

## ASTRONOMY COMPETITIONS AND THEIR ROLE IN ASTRONOMY EDUCATION IN SERBIA

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**Abstract.** For many years astronomy was taught as a separate subject (one hour per week) in the final form of the secondary school education. However, since about quarter a century ago it has been taught as part of physics, only in special schools (like Mathematical High School in Belgrade) it still exists as a separate subject in the final form (also one hour per week). In order to fill the gap NAO (National Astronomical Olympic Committee, a working group within Serbian Astronomical Society – SAC) organises extra-teaching of astronomy. In this way it becomes possible to prepare the interested pupils for astronomical contests both within Serbia and international ones. During the period between the two last National Conferences, from 2014 to 2017, contestants from Serbia participated in the following international contests: 8th IOAA (International Olympiad in Astronomy and Astrophysics) in Romania 2014, 9th IOAA in Indonesia 2015, 10th IOAA in India 2016, 11th IOAA in Thailand 2017 and the Saint-Petersburg Olympiad 2014 – 2017.

### 1. INTRODUCTION

In the period of 25 years between 1969 and 1994 astronomy was taught as a separate subject (one hour per week) in the final form of the secondary school education. After this period astronomy became a part of syllabus in physics with one class per week in final year (4th) of secondary education. Only in special schools, which are rare, like Mathematical High School in Belgrade, astronomy still exists as a separate subject in the final form. For more extensive reports about formal astronomical education in Serbia see e.g. Atanacković-Vukmanović, 2006, Atanacković, 2012, 2016, 2018.

The first participation of Serbia in an international astronomical competition for secondary school pupils was in 2002. Professor Jelena Milogradov-Turin learned about

International Astronomy Olympiad and she prepared two pupils (možda dati imena učenika, ipak su oni prvi) from Mathematical grammar school, Belgrade, they went to the Olympiad (Russia, grad????) and won 2 bronze medals! The beginning of national astronomical competitions for secondary school pupils in Serbia comes after 2002 because the participation in an international competition (International Astronomy Olympiad) required selection on the national level. From that time the number of interested pupils has increased and pupils who are not from the capital have been also included. Since astronomy is very insufficiently present in the regular teaching, extra-teaching has had to be organised. All these problems have been solved in the framework of activity of the National Astronomical Olympic Committee (NAOC) of Serbia that was founded in 2004. The present paper deals with the feedback on the line competitions – education, especially on the secondary school level. The primary school level is not neglected because it is very important to start the preparation for competitions as early as possible.

## 2. WHY ARE COMPETITIONS IMPORTANT?

There are several reasons for which competitions are important. For an exceptionally gifted pupil this is a stimulus to learn more in astronomy than it would be possible if only the regular material were followed. Through participating in a competition a gifted pupil can test her/his knowledge level in astronomy. In addition, the current curricula in Serbia generally give a small space to astronomy and a few special schools have astronomy as separate subject (one class per week, IV, final, year). Extra-teaching becomes necessary. It requires both qualified teachers and adequate literature. Since in Serbian schools there are no qualified teachers for astronomy extra-teaching, NAOC has to engage itself in organising extra-teaching. The same is true for the literature. In both cases the situation in, for example, physics is more favourable, there are many qualified teachers and the total number of physicists in Serbia is much higher than the number of astronomers so that there exists a sufficient number of persons capable of writing the proper literature (handbooks, collection of problems with solutions). Astronomical topics are well covered in a rich and high quality literature in other languages (e.g. Russian and English), thus, for the first aid some of that literature can be used in source languages, or, better, to be translated in Serbian especially the literature which is frequently used in astronomy extra-teaching and preparations for national and international competitions. Two such books have been already translated and published in the Serbian language one from English, Vidojević, 2014 and one from Russian, Vidojević, 2017.

NAOC with its entire activity contributes to the spreading of interest of young people in Serbia in astronomy. Once they are informed on existence of extra-teaching, literature and competitions, then their mere interest can result in real acquiring of knowledge. The most successful among them can participate in international competitions where they make personal contacts with young people who have similar interest from all over the world and make connections for their professional future. This is also the most important benefit from the participation in international competitions.

### 2. 1. COMPETITIONS IN THE SCOPE OF NAOC

The founder of the astronomical competitions in Serbia is Jelena Milogradov Turin (1935–2011). Due to her initiative the first participation of the Serbian team in

an international competition was organised in 2002. Soon after her death NAOC introduced a special award named after her for the absolute winner of the National competition in Serbia. Table 1 contains the names of all winners from 2011 till 2017, it is to be noted that all of them are from Mathematical High School in Belgrade. Since 2004 the National Astronomical Olympic Committee (NAOC) has been in charge of training, testing and selection of the national team. Serbia has participated in several International olympiads: IOAA – International Olympiad on Astronomy and Astrophysics (from 2009); Structure of the competition: theoretical part + practical (data analysis + observation) + group competition. IAO – International Astronomy Olympiad (2002 – 2011); Structure: similar to IOAA except group competition. StPb – Saint Petersburg Astronomical Olympiad (from 2013) correspondence type of competition; structure: theoretical part + data analysis part. For detailed reports from various olympiads see e.g. Eskin et al. 2012, Miler, R., 2009, 2011, Ninković & Milić, 2011, 2014, Vidojević & Ninković, 2016.

Table 1: Jelena Milogradov-Turin award, from 2011 till 2017.

Year	Name (year of birth )
2011	Stefan Andjelković (1992)
2012	Luka Bojović (1996) & Ivan Tanasijević (1995)
2013	Ivan Tanasijević (1995)
2014	Ivan Tanasijević (1995)
2015	Vuk Radović (1998)
2016	Vuk Radović (1998)
2017	Igor Medvedev (1999)

Within Serbia the competitions are organised on two levels: regional and national. Regional: only theoretical part (3 questions + 4 tasks). Selection for higher competition level: every participant who achieves 30% of total number of points, or has right of direct participation, if in the previous year a medal at International olympiad was obtained. National: theoretical part (5 tasks) + practical part (data analysis & observations-indoor or outdoor depending on weather) Selection: 5 to 10 best participants become members of the Serbian national team for international competitions. The achievements of the Serbian participants at international competitions during 15 years, 2002 – 2017, are presented in Table 2. For a more detailed report from recent international olympiads , 2014–2017, see Vidojević et al. 2018(1), 2018(2).

During the first few years the participants of the competitions within Serbia were almost exclusively from the Mathematical High School in Belgrade. NAOC endeavoured to also involve pupils from both other Belgrade schools and schools beyond Belgrade. So we have had participants from other schools in Belgrade; also participants from Novi Sad, Bečej (District of South Bačka), Sremska Mitrovica, Stara Pazova (Srem District), Pančevo, Kovačica (District of South Banat), Šabac (Mačva District), Valjevo (Kolubara District), Priboj na Limu (Zlatibor District), Kraljevo (Raška District), Kragujevac (Šumadija District), Jagodina (Pomoravlje District), Požarevac (Braničevo District), Niš (Nišava District), Pirot (Pirot District) and Prokuplje (Toplica District).



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TO THE PRESIDENT OF THE INTERNATIONAL OLYMPIAD  
ON ASTRONOMY AND ASTROPHYSICS

Professor Dr Grzegorz S. Stachowski

Dear Dr Stachowski,

We are deeply honored to be invited to contribute to the hosting and organizing of the 15th International Olympiad on Astronomy and Astrophysics and I would like to thank you for taking into account Serbia's application.

I wish to officially inform you that the Ministry of Education, Science and Technological Development of the Republic of Serbia will participate in organization and hosting of the International Olympiad on Astronomy and Astrophysics in 2021. I wish to assure you and the International Board that we will do our best to contribute in order to make certain that the organization of the competition is in accordance with the highest standards.

In this regard, we would like to assure you in our readiness to organize this event in 2021 in Serbia, and I believe that this will encourage the development of astronomy and astrophysics education in the region. If you require any additional information, please do not hesitate to contact us. We look forward to hear from you.

Please receive my gratitude and consideration and our best wishes, together with the cordial invitation to join the 15th IOAA in Serbia.

Yours respectfully,

Mladen Sarcevic, Minister



Figure 1: Minister's letter to IOAA President.

Table 2: Olympiad achievements. The number of participants (4th column) pertains to senior+junior+automatically qualified (winners from previous Olympiad); the last column (Special prize+Honourable mention).

Year	Olympiad	Country	Participants	Gold	Silver	Bronze	Recognition
2002	IAO	Russia	2 + 0	0	0	2	0 + 0
2004	IAO	Ukraine	2 + 0	0	1	1	0 + 0
2005	IAO	China	2 + 3	0	0	2	0 + 0
2006	IAO	India	2 + 3	2	0	2	1 + 0
2007	IAO	Ukraine	2 + 3 + 2	2	2	3	0 + 0
2008	IAO	Italy	2 + 3 + 3	0	2	3	0 + 0
2009	IOAA	Iran	4	0	3	0	1 + 1
2009	IAO	China	2 + 2	0	0	1	0 + 0
2010	IOAA	China	5	1	2	1	0 + 1
2010	IAO	Ukraine	2 + 3	1	1	2	0 + 0
2011	IOAA	Poland	5	0	2	1	0 + 1
2011	IAO	Kazakhstan	2 + 1 + 2	0	0	3	0 + 0
2012	IOAA	Brazil	3	0	1	1	0 + 1
2013	IOAA	Greece	5	2	1	0	0 + 2
2013	StPb		2	1	0	0	0 + 0
2014	IOAA	Romania	5	1	1	2	0 + 1
2014	StPb		2	0	0	1	0 + 1
2015	IOAA	Indonesia	5	0	1	1	0 + 3
2015	StPb		2	0	1	0	0 + 0
2016	IOAA	India	10	0	2	6	0 + 1
2016	StPb		5	0	2	0	0 + 0
2017	IOAA	Thailand	5	0	0	2	0 + 3
2017	StPb		1	0	0	0	0 + 0
Total				10	22	34	2 + 15

### 3. Astronomy extra-teaching and International Achievements

NAOC established a syllabus for astronomy extra-teaching following the official IOAA syllabus:

- Basic Astrophysics (Celestial Mechanics, Electromagnetic Theory & Quantum Physics, Thermodynamics, Spectroscopy and Atomic Physics, Nuclear Physics);
- Coordinates and Time (Celestial Sphere, Concept of Time);
- Solar System (Sun, Solar System, Space Exploration, Phenomena);
- Stars (Stellar Properties, Stellar Interior and Atmospheres, Evolution);
- Stellar Systems (Binary Star Systems, Exoplanets, Star Clusters, Milky Way, Interstellar Medium, Galaxies, Accretion Processes);

- Cosmology (Elementary Cosmology);
- Instruments and Space Technologies (Multi-wavelength Astronomy).

Interested pupils are divided into 2 groups: experienced contestants and beginners. The introductory course starts from the basics, but covers the entire syllabus. The advanced lectures are focused on deepening the understanding of astrophysical phenomena and applications of mathematics and physics. During a school year lessons are usually held on weekends. The instructors are school teachers and university students, mostly former contestants. The instructors work mostly voluntarily.

Unlike theory and data analysis the extra-teaching in observations requires special conditions because of its complexness: naked eye observations, telescope observations, star charts and planetarium lectures. The observational extra-teaching has been successfully realised due to distinguished NAOC member Branko Simonović.

The extra-teaching involves intensive preparations where the participants selected for the international competition stay together at the same place for up to 7 days. This contributes to the strengthening of the team spirit. Their schedule comprises working on theory, data analysis and blind star charts during day time and observing by night. Such preparations have been regularly carried out in a student resort place on the Avala mountain.

NAOC Observational Equipment. Telescope 1 (Newton type, 200/1000 mm with equatorial mounting EQ5, purchased in 2015); Telescope 2 (Newton type, 150/750 mm with equatorial mounting EQ3) was lent in 2016 by Vuk Radović, distinguished participant, to NAOC to be used for the purpose of extra-teaching only.

#### 4. 15th IOAA 2021 IN SERBIA

In 2010 Serbia was offered by the International Board of IOAA to be the host country for 2021. In 2014 NAOC informed the Ministry of Education, Science and Technological Development about this and very recently an official letter signed by the current Minister, Mr. Šarčević, was addressed to the President of IOAA wherein the Ministry expressed its support to the hosting and organising of the 15th IOAA in 2021 (Fig. 1). The 10th anniversary of death of Jelena Milogradov- Turin, the founder of the astronomical competitions in Serbia, will be properly notated by such an important event.

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