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**Astronomy in Ukraine: Overview of the situation  
and strategic planning for 2004—2011**

*Short overview of the current state of astronomical research in Ukraine is presented. Scientific and investment priorities of Ukrainian astronomy for 2004—2011 are outlined.*

*АСТРОНОМІЯ В УКРАЇНІ: ОГЛЯД СТАНУ ТА СТРАТЕГІЧНЕ ПЛАНУВАННЯ НА 2004—2011 рр., Яцків Я. С., Вавілова І. Б. — Подано короткий огляд сучасного стану астрономічних досліджень в Україні. Окреслено наукові та інвестиційні пріоритети української астрономії на 2004—2011 рр.*

*АСТРОНОМИЯ В УКРАИНЕ: ОБЗОР СОСТОЯНИЯ И СТРАТЕГИЧЕСКОЕ ПЛАНИРОВАНИЕ НА 2004—2011 гг., Яцкив Я. С., Вавилова И. Б. — Представлен краткий обзор современного состояния астрономических исследований в Украине. Очерчены научные и инвестиционные приоритеты украинской астрономии на 2004—2011 гг.*

**ASTRONOMY IN UKRAINE: OVERVIEW OF THE SITUATION**

Taking into account the quantitative factors, i.e. number of astronomers per population and number of astronomical institutions, we could consider Ukraine a large astronomical country in Europe. In total, more than twenty astronomical observatories and departments at various scientific institutions and universities are engaged in astronomical research. Among them there are well-known astronomical institutions: Main Astronomical Observatory (MAO) and Institute of Radio Astronomy (IRA) of the National Academy of Sciences (NAS) of Ukraine as well as the Scientific Research Institute «Crimean Astrophysical observatory» (CrAO) of the Ministry of Education and Science (MES) of Ukraine.

As to the qualitative factors, i. e. number of publications in world recognized journals, citation index etc., the situation is not so clear. On the one hand, we would like to mention the world recognized astronomical scientific achievements by G. Shain (stellar physics), N. Barabashov (planetary astronomy), A. Severnyj (solar physics), V. Tsesevich (variable stars), S. Vsekh-svyatsky (cometary's astronomy), E. Fedorov (fundamental astronomy), S. Braude (decimeter radio astronomy) and their followers. On the other hand, the overall level of astronomical research in Ukraine still has to be increased. As a positive factor of recent years, we can point out a significant integration

of Ukrainian astronomers into the world astronomical community in those research fields where the state-of-art infrastructure has to be used.

Moreover, astronomy in Ukraine is now facing a difficult time due to economic limitations of the nation and the need for up-grading the existing astronomical infrastructure. Since 1992 Ukraine is on the way to social democracy and de-centralized (market-based) economy. Science and, in particular, astronomy has to also adopt a model that would match the emerging market based economy. During recent years Ukrainian science has experienced complicated processes of institutional and structural changes in the state-administrated scientific systems formed at Soviet times.

The basics of science reforms in Ukraine are the following:

- 2-3 fold quantitative reduction of science, so as to fit science into the economic capabilities of the nation consistent with the severe economic crisis and demilitarization;
- Formation of a legal basis, including protection of intellectual rights, appropriate coordinating mechanism and a budgeting system for effective governing of the Scientific & Technological sphere;
- Equal access to information and other resources for the wide scientific community;
- Abandoning «full coverage» of the R&D fields and specifying science and engineering development priorities;
- Radical improvement of the resources management;
- Openness principle of science in Ukraine and wide international cooperation.

In a way, such a large-scale transformation from an administrative system of science to a market-based one would be performed for the first time in the history of science. Due to conservative traditions of the soviet type institutional system, economic crisis and a lack of skilled personnel, the establishment of a new scientific system in Ukraine under the conditions of transition to a market economy and democratic principles of government has proceeded slowly. This resulted in a slow transformation of the system of astronomical research in Ukraine.

Since 1991 the Ukrainian Astronomical Association (UAA) coordinates the astronomical activity in Ukraine. The UAA consists of 15 Institutional Members and dozens of Individual Members. It also has three Affiliated Societies, namely the Odesa Astronomical Society, the Ukrainian Society for Gravity, Relativistic Astrophysics and Cosmology, the Kyiv Planetarium. A total UAA membership is about of 1500 persons. The UAA serves as the National Committee of astronomers in Ukraine.

Table 1 summarizes information on staff members and main scientific research fields of the largest UAA Institutional Members, which are mainly situated in Kyiv, Kharkiv, L'viv, Mykolaiv, Odesa, and the Crimea.

Table 2 contains of information on the largest astronomical facilities of Ukraine. It is worth to note that Ukraine possesses the largest radio decameter array, two medium-size (2-m and 2.6-m) and a dozens of small-size optical telescopes (up to 1m), as well as several specialized solar and other telescopes.

The Main Astronomical Observatory of the NAS of Ukraine, the Mykolaiv Astronomical Observatory of the MES of Ukraine, and Astronomical Observatory of the I. I. Mechnikov Odesa National Institute have also initiated the programs to store the unique collection of astronegatives obtained during the last decades of the XX century. In particular, the «Sky Patrol» photograph library of the Astronomical Observatory of the I. I. Mechnikov Odesa National University (about of 100,000 negatives) is the largest wide sky field survey of variable stars in the former USSR, and is the third such a collection of astronegatives in the world.

**Table 1. Staff membership and main scientific research fields of the astronomical institutions in Ukraine**

Institution	Total staff membership	Scientific staff membership	Cand. Sci. and Dr. Sci	Research Fields
Main Astronomical Observatory of the NAS of Ukraine	213	90	69	Space Geodynamics; Positional Astronomy; Solar System Small Bodies; Solar Physics; Physics of Stars; Extragalactic Astronomy
Scientific research Institute «Crimean Astrophysical Observatory» of the MES of Ukraine	358	92	58	Solar System Small Bodies; Solar Physics and Solar Activity; Physics of Stars; Extragalactic Astronomy; Gamma-Astronomy; Radio Astronomy: Centimeter and Millimeter Wavelengths; Ground-Based and Space-Born Instrumentation
Institute of Radio Astronomy of the NAS of Ukraine	306	102	88	Radio Astronomy: Decameter and Millimeter Wavelengths; Instrumentation
Astronomical Observatory of the Taras Shevchenko Kyiv National University	64	35	26	Astrometry; Solar Physics and Solar Activity; Solar System Small Bodies; Extragalactic Astronomy; Cosmology and General Relativity
Astronomical Observatory of the Ivan Franko L'viv National University	28	16	12	Satellite Geodesy; Solar Physics and Solar Activity; Extragalactic Astronomy; Cosmology
Scientific Research Institute «Astronomical Observatory» of the I. I. Mechnikov Odesa National University	75	65	26	Physics of the Solar System Small Bodies; Variable Stars; Physics of Stars
Institute of Astronomy of the V.N.Karazin Kharkiv National University	83	43	20	Solar System Small Bodies; Solar Activity; Physics of Stars; Ground-based Instrumentation
Mykolaiv Astronomical Observatory of the MES of Ukraine	75	19	10	Positional astronomy; Ground-based Instrumentation

**Table 2. The largest astronomical facilities of Ukraine**

Institution	Facilities
Main Astronomical Observatory of the NAS of Ukraine	Meridian axial circle, Twin astrograph (0.4 m), AZT-2 (0.7 m), Horizontal Solar Telescope, SLR, GPS
Crimean Astrophysical Observatory of the MES of Ukraine	ZTSh (2.6 m), AZT-11 (1.25-m), AZT (0.5-m), AZT-8 (0.7-m), AZT (1.0-m), RT-22 (22 m), GT-48 (54 m <sup>2</sup> ), Solar Tower Telescope, MTM-500
Institute of Radio Astronomy of the NAS of Ukraine	UTR-2 (operating range 8—40 MHz, effective area 152 000 sq. m), URAN-Network (operating wave range 10—30 MHz)
Astronomical Observatory of the Taras Shevchenko Kyiv National University	AZT-3, Horizontal Solar Telescope
International Center for Astronomical and Medical-Ecological Research	2-m telescope, 1-m Solar Telescope
Astronomical Observatory of the I. I. Mechnikov Odesa National University	1-m, two 0.8-m, 0.6-m, two 0.5-m telescopes
Institute of Astronomy of V. N. Karazin Kharkiv National University	AZT-8 (0.7-m)
Mykolaiv Astronomical Observatory of the MES of Ukraine	Axial Meridian Circle, Multi-Channel Telescope, GPS

## STRATEGIC PLANNING FOR 2004—2011

**Scientific priorities.** In 1997 at the IV-th UAA General Meeting a special group chaired by Prof. R. Gershberg was formed for elaborating scientific priorities of astronomy in Ukraine. A questionnaire has been sent to astronomical institutions with a request to address the current state and prospects of astronomical research as well as to specify the scientific priorities for astronomy in Ukraine as a whole. The contents of documents prepared by observatories differed considerably both in depth of analysis and breadth of resulting recommendations. Nevertheless, there was a general opinion that support has to be given to those research fields, in which Ukrainian astronomers have achieved world recognized results [1].

Following the request of the European Astronomical Society (EAS) for strategic planning of European astronomy, we have reviewed these proposals. Though it is a very difficult task to compose a realistic planning document taking into account the economical situation in Ukraine, we specified scientific and investment priorities for Ukrainian astronomy.

Scientific priorities of Ukrainian astronomy are as follows:

- Physics and kinematics of Solar system small bodies.
- Global characteristics of the Sun and Sun-like-stars.
- Solar-planetary interactions.
- Formation and evolution of stars.
- Formation and evolution of galaxies.
- Observational and theoretical cosmology.
- Ground-based support of space missions.

The understanding of astronomical phenomenon requires high-quality data in all the frequency windows. The activity of Ukrainian astronomical institutions is concentrated on ground-based observations in optical, cm- and decimeter wavelengths of the electromagnetic spectrum. Space mission data from widely separated wavebands are also used. As examples we mention the following recent achievements of Ukrainian astronomy:

- the largest decimeter survey of extragalactic sources and discovery of carbon emission lines by means of UTR-2;
- the detailed study of solar 5'-oscillations using the DIFOS telescope on-board the CORONAS-F satellite;
- study of the helium-lithium-oxygen abundance; the discovery and study of new low surface brightness dwarfs in the Local Volume of the Universe; the discovery and study of unique blue dwarf galaxies in the Universe. These researches have been conducted by using space telescopes, telescopes of the former USSR, and large telescopes in the European countries (France, Spain) and the USA;
- discovery of negative polarization of radiation from Solar-system bodies.

**Investment priorities.** It is useful to distinguish short-term and medium-term investment priorities in Ukrainian astronomy.

*Short-term investment priorities.* The main attention will be paid to the upgrade of some astronomical facilities, which are part of international networks or are involved in conducting international program. In particular,

- RT-22 radio telescope of the Crimean Astrophysical Observatory has to be equipped with the new MARK4 or MARK5 recording systems and new hydrogen frequency standard;
- R&D has to be finished for up-grading UTR-2 decimeter telescope of the Institute of Radio Astronomy of the NAS of Ukraine and a new type of decimeter antenna has to be tested. Following the decision of the NAS of Ukraine this work has to be done in 3 years. In the future Ukraine would like to be involved in the SKA project;

— Optical 2.6-m telescope of the Crimean astrophysical observatory has to be equipped with the same echelle-grating spectrometer as the 2-m telescope at the high altitude observatory at Terskol Peak (North Caucasus, Russia) and with a multicolor photometer-polarimeter;

— Optical telescopes, which are used for observations of Solar system small bodies, stars, and NEO objects, have to be equipped with new CCD-cameras and computer control systems.

Investments will be also allocated for establishing ground-based networks of small-size and medium-size optical telescopes, which are or will be involved in international monitoring projects for studying:

- Gravitational microlensing;
- Ultra-rapid variability of stellar brightness and polarization;
- Multi-wave monitoring of red dwarf flare stars and cataclysmic variable stars;
- Magnetic activity of Sun and solar-like stars;
- Pulsating stars as the single objects vs components of multiple systems.

*Medium-term investment priorities.* As to the medium-term priorities, the attention will be paid to participation of Ukrainian astronomical institutions in space missions: Spectrum-RadioAstron (2006), Spectrum-UV (WSO), and preparation of the special, so-called Solar-Oriented Telescope (SOT) in frame of the International Living with a Star Program, Rosetta (2004).

*A special attention will be paid to the development of the Ukrainian Virtual Observatory as a part of the International Virtual Observatory Alliance.*

At the moment new large ground-based astronomical facilities are not yet foreseen in Ukraine. The main goal of Ukrainian astronomy will be an active participation in the development and use of the large infrastructures of European astronomy. However, this can be achieved only if Ukrainian astronomy receives a considerable support on the governmental level.

## CONCLUSION

The EAS initiative for preparing a strategic plan for the development of astronomy in Europe [2] is very timely and worthwhile. The Ukrainian Astronomical Association will do its best to provide input to this planning document taking into account the discussion, which was organized during the VI-th UAA General Meeting (October 8, 2003, Kyiv).

This paper was also discussed at the EAS General Meeting in Budapest (August, 2003), at the III All-Ukrainian Conference on Perspective Space Research in Katsiveli [3] (September, 2003), at the NATO Advanced Study Institute in Yalta (September, 2003).

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1. Gershberg R. E. Report of the Initiative Commission for Strategic Development of Astronomy in Ukraine. // Inform. Bull. of the Ukrainian Astronomical Association.—1998.—N 16—P. 57—66 (in Ukrainian).
2. Investment Priorities in European Astronomy: An Overview of national planning documents // EAS Report distributed at the JENAM-2003.—17 p.
3. *Yatskiv Ya. S., Vavilova I. B.* Strategic priorities of development of ground-based and space research of the Universe: European initiative // Publ. of the III-rd Ukrainian conference on perspective space research. — K.: ISR NASU, 2003.—P. 18.