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"People. Stars. Life"

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The paper is devoted to the memory of Professor M.A. Svechnikov – founder of Ural school of Close Binary Systems. This lecture is an introduction to the scientific program of the seminar dedicated to the eightieth anniversary of Svechnikov's birth.

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1 Seminar on "Fundamental questions of the research and classification of Close Binary Systems in HIPPARCOS and GAIA epoch"

The 28th January 2013 marked the eightieth anniversary of Svechnikov's birth and was celebrated at the workshop on Close Binary Systems (CBS) that took place in Kourovskaya Astronomical Observatory in the framework of traditional 42nd International Student Conference "Physics of Space" on the base of Ural Federal University. The Ministry of Education and Science of Russian Federation, Astronomy and Geodesy Department, and Kourovskaya Astronomical Observatory named after K.A. Barkhatova were the organizers of this event.

International Student Conference "Physics of Space" is held by tradition in winter student vacation on January, 28 to February, 1 2013. The last day of the conference was devoted to associative scientific seminar on classification problems of CBS.

The team of Ural Scientists formed the Organizing Commettee of the seminar: P.E. Zakharova (chairman, Astronomical Observatory of Ural Federal University), G.N. Dryomova (Russian Federal Nuclear Centre, Snezhinsk), E.A. Avvakumova (Astronomical Observatory of Ural Federal University), S.Yu. Gorda (Astronomical Observatory of Ural Federal University), E.D. Kuznetsov (Ural Federal University), T.S. Polushina (Astronomical Observatory of Ural Federal University), E.I. Staritsin (Astronomical Observatory of Ural Federal University).

The title of the seminar is "Fundamental questions of the research and classification of Close Binary Systems in HIPPARCOS and GAIA epoch".

Many works in the field of space physics are addressed to CBS. These objects serve as basic informational source about fundamental stellar characteristics as masses,

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radii, luminosities as well as about density distribution in the stellar interior – an information that cannot be obtained from observations of single stars. Namely the duplicity allows us to test internal structure theory.

So as up to date numerical models are still not capable of reconstructing all multiformity of observable properties of CBS the statistical approaches are extremely effective here. Duplicity effect may mask properties, processes, and phenomena well known from the study of single stars. Thus the first priority problem is the statistical analysis allowing us to systemize objects generalizing their photometric and spectroscopic data as well as physical and geometric properties. One or another set of criteria for data systematization generates different classification schemes sorting out all known CBS into classes. The guarantee of correctly selected criteria of classification scheme is its efficiency on large-scale statistics and ability to account for evolutionary status.

Another important feedback of statistical research is the method of population synthesis the main goal of which is to establish a link between different evolutionary stages in chronological order. One of the variants of population synthesis is reduced to direct simulation of CBS evolution in the framework of the scenario approach. Each of the scenario models can accurately reproduce the real observed properties of a particular type of star and predict its final evolutionary stages. An ensemble of such scenario models forms synthetic stellar population allowing us to interpret the behavior and features of real stars. Another approach used in the conception of population synthesis is based on the statistical analysis of stellar properties variation between CBS classes including estimations of true population of stars of a given class and their lifetime. From these estimations one may conclude about the presence of genetic relationship between considered stellar classes.

Exponential growth of observation data and the improvement of their quality favor the new conception of star catalogues, the compilation of which calls for theoretical results of the numerical simulations. The successfully accomplished Hipparcos project and the preparation of the launch of new space astrometry mission GAIA of the ESA in 2013 show that it is impossible to comprehend the expected data volume without automated principles of the classification based on methods of mathematical statistics.

The most famous discoveries made by statistical methods are Hertzsprung–Russel diagram (1910) recognized as the first rank instrument for evolutionary diagnostics of stars, and accelerated expansion of the Universe supported by vacuum energy. The last discovery was made literally at the "tip of a pen", as soon as sufficient statistics on distant SNIa was gathered. These intriguing objects generating most vigorous explosions in the Universe are also Close Binary Systems.

The seminar concerns the following scientific topics:

1. Fundamental problems of CBS formation and evolution;
2. Criteria of modern classification for CBS;
3. The role of statistical astronomy methods in GAIA mission epoch.

This seminar was supported by Ural Federal University and Dmitry Zimin nonprofit Dynasty Foundation.

Selected contributions to the seminar include:

1. Review lectures prepared by reputed specialists in the field of CBS;
2. Review lectures prepared by leading authorities in the simulation of photometric and spectroscopic phenomena in CBS;

3. Review lectures prepared by experts dealing with the statistical astronomy and the methods of data systematization to handle large information volumes for further usage;
4. Reports by young scientists taking an active part in CBS research;
5. Final discussion devoted to basic modern problems in CBS study.

2 Brief biography of Mariy Anatolievich Svechnikov

2.1 Leningrad period

The 28th January 2013 marked the eightieth anniversary of Svechnikov's birth and was celebrated at the workshop on CBS that took place in Kourovskaya Astronomical Observatory in the framework of traditional International Student Conference "Physics of Space" on the base of Ural Federal University. The University became home for Mariy Anatolievich beginning from 1964 and for many years.

At that time he was already a scholar with a lot of experience of scientific work under his belt. In 1954 he graduated from the Astronomical Division of Mathematics & Mechanics Department of Leningrad State University named after A.A. Zhdanov and straightaway matriculated as post-graduate student to Professor V.A. Dombrovskiy, who was among the first to explore interstellar polarization of the radiation of stars and nebulas. Svechnikov's research then concerned the study of some eclipsing variable stars the observations of which he carried out at Almaty Observatory. Two years later after completion of the post-graduate course, in 1959 he defended his PhD thesis on the topic "Spectroscopic research of eclipsing variable stars".

Svechnikov made the first unsupervised steps in science at Pulkovo State Observatory combining his observations of eclipsing binaries with teaching activities in Leningrad at Education University named after A.I. Herzen. Later these practices helped Svechnikov to acquire the unsurpassed craftsmanship of a lecturer and to become a talented teacher for students of many generations. During the Leningrad period Mariy Anatolievich took part in the building of South Observational Station of Astronomical Observatory of Leningrad State University. This project was realized on the territory of Buracan Astrophysical Observatory and included the telescope and dome mounting as well as optics testing.

Then his scientific life turned to the Ural. Nobody knows why, apart from the metropolis, this period of his life proved to be the most fruitful and successful. Namely in the Ural Mariy Anatolievich made his life, met like-minded people, created the close binary stars school, and found friends and family. Now one dreads to think if it would not be so. Born in a family of physicians he set his sights on a medical career.

His father, from a Cossack family background, Anatoly Savvich Svechnikov was military doctor, candidate of medical sciences who returned from the battlefields of the Second World War in the rank of lieutenant colonel. His mother, Esther Lvovna Svechnikova, the daughter of the doctor was a microbiologist, candidate of medical sciences. During the evacuation from Odessa under bombing raids Mariy Svechnikov was injured and this injury later affected and compromised his health. The war forced him to change his childhood dream. One night when he was deep in thoughts about it the stars themselves prompted the solution.

All his life Mariy Anatolievich (1933–2011) gave to the stars and to students and his work resulted in the initiation of Ural school of CBS and the formulation of general classification for eclipsing binaries being in the phase of first mass exchange.

2.2 Ural period

The Ural period of his life began in 1964 when Mariy Anatolievich came to Ural State University named after A.M. Gorky (USU) at Astronomy and Geodesy Department. His optimistic and cheerful character, his openness for everyone were immediately acknowledged by his colleagues. As a true native of Odessa, Mariy Svechnikov possessed an excellent sense of humor and an inexhaustible store of original stories which made an unforgettable impression on an audience. Not only students but also colleagues were surprised by his great erudition and mental outlook. People say that he was a collector of books but this saying is too formal. One ought to see his home library. We could also say many fascinating things about his other interests including expeditions for Ural minerals, snorkeling, harpooning, painting, mountain hiking, foreign languages, and many others.

Over a period of the work in USU (1964–2009) he prepared and then for a long time delivered courses of lectures including "Theoretical Astrophysics", "Complementary Chapters of Theoretical Astrophysics", "Variable Stars", "General Astrophysics", "General Astronomy" (for physicists), "Theory of dimension and conformity", "Physics and evolution of stars" (for students of Mathematics Department), "Cosmic Physics" (for physicists), and "Problems of Modern Astrophysics", "Physiography and geophysics in natural history" for students of teacher's training institute.

They were rather serious lectures skillfully interweaving the newest data not entered into textbooks and catalogues yet with basic knowledge and mathematical traditions founded by Delil, Gauss, Struve, when great importance was attached to mathematical culture and the capability to routine derivations of formulas.

2.3 Algerian period

Mariy Anatolievich always tried to be in situations and places where labor conditions were difficult and uncomfortable and the work procedures were not yet established. An academic mission in Algeria just reflected this situation. During the mission (from December 1972 to March 1976) Svechnikov restored the Algerian Observatory and trained the scientific staff there. He delivered two lecture courses in French – "Practical Astronomy" and "Theoretical Astrophysics".

In Algeria he was far away from progressive science and he spent all his free time thinking about CBS classification. While he was in Algeria he invented the criteria of future classification of eclipsing variables stars that proved to be so simple and obvious that the classification won general recognition very soon.

2.4 About his classification

This classification unified merits of Kopal's classification that takes into account geometrical characteristics of CBS with respect to the degree of inner Roche lobe filling

and Krat's classification based only on physical properties of CBS components that follow from the position of the components in Hertzsprung–Russel diagram. His classification proved to be naturally connected with evolutionary stages of eclipsing variables defined by ages, initial masses and radii of components. Later the classification was adopted as a standard for eclipsing variable stars compiled in General Catalogue of Variable Stars, fourth edition.

Along with his associates from USU Svechnikov specified different fundamental statistical dependences connecting mass with luminosity or spectrum as well as with radius and with other stellar parameters of CBS components belonging to Main Sequence or being in a subgiant status.

Basic results on the classification and statistics of Close Binary Systems were successfully defended as Doctoral Dissertation in 1984 at State Astronomical Institute named after P.K. Sternberg in Moscow.

2.5 Interuniversity collaboration

Svechnikov paid special attention to interuniversity collaboration and he was in close scientific cooperation with Saint-Petersburg State University, Odessa National University named after I.I. Mechnikov, Chelyabinsk State University, Karaganda Educational University, Chita Educational University and also with the series of observatories such as Pulkovo Observatory of Russian Academy of Sciences, Crimean Astrophysical Observatory of Ukrainian National Academy of Sciences as well as with the Estonian Academy of Sciences and Uzbek Academy of Sciences.

2.6 Chelyabinsk period

Since 1979, over a period of almost twenty years Mariy Anatolievich combined his work in Ural State University with that in Chelyabinsk State University at Theoretical Physics Division of Physics Department, where he prepared and delivered courses of lectures "General astrophysics", "Thermodynamics", "Theory of dimension and conformity","Stellar atmosphere and photosphere theory" .

In Chelyabinsk Svechnikov headed the scientific direction on the topic of statistical research of Close Binary Systems with an emphasis on individual probability of CBS discovery as eclipsing variable star taking into account the evolutionary class of CBS (1984–1995). Under his leadership the unique method for the estimation of spatial density of different classes of CBS stars in close solar neighborhood was developed (1987–1993). These data supplemented by the information about ages of CBS allowed us to evaluate modern and initial mass functions independently that is of great interest for star formation history in our Galaxy. The method constructed on principles of statistics is invaluable today in expectation of new data volumes, when only paging of electronic catalogue would take several months.

3 Svechnikov's catalogues of Close Binary Systems

Working on the classification of Close Binary Stars Professor Svechnikov founded a school that united round him many pupils, followers, continuers of his ideas. Mariy

Svechnikov repeated often "a good regular paper lives on average one or two decades but catalogues live on through the ages".

Below is the list of CBS's catalogues compiled by Svechnikov and his followers:

Svechnikov M.A., Catalogue of orbital elements, masses and luminosities of Close Binary Stars, 1969, Sverdlovsk, Scientific Notes, No 88, Astronomy series, issue 5, 179 pp.

Svechnikov M.A., Bessonova L.A., Catalogue of orbital elements, masses and luminosities of close double stars, 1984, Bull. Inform Centre Donnees Stellaires, Strasbourg, No 26, pp. 99–101

Svechnikov M.A., Catalogue of orbital elements, masses and luminosities of Close Binary Stars, 1986, Irkutsk, Publishing House of Irkutsk State University, 226 pp.

Svechnikov M.A., Kuznetsova E.F., Approximate photometric and absolute elements of Eclipsing Variable Stars, 1990, Sverdlovsk, Publishing House of Ural State University, vol. 1, 2

Svechnikov M.A., Perevozkina E.L., Catalogue of orbital elements, masses and luminosities of Eclipsing Variable Stars of DMS type with known photometric and spectroscopic elements, 1999, Yekaterinburg, Publishing House of Ural State University, pp. 5–30

Svechnikov M.A., Perevozkina E.L., Catalogue of orbital elements, masses and luminosities of Eclipsing Variable Stars of DMS type with known elements of photometric orbit and unknown spectroscopic elements, 1999, Yekaterinburg, Publishing House of Ural State University, pp. 122–132

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