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ASTRONOMY OLYMPIADS IN RUSSIA AND THEIR POSITION IN ASTRONOMY EDUCATION

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Abstract. Astronomy olympiads started to be organised in Russia more than 60 years ago (then it was still USSR). In 1994, on the basis of several regional astronomy olympiads, appeared the All-Russian Astronomy Olympiad (Vserossijskaya astronomicheskaya olimpiada) or ARAO. It has been organised under the auspices of the Ministry of Education and pupils attending higher forms have taken part in it. The main objective of ARAO is to find and support talented pupils.

Leading universities of the country (Russia) have also organised their own astronomy olympiads. In this way there are Astronomy Olympiads of Saint Petersburg, Moscow and Kazan. Among them the largest is that of Saint Petersburg. The main characteristic of these olympiads is that they have also included pupils of younger forms and have prepared their own tasks. The main objective of these olympiads is to find and support future students of astronomy classes at those universities.

All astronomy Olympiads have played an important role in preparing future astronomers.

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1. HISTORY

For the first time an astronomical contest (Olympiad) in the USSR took place as early as in 1947 in Moscow. In this contest several tens of pupils took part. From that time the Moscow Astronomy Olympiad has been held every year. The total number of participants for this contest is within limits of 150-200. The most part of its participants has concerned pupils from Moscow and Moscow Land, and sometimes also the cities and towns closest to Moscow (Kaluga, Tula). Over a very long time this contest was the only astronomy contest in the USSR. Rarely and not regularly such contests were organised in Gorky (now Nizhny Novgorod) and once in Leningrad (now Saint Petersburg). In their present form Astronomy Olympiads appeared already in the new country Russian Federation (RF).

In the spring 1993 in Saint Petersburg the first experimental astronomical city contest took place. Its character was experimental because the organisers did not have experience enough how to organise such a contest. After the contest a decision was made to organise a city contest (Olympiad) in astronomy in the year to come 1994. The preparations started in the autumn 1993. Just then, in the autumn 1993 a document came from the Ministry of Education of the Russian Federation,

which concerned the organisation of the first All-Russian Astronomy Olympiad. Its official name then was "All-Russian Olympiad for Pupils on Astronomy and Space Physics". Space physics was mentioned not accidentally. Astronomy was taught in schools mostly by physics teachers and space physics was mentioned for the purpose of drawing their attention.

The First All-Russian Olympiad on Astronomy and Space Physics was held in the city of Yaroslavl between May 16 and 20 1994;it involved two rounds: theory and creativity.

From the first year afterwards such contests began to be organised in other cities (towns) and regions of RF. For the purpose of participating in an All-Russian Olympiad it was necessary to carry out selection contests, as well as to find and train pupils for the final contest of the Olympiad. In 1995 local astronomy olympiads started in the city of Ryazan and Leningrad ; in 1998 in the Moscow Land, in 1999 in Tula, so that such contests began to be organised in about 30 regions and cities. The tasks and problems were due either to the local jury members or recommendations of the Ministry of Education were followed. There were no strict rules concerning the problems.

The title "All-Russian Olympiad for Pupils on Astronomy and Space Physics" had persisted by 2006; in that year the contest got its present title of All-Russian Astronomy Olympiad. At the same time the style and type of problems proposed were slightly changed. From that time the All-Russian Olympiad has been held every year in spring, as a rule in early April.

At the same time, in 2006, following the reforms of the Ministry of Education almost all local astronomy contests (regions, cities) ceased to exist. The local contests were replaced by the regional phase of the All-Russian Olympiad (not only astronomy, but other subjects as well). This phase was carried out strictly with the same problems which were sent from one centre the Central Methodics Commission. The works of the participants were checked following the same rules for the whole country.

Only two cities Saint Petersburg and Moscow have preserved their own Astronomy Olympiads. They are organised independently of the All-Russian Olympiad so that they appear as independent contests.

In 2009 new contests appeared; they are organised not by the Ministry of Education, but by universities or scientific institutes and academies. The list of such contests is stipulated every year anew. The Saint-Petersburg Astronomy Olympiad has been three years in succession the only astronomy contest from this list. In 2011 the Moscow Olympiad on Astronomy and Space Physics joined it.

2. STRUCTURE

The All-Russian Astronomy Olympiad is carried out following the rules adopted for all contests concerning RF as a whole (there are 23 such contests). Such a contest has four levels: first selection (school level), municipal (within a city), regional and the final one, also known as All-Russian. The participants are pupils of higher forms of secondary school (age 15-18).

The problems for the former two levels are made locally, in the case of the higher ones this belongs to the Central Commission in Moscow. Among the members of this Commission are representatives of leading universities of RF, such as Moscow University, that of Saint Petersburg, Institute of Space Research, Institute of Physics

of Academy of Sciences, etc. Pupils successful enough at the regional level are invited to take part in the final one. The number of participants at the final phase is about 150.

The jury members are both university teachers and those teaching at a secondary school. Representatives of the host region are always present in the jury of the final phase. They come from observatories and institutes, from universities, or are secondary-school teachers.

3. RULES OF ORGANISATION

The final phase of the All-Russian Olympiad consists of two rounds theoretical and practical. In the framework of the former one the participants have six problems to solve within five hours. In the framework of the practical round the participants have two or three tasks, also to solve within five hours. In order to remove mistakes the checking procedure for every problem (task) is independently done by two jury members. The maximum number of points which a jury member can give for one problem (task) is eight. However, if a solution appears to be better than the official one (presented by the author), the participant can be awarded with an extrapoint. If a solution is evaluated as "that of a genius", then the addition contains two points. There have been such cases.

The checking procedure, first of all, does not consist of controlling the mere coincidence between the solution of a participant and the official one, but involves the evaluation of its qualities, such as: originality degree, non-standard approach, understanding of the basic idea of the problem, etc. Errors in the arithmetics or "printing errors in arithmetics" do contribute to a reduction in the final number of points, but not strongly. An incorrect answer also results in a reduction of points, but in different ways. A simple error has no serious consequences, but an answer contradicting the laws of nature (for instance, mass of Earth equal to 5 g, speed of a body 100 times as large as that of light, lifetime of the Sun 3 s and the like) results in a substantial diminishing of the number of points.

During the final phase, which gathers pupils from many regions of RF (in the last years the number of regions approached 40), there are lectures covering various topics of modern astronomy for the participants and their teachers jury members. Such an event is not a contest only, but also contact among pupils and their contact with the jury members, as well as contact between the teachers coming from different parts of the country and the jury members. During such a contest the teachers can exchange their experience, they talk one to another, exchange the problems of the preceding levels, composed by themselves. Among team leaders we have secondary-school teachers, people engaged at planetaria, university teachers, sometimes administrative representatives of education organs.

According to their results pupils get diplomas and medals. The maximum number of diplomas is regulated by the Ministry of Education. The jurys duty is to decide who gets a diploma and the kind of this diploma. For this purpose a general rating of the participants following age groups is formed (3 groups following the 9th, 10th and 11th forms) and for each group the number and category of diplomas is determined victorious contestant or prize winner.

According to the Law of Education of RF victorious contestants and prize winners at the final phase of an All-Russian Olympiad are allowed to enroll any university

in RF without examination in the field of the contest. Victorious contestants of Astronomy Olympiad are allowed to enroll many engineering specialties, faculties of physics and specialty of astronomy.

4. CHARACTERISTICS OF VARIOUS OLYMPIADS

The organisation of contests supported by the Council of Rectors of RF is somewhat different from that concerning All-Russian Olympiad for pupils. As a rule, they contain only two levels selection and final ones. The Saint Petersburg and Moscow Astronomy Olympiads are also organised in two levels.

These contests are organised not only for pupils of higher forms, but also involve those of lower forms with the fifth form as the lowest one. The corresponding age of pupils is at least 11 years.

Both contests are characterised by use of their own tasks (problems) for which jury members are the authors; among them 80-90% are original problems, never used before.

The Saint-Petersburg Astronomy Olympiad has also additional constraints. The use of electron calculators is forbidden. Some problems are made in a way that the only possibility to obtain the solution is if one can grasp the method of calculation. Examples are when a problem involves trigonometric functions, logarithms and the like. Also, the participants are not informed on any particular knowledge concerning the contents of problems. It is assumed that the values of the fundamental constants of physics, such as gravitation constant, Planck one, Boltzmann one, etc, should be known to the participants. In the same way the participants are also not informed on the general astronomical data, for instance, the size of the Solar System, the distances to the planets, the masses of planets, Sun and Moon, the distances to the nearest stars, etc. It is assumed that participants who have already passed the selection phase should be informed on the fundaments of astronomy, physics and mathematics.

Such constraints are introduced for a very simple reason. For those participants who have finished secondary school, the Olympiad is also the entrance examination for the astronomy group of the Saint-Petersburg University. Therefore, not only the ability of solving problems is verified, but also the general level of knowledge possessed by the participants, which concerns the subject itself, as well as physical and mathematical problems.

5. EXAMPLES OF TASKS

Below one finds some examples of problems to be solved during the lower levels (city, town region):

- If the angular path length on the sky for a meteor is equal to 30 degrees, estimate its velocity; it is also known that the meteor burnt at the zenith at an altitude of 100 km above the surface of the Earth and the time corresponding to its path length is 1 second.

- On a distant inhabited planet the heat conditions are analogous to the terrestrial ones, but the angular diameter of the local sun is twice as small as ours. Find the temperature of that distant star.

- The astronomical azimuth of a setting star on a latitude of +60 is equal to 20. What are the minimum distance and the direction for the movement aimed at seeing this star during the next day at the zenith?

Now the problems for the highest level of the All-Russian Astronomy Olympiad:

- At the North Pole of Mercury a horizontal sundial is mounted. What are the limits within which the angular velocity (degrees per terrestrial day) of the shadow of the style will be varied? Can such a sundial yield a reliable information about time? Mercurys revolution around the Sun takes place along an elliptical orbit of 0.205 eccentricity and lasts 88 days. The duration of Mercurys rotation is equal to 2/3 of the orbital period and has the same sense. The equatorial plane of the planet coincides with that of the orbit, the planet relief is not of importance.

- A pulsating variable star changes its characteristics so that the ratio of the heat velocity to the escape one for the matter on the stellar surface remains constant. Find the relation for the star size at the maximum and minimum of its brightness if the amplitude of the change in the apparent magnitude is equal to unity. The surface matter is not ionised and is in the state of thermodynamical equilibrium (tenth form).

- Which of the inner planets is closest to the Earth over a sufficiently long time? The planet orbits are circular in the same plane.

Examples of problems from the Saint-Petersburg Astronomy Olympiad:

- How far in the future could see the ancient Greeks admiring the night sky?

- Why are short-period eclipsing variables are more frequent than long-period ones?

- Bearing in mind the appearance of the tail of Great Bear estimate the distance to the tail stars.

6. RESULTS

The main task of astronomical contests is the search for and further training of talented pupils interested in astronomy, as well as the development and support of the interest in astronomy of pupils. In general this task has been successfully provided. Every year we have new contestants with good results. Afterwards these pupils are invited to become members of circles aimed at achieving a more profound study of astronomy and training for contests. Some of these young people keep their interest in astronomy and take part in the contests till the end of their school period. In most cases after secondary school they become students at faculties of physics or in astronomy groups of universities.

For the purpose of training pupils for contests there is a whole network of circles, special groups in schools, short-term schools (summer, winter, autumn, etc) where the pupils learn not only how to solve problems, but also prepare themselves for universities.

Astronomy contests appear as a very important part of the professional education in astronomy they provide future students. For instance, at the Saint-Petersburg University the fraction of students, who took part in such contests, is 50%. Almost 70% of the post-graduate students also took part in a contest. In this way participants of astronomy contests provide such universities with students and, consequently, to a large extent, make it possible to preserve the professional astronomical education.

7. INTERNATIONAL OLYMPIADS

As a continuation of participating in the All-Russian Astronomy Olympiad we have the participation in an international contest. There are several international contests: International Astronomy Olympiad (IAO) and International Olympiad on Astronomy

and Astrophysics (IOAA), as well as a few regional ones Asian-Pacific Astronomy Olympiad (APAO), Latin American Olympiad (Olimpada Latinoamericana de Astronoma y Astronutica) and so on.

The participation in these contests requires the contestants to be trained additionally. This is due to the circumstance that problems and tasks, as well as the way of checking, at these contests are different from the procedure usual in RF. The checking at an international contest is, as a rule, much more formal than in RF, even the problems and tasks are more formal. Therefore, the work of a contestant has to follow some rules. The contests in RF are characterised by less attention to the formalism for both procedure and solution. It seems that a converse rule holds: the less standard a solution is the better is the mark!

Our concluding remark is that contests in astronomy play an important role in the training process for future professional astronomers. They also stimulate the creativity of schoolgirls/boys, their ways towards looking for non-standard solutions and simply result in becoming fond of astronomy.

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