^m ST should be at the lowest point of the device, as β *UMi* will always be at lower culmination at the same local sidereal time.

[4]

The mark at 0^h00^m ST should point to an analogous mark on the outer card (i.e. the ring should be "fixed" relative to the outer card. **[4]**

Night Observation Q1 – Little Dolphin

Marking scheme :

On Drawing 1 :

Draw as the view of the constellation Delfinus (Del) through the finder scope.

all 4 stars of the parallelogram	**[1]**
the 'tail'	**[1]**
correct scale	**[1]**
correct shape	**[1]**
additional field stars	**[1]**

With an arrow, mark the apparent direction of motion of the stars across the field of view of the finder scope caused by the rotation of the Earth. **[2]**

Label the stars with the Bayer designations given on the map (α, β, γ, δ and ε). **[1]**

Also label the brightest of these 5 stars "m_{max}". **[1]**

Also label the faintest of these 5 stars "m_{min}". **[1]**

On Drawing 2 :

Draw the view of the Little Dolphin through the larger telescope.

all 4 stars of the parallelogram	**[4]**
the 'tail'	**[1]**
correct scale	**[1]**
correct shape	**[1]**
additional field stars	**[1]**

With an arrow, mark the apparent direction of motion of the stars across the field of view of the finder scope caused by the rotation of the Earth. **[2]**

Label the stars of the Little Dolphin α′, β′, γ′, δ′ and ε′ such that they match the labels of the stars in the constellation Delfinus as given on the map. **[3]**

Label the brightest of these stars "m_{max}". **[2]**

Total **[25]**

5th IOAA

Night Observation – Q2 Measuring Declination

Marking scheme:

Draw of field of view (any stars)

- if picture present position of S1, S2, Sx stars	**[3]**
- if there is more stars presented on attached maps	**[1]**
- mark North directions on picture of FoV	**[1]**
- mark East directions on picture of FoV	**[1]**

Proper method of observations:

- if cross is parallel to N-S and E-W and total score will be calculated from previous points	**[0]**
- cross twisted from N-S and E-W direction	**[2]**
- proper position angle of cross corresponding to formula used for calculations	**[4]**

If student will need make a measurements in two or more different position angle they will receive 4 points if all of them will be corrected

- Proper formula for δ_X calculation	**[6]**
- several repetitions of stopwatch measuring.	**[3]**
or	
- if student will give any subjective estimation of time measuring (from watching the transit of star under cross etc.)	**[2]**
- Proper calculation for δ_X calculation	**[2]**
- proper estimations of final error	**[2]**

Code: THA-3

5th IOAA SILESIA POLAND 2011

Task No. 15 S

(15) Because of the black body radiation

from Wein's Law $\lambda T = $ const. — temperature

* so $\lambda \propto \frac{1}{T}$ ——— (1)

* the universe is expanding so the wavelenght is proportional to scale factor

$\lambda \propto a$ ——— (2)

a — scale factor

red shift $z = \frac{\Delta\lambda}{\lambda} = \frac{\lambda_{observe} - \lambda_{emit}}{\lambda_{emit}}$

so $z = \left(\frac{\lambda_{observe}}{\lambda_{emit}}\right) - 1$

From (2); $z = \frac{a_0}{a} - 1$; present scale factor $a_0 = 1$

~~we get~~ we get $a = \frac{1}{1+z}$ ——— (3)

From (1), (2); $\frac{1}{T} \propto a$

From (3); $\frac{1}{T} \propto \frac{1}{1+z}$

$\boxed{T \propto 1+z}$

* find T at $z = 10$

$\frac{T}{T_0} = \frac{1+z}{1+z_0}$

$z_0 =$ red shift at present $= 0$

$z = 10$

$T_0 = 2.73$ K

so $\boxed{T = 30.03 \text{ K}}$

Code: CZE-1

Task No. 35

Pro celkovou ~~...~~ mech. energii sondy platí:

$$E = \frac{1}{2} m v^2 - \frac{G M_S m}{r}$$

$$\frac{E}{m} = \frac{1}{2} v^2 - \frac{G M_S}{r}$$

jestli

$\frac{E}{m} > 0 \rightarrow$ hyperbola

$\frac{E}{m} = 0 \rightarrow$ parabola

$\frac{E}{m} < 0 \rightarrow$ elipsa

$\frac{E}{m} = 4{,}35 \cdot 10^{8}\ \mathrm{J \cdot kg^{-1}} \rightarrow$ $\boxed{\text{c) hyperbola}}$

Známe zdánlivou velikost Slunce ze Země: $m_S = -26{,}8$ mag

$$m - m_S = -2{,}5 \log \frac{j}{j_S} = -2{,}5 \log \frac{a_E^2}{r^2} = -5 \log \frac{a_E}{r}$$

$$\hookrightarrow m = m_S + 5 \log \frac{r}{a_E},$$

kde $a_E = \underline{1\ AU}$

$$\rightarrow m = -16{,}47\ \mathrm{mag} \doteq \boxed{-16{,}5\ \mathrm{mag}}$$

Code: SVK-5

Task No. 25

$M_{sdov} = M_\odot$ (const.)

$D = 40pc$; $R = 20pc$

$v_k = 6 km s^{-1}$

$N = ?$

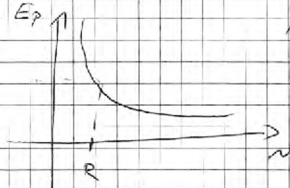
pre $v_k = \sqrt{\frac{2\kappa M}{R}}$

poloze

$E_k \quad E_p$

$\frac{1}{2} m v^2 = - \frac{\kappa M m}{R}$

$v^2 = \frac{2\kappa M}{R}$



$M = N \cdot M_{sdov}$

$v_k^2 = \frac{2\kappa M_{sdov} N}{R}$

$N = \frac{v_k^2 R}{2\kappa M_{sdov}}$ $\qquad N = \frac{v_k^2 R}{2\kappa M_\odot}$

$N = \frac{(6000 m s^{-1})^2 \cdot (20pc \cdot 3.0860 \cdot 10^{16} m)}{2 \cdot 6,6738 \cdot 10^{-11} N m^2 kg^{-2} \cdot 1,98892 \cdot 10^{30} kg}$

$N = 83\,696,6$ hv.

→ des. číslo (nemôže byť) reálne

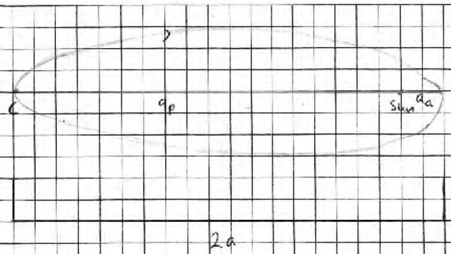
~~(aby hviezda mala rýchlosť 6 km s^-1, musel by som~~

Počet hviezd v hviezdokope je 83 696

Code: INA-2

5th IOAA SILESIA POLAND 2011

Task No. 1 (5)



The comet that come from Oort Cloud have eccentricity near 1. ($e \approx 1$)

So, $a_a \ll a_p$

$$2a = a_p + a_a$$
$$\approx a_p$$
$$a \approx \frac{1}{2} a_p$$

From Kepler 3 law:

$$\frac{a^3}{P^2} = M$$

$$P = a^{3/2} \quad \rightarrow a \text{ in AU } \& \text{ P in year}$$

the time for comet to make the journey is:

$$t = \frac{1}{2} P$$
$$t = \frac{1}{2} a^{3/2}$$
$$t = \frac{1}{2} \cdot \left(\frac{1}{2}\right)^{3/2} a_p^{3/2}$$
$$t = \left(\frac{1}{2}\right)^{5/2} a_p^{3/2}$$
$$\boxed{t = 1.157r \times 10^{8} \text{ years.}}$$

Code: LTU-4	5th IOAA Silesia Poland 2011	Task No. 5

D: $D_1 = 0{,}1\,m$ $\quad \lambda_1 = 550 \cdot 10^{-9}\,m$ $\quad \lambda_2 = 0{,}01\,m$

Teleskopo normalaus $\theta_1 = 1{,}22 \frac{\lambda_1}{D_1}\,rad$

~~arba $\theta = \frac{14''}{D(cm)}$~~ $\quad$ ~~$[\theta] = 1''$~~

~~$\theta_1 = \frac{14''}{10} = 1{,}4''$~~

~~θ_2 – radijo teleskopo $\theta_2 = \frac{\lambda}{D'} 206265''$~~

~~$[\theta_2] = 1''$~~

~~$\theta_1 = \theta_2$~~

~~$D' = \frac{\lambda}{\theta_2} 206265'' = \frac{\lambda}{\theta_1} 206265'' =$~~

~~$= \frac{10^{-2}}{1{,}4''} 206265'' =$~~

radijo teleskop – $\theta_2 = \frac{\lambda_2}{D_2}\,rad$

$$\theta_1 = \theta_2$$

$$1{,}22 \frac{\lambda_1}{D_1} \cancel{rad} = \frac{\lambda_2}{D_2} \cancel{rad}$$

$$D_2 = \frac{D_1 \lambda_2}{1{,}22 \lambda_1} = \frac{0{,}1 \cdot 0{,}01}{1{,}22 \cdot 550 \cdot 10^{-9}} =$$

$$= 1490\,m$$

$\boxed{\text{Ats.: } D_2 = 1490\,m}$

Code: SRB-4

5th IOAA Silesia Poland 2011

Task No. 9

Тражени однос је

$$W = \frac{N\pi R_o^2}{D^2} = \frac{N\pi R_o^2}{\left(\frac{d}{206265}\right)^2} = \frac{N\pi R_o^2\, 206265^2}{d^2}$$

а са друге стране $\lg N - 2\lg d\,[pc] = -7{,}3$

$$\Rightarrow \frac{N}{d^2[pc]} = 10^{-7{,}3}$$

то је тражени однос:

$$\Rightarrow W = \frac{N \cdot R_o^2[pc]}{d^2[pc]}\,\pi \cdot 206265^2$$

$$= 10^{-7{,}3} \cdot R_o^2[pc]\,\pi\, 206265^2$$

$$= 10^{-7{,}3}\,\pi \cdot R_o[AU]^2$$

$$= 10^{-7{,}3}\,\pi \cdot \left(\frac{6{,}96 \cdot 10^8}{1{,}4960 \cdot 10^{11}}\right)^2 \approx 3{,}40804 \cdot 10^{-12}$$

$$= \boxed{3{,}41 \cdot 10^{-12}}$$

3

Code: SGP-4	Silesian Planetarium · Silesia. Positive energy · 5th IOAA Silesia Poland 2011 · ioaa International Olympiad on Astronomy and Astrophysics · Ministerstwo Edukacji Narodowej · IAU	Task No. ....

~~4.75~~

$$\log\left(\frac{\left(10^{\frac{-26.8}{2.5}}\right)}{\left(\left(\frac{30'}{2}\right)\cdot 60\right)^2\cdot\pi}\right)\cdot(-2.5) = -2.5\log\left(\frac{5.2480746\times10^{10}}{2.54469\times10^{6}}\right)$$

$$= -10.7859 \text{ mag arcsecond}^{-2}$$

$$\boxed{\frac{\left(10^{-\frac{18}{2.5}}\right)}{\left(\frac{5.2480746\times10^{10}}{2.54469\times10^{6}}\right)} = 3.06\times10^{-12}}$$

Code: IND-4

5th IOAA SILESIA POLAND 2011

Task No. 6

$$I_{earth} = \frac{2}{5} M_E R_E^2 = \frac{2}{5} \times 5.9736 \times 10^{24} \times (6.371)^2 \times 10^{12} \ kg\text{-}m^2$$

$$= 9.698 \times 10^{37} \ kg\text{-}m^2$$

we know $\tau = I \alpha \rightarrow$ angular deceleration.

$$6.0 \times 10^{16} = 9.698 \times 10^{37} \times \alpha$$

$$\Rightarrow \alpha = 6.18 \times 10^{-22} \ rad\,s^{-2}$$

But $\alpha = \frac{\omega_i - \omega_f}{t} \Rightarrow \omega_i = \alpha t + \omega_f$.

$$\omega_i = 6.18 \times 10^{-22} \times 6 \times 10^8 \times 86400 \times 365.2564 + \frac{2\pi}{23^h 56^m 4.091^s \times 3600}$$

$$(\omega_i)_{Earth} = 1.17 \times 10^{-5} + 7.29 \times 10^{-5} \ rad/s.$$

$$= 8.46 \times 10^{-5} \ rad/s.$$

$$\Rightarrow \omega_{Earth\ in\ orbit} = \frac{2\pi}{365.2564 \times 86400} = 1.99 \times 10^{-7} \ rad/s$$

$$\Rightarrow \text{Length of solar day} = \frac{2\pi}{(\omega_E)_i - \omega_{Earth\ in\ orbit}}$$

$$= \frac{2\pi}{8.46 \times 10^{-5} - 1.99 \times 10^{-7}} = 7.444 \times 10^4 \ sec \approx 20^h 40^m$$

$$\text{No of solar days in one year} = \frac{365.2564 \times 24}{20.679}$$

$$= 423.9 \approx 424 \ days$$

Hence there were $\boxed{\approx 424 \text{ solar days}}$ in one sidereal year

Code: KOR-1

5th IOAA SILESIA POLAND 2011

Task No. 11

$$R=\frac{1}{1+z}$$

$$\frac{1}{1+z}=C\times t^{\frac{2}{3}}$$

now $z=0$ $t_0=13.7\times10^9$ yr.

$$1=C\times t_0^{\frac{2}{3}} \qquad C=\frac{1}{t_0^{\frac{2}{3}}}$$

t : the time that galaxy is formed

Δt : the age of star in this galaxy.

$$\frac{1}{1+z_1}=C\times\left(t+\Delta t\right)^{\frac{2}{3}} \qquad z_1=6.03$$

$$t+\Delta t=t_0\times\left(\frac{1}{1+z_1}\right)^{\frac{3}{2}} \quad \text{---}(1)$$

$$\frac{1}{1+z_2}=C\times(t)^{\frac{2}{3}} \qquad t=t_0\left(\frac{1}{1+z_2}\right)^{\frac{3}{2}} \quad \text{---}(2)$$

(1) − (2)

$$\Delta t=t_0\left(\left(\frac{1}{1+z_1}\right)^{\frac{3}{2}}-\left(\frac{1}{1+z_2}\right)^{\frac{3}{2}}\right)=(560\sim600)\times10^6\text{ yr}$$

$$\hat{=}\,6\times10^8\text{ yr}$$

$$\left(\frac{1}{1+z_2}\right)^{\frac{3}{2}}=\left(\frac{1}{1+z_1}\right)^{\frac{3}{2}}-\frac{\Delta t}{t_0}=\left(\frac{1}{1+6.03}\right)^{\frac{3}{2}}-\frac{6\times10^8\text{ yr}}{13.7\times10^9\text{ yr}}$$

$$=0.00985.$$

$$z_2=20.8$$

$$=\boxed{20}$$

Code: PL-62

5th IOAA SILESIA POLAND 2011

Task No. 105

$L = 10^4\,km$ $B = 30\,nT$

proton wewnątrz pasa będzie się poruszał

po ~~[illegible]~~ półokręgu. Zauważamy że

jeśli dla pewnej prędkości v zatoczy on półokrąg

o promieniu L, to dla minimalnie większej prędkości

przejdzie się on z ~~[illegible]~~ pasa na drugą stronę

w problemie relatywistycznym

$p = \frac{E}{c}$ i $p = \gamma m v$

co więcej musimy skorzystać z relatywistycznego wzoru na ruch po

okręgu w polu magnetycznym. $\gamma \frac{mv^2}{R} = Bqv$ czyli $\gamma m v = Bqr$

a ponieważ $E = pc = \gamma m v c = Bqrc$ dla nas

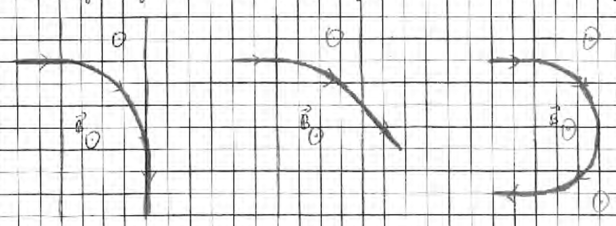
$$E = BeLc = 1{,}4 \cdot 10^{-8}\,J$$

Po przeliczeniu na elektronowolty mamy wynik rzędu 100 GeV

co uzasadnia relatywistyczne podejście

trajektorie

dla v granicznego dla v większego i dla v mniejszego



Code: CHN-2

5th IOAA Silesia Poland 2011

Task No. 14 S

Short 14

in 1 s

the energy of sun light is

$$E = 3.96 \times 10^{26}\,J$$

the number of fusion reaction is

$$N = \frac{E}{E_f} = \frac{3.96 \times 10^{26}\,J}{26.8\,MeV} = 9.22 \times 10^{37}$$

the number of neutrinos is

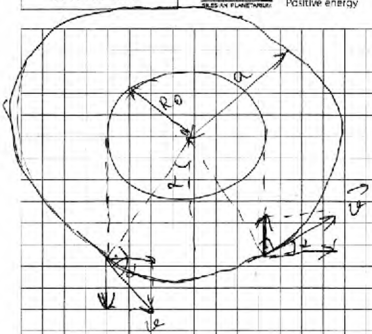
$$N_n = 2N = 1.845 \times 10^{38}$$

the number of neutrinos on every square meter on earth per second is

$$N_{ne} = \frac{N_n}{4\pi r^2} = 6.56 \times 10^{14}$$

Code: RoM-4

Task No. 1-L



$$2v \sin\alpha = \Delta v = 30 \,km/s$$

$$\Rightarrow v \sin\alpha = 15 \frac{km}{s}$$

$$\sin\alpha = \frac{R_\odot}{a}$$

$$v \cdot \frac{R_\odot}{a} = 15 \frac{km}{s} = \frac{2\pi}{T} \cdot R_\odot$$

$$\frac{T^2 \cdot M}{a^3} = \frac{4\pi^2}{G}$$

$$\frac{2\alpha}{360^\circ} = \frac{180/60}{84} \Rightarrow \alpha = 180^\circ \cdot \frac{\frac{180 min}{60}}{84 h} = 6^\circ 25' 43''$$

$$\frac{R_\odot}{a} = \sin\alpha = 0,112 \qquad R_\odot = 15 \frac{km}{s} \cdot \frac{T}{2\pi} \qquad T = 84 \cdot 3600$$

$$\boxed{R_\odot = 7,22 \cdot 10^5 \, km}$$

$$a = \frac{R_\odot}{0,112} = \boxed{6,45 \cdot 10^6 \, km = a}$$

$$\boxed{M = \frac{4\pi^2 a^3}{T^2 G}} \qquad \boxed{M = 1,74 \cdot 10^{30} \, kg}$$

Code: IRG_4

Task No. 112

1

Short 4

$e = 0$ خروج از مرکز فوبوس

$i = 0^\circ$ زاویه تمایل مداری با استوا

* از شکل در جهت چرخش مریخ به علت رفتن میدان

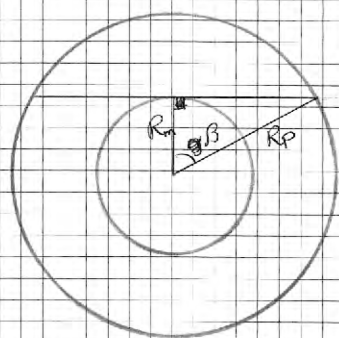
چون آن حرف نظری نیستم!

$R_{Mars} = 3393$ km

$M_{Mars} = 6.421 \times 10^{23}$ kg

$T_{Mars} = 24.623$ h

$R_p = 9380$ km

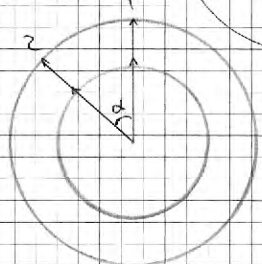


$$T^2 = \frac{4\pi^2 a^3}{G(M+m)} \qquad M \gg m$$

$$\rightsquigarrow T^2 = \frac{4\pi^2 a^3}{GM}$$

چون می‌دانیم فرض بر این است که قمر و سیاره هم جهت می‌چرخند!

$\rightsquigarrow T_p = 7.662$ hours



$$\left.\begin{array}{l} 2\pi + \alpha = \omega_p t \\ \alpha = \omega_m t \\ 2\pi = \omega_s t \end{array}\right\} \rightsquigarrow \omega_s + \omega_m = \omega_p$$

$$\rightsquigarrow \frac{1}{T_s} = \frac{1}{T_p} - \frac{1}{T_m}$$

$\rightsquigarrow T_s = 11.122$ hours

Code: IRG-4

Task No. 112

2

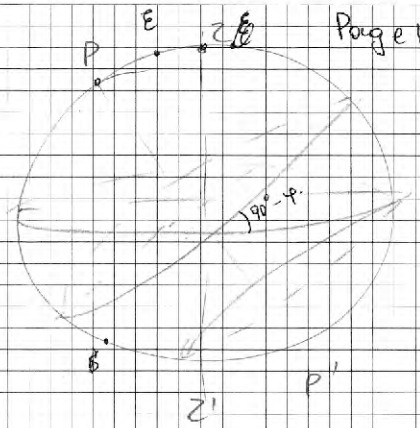
S4

$\cos\beta = \frac{R_m}{R_p} \rightarrow \beta = 68.794^\circ$

$\frac{2\beta}{360} = \frac{\Delta t}{T_s} \rightarrow \boxed{\Delta t = 4.251 \text{ hours} \equiv 1.530 \times 10^4 \text{ s}}$

Code: BGR4	5th IOAA Silesia Poland 2011	Task No. 12

Page 1

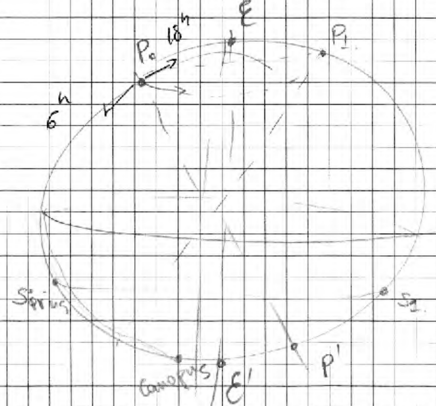


if $\delta < 90° - \varphi = -39{,}9°$ Sirius won't rise.

$h = \delta + 90° - \varphi = 0.$

$\delta = \varphi - 90° = -39{,}9°$

if ~~δ canopus~~



the north ecl. pole
$\delta = 66°37'$
$\alpha = 18^h.$

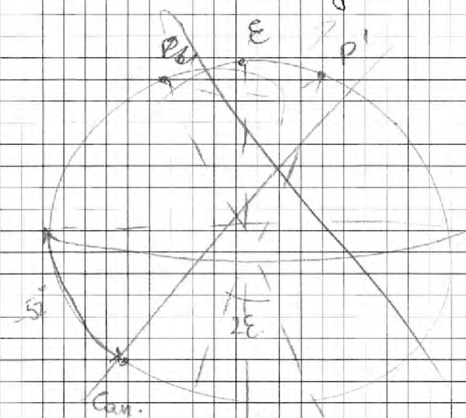
δ sirius will fall to $-63°$ after 13 000 years and won't rise

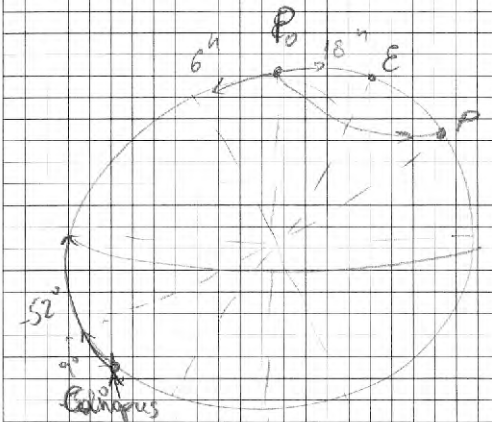
Code: BGR4

5th IOAA SILESIA POLAND 2011

Task No. 12

Page 2





The ~~Se~~ decl. of Canopus will fall even much and won't rise

$\boxed{\text{Sirius yes} \quad \text{Canopus no.}}$

Code: BRA2

Task No. 2

Doppler effect

In the near of the center of the galaxy,

$\Delta\lambda$ from 6564 Å is 3,0 Å

In the outside of the near center it is about 4,0 Å

$$\frac{\Delta\lambda}{\lambda} = \frac{V}{c} \Rightarrow V = \frac{\Delta\lambda}{\lambda}\cdot c = 130\,000 \text{ m/s (Center)}$$

$$180\,000 \text{ m/s (Outside)}$$

$$\frac{V^2}{R} = \frac{GM}{R^2} \Rightarrow M = \frac{R\cdot V^2}{G}$$

$G = 6.67\cdot 10^{-11}$ (SI)

Pc = 206265 UA

UA = $1,5\cdot 10^{11}$ m

$$2\frac{R}{d} = \alpha$$

$$\frac{2\cdot R}{d} = 5\cdot 50\cdot 0.82 \text{ Arc Sec} = \cancel{2,0\cdot 10^{-4}}\ 10^{-3} \text{ rad}$$

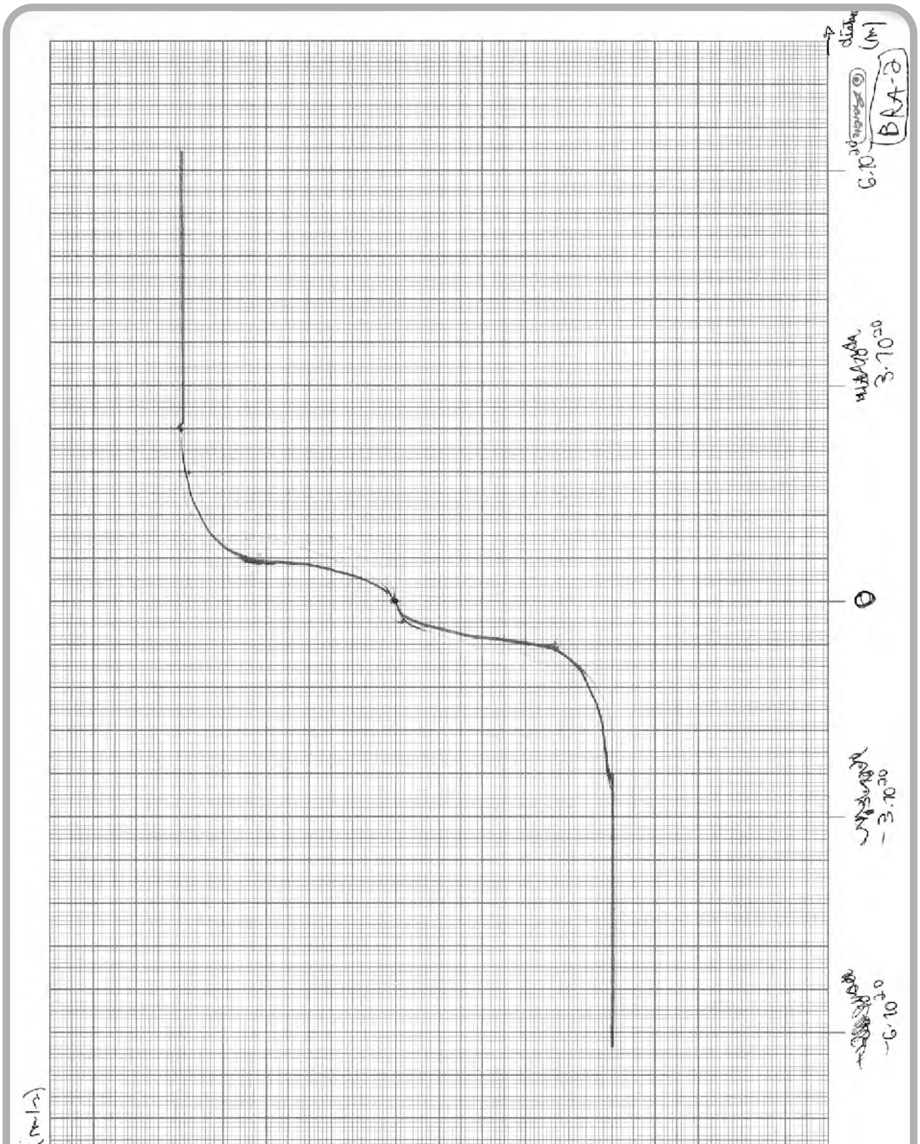
$$R = \frac{\cancel{2,0\cdot 10^{-4}}\ 10^{-3}\text{ rad}}{2}\cdot 40 \text{ MPc} \approx 20 \text{ Kpc} \approx 6,2\cdot 10^{20} \text{ m}$$

$$M \approx \cancel{6.0\cdot 10^{41}}\ 3.0\cdot 10^{41} \text{ Kg}$$ galaxy mass

Central Bulge: $\frac{2R}{d} = 2\cdot 5\cdot 0.82$ Arc Sec $= 4.0\cdot 10^{-5}$ rad

$$R = \frac{4.0\cdot 10^{-5}}{2}\cdot 40 \text{ MPc} = 8.0\cdot 10^{2} \text{ pc} = 2.5\times 10^{19} \text{ m}$$

$$\boxed{M \approx 6.3\times 10^{39} \text{ Kg}}$$



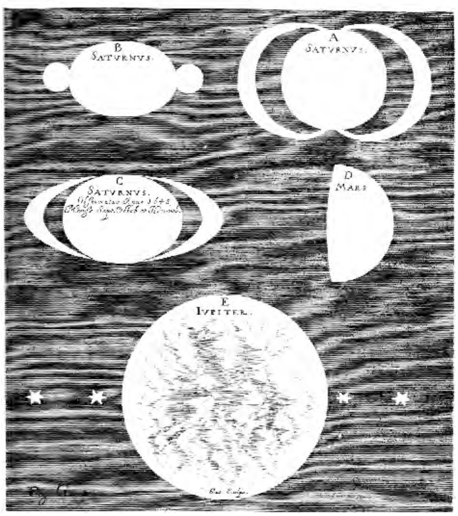
Velocity (m/s)
distance (m)
BRA-2
0
3.10^20
-3.10^20
-6.10^20

Team score

	MAX:	20	20	20	20	20				
	weight	1	1	1	1	1				
TEAM:	Code:	1	2	3	4	5	TOTAL	A	FINAL	B
Romania	ROM	19	15	16	20	20	90	1,03	92,7	
Iran	IRN	19	18	19	19,5	20	95,5	0,96	91,68	-4:26
India	IND	17,5	20	18	16	20	91,5	1	91,5	+0:52
China	CHN	17	13	20	20	12	82	0,93	76,26	-7:23
Indonesia	INA	14,5	8	17	17	20	76,5	0,97	74,205	-3:12
Korea	KOR	13,5	7	19	19	16	74,5	0,95	70,775	-5:28
Brazil	BRA	14	13	17	19	8	71	0,99	70,29	-1:52
Slovakia	SVK	16,5	7	18	20	8	69,5	1	69,5	-0:20
Poland II	PLg	14	8	18	20	4	64	1,08	69,12	+8:40
Bulgaria	BGR	13,5	8	19	18	12	70,5	0,96	67,68	-4:50
China II	CNg	13,5	9	16,5	20	8	67	1	67	+0:50
Iran II	IRg	20	19	13	19,5	0	71,5	0,93	66,495	-7:49
Croatia	HRV	20	8	16,5	12	8	64,5	0,94	60,63	-6:21
Belarus	BLR	18	8	16	14	4	60	0,98	58,8	-2:58
Czech Republic	CZE	15	10	19	12	0	56	1,01	56,56	+1:21
Lithuania	LTU	15,5	16	14	2	12	59,5	0,92	54,74	-8:15
Ukraine	UKR	9,5	13	16	7	8	53,5	0,99	52,965	-1:30
RUS+KAZ	RUS+KAZ	13,5	8	16	20	0	57,5	0,91	52,325	-9:09
Serbia	SRB	10,5	8	15,5	7	8	49	0,99	48,51	-1:53
Poland	POL	15	4	18	7	4	48	0,98	47,04	-2:51
Sri Lanka	LKA	6,5	19	15,5	2	0	43	1,03	44,29	+3:42
Singapore	SGP	11,5	8	17	6	4	46,5	0,91	42,315	-9:42
Hungary	HUN	14	12	14,5	3	0	43,5	0,96	41,76	-4:42
Thailand	THA	13	1	18	9	4	45	0,87	39,15	-13:13
Greece	GRC	10	7	12,5	7	0	36,5	0,9	32,85	-10:25
BAN+KAZ	BAN+KAZ	7,5	4	13	1	0	25,5	0,9	22,95	-10:40
COL+PRT	COL+PRT	0,5	8	11	0	0	19,5	0,83	16,185	-17:20

A - Weight: the score will be multiply by A

B - The time **(mm:ss)**: before deadline (+mm:ss), after deadline (-mm:ss)



Results

Absolute Winner:	**Stanislav Fort**	(Czech Republic)
Best in Theory:	**Jeevana Priya Inala**	(India)
Best in Practical:	**Akshay Krishna**	(India)
Winner of Group Competition:	**Romania**	

Gold Medals

Country	Student code	Overall score	Name
Czech Republic	CZE-S-5	101.42	Stanislav Fort
China	CHN-S-4	99.74	Sihao Cheng
India	IND-S-2	98.84	Akshay Krishna
Slovakia	SVK-S-2	96.69	Peter Kosec
Bulgaria	BGR-S-2	96.06	Momchil Molnar
India	IND-S-3	95.32	Jeevana Priya Inala
Poland (G)	PLg-S-2	94.08	Filip Ficek
Iran (G)	IRg-S-4	93.09	Ali Akbar Kavei
India	IND-S-5	92.10	Sharad Mirani
China	CHN-S-3	90.70	Simiao Cheng

Silver Medals

Country	Student code	Overall score	Name
Indonesia	INA-S-4	89.22	Ko Matias Adrian Kosasih
China	CHN-S-1	88.20	Geng Zhao
China	CHN-S-2	87.27	Jianyang Fu
Iran	IRN-S-1	86.72	Ali Fahimniya
Indonesia	INA-S-2	86.42	Raymond Djajalaksana
Iran (G)	IRg-S-3	86.36	Aryan Hashemi Talkhooncheh
India	IND-S-4	86.17	Bharadwaj Rallabandi
Czech Republic	CZE-S-1	85.51	Jakub Vosmera
Singapore	SGP-S-1	85.07	Ye Wang
Iran (G)	IRg-S-2	83.34	Behnam Pourghassemi Najafabadi
Lithuania	LTU-S-5	83.17	Motiejus Valiunas
Korea	KOR-S-2	82.27	Heungsik Park
Korea	KOR-S-4	81.53	Sangwon Kim
Poland	POL-S-1	81.53	Maksymilian Sokołowski
Thailand	THA-S-3	81.33	Nondh Panithanpaisal
Iran	IRN-S-3	81.20	Ehsan Abedi
Serbia	SRB-S-2	81.09	Stefan Andjelkovic
Serbia	SRB-S-3	80.26	Ognien Markovic

Bronze Medals

Country	Student code	Overall score	Name
India	IND-S-1	77.54	Akhil Kedia
Iran	IRN-S-5	77.27	Ramtin Keramati
Korea	KOR-S-3	76.53	Yunseo Jang
Belarus	BLR-S-5	75.43	Zakhar Plodunov
Brazil	BRA-S-5	74.66	Gustavo Haddad F.eS.Braga
Russia	RUS-S-2	74.55	Aleksey Akinshchikov
Indonesia	INA-S-5	74.22	Muhammad Wildan Gifari
Iran	IRN-S-2	73.97	Aslan Noorghasemi
Ukraine	UKR-S-4	73.75	Anton Dmytriyev
Thailand	THA-S-4	73.26	Krittanon Sirorattanakul
Iran (G)	IRg-S-1	71.36	Mehdi Soleimanifar
Romania	ROM-S-4	71.14	Mihai Racoreanu
Romania	ROM-S-3	70.51	Andrei Alexandru Cuceu
Poland (G)	PLg-S-1	70.42	Dominik Suszalski
China (G)	CNg-S-4	70.32	Ye Wang
Ukraine	UKR-S-2	70.32	Arkadiy Kossakovs`ky
Thailand	THA-S-1	68.97	Pongpichit Chuanraksasat
Croatia	HRV-S-2	68.89	Leonardo Pierobon
Greece	GRC-S-2	68.53	Despoina Pazouli
Iran (G)	IRg-S-5	68.20	Mohammad Bayazi
Brazil	BRA-S-2	67.79	Ivan Tadeu Ferreira Antunes
Poland (G)	PLg-S-4	67.68	Krzysztof Będkowski
Poland (G)	PLg-S-5	67.57	Przemysław Kuta
Thailand	THA-S-5	67.48	Kitipoj Ngernyuang
Slovakia	SVK-S-4	67.35	Matus Kulich
Poland	POL-S-5	67.27	Miłosz Jakubek
Iran	IRN-S-4	66.61	Parham Porsandeh Khial
Greece	GRC-S-1	66.22	Georgios Lioutas
Belarus	BLR-S-3	65.78	Svetlana Komar
Korea	KOR-S-1	65.42	Gilhyun Ryou
Serbia	SRB-S-4	65.01	Filip Zivanovic
Bulgaria	BGR-S-4	64.82	Konstantin Gundev
Belarus	BLR-S-2	64.79	Hanna Fakanava

Honourable Mention

Country	Student code	Name
Serbia	SRB-S-1	Stefan Badza
Bulgaria	BGR-S-1	Miroslav Radomirov
Poland	POL-S-2	Jakub Klencki
Brazil	BRA-S-4	Pedro Rangel Caetano
China (G)	CNg-S-2	Jingyu Qian
Greece	GRC-S-5	Emmanouli Voulliotis
Poland	POL-S-3	Eryk Lipka
China	CHN-S-5	Mingjie Jian
Belarus	BLR-S-1	Artsiom Kopats
Poland	POL-S-4	Michał Glanowski
Singapore	SGP-S-5	Yu Jian Ang
Brazil	BRA-S-3	Tabata Claudia Amaral de Pontes
Lithuania	LTU-S-1	Arturas Zukovkij
Czech Republic	CZE-S-3	Filip Murar
Greece	GRC-S-3	Stefanos Tyros
China (G)	CNg-S-1	Qixi Chen
Korea	KOR-S-5	Seungeon Lee
Thailand	THA-S-2	Thippayawis Cheunchitra
Lithuania	LTU-S-4	Justas Tamasauskas
Russia	RUS-S-1	Darya Turichina
Greece	GRC-S-4	Paraskevas Tzitzimpasis
Lithuania	LTU-S-2	Dainius Kilda
China (G)	CNg-S-5	Zhixuan Lai
Poland (G)	PLg-S-3	Michał Kamil Siłkowski
Belarus	BLR-S-4	Valery Zharabitski
China (G)	CNg-S-3	Luya Wang
Ukraine	UKR-S-3	Oleksandr Kayda
Hungary	HUN-S-1	Gergely Dalya
Singapore	SGP-S-4	Jue Hang Qin

Certificates of Participation

Country	Student code	Name
Indonesia	INA-S-3	James Lim
Lithuania	LTU-S-3	Gabija Mamarsalkaite
Romania	ROM-S-2	Ana Maria Constantin
Slovakia	SVK-S-1	Michal Racko
Ukraine	UKR-S-1	Ievgenii Kuriatnikov
Croatia	HRV-S-3	Julio Car
Romania	ROM-S-1	Bogdan Cristian Marchis
Singapore	SGP-S-3	Rion You
Serbia	SRB-S-5	Ivan Tanasijevic
Czech Republic	CZE-S-2	Lukas Timko
Croatia	HRV-S-4	Kresimir Tisanic
Romania	ROM-S-5	Roberta Raileanu
Brazil	BRA-S-1	Rafael de Lima Bordoni
Bulgaria	BGR-S-3	Miroslov Zhekov
Russia	RUS-S-3	Arina Apetyan
Indonesia	INA-S-1	Miftahul Hilmi
Colombia	COL-S-3	Juan Sebatian Valbuena Bermudez
Hungary	HUN-S-2	Gabor Galgoczi
Singapore	SGP-S-2	Timothy Tay
Bulgaria	BGR-S-5	Vasil Todorinov
Sri Lanka	LKA-S-3	Lakmal Buddika Neegahapola
Slovakia	SVK-S-5	Dominik Imrich
Hungary	HUN-S-4	Bela Hegyesi
Portugal	PRT-S-1	Carolina Almeida Duarte
Russia	RUS-S-4	Ilkham Galiullin
Slovakia	SVK-S-3	Miroslav Gasparek
Kazakhstan	KAZ-S-2	Diana Askhatova
Hungary	HUN-S-5	Zoltan Jager
Kazakhstan	KAZ-S-1	Bekzat Abdulla
Croatia	HRV-S-5	Drago Plecko
Croatia	HRV-S-1	Anna Khrystyna Andreikanich
Sri Lanka	LKA-S-2	Hiranthaka Sandun Bandara Palugaswewa
Ukraine	UKR-S-5	Yuriy Denysenko
Hungary	HUN-S-3	Otto Hanyecz
Sri Lanka	LKA-S-5	Ashen Chaturanga Bellana Vithanage
Colombia	COL-S-2	Sergio David Lobo Bolano
Sri Lanka	LKA-S-4	Banuka Dimuthu Kularatne Munaweera Kankanamge
Sri Lanka	LKA-S-1	Jude Vijayanga Wijesekera
Bangladesh	BGD-S-1	Tazkera Haque
Colombia	COL-S-1	Logan Fernando Perez Monsalve
Czech Republic	CZE-S-4	Eva Miklusova
Bangladesh	BGD-S-3	Md. Sams Afif Nirjhor
Bangladesh	BGD-S-2	Md. Moshiur Rahman
Bangladesh	BGD-S-4	Paritosh Roy

Group Competition

Team	Final score
Romania	92.7
Iran	91.68
India	91.5
China	76.26
Indonesia	74.205
Korea	70.775
Brazil	70.29
Slovakia	69.5
Poland (G)	69.12
Bulgaria	67.68
China (G)	67
Iran (G)	66.495
Croatia	60.63
Belarus	58.8
CzechRepublic	56.56
Lithuania	54.74
Ukraine	52.965
Russia+Kazakhstan	52.325
Serbia	48.51
Poland	47.04
Sri Lanka	44.29
Singapore	42.315
Hungary	41.76
Thailand	39.15
Greece	32.85
Bangladesh+Kazakhstan	22.95
Columbia+Portugal	16.185

Statutes of the IOAA

#1

In recognition of the growing significance of astronomy and related subjects in all fields of our life, including the general education of young people, and with the aim of enhancing the development of international contacts between different countries in the field of school education in astronomy and astrophysics, an annual competition in these subjects has been organized for high school students; the competition is called the "International Olympiad on Astronomy and Astrophysics" (IOAA). The International Olympiad on Astronomy and Astrophysics should be organized during the within of August – December.

#2

The competition is organized by the Ministry of Education or other appropriate institution of one of the participating countries on whose territory the competition is to be conducted. Hereunder, the term "Ministry of Education" is used in the above meaning. The organizing country is obliged to ensure equal participation of all delegations, and to invite all the participants of any of the latest three competitions. Additionally, it has the right to invite other countries.

The International Olympiad on Astronomy and Astrophysics is a purely educational event. No country may have its team excluded from participation on any political ground resulting from political tension, lack of diplomatic relation, lack of recognition of some countries by the government of the organizing country, imposed embargo and similar reasons. When difficulties preclude formal invitation of the team representing a country, students from such a country should be invited to participate as individuals.

Within five years of its entry in the competition a country should declare its intention to be the host for a future Olympiad. This declaration should propose a timetable so that a provisional list of the order of countries willing to host Olympiads can be compiled.

A country that refuses to organize the competition may be barred from participation, even if delegations from that country have taken part in previous competitions.

Any kind of religious or political propaganda against any other country at the Olympiad is forbidden. A country that violates this rule may be barred from participation.

#3

The Ministries of Education of the participating countries, as a rule, assign the organization, preparation and execution of the competition to a scientific society or other institution in the organizing country. The Ministry of Education of the organizing country notifies the Ministries of Education of the participating countries of the name and address of the institution assigned to organize the competition.

#4

Each participating country sends one regular team consisting of high school students. Also students who finish their high school in the year of the competition can be members of a team. The age of the contestants must not exceed twenty on December 31st of the year of the competition. Each teamshould normally have 5 students. In addition to the students, two accompanying persons are invited from each country, one of which is designated as delegation head (responsible for the whole delegation), and the other – as pedagogical leader (responsible for the students). The accompanying persons become members of the International Board, where in they have equal rights. Members of the International Board are treated as contact persons for the participating countries concerning the affairs of the International

Olympiad on Astronomy and Astrophysics until the following competition.
The competition is conducted in a friendly atmosphere designed to promote future collaborations and to encourage friendships in the scientific community. To that effect all possible political tensions among the participants should not be reflected in any activity during the competition. Any political activity directed against any individuals or countries is strictly prohibited.
The delegation head and pedagogical leader must be selected from scientists or teachers, capable of solving the problems of the competition competently. Normally each of them should be able to speak English.
The delegation head of each participating team should, on arrival, hand over to the organizers a list containing the contestants' personal data (first name, family name, date of birth, home address and address of the school attended) and certificates (in English) from the schools confirming the contestants attendance or graduation in the year of the competition.

#5
The organizing country has the right to invite guest teams in addition to the regular teams (no more than one guest team per country). Normally the guest team consists also of five students and two leaders. However, the leaders of the guest teams are not members of the International Board. Except for that, their duties are the same as those of the leaders of the regular teams.
Participation of a guest team always needs approval from the organizing country.
The country sending a guest team pays all the expenses arising from its participation.
The next organizers are not obliged to invite guest teams present at the previous competition. Countries present with guest teams only are not obliged to organize the IOAA in the future.
Contestants from guest teams and guest teams are classified in the same way as regular teams. They may receive diplomas and prizes, their names should be identified with the letter “G” (“Guest”) in all official documents.

#6
The working language of the International Olympiad in Astronomy and Astrophysics is English. Competition problems and their solutions should be prepared in English; the organizers, however, may prepare those documents in other languages as well.

#7
The financial principles of the organization of the competition are as follows:

- The Ministry which sends the students to the competition covers the roundtrip travel expenses of the students and the accompanying persons to the place where the competition is held.
- The Ministry of the organizing country covers all other costs from the moment of arrival until the moment of departure. In particular, this concerns the costs for board and lodging for the students and the accompanying persons, the costs of excursions, awards for the winners, etc.

#8
The competition consists of 2 parts: theoretical competition (including short and long questions) and practical competition (including observations and data analysis). There should normally be 15 short and 2 or 3 long questions for the theoretical part. For the practical part, the organizer may give a set task on 1) observation, 2) paper-based practical problem, 3) computer-based problem, 4) planetarium simulation or combination of the four, which is expected to be solvable in 5 hours. The problems should involve at

least four areas mentioned in the Syllabus.
The sequence of the competition days is decided by the organizers of the competition. There should be one free day between the two parts of the competition. The time allotted for solving the problems should normally be five hours for the theoretical part and five hours for the practical part. The duration of the Olympiad (including the arrival and departure days) should normally be 10 days.
When solving the problems the contestants may use nonprogrammable pocket calculators without graphics and drawing materials, which are brought by the contestants themselves. Collections of formulae from mathematics, chemistry, physics, etc. are not allowed.
The host country has to prepare 5 short and 1 long spare theoretical problems and 2 spare practical problems. They will be presented to the International Board if some of the originally presented is/are rejected by two thirds of members of the International Board. The rejected problem cannot be reconsidered.

#9
The competition tasks are prepared by the host country.

#10
The theoretical part makes up 50 % of the total mark, and the practical part - 50 % (25% data analysis, 25% observation) of the total mark. The practical solutions should consist of theoretical analysis (plan and discussion) and practical execution. The solution to each problem should contain an answer and its complete justification.

#11
The contestants will receive diplomas and medals or honorable mentions in accordance with the number of points accumulated as follows:

- The mean number of points accumulated by the three best contestants is considered as 100%.
- The contestants who accumulated at least 90% of points receive first prize (diplomas and gold medals).
- The contestants who accumulate 78% or more but less than 90% receive second prize (diplomas and silver medals).
- The contestants who accumulate 65% or more but less than 78% receive third prize (diplomas and bronze medals).
- The contestants who accumulate 50% or more but less than 65% receive an honorable mention (diplomas).
- The contestants who accumulate less than 50% of points receive certificates of participation in the competition.
- The participant who obtains the highest score (Absolute Winner) will receive a special prize and diploma.
- Other special prizes may be awarded.

#12
In addition to the individual classification one establishes the team classification according to the following rules:

- Teams consisting of less than three contestants are not classified.
- For judging the best team, a task to be performed by the team as a whole will be designed. This task may form either a part of the theory exam, practical exam, or be held at a different time. In case it is

included in the theory or practical exam, the duration of the individual exam may be suitably reduced. The test may contain theory, practical or observation aspect or any combination thereof. The host country will be free to decide which option to use or propose a different format in consultation with the Secretariat. This should be announced to all participants in advance.

#13

The obligations of the organizer:

1. The organizer is obliged to ensure that the competition is organized in accordance with the Statutes.
2. The organizer should produce a set of "Organization Rules", based on the Statutes, and send them to the participating countries in good time. These Organization Rules shall give details of the Olympiad not covered in the Statutes, and give names and addresses of the institutions and persons responsible for the Olympiad.
3. The organizer establishes a precise program for the competition (schedule for the contestants and the accompanying persons, program of excursions, etc.), which is sent to the participating countries in advance.
4. The organizer should check immediately after the arrival of each delegation whether its contestants meet the conditions of the competitions.
5. The organizer chooses (according to the Syllabus) the problems and ensures their proper formulation in English and in other languages set out in # 6. It is advisable to select problems where the solutions require a certain creative capability and a considerable level of knowledge. Everyone taking part in the preparation of the competition problems is obliged to preserve complete secrecy.
6. The organizer must provide the teams with guides.
7. The organizer should provide the delegation leaders with Photostat copies of the solutions of the contestants in their delegation at least 24 hours before the moderation.
8. The organizer is responsible for organizing the grading of the problem solutions and moderation.
9. The organizer drafts a list of participants proposed as winners of the prizes and honorable mentions.
10. The organizer prepares the prizes (diplomas and medals), honorable mentions and awards for the winners of the competition.
11. The organizer is obliged to publish the proceedings (in English) of the Olympiad. Each of the participants of the competition (delegation heads, pedagogical leaders and contestants) should receive one copy of the proceedings free of charge not later than one year after the competition.

#14

The International Board is chaired by a representative of the organizing country. He/she is responsible for the preparation of the competition and serves on the Board in addition to the accompanying persons of the respective teams. All decisions, except those described separately, are passed by a majority of votes. In the case of equal number of votes for and against, the chairman has the casting vote.

#15

The delegation leaders are responsible for the proper translation of the problems from English (or other languages mentioned in # 6) to the mother tongue of the participants.

#16

The International Board has the following responsibilities:

1. To direct and supervise the competition to ensure that it is conducted according to the regulations.
2. To discuss the organizers' choice of tasks, their solutions and the suggested evaluation guidelines before each day of the competition. The Board can change or reject suggested tasks but cannot propose new ones. Changes may not affect practical equipment. There will be a final decision on the formulation of tasks and on the evaluation guidelines. The participants in the meeting of the International Board are bound to preserve secrecy concerning the tasks and to be of no assistance to any of the contestants.
3. To ensure correct and just classification of the prize winners.
4. To establish the winners of the competition and make decisions concerning the presentation of prizes and honorable mentions. The decision of the International Board is final.
5. To review the results of the competition.
6. To select the country which will be the organizer of the next competition.

The International Board is the only body that can make decisions on barring countries from participation in the International Olympiad on Astronomy and Astrophysics for the violation of these Statutes.

Observers may be present at meetings of the International Board, but may not vote or take part in the discussions.

#17

The institution in charge of the Olympiad announces the results and presents the awards and diplomas to the winners at an official ceremony. It invites the representatives of the organizing Ministry and scientific institutions to the closing ceremony of the competition.

#18

The long term work involved in organizing the Olympiads is coordinated by a "Secretariat for the International Olympiad on Astronomy and Astrophysics". This Secretariat consists of the President and Secretary. They are elected by the International Board for a period of five years when the chairs become vacant.

The President and Secretary are members of the International Board in addition to the regular members mentioned in # 4. They are invited to each International Olympiad on Astronomy and Astrophysics at cost (including travel expenses) of the organizing country.

#19

Changes in the present Statutes, the insertion of new paragraphs or exclusion of old ones, can only be made by the International Board and requires qualified majority (2/3 of the votes).

No changes may be made to these Statutes or Syllabus unless each delegation obtained written text of the proposal at least 3 months in advance.

#20

Participation in the International Olympiad in Astronomy and Astrophysics signifies acceptance of the present Statutes by the Ministry of Education of the participating country.

#21

The originals of these Statutes are written in English.

Syllabus
of 5th International Olympiad on Astronomy and Astrophysics

General Notes

1. Extensive contents in basic astronomical concepts are required in theoretical and practical problems.

2. Basic concepts in physics and mathematics at high school level are required in solving the problems. Standard solutions should not involve calculus.

3. Astronomical software packages may be used in practical and observational problems. The contestants will be informed the list of software packages to be used at least 3 months in advance.

4. Contents not included in the Syllabus may be used in questions but sufficient information must be given in the questions so that contestants without previous knowledge of these topics would not be at a disadvantage.

5. Sophisticated practical equipment

A. Theoretical Part

The following theoretical contents are proposed for the contestants.

1. Basic Astrophysics

Contents	**Remarks**
Celestial Mechanics	Kepler's Laws, Newton's Laws of Gravitation
Electromagnetic Theory & Quantum Physics	Electromagnetic spectrum, Radiation Laws, Blackbody radiation, Doppler effect
Thermodynamics	Thermodynamic equilibrium, Ideal gas, Energy transfer
Spectroscopy and Atomic Physics	Absorption, Emission, Scattering, Spectra of Celestial objects, Line formations
Nuclear Physics	Basic concepts

2. Coordinates and Times

Contents	**Remarks**
Celestial Sphere	Spherical trigonometry, Celestial coordinates, Equinox and Solstice, Circumpolar stars, Constellations and Zodiac
Concept of Time	Solar time, Sidereal time, Julian Date, Heliocentric Julian Date, Time zone, Universal Time, Local Mean Time

3. Solar System

Contents	Remarks
The Sun	Solar structure, Solar surface activities, Solar rotation, Solar radiation and Solar constant, Solar neutrinos, Sun-Earth relations, Role of magnetic fields, Solar wind
The Solar System	Earth-Moon System, Formation of the Solar System, Structure and components of the Solar System, Structure and orbits of the Solar System objects, Sidereal and Synodic periods
Phenomena	Tides, Seasons, Eclipses, Aurorae, Meteor Showers

4. Stars

Contents	Remarks
Stellar Properties	Distance determination, Radiation, Luminosity and magnitude, Color indices and temperature, Determination of radii and masses, Stellar motion, Stellar variabilities
Stellar Interior and Atmospheres	Stellar nucleosynthesis, Energy transportation, Stellar atmospheres and spectra
Stellar Evolution	Stellar formation, Hertzsprung-Russell diagram, Pre-Main Sequence, Main Sequence, Post-Main Sequence stars, End states of stars

5. Stellar Systems

Contents	Remarks
Binary Star Systems	Classification, Mass determination in binary star systems, Light and radial velocity curves of eclipsing binary systems, Doppler shifts in binary systems
Star Clusters	Classification and Structure
Milky Way Galaxy	Structure and composition, Rotation, Interstellar medium
Normal and Active Galaxies	Classification, Distance determination
Accretion Processes	Basic concepts

6. Cosmology

Contents	Remarks
Elementary Cosmology	Cluster of galaxies, Dark matter, Gravitational lenses, Hubble's Law, Big Bang, Cosmic Microwave Background Radiation

7. Instrumentation and Space Technologies

Contents	Remarks
Multiwavelength Astronomy	Observations in radio, microwave, infrared, visible, ultraviolet, X-ray, and gamma-ray wavelength bands, Earth's atmospheric effects
Instrumentation and Space Technologies	Ground- and space-based telescopes and detectors (e.g. charge-coupled devices, photometers, spectrographs), Magnification, Resolving and light-gathering powers of telescopes

B. Practical Part

This part consists of 2 sections: observations and data analysis sections. The theoretical part of the Syllabus provides the basis for all problems in the practical part. The observations section focuses on contestant's experience in

1. Naked-eye observations.

2. Usage of sky maps and catalogues.

3. Usage of basic astronomical instruments–telescopes and various detectors for observations but enough instructions must be provided to the contestants.

Observational objects may be from real sources in the sky or imitated sources in the laboratory. Computer simulations may be used in the problems but sufficient instructions must be provided to the contestants. The data analysis section focuses on the calculation and analysis of the astronomical data provided in the problems. Additional requirements are as follows:

1. Proper identification of error sources, calculation of errors, and estimation of their influence on the final results.

2. Proper use of graph papers with different scales, i.e. polar and logarithmic papers.

3. Basic statistical analysis of the observational data.

Summary of the International Board Meetings held during the 5th IOAA

IBM #1 – 26th August, 2011

The first Board Meeting was a short one. It began with the Chair of the LOC welcoming everyone. As has become traditional at the IOAA, the Leaders then introduced themselves with a few words, followed by the President and General Secretary. The Chair of the LOC then outlined the programme for the IOAA and the tasks ahead of the Leaders. The meeting closed to allow the Leaders to begin discussion of the Group Competition tasks.

IBM #2 – 29th August, 2011

During this meeting, the elections for President and General Secretary were discussed. The Board discussed and agreed on the procedure for the election, selected three leaders to supervise the election, and listened to the presentations of the candidates. The procedures, supervising committee, the elections and the results are described in a separate section of these Proceedings.

The meeting also discussed the use of computers in the IOAA. A number of issues with technical questions and logistics with a large number of computers were brought up. A possible solution was proposed to use computers for the group rounds or to use rotation (like in the observing round). It was noted, however, that rotation takes significant time. It was also pointed out that the design of the Group Competition is entirely open to the organisers (so computers can be used if desired). The progress of technology was also noted (from desktops in the 1st IOAA in Thailand to laptops in the 5th IOAA to perhaps tablets in the 8th IOAA). The experience of using computers in the Indonesian national Olympiad was described, including live marking and SMS answers by external (non-competing) participants which expands interest in the Olympiad. The use of free/open-source software vs. commercial software was discussed. The Virtual Observatory was mentioned as a potentially useful software tool. Syllabus point #3 which allows use of software for problems was also mentioned.

The general consensus of the Board was to allow each organising country freedom in deciding if and how to use computers in the tasks, without forcing the issue one way or the other, as long as it is announced prior to the IOAA. Free software should be preferred but not mandated.

Christian Alberto Goez Theran (Colombia) presented the nascent state of astronomical olympiads in Colombia and asked for suggestions on their development. The Leaders provided a number of suggestions for development and assistance.

The question of fees for future IOAAs was brought up, including the ideas of a voluntary rather than mandatory fee, or of a group of "founder countries" which would pay a fee to assist the organising country. The Chair of the LOC responded to this comment, noting that a small participation fee for each team would represent only a tiny fraction of the budget, and a larger fee might put off many countries from

participating. Also, in his opinion, although a participation fee would eventually be necessary as the IOAA expanded, the IOAA is still too young to consider a participation fee, and that it needed to exist for about a decade to become sufficiently established in the eyes of the Ministries of Education and the government beaurocracy that a participation fee would be acceptable.
No further comments were made and the discussion was closed.

IBM #3 – 30th August, 2011
The International Board discussed the changes to the syllabus proposed by the Working Group chosen during the 4th IOAA, consisting of Chatief Kunjaya, Aniket Sule, Thais Mothé Diniz, Slobodan Ninkovic and Greg Stachowski. The changes to the syllabus were presented by Aniket Sule. The primary aim of the the changes was clarification of the wording of the general notes and the topics, in particular clarifying where the Syllabus had previously mentioned only "Basic concepts" and expanding some topics where required associated knowledge was not previously mentioned (e.g. "Celestial coordinates" added alongside "Spherical trigonometry"). Statements regarding rounding, significant digits and proper units were moved to the General Notes to underline that they apply to the whole syllabus, not just the practical part. A "qualitative understanding" category was introduced (marked "Q"), for topics where the student should be aware of the subject but would not be expected to perform calculations without help. A number of new sections were added, in particular "Space Exploration".

The Board agreed with the intent and nature of the new syllabus while proposing a number of corrections and improvements, which were accepted by the Working Group and incorporated into the new Syllabus. The new Syllabus is published in these proceedings and will be used from the 6th IOAA in Brazil.

IBM #4 – 1st September, 2011
During this meeting, the LOC presented the results of marking and moderation and the proposed division of medals and prizes. The points obtained by the students fell naturally into the divisions given in the Statues (Statute #11), with clear gaps between the Gold, Silver and Bronze medallists, thus there was no need to adjust the divisions. There was some discussion from the Leaders about the small (relative to previous years) number of Gold medals, however the Board decided that the divisions given in the Statutes should stand and not be adjusted.

The Board also accepted the LOC proposal to award additional joint Silver medals to Iran and India for the group competition, as these countries' teams had both acheived equal results which were close to that of the winning team, Romania, and significantly ahead of the other teams.

IBM #5 – 2nd September, 2011
During this meeting the International Board voted in the elections for President and General Secretary, as previously discussed in IBM #2 and described elsewhere in these Proceedings. Dr. Chatief Kunjaya was elected as the new President, and Dr. Greg Stachowski was elected as the new General Secretary. The terms will begin from 1st January 2012.

The Board discussed a proposal from Dr. Chatief Kunjaya to allow the President of the IOAA to appoint Regional Coordinators to support and promote the IOAA in different areas of the world. The IOAA is expanding and staff in addition to the President and General Secretary are needed. Also, the post of

Regional Coordinator would give official standing to a person organising an IOAA in their region which would make discussion with officials easier. The Board agreed with this proposal and empowered the President to appoint Regional Coordinators as required. [In January 2012, in accordance with this decision the new President of the IOAA, Dr. Chatief Kunjaya, appointed Aniket Sule (India) and Thais Mothé Diniz (Brazil) as Regional Coordinators for the Asia-Pacific region and for South America, respectively.]

The Board also discussed the locations for the following IOAAs. The following countries proposed that they will hold IOAAs in future years:

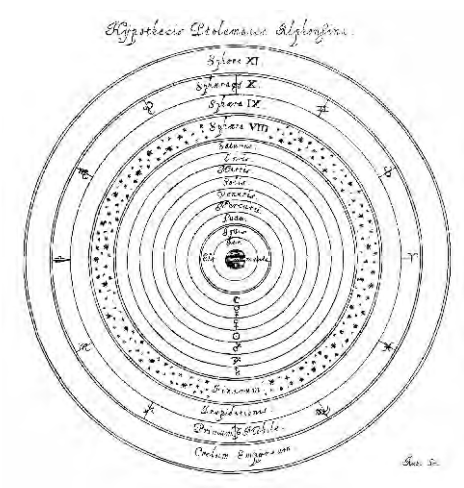
2012	Brazil
2013	Greece
2014	Romania
2015	Bangladesh
2016	Colombia
2017	India
2018	Hungary
2019	Sri Lanka

Thais Mothé Diniz presented the preparations for the 6th IOAA in Brazil and invited everyone.
John Seiradakis and Loukas Zachilas discussed the preparations for the 7th IOAA in Greece.
The International Board passed a resolution approving the proposals to hold the 6th IOAA in Brazil in 2012 and the 7th IOAA in Greece in 2013. Thus these two are now regarded as definite.

Finally, the President thanked the Organisers and Jury of the 5th IOAA. The Board in turn thanked the outgoing President for his hard work on behalf of the IOAA.

This closed the final IBM of the 5th IOAA.

Greg Stachowski



Syllabus (new) of 5th International Olympiad on Astronomy and Astrophysics

General Notes

1. Extensive contents in basic astronomical concepts are required in theoretical and practical problems.

2. Basic concepts in physics and mathematics at high school level are required in solving the problems. Standard solutions should not involve use of calculus and/or the use of complex numbers and/or solving differential equations.

3. Astronomical software packages may be used in practical and observational problems. The contestants will be informed the list of software packages to be used at least 3 months in advance. The chosen software packages should be preferably freewares or low-cost ones enabling all countries to obtain them easily for practice purpose. The chosen softwares should preferably be available on multiple OSs (Windows / Unix / GNU-Linux / Mac).

4. Concepts and phenomena not included in the Syllabus may be used in questions but sufficient information must be given in the questions so that contestants without previous knowledge of these topics would not be at a disadvantage.

5. Sophisticated practical equipments likely to be unfamiliar to the candidates should not dominate a problem. If such devices are used in the questions, sufficient information must be provided. In such case, students should be given opportunity to familiarise themselves with such equipments.

6. The original texts of the problems have to be set in the SI units, wherever applicable. Participants will be expected to mention appropriate units in their answers and should be familiar with the idea of correct rounding off and expressing the final result(s) and error(s) with correct number of significant digits.

A. Theoretical Part

Symbol (Q) is attached to some topics in the list. It means "qualitative understanding only". Quantitative reasoning / proficiency in these topics is not mandatory.

The following theoretical contents are proposed for the contestants.

1. Basic Astrophysics

Contents	Remarks
Celestial Mechanics	Newton's Laws of Gra vitation, Kepler's Laws for circular and non-circular orbits, Roche limit, barycentre, 2-body problem, Lagrange points
Electromagnetic Theory & Quantum Physics	Electromagnetic spectrum, Radiation Laws, Blackbody radiation

Thermodynamics	Thermodynamic equilibrium, Ideal gas, Energy transfer
Spectroscopy and Atomic Physics	Absorption, Emission, Scattering, Spectra of Celestial objects, Doppler effect, Line formations, Continuum spectra, Splitting and Broadening of spectral lines, Polarisation
Nuclear Physics	Basic concepts including structure of atom, Mass defect and binding energy Radioactivity, Neutrinos (Q)

2. Coordinates and Times

Contents	**Remarks**
Celestial Sphere	Spherical trigonometry, Celestial coordinates and their applications, Equinox and Solstice, Circumpolar stars, Constellations and Zodiac
Concept of Time	Solar time, Sidereal time, Julian Date, Heliocentric Julian Date, Time zone, Universal Time, Local Mean Time, Different definitions of "year", Equation of time

3. Solar System

Contents	**Remarks**
The Sun	Solar structure, Solar surface activities, Solar rotation, Solar radiation and Solar constant, Solar neutrinos (Q), Sun-Earth relations, Role of magnetic fields (Q), Solar wind and radiation pressure, Heliosphere (Q), Magnetosphere (Q)
The Solar System	Earth-Moon System, precession, nutation, Libration, Formation and evolution of the Solar System (Q), Structure and components of the Solar System (Q), Structure and orbits of the Solar System objects, Sidereal and Synodic periods, Retrograde motion, Outer reaches of the solar system (Q)
Space Exploration	Satellite trajectories and transfers, Human exploration of the Solar System (Q), Planetary missions (Q), Sling-shot effect of gravity, Space-based instruments (Q)
Phenomena	Tides, Seasons, Eclipses, Aurorae (Q), Meteor Showers

4. Stars

Contents	Remarks
Stellar Properties	Methods of Distance determination, Radiation, Luminosity and magnitude, Color indices and temperature, Determination of radii and masses, Stellar motion, Irregular and regular stellar variabilities – broad classification & properties, Cepheids & period-luminosity relation, Physics of pulsation (Q)
Stellar Interior and Atmospheres	Stellar equilibrium, Stellar nucleosynthesis, Energy transportation (Q), Boundary conditions, Stellar atmospheres and atmospheric spectra
Stellar Evolution	Stellar formation, Hertzsprung-Russell diagram, Pre-Main Sequence, Main Sequence, Post-Main Sequence stars, supernovae, planetary nebulae, End states of stars

5. Stellar Systems

Contents	Remarks
Binary Star Systems	Different types of binary stars, Mass determination in binary star systems, Light and radial velocity curves of eclipsing binary systems, Doppler shifts in binary systems, interacting binaries, peculiar binary systems
Exoplanets	Techniques used to detect exoplanets
Star Clusters	Classification and Structure, Mass, age, luminosity and distance determination
Milky Way Galaxy	Structure and composition, Rotation, Satellites of Milky Way (Q)
Interstellar Medium	Gas (Q), dust (Q), HII regions, 21cm radiation, nebulae (Q), interstellar absorption, dispersion measure, Faraday rotation
Galaxies	Classifications based on structure, composition and activity, Mass, luminosity and distance determination, Rotation curves
Accretion Processes	Basic concepts (spherical and disc accretion) (Q), Eddington luminosity

6. Cosmology

Contents	Remarks
Elementary Cosmology	Expanding Universe and Hubble's Law, Cluster of galaxies, Dark matter, Dark energy (Q), Gravitational lensing, Cosmic Microwave Background Radiation, Big Bang (Q), Alternative models of the Universe (Q), Large scale structure (Q), Distance measurement at cosmological scale, cosmological redshift

7. Instrumentation and Space Technologies

Contents	Remarks
Multi-wavelength Astronomy	Observations in radio, microwave, infrared, visible, ultraviolet, X-ray, and gamma-ray wavelength bands, Earth's atmospheric effects
Instrumentation	Telescopes and detectors (e.g. charge-coupled devices, photometers, spectrographs), Magnification, Focal length, Focal ratio, resolving and light-gathering powers of telescopes, Geometric model of two element interferometer, Aperture synthesis, Adaptive optics, photometry, astrometry

B. Practical Part

This part consists of 2 sections: observations and data analysis sections. The theoretical part of the Syllabus provides the basis for all problems in the practical part.

The observations section focuses on contestant's experience in

1. naked-eye observations,
2. usage of sky maps and catalogues,
3. application of coordinate systems in the sky, magnitude estimation, estimation of angular separation
4. usage of basic astronomical instruments–telescopes and various detectors for observations but enough instructions must be provided to the contestants.

Observational objects may be from real sources in the sky or imitated sources in the laboratory. Computer simulations may be used in the problems but sufficient instructions must be provided to the contestants.

The data analysis section focuses on the calculation and analysis of the astronomical data provided in the problems. Additional requirements are as follows:

1. Proper identification of error sources, calculation of errors, and estimation of their influence on the final results.
2. Proper use of graph papers with different scales, e.g., polar and logarithmic papers. Transformation of the data to get a linear plot and finding "Best Fit" line approximately.
3. Basic statistical analysis of the observational data.
4. Knowledge of the most common experimental techniques for measuring physical quantities mentioned in Part A.

Elections for President and General Secretary

The 5th IOAA marked the end of the terms of office of the President and the General Secretary of the IOAA. Therefore, elections to fill these posts were scheduled to be held during the IBM on 2nd September, 2011.

As agreed during the 4th IOAA in Beijing, candidates for each post were nominated by team leaders before the 5th IOAA. The outgoing President, Prof. Boonrucksar Soonthorntum, declined to be nominated for a second term. One nominated candidate, Dr. Seyed Mohammad Sadegh Movahed (Iran) withdrew prior to the election. Thus, the nominated candidates were:

for President:	Dr. Chatief Kunjaya (Indonesia, outgoing General Secretary)
for General Secretary:	Dr. Aniket Sule (India) Dr. Greg Stachowski (Poland)

During the IBM on 29th August, 2011, the International Board discussed the elections and agreed on the **Procedures** according to which the election was held. A comittee consisting of **Loukas Zachilas** (Greece), **Hakim L. Malasan** (Indonesia) and **Thais Mothé Diniz** (Brazil) was chosen to supervise the election. (The procedures and the list of electors allowed to vote according to the IOAA statutes are given below.) The nominated candidates then presented themselves, explaining their programme and answering questions from the Board.

For the election, and in accordance with the instructions of the supervising committee, the LOC prepared two ballot boxes (one for the election for President and one for the election for General Secretary) and blank ballot papers. The election was held as planned during the IBM on 2nd September, 2011. The electors were each called by the supervising committee to sign the list, mark their ballot papers in secret behind a screen, and place them in the ballot box. Three leaders were not present and did not vote, thus 47 votes were cast from a possible total of 50. The ballots were then counted by the supervising committee and the results announced. The results were:

For President:

Candidate	**No. of votes in favour**	**No. of blank votes**	**Total no. of valid votes**	No. of ballot papers spoiled	Total
Dr. Chatief Kunjaya	47	0	47	0	47

For General Secretary:

<table>
<tr><th>Candidate</th><th>No. of votes in favour</th><th>No. of blank votes</th><th>Total no. of valid votes</th><th>No. of ballot papers spoiled</th><th>Total</th></tr>
<tr><td>Dr. Aniket Sule</td><td>9</td><td rowspan="2">1</td><td rowspan="2">47</td><td rowspan="2">0</td><td rowspan="2">47</td></tr>
<tr><td>Dr. Gregory Stachowski</td><td>37</td></tr>
</table>

Therefore, **Dr. Chatief Kunjaya (Indonesia) was elected President of the IOAA**, and **Dr. Greg Stachowski (Poland)** was elected General Secretary of the IOAA. The votes were recorded in the **Protocol** of the election, which was signed by the supervising committee and the outgoing President and General Secretary. The Protocol is reproduced below. The terms of office of the new President and General Secretary began on 1st January 2012.

Procedures for the Election

1. The election will be by secret ballot.

2. As is the custom of the IOAA, each member of the International Board Meeting (the IBM), that is: the current President, General Secretary (Statute #18), each current Leader (Statute #4) and the Chair of the Local Organising Committee (Statute #14), vote independently.

3. Leaders of Guest Teams and Observers are not members of the Board and do not vote (Statute #5).

4. Before voting, the International Board will select 3 of its members to supervise the vote and sign the protocol of the election.

5. For a vote with one candidate, each elector will be given a piece of paper with the nsame of the candidate, and a blank piece of paper. They will place one of these in the ballot box.

6. For a vote with two or more candidates, each elector will be given a piece of paper with the names of the candidates for the post, which they will clearly mark to indicate their preference, and a blank piece of paper. They will place one of these in the ballot box.

7. The votes will be collected by the LOC in a ballot box. Once all votes are collected the LOC will count the votes in front of the supervising leaders.

8. For a single candidate, only papers with the name of the candidate are counted as votes in favour of that candidate. Blank papers are counted towards the total number of votes but do not count in favour of the candidate.

9. For two or more candidates, only papers with the name of one candidate marked count as votes in favour of that candidate. Blank papers are counted towards the total number of votes but do not count in favour of any candidate. Other papers are spoiled votes and do not count.

10. The candidate with a simple majority of votes in favour will be declared the winner.

11. In case of a tied vote, the IBM will then decide the procedure for determining the winner.

12. The vote count will be reported to the IBM and recorded in the protocol. The supervisors and current President and General Secretary will sign the protocol.

List of Electors allowed to vote at the IBM on 2nd September 2011

1. Boonrucksar Soonthornthum (President; by Statute #18)
2. Chatief Kunjaya (General Secretary; by Statute #18)
3. Ronald Cruise (Bangladesh)
4. Moshurl Amin (Bangladesh)
5. Stanislaw Sekerzhitsky (Belarus)
6. Alexander Poplavsky (Belarus)
7. Thais Mothe Diniz (Brasil)
8. Felipe Goncalves Assis (Brasil)
9. Alexey Stoev (Bulgaria)
10. Nikola Karavasilev (Bulgaria)
11. Daihui Zuo (China)
12. Dongni Chen (China)
13. Christian Alberto Goez Theran (Columbia)
14. Damir Hrzina (Croatia)
15. Ivan Romstajn (Croatia)
16. Jan Kozusko (Czech Republic)
17. Tomas Graf (Czech Republic)
18. John Hugh Seiradakis (Greece)
19. Loukas Zachilas (Greece)
20. Tibor Hegedus (Hungary)
21. Robert Szabats (Hungary)
22. Hakim L. Malasan (Indonesia)
23. M. Ikbal Arifyanto (Indonesia)
24. Anwesh Mazumdar (India)
25. Aniket Sule (India)
26. Hossein Hakimi Pajouh (Iran)
27. Seyed Mohammad Sadegh Movahed (Iran)
28. Svetlana Baranovskaya (Kazakhstan)
29. Hong Bae Ann (Korea)
30. Yoojea Kim (Korea)
31. Jokubas Sudzius (Lithuania)
32. Audrius Bridzius (Lithuania)
33. Grzegorz Kondrat (Poland)
34. Przemysław Mróz (Poland)
35. Eduardo Brescansin de Amores (Portugal)
36. Sorin Trocaru (Romania)
37. Craciun Petrica (Romania)
38. Boris Eskin (Russia)
39. Elena Zhabrunova (Russia)
40. Slobodan Ninkovic (Serbia)

41. Aleksandar Vasilijkovic (Serbia)
42. Xiang Hao Yuen (Singapore)
43. Ladislav Hric (Slovakia)
44. Maria Hricova Bartlomejowa (Slovakia)
45. K. P. S. Chandana Jayaratne (Sri Lanka)
46. Orrarujee Muanwong (Thailand)
47. Umnart Sathanon (Thailand)
48. Volodymyr Reshetnyk (Ukraine)
49. Kateryna Mykhailyk (Ukraine)
50. Greg Stachowski (Chair of LOC; by Statute #14)

ioaa

International Olympiad on Astronomy and Astrophysics

Elections for the posts of President and General Secretary of the IOAA

PROTOCOL

On 2[nd] September 2011, at the Meeting of the International Board of the IOAA in Kraków, Poland, elections were held for the posts of President and General Secretary of the IOAA.

The results of the elections were as follows:

For President:

Candidate	No. of votes in favour	No. of blank votes	Total no. of valid votes	No. of ballot papers spoiled	Total
Dr. Chatief Kunjaya	47	0	47	0	47

The election was won by __________

For General Secretary:

Candidate	No. of votes in favour	No. of blank votes	Total no. of valid votes	No. of ballot papers spoiled	Total
Dr. Aniket Sule	9	1	47	0	47
Dr. Gregory Stachowski	37				

The election was won by __________

The undersigned confirm that they supervised the election and that the results are as given above:

Loukas Zachilas — Hakim L. Malasan — Thais Mothé Diniz

The undersigned accept the above results in the name of the International Board of the IOAA:

President
Prof. Boonrucksar Soonthornthum

General Secretary
Dr. Chatief Kunjaya

01 NEWSLETTER

No 1, 27th August 2011

5th IOAA
SILESIA POLAND 2011

ioaa International Olympiad on Astronomy and Astrophysics

Silesia. Positive energy

SILESIAN PLANETARIUM

WHAT'S IN THIS ISSUE?

Today's program

The Opening Ceremony

HUBBLE SPACE TELESCOPE – fascinating documentary in 3D

A FEW WORDS IN POLISH

Media patrons:

POLSKA THE TIMES DZIENNIK ZACHODNI · TVP KATOWICE · POLSKIE RADIO KATOWICE · echo miasta · naszemiasto.pl

Media patrons:

POLSKA THE TIMES DZIENNIK ZACHODNI · TVP KATOWICE · POLSKIE RADIO KATOWICE · echo miasta · naszemiasto.pl

04 NEWSLETTER

No 4, 30th August 2011

WHAT'S IN THIS ISSUE?

Today's program

Students' and leaders' trip

Let there be more light!

Media patrons:

POLSKA THE TIMES DZIENNIK ZACHODNI

TVP KATOWICE

POLSKIE RADIO KATOWICE

echo miasta

naszemiasto.pl

05

NEWSLETTER

No 5, 31th August 2011

5th IOAA SILESIA POLAND 2011

International Olympiad on Astronomy and Astrophysics

Silesia. Positive energy

SILESIAN PLANETARIUM

WHAT'S IN THIS ISSUE?

Today's program

Observations in Planetarium

Data analysis tasks

Book review: „Solaris" by Stanisław Lem

Media patrons:

POLSKA THE TIMES DZIENNIK ZACHODNI · TVP KATOWICE · POLSKIE RADIO KATOWICE · echo miasta · naszemiasto.pl

06 NEWSLETTER

No 6, 1st September 2011

5th IOAA
SILESIA POLAND 2011

ioaa International Olympiad on Astronomy and Astrophysics

Silesia. Positive energy

SILESIAN PLANETARIUM

WHAT'S IN THIS ISSUE?

Media patrons:

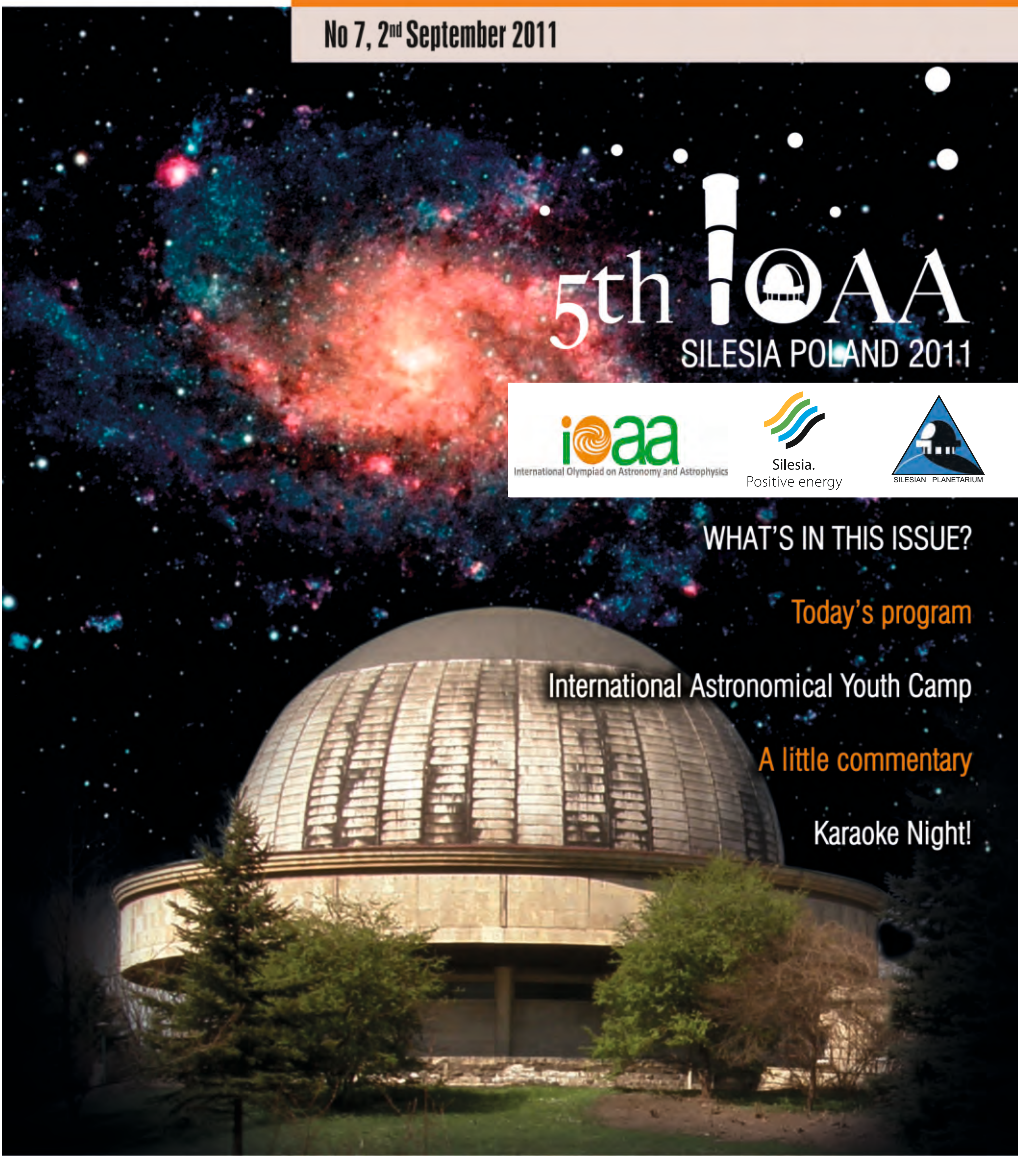
POLSKA THE TIMES DZIENNIK ZACHODNI · TVP KATOWICE · POLSKIE RADIO KATOWICE · echo miasta · naszemiasto.pl

07 NEWSLETTER

No 7, 2nd September 2011

5th IOAA

SILESIA POLAND 2011



International Olympiad on Astronomy and Astrophysics

Silesia. Positive energy

SILESIAN PLANETARIUM

WHAT'S IN THIS ISSUE?

- Today's program
- International Astronomical Youth Camp
- A little commentary
- Karaoke Night!

Media patrons:

08 NEWSLETTER

No 8, 3rd September 2011

Media patrons:

POLSKA THE TIMES DZIENNIK ZACHODNI · TVP KATOWICE · POLSKIE RADIO KATOWICE · echo miasta · naszemiasto.pl

INAUGURATION


BANGLADESH


BELARUS


BULGARIA


BRAZIL


CHINA


COLOMBIA

CROATIA

CZECH REPUBLIC

GREECE

HUNGARY

INDIA

INDONESIA

IRAN


KAZAKHSTAN

KOREA

LITHUANIA

POLAND

PORTUGAL

ROMANIA

USSIAN FEDERATION

SERBIA


SINGAPORE


THAILAND


SLOVAKIA


UKRAINE


SRI LANKA


CHINA


POLAND


IRAN

COMPETITION







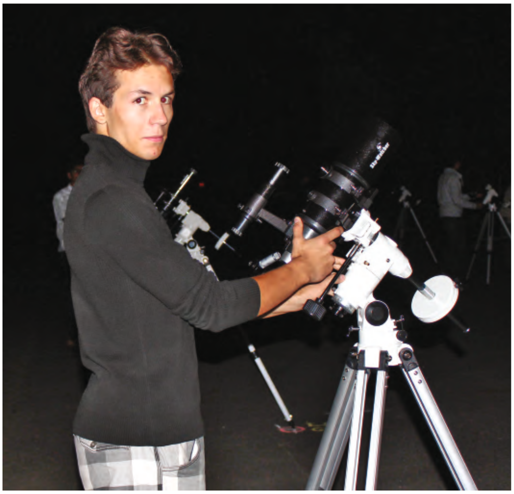

14

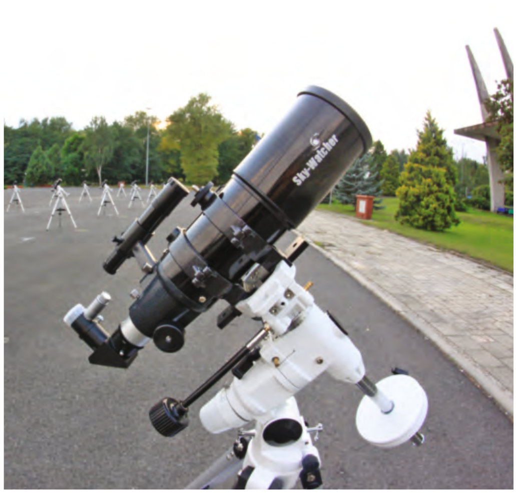

12
3


101


29
61


5th IOAA
TVP KATOWICE
echo
naszemiasto.pl
5th International Olympiad on Astronomy and Astrophysics, Katowice, 25.08-04.09.2011
ioaa




Sky-Watcher

About LOC and Leaders


Observing competition –
planetarium round


Earth (25 points)


Earth (25 points)


GREECE

Leaders' travelling


ZABYTKOWA KOPALNIA SREBRA


Muzeum
Chleba





BRUGI
FOR SPORT SINCE 1956
29
Szyndzielnia


Meeting in Ethnographic Park












IMAX


5th IOAA
5th International Olympiad on Astronomy and Astrophysics.







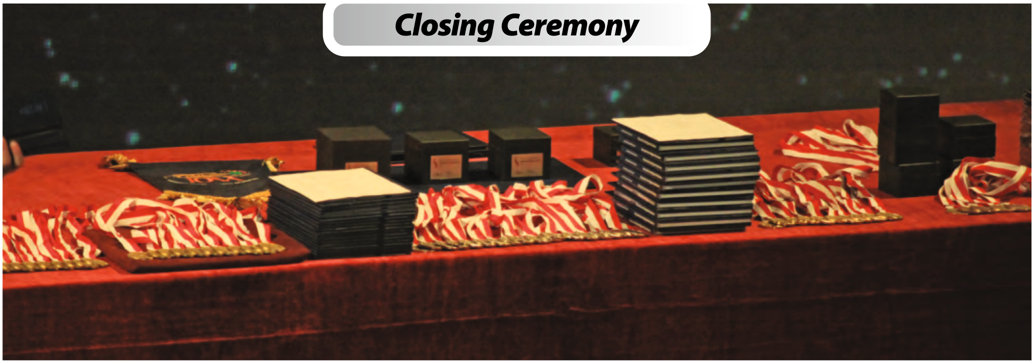







WYJŚCIE
EWAKUACYJNE

Closing Ceremony




IOAA
Piotr Sadowski

Superlunety już jadą z Chin do Chorzowa

FOT. MARZENA BUGAŁA

Lech Motyka, dyrektor Planetarium, czeka na nowy sprzęt

Naprawdę wyjątkowy ładunek o kosmicznej randze zawinął już do portu w Hamburgu! To superlunety, które Śląski Urząd Marszałkowski kupił za niemal 40 tysięcy złotych w Chinach. Za kilka dni trafią one do Śląskiego Planetarium w Chorzowie.

Obserwować dzięki nim gwiezdne konstelacje już niedługo będą mogli uczestnicy V Międzynarodowej Olimpiady z Astronomii i Astrofizyki.

Lunety z Hamburga do Chorzowa dotrą już drogą lądową. Jeszcze przed tym, jak Księżyc, Saturn i Kłos, najjaśniejsza gwiazda Panny, znajdą się na niebie tuż obok siebie – czyli 5 lipca – lunety pojawią się w Planetarium Śląskim.

Urządzenia – jak zapewnia ich producent – są bardzo łatwe w obsłudze i mobilne, ale jednocześnie przystosowane do prowadzenia prawdziwie profesjonalnych obserwacji nieba. Międzynarodowe zawody olimpijskie, na które je zakupiono, odbywać będą się na przełomie sierpnia i września w specjalnie do tego celu przystosowanej hali Targów Katowickich oraz w Planetarium Śląskim.

Polska będzie po raz pierwszy gospodarzem tej niezwykłej olimpiady. Patronat nad nią objął prezydent RP Bronisław Komorowski.

Rok temu zorganizowano ją w Pekinie, ale brało w niej udział mniej gości niż w tym roku zapowiedziało przyjazd na Śląsk. W Chinach było 25 drużyn z 23 krajów.

Tym razem w gwiezdnych zmaganiach weźmie udział aż 31 drużyn z 29 krajów, w sumie to będzie 151 zawodników oraz 73 liderów i obserwatorów.

Swój udział w zmaganiach olimpijskich zapowiedziały: Bangladesz, Białoruś, Boliwia, Brazylia, Bułgaria, Chiny, Kolumbia, Chorwacja, Czechy, Egipt, Grecja, Węgry, Indie, Indonezja, Iran, Kazachstan, Korea Południowa, Litwa, Portugalia, Rumunia, Rosja, Serbia, Singapur, Słowacja, Sri Lanka, Tajlandia, Turcja, Ukraina oraz oczywiście Polska.

Ze względu na ogromne zainteresowanie uczestników, olimpiada odbywać się będzie jednocześnie aż w trzech miastach: Chorzowie, Katowicach oraz Krakowie.

Po zakończeniu olimpijskich zmagań lunety pozostaną na Śląsku i nadal będą służyły miłośnikom niebiańskich obserwacji.

AMC

Super telescopes are already on the way from China to Chorzów

A truly unusual load of a cosmic rank has already called at the port in Hamburg! It contains super telescopes bought in China by the Marshall's Office in Katowice for almost 40 thousand zlotys. In a few days time they will get to the Silesian Planetarium in Chorzów.

The participants of the 5th International Olympiad on Astronomy and Astrophysics will soon be able to use them to observe the constellations.

Telescopes will get from Hamburg to Chorzów overland. They will appear in the Silesian Planetarium even before July 5th – the day when the Moon, Saturn and Spica, the brightest star in Virgo constellation, will appear on the sky just next to each other.

The devices, as their producer confirms, are portable and easy to operate, but at the same time they are adjusted to conduct truly professional sky observations. The international competitions – the occasion for which they were bought - are to take place at the turn of August and September in the hall being the part of Katowice International Fair and in the Silesian Planetarium as well.

Poland will be the host of this extraordinary event for the first time. The president of the Republic of Poland, Bronisław Komorowski, took the patronage over it.

Last year the Olympiad was organised in Beijing. Nevertheless, there were fewer guests than supposed to come to Silesia. In China there were 25 teams from 23 countries.

This time, 31 teams from 29 countries will take part in 'cosmic competitions': 151 competitors and 73 leaders and observers altogether.

The participation in the Olympiad was declared by Bangladesh, Belarus, Bolivia, Brazil, Bulgaria, China, Columbia, Croatia, Czech Republic, Egypt, Greece, Hungary, India, Indonesia, Iran, Kazakhstan, South Korea , Lithuania, Portugal, Romania, Russia, Serbia, Singapore, Slovakia, Sri Lanka, Thailand, Turkey, Ukraine, and of course Poland.

Because of the great interest that the Olympiad aroused, it is going to take place in three cities simultaneously: Chorzów, Katowice and Kraków.

When the Olympic competitions come to an end, the telescopes will stay in Silesia and they will keep serving the fans of 'heavenly observations'.

Uczniowie z całego świata przyjadą wkrótce do Chorzowa

W przyszłym miesiącu do Chorzowa przyjadą uczniowie z 29 krajów z całego świata, by wziąć udział w V Międzynarodowej Olimpiadzie z Astronomii i Astrofizyki. Od dwóch dni Chatief Kunjaya, sekretarz olimpiady, sprawdza w Chorzowie, jak przebiegają przygotowania. Wczoraj wizytował hale Międzynarodowych Targów w Chorzowie, w których uczniowie będą wykonywać część zadań.

Dziś wybiera się do Krakowa, by sprawdzić, w jakich warunkach będą tam przebywać uczestnicy olimpiady.

Olimpiada odbywać się będzie równolegle w trzech miastach: Chorzowie, Katowicach oraz Krakowie. Organizatorem tego prestiżowego przedsięwzięcia jest Planetarium Śląskie w Chorzowie. Uczestnicy zawodów będą mieli także okazję zapoznać się z atrakcjami naszego regionu. Odwiedzą m.in. zabytkową kopalnię Guido w Zabrzu, zabytkową kopalnię srebra w Tarnowskich Górach, Zamek Książąt Pszczyńskich czy Muzeum Chleba.

Planetarium Śląskie posiada ponad pięćdziesięcioletnie doświadczenie w organizowaniu krajowej olimpiady astronomicznej i czteroletnie doświadczenie w przygotowywaniu polskiej drużyny do udziału w międzynarodowej olimpiadzie. *KK*

Chatief Kunjaya, sekretarz V Międzynarodowej Olimpiady z Astronomii i Astrofizyki, mówi o przygotowaniach do tego wydarzenia

FOT. MARZENA BUGAŁA

Co zadecydowało o tym, że Polska została organizatorem olimpiady?
Gdy w 2007 roku założyciele olimpiady – Tajlandia, Indonezja, Iran, Chiny i Polska – spotkały się, by ustalić, jak to przedsięwzięcie ma wyglądać, zdecydowano, że w pierwszej kolejności organizatorami będą założyciele. W tym roku organizacja przypadła Polsce.

Jak ocenia pan nasze przygotowania?
Idą bardzo szybko i sprawnie. Nie zdążyłem sprawdzić jeszcze wszystkich kwestii, jednak po rozmowach mogę stwierdzić, że wszystko przebiega zgodnie z planem.

Co jest najtrudniejsze w przygotowaniu?
Najtrudniejszą częścią jest przygotowanie zadań. Nie mogą być zbyt trudne, by tylko kilku uczniów mogło je wykonać, ani też zbyt proste, by mogli zrobić je wszyscy. Organizatorzy muszą mieć pewne przeczucia na temat średnich zdolności uczniów.

Jakie umiejętności muszą posiadać uczestnicy?
Muszą znać zagadnienia i teorię astronomii, jak też posiadać zdolność logicznego myślenia, jeżeli chodzi o kwestie astronomiczne. Muszą zająć się analizą danych. Otrzymują pewne dane i muszę je przeanalizować i wyciągnąć wnioski. Muszą również wykazać się zdolnościami obserwacyjnymi, by móc rozpoznawać konstelacje na niebie, ciała niebieskie.

Czy taka olimpiada może być drogą do kariery?
Myślę, że kiedy laureaci otrzymają medale, będzie im łatwiej kontynuować dalszą naukę, bo najlepsze uniwersytety z całego świata zabiegają o zwycięzców tej olimpiady.
Rozmawiała: K. Kapusta

Students from the whole world will soon come to Chorzów

Next month the students from 29 countries from the whole world are coming to Chorzów to participate in the 5th International Olympiad on Astronomy and Astrophysics. For two days, the Secretary General of the Olympiad, Chatief Kunjaya, has been monitoring the course of preparations in Chorzów. Yesterday, he visited Chorzów International Trade Hall where the students are going to solve some of the tasks.

Today he is leaving for Kraków to see the conditions of the hotel in which the leaders and observers are to stay at.

The Olympiad will take place simultaneously in three cities: Chorzów, Katowice and Kraków. The organizer of this prestigious event is the Silesian Planetarium in Chorzów. The participants will also have the chance to get familiar with the tourist attractions of our region. They are going to visit a historical coal mine Guido in Zabrze, a historical silver mine in Tarnowskie Góry, the Castle of the Princes of Pszczyna and the Museum of Bread.

The Silesian Planetarium has an over 50-year experience in organising a national astronomy olympiad and a 4-year experience in preparing a Polish team to participate in the international Olympiad.

Chatief Kunjaya, a Secretary General of the 5th International Olympiad on Astronomy and Astrophysics, is talking about the preparations for this event.

What has determined the fact that Poland has become the host of the Olympiad?

In 2007 the Olympiad founders – Thailand, Indonesia, Iran, China and Poland – met to decide how the event was to look like and it was decided that the founders would be the first organizers. This year, the organisation fell to Poland.

How do you evaluate our preparations?

They are going very quickly and efficiently. I haven't managed to check all the things yet. Nevertheless, after all the conversations I had I can say that everything is going according to the plan.

What is the most difficult aspect of preparations?

The most difficult thing is the preparation of tasks. They cannot be too difficult so that only a few students can solve them but they cannot be too easy so that everyone can solve them. The organizers need to have a feeling about the average level of students.

What kind of skills do participants need?

They need to know astronomical problems and the theory of astronomy. They must also have the ability to think logically when it comes to astronomy. They also must analyse data; they receive certain data and they need to analyse it and draw some conclusions. Moreover, the students need to show their observational skills and recognise constellations and heavenly bodies in the sky.

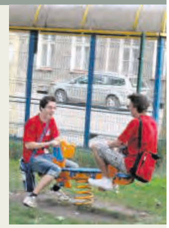
Can such an Olympiad be a way to the career?

I think that after the winners are granted medals, it will be easier for them to continue their education, because the best universities in the whole world compete for laureates of this Olympiad.

Najpierw patrzyli w niebo, potem zjechali do kopalni, a jutro zobaczymy ich w teatrze

Chorzów, Zabrze

Uczestnicy odbywającej się w Chorzowie i Katowicach V Międzynarodowej Olimpiady z Astronomii i Astrofizyki po czterech dniach rozwiązywania zadań przestali obserwować niebo i... zeszli na ziemię. A nawet jeszcze niżej – zjechali bowiem do zabytkowej kopalni Guido. Podzieleni na cztery grupy młodzi astronomowie zwiedzili też pałac w Pszczynie, Szyndzielnię i tor saneczkowy w Bielsku-Białej oraz Zespół Pałacowo-Parkowy w Pławniowicach. Wielkie wrażenie zrobiła na nich jednak kopalnia – żaden z nich nie był jeszcze 170 metrów pod ziemią. – Tutaj jest zimno, nawet bardzo – powiedział nam Mahammad Wildan Gisari z Indonezji. – Dotychczas znałem podziemia kopalni tylko z gier komputerowych i jestem zaskoczonym tym, jak wyglądają w rzeczywistości. Bardzo mi się tu podoba – dodaje. Zachwyceni byli także Europejczycy: – W kopalni jestem pierwszy raz – przyznał Bela Hegyesi z Węgier. – Robi ogromne wrażenie. Do tej pory nie zdawałem sobie sprawy z tego, że praca górnika jest taka trudna i niebezpieczna – zaznacza. Gościom z zagranicy podobały się również zabytkowe pałace, a także Beskidy. – Lubię góry, a Beskidy bardzo mi się podobają – dodaje Bela Hegyesi. Młodemu Węgrowi podobał się zresztą cały nasz region. – Śląsk jest bardzo fajny, a ludzie mili. Cieszę się, że mogłem tu przyjechać – podkreślał.
Dzisiaj uczestnicy olimpiady będą mieli okazję zobaczyć jeszcze Górnośląski Park Etnograficzny. Właśnie w skansenie odbędzie się impreza integracyjna. Zwycięzców olimpiady poznamy dopiero jutro, podczas oficjalnego zakończenia, które odbędzie się w chorzowskim Teatrze Rozrywki. *PSZ*



FOT. ARKADIUSZ GOŁA

First they looked at the sky, then went down into the mine and tomorrow we are going to see them in the theatre

After four days of solving tasks, the participants of 5th International Olympiad on Astronomy and Astrophysics stopped observing the sky and… came down to earth. Actually, even deeper – to the historical coal mine Guido. Young astronomers divided into four groups sightsaw a palace in Pszczyna, Szyndzielnia cable railway and a toboggan run in Bielsko-Biała and the Palace and Park Complex in Pławniowice. Great impression, however, was made by the mine – no one had been 170 m below the ground level before. 'It is cold here,' Mahammad Wildan Gisari from Indonesia told us. 'So far, I've known the underground only from computer games and I'm surprised how they look like in reality'. I like it here very much,' he adds. Europeans were also delighted. 'It's my first time in the mine,' Bela Hegyesi from Hungary admitted. 'It is really impressive. So far I haven't realised that the miner's work is so dangerous,' he says. Guests from abroad also liked historical palaces and the Beskids. 'I like mountains and I love the Beskids,' Bela Hegyesi adds. The young Hungarian grew fond of the whole region. 'Silesia is really nice and people are kind. I'm glad I could come here,' he emphasised.

Today the participants will have the opportunity to visit the Upper Silesian Ethnographical Park. Here, in the open-air ethnographic museum the integration party is going to take place. Tomorrow, at the official closing ceremony which is going to be held in the Entertainment Theatre in Chorzów we will get to know the Olympiad winners.

Fakty 24

Śląsk stał się światową stolicą astronomii i astrofizyki. Do 4 września będziemy gościć olimpijczyk

Paweł Szałankiewicz

Wczoraj w Teatrze Rozrywki w Chorzowie uroczyście otwarto V Międzynarodową Olimpiadę z Astronomii i Astrofizyki, która po raz pierwszy odbędzie się nie tylko na Śląsku, ale w Polsce, a nawet i w Europie! – To wielkie wyróżnienie dla regionu, bo dziś zjeżdżają się tu najtęższe umysły światowej astronomii – powiedział Adam Matusiewicz, marszałek województwa śląskiego tuż przed ceremonią otwarcia i dodał: – Jesteśmy dumni, że Śląskie jest pierwszym europejskim regionem goszczącym uczestników olimpiady.

A przyjechali oni do Polski aż z 27 krajów z całego świata. Dotarli również reprezentanci Indii, których przyjazd (ze względu na problem z otrzymaniem wiz) był niepewny do ostatniej chwili. – Uważam, że jakaś dodatkowa siła ludzkiej odpowiedzialności i dobra pomogła nam, że wszystkie drużyny do nas dotarły – przyznał Lech Motyka, dyrektor Planetarium.

Olimpijczycy rozpoczną zmagania już dzisiaj. Wczoraj natomiast wszystkie drużyny startujące w olimpiadzie oficjalnie zostały zaprezentowane na deskach Teatru Rozrywki.

A my zapytaliśmy gości, co sądzą o naszym regionie. PSZ

PAWEŁ SZAŁANKIEWICZ

Reprezentanci Iranu do Polski przyjechali w czwartek późnym wieczorem, stąd też niewiele byli w stanie zobaczyć. – Ale muszę przyznać, że w waszym kraju jest bardzo zielono – stwierdza Hossein Hakimi Pajouh, lider Irańczyków. Hossein pochwalił ponadto naszą gościnność. Zapytany o to, czy wiedział, że w Katowicach jest Spodek, odpowiedział nam: – Nic nie widziałem, nic nie słyszałem.

Dla drużyny Bangladeszu przyjazd do naszego kraju jest niezwykłym i cennym doświadczeniem. – Jesteśmy mocno podekscytowani. Wszyscy są dla nas przyjaźni. Widać, że ta olimpiada przede wszystkim łączy ludzi – uważa Md. Sams Afif Nirjhor. Zapytany o to, z czym kojarzy mu się Polska, odpowiedział: – Z Planetarium! Ale wasz kraj bardzo mi się podoba – dodał.

PAWEŁ SZAŁANKIEWICZ

Silesia became the world capital of astronomy and astrophysics. Until 4th September we will be hosting the Olympiad participants

Yesterday in the Entertainment Theatre in Chorzów there was a festive opening of the 5th International Olympiad on Astronomy and Astrophysics. The Olympiad will be the first event of this kind not only in Silesia, but also in Poland and even in Europe! 'It's a great honour for the region as the most outstanding minds of the world astronomy are coming here today,' said Adam Matusiewicz, the Marshall of the Silesian voivodship just before the opening ceremony and added that 'We are proud that Silesia is the first European region to host the Olympiad participants.'

They came to Poland from 27 countries from the whole world. The representatives of India, whose visit was called into question until the last minute (due to the problem with obtaining visas), also finally arrived.' I think that some additional amount of human responsibility and goodness helped us and all the teams finally came to us,' said Lech Motyka, the director of the Planetarium.

The participants will start the rivalry today. Yesterday, in turn, all the teams taking part in the Olympiad were officially presented on the stage of the Entertainment Theatre.

We asked guests what they think about our region.

The representatives of Iran came to Poland on Thursday late in the evening. Hence, they were not able to see much. 'But I have to admit that it is really green in your country,' says Hosseln Pajouh, the Iranian leader. What Hosseln also praised is our hospitability. When asked whether he knew that we have a 'Saucer' in Katowice, he answered: 'I didn't know anything, I didn't hear anything.'

As for the team from Bangladesh, the visit in our country is a remarkable and precious experience. 'We are all really excited. Everyone is really friendly to us. It is clear that above all this Olympiad is connecting people,' thinks Md. Sams Afif Nirjhof. When asked about what he associates Poland with, he said 'With www.dziennikzachodni.pl

Polska Dziennik Zachodni | 27–28 sierpnia 2011 | 5

Fakty 24

…ów z 27 krajów. Goście po pierwszym dniu pobytu są zachwyceni naszym województwem

PAWEŁ SZAŁANKIEWICZ

Wiele państw wymaga tego, aby uzyskać wizy, by móc do nich wjechać. To normalne, więc nie martwiliśmy się o to, że nie weźmiemy udziału w olimpiadzie – powiedział Akshay Krishna, reprezentant Indii. – Do Katowic przyjechaliśmy z Krakowa i... Śląsk jest piękny – dodaje.

Reprezentacji Serbii bardzo się w Polsce spodobało, choć tak naprawdę jeszcze niewiele zdążyła zobaczyć. – Pewnie okazja do tego będzie, jak pojedziemy na jakąś wycieczkę – mówi Ognjen Markovic, który po raz drugi uczestniczy w olimpiadzie

PAWEŁ SZAŁANKIEWICZ

Śląsk jest kosmicznym regionem?

● **Pierwszą rzeczą, jaka w naszym regionie może się skojarzyć z przestrzenią kosmiczną, jest katowicki Spodek.** Po wymianie łusek prezentuje się on obecnie imponująco. A czy są jeszcze inne miejsca kojarzące się przynajmniej z nazwy z przestrzenią kosmiczną? Okazuje się, że tak! Żeby nie szukać daleko, to na drodze od Spodka w kierunku Sosnowca znajduje się osiedle Gwiazdy. Osiem wybudowanych tam wieżowców kształtem przypomina, co oczywiste, gwiazdy. W centrum Katowic znajduje się też kino Kosmos. Co jeszcze? Gliwice i osiedle Kopernika. Każda z ulic nosi nazwę kojarzącą się z kosmosem, m.in.: Andromedy, Oriona, Saturna, Wielkiej Niedźwiedzicy czy Galaktyki. A jeśli już mowa o Koperniku, to ma on swoje ulice w niemal każdym mieście naszego województwa. PSZ

'Many countries require entry visas. It's normal so we weren't afraid that we weren't going to participate in the Olympiad,' said Akshay Krishna, the representative of India. 'We came to Katowice from Kraków… Silesia is beautiful,' he adds.
The representation of Serbia also grew fond of Poland, though they have not managed to see much so far. 'I guess there will be such an opportunity when we go for a trip,' says Ognjen Markovic who is taking part in the Olympiad for the second time.

To Czech najlepiej zna się na astronomii!

MARZENA BUGAŁA

Nie mogę w to uwierzyć, to niesamowite uczucie! – mówi Stanislav Fort z Czech, zwycięzca V Międzynarodowej Olimpiady z Astronomii i Astrofizyki. W sobotę, w chorzowskim Teatrze Rozrywki, odbyła się uroczysta gala wręczenia uczestnikom certyfikatów i medali. Rozdano 61 medali: 10 złotych, 18 srebrnych i 33 brązowe.
18-letni Filip Ficek z Krakowa, jako jedyny Polak otrzymał złoto. Skromnie komentuje swoją wygraną: – Uważam, że w mojej drużynie były osoby lepiej przygotowane niż ja. Najlepszym praktykiem okazał się Akshay Krishna z Indii, najlepszym teoretykiem – Jeevana Priya Inala, też z Indii. Rumunia otrzymała złoty medal w zawodach drużynowych. W olimpiadzie udział wzięło 29 drużyn z 26 państw. Kolejna za rok, tym razem w Rio de Janeiro.
MSH

Czech the best at astronomy!

'I can't believe it. It's an amazing feeling!' says Stanislav Fort from the Czech Republic, the winner of the 5th International Olympiad on Astronomy and Astrophysics. On Saturday, in the Entertainment Theatre in Chorzów, there was a festive ceremony during which the participants were granted medals and certificates. There were 61 medals given altogether: 10 gold, 18 silver and 33 bronze ones.

An 18-year-old Filip Ficek from Kraków was the only Polish student who received the gold medal. That is how he modestly comments his victory: 'I think that in my team there were some who were prepared better than me.'

Akshay Krishna from India turned out to be the best in practice, Jeevana Priya Inala - also from India - the best in theory. Romania received a gold medal in team competitions. All in all, 29 teams from 26 countries participated in this event. The next Olympiad will be organised in the following year in Rio de Janeiro.

POLSKA Naszą gazetę przygotowujemy we współpracy z THE TIMES
DZIENNIK ZACHODNI

Superlunety już jadą z Chin do Chorzowa

Naprawdę wyjątkowy ładunek o kosmicznej randze zawinął już do portu w Hamburgu! To superlunety, które Śląski Urząd Marszałkowski kupił za niemal 40 tysięcy złotych w Chinach. Za kilka dni trafią one do Śląskiego Planetarium w Chorzowie.

Obserwować dzięki nim gwiezdne konstelacje już niedługo będą mogli uczestnicy V Międzynarodowej Olimpiady z Astronomii i Astrofizyki.

Lunety z Hamburga do Chorzowa dotrą już drogą lądową. Jeszcze przed tym, jak Księżyc, Saturn i Kłos, najjaśniejsza gwiazda Panny, znajdą się na niebie tuż obok siebie – czyli 5 lipca – lunety pojawią się w Planetarium Śląskim.

Urządzenia – jak zapewnia ich producent – są bardzo łatwe w obsłudze i mobilne, ale jednocześnie przystosowane do prowadzenia prawdziwie profesjonalnych obserwacji nieba. Międzynarodowe zawody olimpijskie, na które je zakupiono, odbywać będą się na przełomie sierpnia i września w specjalnie do tego celu przystosowanej hali Targów Katowickich oraz w Planetarium Śląskim.

FOT. MARZENA BUGAŁA

Lech Motyka, dyrektor Planetarium, czeka na nowy sprzęt

Polska będzie po raz pierwszy gospodarzem tej niezwykłej olimpiady. Patronat nad nią objął prezydent RP Bronisław Komorowski.

Rok temu zorganizowano ją w Pekinie, ale brało w niej udział mniej gości niż w tym roku zapowiedziało przyjazd na Śląsk. W Chinach było 25 drużyn z 23 krajów.

Tym razem w gwiezdnych zmaganiach weźmie udział aż 31 drużyn z 29 krajów, w sumie to będzie 151 zawodników oraz 73 liderów i obserwatorów.

Swój udział w zmaganiach olimpijskich zapowiedziały: Bangladesz, Białoruś, Boliwia, Brazylia, Bułgaria, Chiny, Kolumbia, Chorwacja, Czechy, Egipt, Grecja, Węgry, Indie, Indonezja, Iran, Kazachstan, Korea Południowa, Litwa, Portugalia, Rumunia, Rosja, Serbia, Singapur, Słowacja, Sri Lanka, Tajlandia, Turcja, Ukraina oraz oczywiście Polska.

Ze względu na ogromne zainteresowanie uczestników, olimpiada odbywać się będzie jednocześnie aż w trzech miastach: Chorzowie, Katowicach oraz Krakowie.

Po zakończeniu olimpijskich zmagań lunety pozostaną na Śląsku i nadal będą służyły miłośnikom niebiańskich obserwacji.

AMC

Super telescopes are already on the way from China to Chorzów

A truly unusual load of a cosmic rank has already called at the port in Hamburg! It contains super telescopes bought in China by the Marshall's Office in Katowice for almost 40 thousand zlotys. In a few days time they will get to the Silesian Planetarium in Chorzów.

The participants of the 5th International Olympiad on Astronomy and Astrophysics will soon be able to use them to observe the constellations.

Telescopes will get from Hamburg to Chorzów overland. They will appear in the Silesian Planetarium even before July 5th – the day when the Moon, Saturn and Spica, the brightest star in Virgo constellation, will appear on the sky just next to each other.

The devices, as their producer confirms, are portable and easy to operate, but at the same time they are adjusted to conduct truly professional sky observations. The international competitions – the occasion for which they were bought - are to take place at the turn of August and September in the hall being the part of Katowice International Fair and in the Silesian Planetarium as well.

Poland will be the host of this extraordinary event for the first time. The president of the Republic of Poland, Bronisław Komorowski, took the patronage over it.

Last year the Olympiad was organised in Beijing. Nevertheless, there were fewer guests than supposed to come to Silesia. In China there were 25 teams from 23 countries.

This time, 31 teams from 29 countries will take part in 'cosmic competitions': 151 competitors and 73 leaders and observers altogether.

The participation in the Olympiad was declared by Bangladesh, Belarus, Bolivia, Brazil, Bulgaria, China, Columbia, Croatia, Czech Republic, Egypt, Greece, Hungary, India, Indonesia, Iran, Kazakhstan, South Korea , Lithuania, Portugal, Romania, Russia, Serbia, Singapore, Slovakia, Sri Lanka, Thailand, Turkey, Ukraine, and of course Poland.

Because of the great interest that the Olympiad aroused, it is going to take place in three cities simultaneously: Chorzów, Katowice and Kraków.

When the Olympic competitions come to an end, the telescopes will stay in Silesia and they will keep serving the fans of 'heavenly observations'.

Uczniowie z całego świata przyjadą wkrótce do Chorzowa

W przyszłym miesiącu do Chorzowa przyjadą uczniowie z 29 krajów z całego świata, by wziąć udział w V Międzynarodowej Olimpiadzie z Astronomii i Astrofizyki. Od dwóch dni Chatief Kunjaya, sekretarz olimpiady, sprawdza w Chorzowie, jak przebiegają przygotowania. Wczoraj wizytował hale Międzynarodowych Targów w Chorzowie, w których uczniowie będą wykonywać część zadań.

Dziś wybiera się do Krakowa, by sprawdzić, w jakich warunkach będą tam przebywać uczestnicy olimpiady.

Olimpiada odbywać się będzie równolegle w trzech miastach: Chorzowie, Katowicach oraz Krakowie. Organizatorem tego prestiżowego przedsięwzięcia jest Planetarium Śląskie w Chorzowie. Uczestnicy zawodów będą mieli także okazję zapoznać się z atrakcjami naszego regionu. Odwiedzą m.in. zabytkową kopalnię Guido w Zabrzu, zabytkową kopalnię srebra w Tarnowskich Górach, Zamek Książąt Pszczyńskich czy Muzeum Chleba.

Planetarium Śląskie posiada ponad pięćdziesięcioletnie doświadczenie w organizowaniu krajowej olimpiady astronomicznej i czteroletnie doświadczenie w przygotowywaniu polskiej drużyny do udziału w międzynarodowej olimpiadzie. *KK*

Chatief Kunjaya, sekretarz V Międzynarodowej Olimpiady z Astronomii i Astrofizyki, mówi o przygotowaniach do tego wydarzenia

Co zadecydowało o tym, że Polska została organizatorem olimpiady?
Gdy w 2007 roku założyciele olimpiady – Tajlandia, Indonezja, Iran, Chiny i Polska – spotkały się, by ustalić, jak to przedsięwzięcie ma wyglądać, zdecydowano, że w pierwszej kolejności organizatorami będą założyciele. W tym roku organizacja przypadła Polsce.

FOT. MARZENA BUGAŁA

Jak ocenia pan nasze przygotowania?
Idą bardzo szybko i sprawnie. Nie zdążyłem sprawdzić jeszcze wszystkich kwestii, jednak po rozmowach mogę stwierdzić, że wszystko przebiega zgodnie z planem.

Co jest najtrudniejsze w przygotowaniu?
Najtrudniejszą częścią jest przygotowanie zadań. Nie mogą być zbyt trudne, by tylko kilku uczniów mogło je wykonać, ani też zbyt proste, by mogli zrobić je wszyscy. Organizatorzy muszą mieć pewne przeczucia na temat średnich zdolności uczniów.

Jakie umiejętności muszą posiadać uczestnicy?
Muszą znać zagadnienia i teorię astronomii, jak też posiadać zdolność logicznego myślenia, jeżeli chodzi o kwestie astronomiczne. Muszą zająć się analizą danych. Otrzymują pewne dane i muszę je przeanalizować i wyciągnąć wnioski. Muszą również wykazać się zdolnościami obserwacyjnymi, by móc rozpoznawać konstelacje na niebie, ciała niebieskie.

Czy taka olimpiada może być drogą do kariery?
Myślę, że kiedy laureaci otrzymają medale, będzie im łatwiej kontynuować dalszą naukę, bo najlepsze uniwersytety z całego świata zabiegają o zwycięzców tej olimpiady.
Rozmawiała: K. Kapusta

Students from the whole world will soon come to Chorzów

Next month the students from 29 countries from the whole world are coming to Chorzów to participate in the 5th International Olympiad on Astronomy and Astrophysics. For two days, the Secretary General of the Olympiad, Chatief Kunjaya, has been monitoring the course of preparations in Chorzów. Yesterday, he visited Chorzów International Trade Hall where the students are going to solve some of the tasks.

Today he is leaving for Kraków to see the conditions of the hotel in which the leaders and observers are to stay at.

The Olympiad will take place simultaneously in three cities: Chorzów, Katowice and Kraków. The organizer of this prestigious event is the Silesian Planetarium in Chorzów. The participants will also have the chance to get familiar with the tourist attractions of our region. They are going to visit a historical coal mine Guido in Zabrze, a historical silver mine in Tarnowskie Góry, the Castle of the Princes of Pszczyna and the Museum of Bread.

The Silesian Planetarium has an over 50-year experience in organising a national astronomy olympiad and a 4-year experience in preparing a Polish team to participate in the international Olympiad.

Chatief Kunjaya, a Secretary General of the 5th International Olympiad on Astronomy and Astrophysics, is talking about the preparations for this event.

What has determined the fact that Poland has become the host of the Olympiad?

In 2007 the Olympiad founders – Thailand, Indonesia, Iran, China and Poland – met to decide how the event was to look like and it was decided that the founders would be the first organizers. This year, the organisation fell to Poland.

How do you evaluate our preparations?

They are going very quickly and efficiently. I haven't managed to check all the things yet. Nevertheless, after all the conversations I had I can say that everything is going according to the plan.

What is the most difficult aspect of preparations?

The most difficult thing is the preparation of tasks. They cannot be too difficult so that only a few students can solve them but they cannot be too easy so that everyone can solve them. The organizers need to have a feeling about the average level of students.

What kind of skills do participants need?

They need to know astronomical problems and the theory of astronomy. They must also have the ability to think logically when it comes to astronomy. They also must analyse data; they receive certain data and they need to analyse it and draw some conclusions. Moreover, the students need to show their observational skills and recognise constellations and heavenly bodies in the sky.

Can such an Olympiad be a way to the career?

I think that after the winners are granted medals, it will be easier for them to continue their education, because the best universities in the whole world compete for laureates of this Olympiad.

Najpierw patrzyli w niebo, potem zjechali do kopalni, a jutro zobaczymy ich w teatrze

Chorzów, Zabrze

Uczestnicy odbywającej się w Chorzowie i Katowicach V Międzynarodowej Olimpiady z Astronomii i Astrofizyki po czterech dniach rozwiązywania zadań przestali obserwować niebo i… zeszli na ziemię. A nawet jeszcze niżej – zjechali bowiem do zabytkowej kopalni Guido. Podzieleni na cztery grupy młodzi astronomowie zwiedzili też pałac w Pszczynie, Szyndzielnię i tor saneczkowy w Bielsku-Białej oraz Zespół Pałacowo-Parkowy w Pławniowicach.

Wielkie wrażenie zrobiła na nich jednak kopalnia – żaden z nich nie był jeszcze 170 metrów pod ziemią.

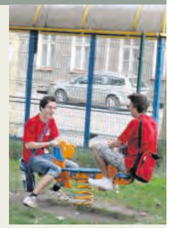
– Tutaj jest zimno, nawet bardzo – powiedział nam Mahammad Wildan Gisari z Indonezji. – Dotychczas znałem podziemia kopalni tylko z gier komputerowych i jestem zaskoczonym tym, jak wyglądają w rzeczywistości. Bardzo mi się tu podoba – dodaje. Zachwyceni byli także Europejczycy: – W kopalni jestem pierwszy raz – przyznał Bela Hegyesi z Węgier.

– Robi ogromne wrażenie. Do tej pory nie zdawałem sobie sprawy z tego, że praca górnika jest taka trudna i niebezpieczna – zaznacza.

Gościom z zagranicy podobały się również zabytkowe pałace, a także Beskidy.

– Lubię góry, a Beskidy bardzo mi się podobają – dodaje Bela Hegyesi. Młodemu Węgrowi podobał się zresztą cały nasz region. – Śląsk jest bardzo fajny, a ludzie mili. Cieszę się, że mogłem tu przyjechać – podkreślał.

Dzisiaj uczestnicy olimpiady będą mieli okazję zobaczyć jeszcze Górnośląski Park Etnograficzny. Właśnie w skansenie odbędzie się impreza integracyjna. Zwycięzców olimpiady poznamy dopiero jutro, podczas oficjalnego zakończenia, które odbędzie się w chorzowskim Teatrze Rozrywki. *PSZ*



FOT. ARKADIUSZ GOLA

First they looked at the sky, then went down into the mine and tomorrow we are going to see them in the theatre

After four days of solving tasks, the participants of 5th International Olympiad on Astronomy and Astrophysics stopped observing the sky and… came down to earth. Actually, even deeper – to the historical coal mine Guido. Young astronomers divided into four groups sightsaw a palace in Pszczyna, Szyndzielnia cable railway and a toboggan run in Bielsko-Biała and the Palace and Park Complex in Pławniowice. Great impression, however, was made by the mine – no one had been 170 m below the ground level before. 'It is cold here,' Mahammad Wildan Gisari from Indonesia told us. 'So far, I've known the underground only from computer games and I'm surprised how they look like in reality'. I like it here very much,' he adds. Europeans were also delighted. 'It's my first time in the mine,' Bela Hegyesi from Hungary admitted. 'It is really impressive. So far I haven't realised that the miner's work is so dangerous,' he says. Guests from abroad also liked historical palaces and the Beskids. 'I like mountains and I love the Beskids,' Bela Hegyesi adds. The young Hungarian grew fond of the whole region. 'Silesia is really nice and people are kind. I'm glad I could come here,' he emphasised.

Today the participants will have the opportunity to visit the Upper Silesian Ethnographical Park. Here, in the open-air ethnographic museum the integration party is going to take place. Tomorrow, at the official closing ceremony which is going to be held in the Entertainment Theatre in Chorzów we will get to know the Olympiad winners.

Fakty 24

Śląsk stał się światową stolicą astronomii i astrofizyki. Do 4 września będziemy gościć olimpijczyk

Paweł Szałankiewicz

Wczoraj w Teatrze Rozrywki w Chorzowie uroczyście otwarto V Międzynarodową Olimpiadę z Astronomii i Astrofizyki, która po raz pierwszy odbędzie się nie tylko na Śląsku, ale w Polsce, a nawet i w Europie! – To wielkie wyróżnienie dla regionu, bo dziś zjeżdżają się tu najtęższe umysły światowej astronomii – powiedział Adam Matusiewicz, marszałek województwa śląskiego tuż przed ceremonią otwarcia i dodał: – Jesteśmy dumni, że Śląskie jest pierwszym europejskim regionem goszczącym uczestników olimpiady.

A przyjechali oni do Polski aż z 27 krajów z całego świata. Dotarli również reprezentanci Indii, których przyjazd (ze względu na problem z otrzymaniem wiz) był niepewny do ostatniej chwili. – Uważam, że jakaś dodatkowa siła ludzkiej odpowiedzialności i dobra pomogła nam, że wszystkie drużyny do nas dotarły – przyznał Lech Motyka, dyrektor Planetarium.

Olimpijczycy rozpoczną zmagania już dzisiaj. Wczoraj natomiast wszystkie drużyny startujące w olimpiadzie oficjalnie zostały zaprezentowane na deskach Teatru Rozrywki.

A my zapytaliśmy gości, co sądzą o naszym regionie. PSZ

PAWEŁ SZAŁANKIEWICZ

Reprezentanci Iranu do Polski przyjechali w czwartek późnym wieczorem, stąd też niewiele byli w stanie zobaczyć. – Ale muszę przyznać, że w waszym kraju jest bardzo zielono – stwierdza Hossein Hakimi Pajouh, lider Irańczyków. Hossein pochwalił ponadto naszą gościnność. Zapytany o to, czy wiedział, że w Katowicach jest Spodek, odpowiedział nam: – Nic nie widziałem, nic nie słyszałem.

Dla drużyny Bangladeszu przyjazd do naszego kraju jest niezwykłym i cennym doświadczeniem. – Jesteśmy mocno podekscytowani. Wszyscy są dla nas przyjaźni. Widać, że ta olimpiada przede wszystkim łączy ludzi – uważa Md. Sams Afif Nirjhor. Zapytany o to, z czym kojarzy mu się Polska, odpowiedział: – Z Planetarium! Ale wasz kraj bardzo mi się podoba – dodał.

PAWEŁ SZAŁANKIEWICZ

Silesia became the world capital of astronomy and astrophysics. Until 4th September we will be hosting the Olympiad participants

Yesterday in the Entertainment Theatre in Chorzów there was a festive opening of the 5th International Olympiad on Astronomy and Astrophysics. The Olympiad will be the first event of this kind not only in Silesia, but also in Poland and even in Europe! 'It's a great honour for the region as the most outstanding minds of the world astronomy are coming here today,' said Adam Matusiewicz, the Marshall of the Silesian voivodship just before the opening ceremony and added that 'We are proud that Silesia is the first European region to host the Olympiad participants.'

They came to Poland from 27 countries from the whole world. The representatives of India, whose visit was called into question until the last minute (due to the problem with obtaining visas), also finally arrived.' I think that some additional amount of human responsibility and goodness helped us and all the teams finally came to us,' said Lech Motyka, the director of the Planetarium.

The participants will start the rivalry today. Yesterday, in turn, all the teams taking part in the Olympiad were officially presented on the stage of the Entertainment Theatre.

We asked guests what they think about our region.

The representatives of Iran came to Poland on Thursday late in the evening. Hence, they were not able to see much. 'But I have to admit that it is really green in your country,' says Hosseln Pajouh, the Iranian leader. What Hosseln also praised is our hospitability. When asked whether he knew that we have a 'Saucer' in Katowice, he answered: 'I didn't know anything, I didn't hear anything.'

As for the team from Bangladesh, the visit in our country is a remarkable and precious experience. 'We are all really excited. Everyone is really friendly to us. It is clear that above all this Olympiad is connecting people,' thinks Md. Sams Afif Nirjhof. When asked about what he associates Poland with, he said 'With

www.dziennikzachodni.pl

Polska Dziennik Zachodni | 27–28 sierpnia 2011 | 5

Fakty 24

ków z 27 krajów. Goście po pierwszym dniu pobytu są zachwyceni naszym województwem

PAWEŁ SZAŁANKIEWICZ

Wiele państw wymaga tego, aby uzyskać wizy, by móc do nich wjechać. To normalne, więc nie martwiliśmy się o to, że nie weźmiemy udziału w olimpiadzie – powiedział Akshay Krishna, reprezentant Indii. – Do Katowic przyjechaliśmy z Krakowa i... Śląsk jest piękny – dodaje.

Reprezentacji Serbii bardzo się w Polsce spodobało, choć tak naprawdę jeszcze niewiele zdążyła zobaczyć. – Pewnie okazja do tego będzie, jak pojedziemy na jakąś wycieczkę – mówi Ognjen Markovic, który po raz drugi uczestniczy w olimpiadzie

PAWEŁ SZAŁANKIEWICZ

Śląsk jest kosmicznym regionem?

● **Pierwszą rzeczą, jaka w naszym regionie może się skojarzyć z przestrzenią kosmiczną, jest katowicki Spodek.**
Po wymianie łusek prezentuje się on obecnie imponująco. A czy są jeszcze inne miejsca kojarzące się przynajmniej z nazwy z przestrzenią kosmiczną? Okazuje się, że tak! Żeby nie szukać daleko, to na drodze od Spodka w kierunku Sosnowca znajduje się osiedle Gwiazdy. Osiem wybudowanych tam wieżowców kształtem przypomina, co oczywiste, gwiazdy. W centrum Katowic znajduje się też kino Kosmos. Co jeszcze? Gliwice i osiedle Kopernika. Każda z ulic nosi nazwę kojarzącą się z kosmosem, m.in.: Andromedy, Oriona, Saturna, Wielkiej Niedźwiedzicy czy Galaktyki. A jeśli już mowa o Koperniku, to ma on swoje ulice w niemal każdym mieście naszego województwa. PSZ

'Many countries require entry visas. It's normal so we weren't afraid that we weren't going to participate in the Olympiad,' said Akshay Krishna, the representative of India. 'We came to Katowice from Kraków… Silesia is beautiful,' he adds.

The representation of Serbia also grew fond of Poland, though they have not managed to see much so far. 'I guess there will be such an opportunity when we go for a trip,' says Ognjen Markovic who is taking part in the Olympiad for the second time.

To Czech najlepiej zna się na astronomii!

MARZENA BUGAŁA

Nie mogę w to uwierzyć, to niesamowite uczucie! – mówi Stanislav Fort z Czech, zwycięzca V Międzynarodowej Olimpiady z Astronomii i Astrofizyki. W sobotę, w chorzowskim Teatrze Rozrywki, odbyła się uroczysta gala wręczenia uczestnikom certyfikatów i medali. Rozdano 61 medali: 10 złotych, 18 srebrnych i 33 brązowe.

18-letni Filip Ficek z Krakowa, jako jedyny Polak otrzymał złoto. Skromnie komentuje swoją wygraną: – Uważam, że w mojej drużynie były osoby lepiej przygotowane niż ja. Najlepszym praktykiem okazał się Akshay Krishna z Indii, najlepszym teoretykiem – Jeevana Priya Inala, też z Indii. Rumunia otrzymała złoty medal w zawodach drużynowych. W olimpiadzie udział wzięło 29 drużyn z 26 państw. Kolejna za rok, tym razem w Rio de Janeiro. MSH

Czech the best at astronomy!

'I can't believe it. It's an amazing feeling!' says Stanislav Fort from the Czech Republic, the winner of the 5th International Olympiad on Astronomy and Astrophysics. On Saturday, in the Entertainment Theatre in Chorzów, there was a festive ceremony during which the participants were granted medals and certificates. There were 61 medals given altogether: 10 gold, 18 silver and 33 bronze ones.

An 18-year-old Filip Ficek from Kraków was the only Polish student who received the gold medal. That is how he modestly comments his victory: 'I think that in my team there were some who were prepared better than me.'

Akshay Krishna from India turned out to be the best in practice, Jeevana Priya Inala - also from India - the best in theory. Romania received a gold medal in team competitions. All in all, 29 teams from 26 countries participated in this event. The next Olympiad will be organised in the following year in Rio de Janeiro.

POLSKA THE TIMES
Naszą gazetę przygotowujemy we współpracy z
DZIENNIK ZACHODNI