



Integrating and strengthening the European Research Area

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Table of contents

Introduction	1
Part A	
Conditions for research	3
Publication data analysis	7
Concluding remarks	10
Part B	
Bulgaria	13
Croatia	16
Czech Republic	18
Estonia	20
The Former Yugoslav Republic of Macedonia	22
Hungary	24
Latvia	26
Lithuania	28
Poland	30
Romania	33
Serbia	36
Slovakia	39
Ukraine	41
Appendix List of abbreviations	49

Introduction

This report concerns research in astronomy in the Central and East European Countries: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Serbia, Slovakia, Slovenia and Ukraine. Due to having too small research communities the countries Albania, Bosnia and the Former Yugoslav Republic of Macedonia were excluded. However, as some data was initially collected for the Former Yugoslav Republic of Macedonia, this data is presented in the country overviews.

Many of these countries are not yet fully integrated in future mainstream European astronomy as described in the ASTRONET Roadmap. The aim of the ASTRONET WP3 is to analyse the obstacles impeding the full participation and then propose suitable actions at the institutional and agency level that may accelerate the integration.

The astronomical research in Central and Eastern European countries has a long tradition. The modern era starts in 16th century in Toruń with Nicolaus Copernicus. In 1543 his book “On the Revolutions of the Celestial Spheres” was published, which is considered a major event in the history of science. Later in 16th century Tycho Brahe's used astronomical instruments at his observatory Uraniborg on the Danish island Hven, where he collected very precise observations of planets. He moved in 1599 to Benátky nad Jizerou and to Prague. There, in the beginning of 17th century his data were used by Johannes Kepler for his brilliant inventions of laws of planetary motions. Another achievement of mid-17th century was the observatory built by Johannes Hevelius in Gdańsk, where he erected the giant telescope of focal length 45 m. His book *Selenographia* published in 1647 offers detailed description of the Moon surface and of sun spots. The astronomical observatory in Vilnius was established in 1753 by Jesuit monk Thomas Zebrowski followed by Martynas Poczobut who equipped it with astronomical instruments. The history of Tartu observatory starts early in 19th century when Friedrich Georg Wilhelm Struve worked as astronomer there, later he became the director of the Pulkovo observatory (Russia). His successors of the Struve dynasty influenced astronomy in Kharkov, Kyiv and Odessa. In 19th century the astronomy progresses with the discoveries by Christian Doppler who worked at the Prague Polytechnic. In 1842 he published the paper “*On the coloured light of the binary stars and some other stars of the heavens*”, where he postulated his principle (later labelled the Doppler effect) that the observed frequency of a wave depends on the relative speed of the source and the observer, and he tried to use this concept for explaining the changing colors of binary stars. Late in the 19th century Ernst Mach invented his principle in Prague, which later lead Albert Einstein to the theory of general relativity. In 1887 the Astronomical Observatory of Belgrade was founded by Milan Nedeljkovic starting the research in astronomy in Serbia. In end of 19th and beginning of 20th century Miklós Kokoly-Thege performed astronomical observations and established an observatory in Ógyalla. An important person for astronomy in Slovakia is Milan Rostislav Štefánik, who collaborated with the French astronomer Pierre Jules César Janssen of the Meudon observatory. In 1908 Nicolae Coculascu, after his return from the Observatory in Paris, established the astronomical observatory in Bucharest. In 1958, Janis Ikaunieks founded Baldone observatory in Riga and where he focused on the exploration of carbon stars. The course and advancement of astronomy in 20th century was undoubtedly influenced by Albert Einstein, who in 1911-1912 worked in Prague, by Ernst Julius Opik of Estonia, who in 1922 estimated the distance to Andromeda galaxy, by Milutin Milankovic of Belgrade who explored the climate change due to the Earth's position relative to the Sun explaining the past ice ages¹, by George Gamow by of Odessa, who contributed to quantum mechanics, nuclear physics and theory of stellar structure, by Jaan Einasto of Tartu who in 1974 discovered dark matter

¹ later labeled Milankovic cycles

in the Universe, and by Bogdan Paczynski who developed the gravitational microlensing as a tool for exploring the low-mass objects in the halo of the Milky Way. Lately, as astronomical observations become more and more dependent on large infrastructures and theoretical work on large numerical simulations, these countries have been less well equipped than the rest of Europe.

Methods and aim

In this report the currently existing scientific domains are surveyed and opportunities for development of new domains and/or technologies are considered. The major actors are identified, and the current involvement in major European projects is investigated. This report is not intended to be a review of the scientific quality of the research, as that would require either a number of expert-panels, or reliance on bibliometry, such as citation analysis. The former would require a considerably larger cost, and is not within the remit of this ERA-net. The latter would be problematic, as the astronomical communities are rather small, and errors in publications databases would be too large to give any reliable data. It can also be questioned as a mean of measuring quality if used on its own.

In order to obtain reliable information, contacts persons in new member states were asked to provide more information or updates from D29 of ASTRONET FP6 "*Report on the management of European Astronomy: Eastern European Countries*". A questionnaire was then sent to gather further information on the research areas. In addition to this publication data from ADS during the years 2008-2012 was retrieved through the affiliation search form. This may not be a complete set of publications; however it gives complementary information compared to questionnaires regarding activity in different research subjects and the participation in international projects.

A working group consisting of ASTRONET partners and associates has been working with this report: Jean-Marie Hameury, Nikos Kylafis, Laurits Leedjäv, Birgitta Nordström, Emma Olsson, Jan Palouš and Nedelia Popescu.

Part A

Conditions for astronomical research

An important requirement for a discussion of future opportunities is to investigate the conditions for astronomical research. For example, a country with a large research community can cover a larger number of areas, explore new topics while still keeping current strong areas. The access to top level research infrastructure is also a factor that affects the integration in mainstream European astronomy.

Numbers of researchers

The countries surveyed have very different conditions for astronomy research, i.e. regarding the population of the country and the number of astronomers (Table 1). When comparing the number of astronomers in different countries, one should bear in mind that the time available for doing research may vary a lot. We therefore also look at the number of individual IAU members, to get a different measure. One can however see that the countries with the largest population – Poland and Ukraine – also have the largest community of astronomers. The intermediate size countries - Bulgaria, Czech Republic, Hungary and Romania – has a community of astronomers of the size 100 – 150, Hungary having slightly lower number of astronomers, but equally many IAU members as e.g. Bulgaria. Serbia has similar number of astronomers and IAU members as the slightly smaller country, Slovakia. Of the smaller countries, Estonia, despite having the smallest population of these countries have a comparably high number of IAU members.

Table 1 Overview of population, number of astronomers, number of IAU members. The population data is taken from EUROSTAT data for 2012, number of astronomers from the country reports (part B) and the number of IAU members is according to IAU's webpage 2012.

Country	Population (millions)	Number of astronomers ¹	Number of IAU members	Astronomers per million inhabitants	IAU members per million inhabitants
Bulgaria	7,3	101	58	14	8
Croatia	4,3	38	18	7	4
Czech R	10,5	150	106	14	10
Estonia	1,3	40	26	31	20
Hungary	9,9	85	56	9	6
Latvia	2,0	50	16	25	8
Lithuania	3,0	40	19	13	6
Poland	38,5	340	160	9	4
Romania	20,1	115	34	6	2
Serbia	7,2	70	41	10	6
Slovakia	5,4	63	42	11	7
Slovenia	2,1	-- ²	7	--	3
Ukraine	45,4	320 ³	198	7 (14) ⁴	4

¹ For most countries, these number includes also PhD students, but not technicians or other astronomers that without PhD.

² No response to questionnaire

³ In Ukraine there are 614 astronomers, counting only those with a PhD or Dr Sc degree one arrives at the number 320.

⁴ The number in parenthesis is including all astronomers in Ukraine.

In addition to the number of people currently in astronomy the government spending on research matters. The financial need will be investigated in a separate report.

Membership in international organisations

Of the countries here studied, only one is currently member of ESO: the Czech Republic. Three countries are members of ESA⁵: the Czech Republic, Poland and Romania. Three further countries have signed the PECS agreement: Estonia, Hungary and Slovenia, and another three – Latvia, Lithuania and Slovakia –have individual cooperation agreements.

All countries, apart from Serbia, are connected to ASTRONET. Of these, the Czech Republic and Poland are contractors, and the others are associates. Since, in ASTRONET, also the organisations ESO and ESA are present, it can in that way be an organisation where the information on current astronomical projects and future plans are exchanged, thus increasing the synergy of human resources and financing.

All countries are members of the IAU. The IAU membership of any country promotes the national astronomical researchers and helps to access the international infrastructures, making IAU an unavoidable instrument of scientific education and development, and advancement in front research.

Table 2 Institutional memberships in IAU and ASTRONET . The explanations for the abbreviations can found in the appendix

Organisational memberships	IAU	ASTRONET
Bulgaria	BAS	BAS
Croatia	CASA	MSES
Czech Republic	CAS	Astronomical Institute, CAS
Estonia	EAS	ERC
Hungary	HAS	HAS
Latvia	UL	Institute of Astronomy,UL
Lithuania	LAS	LAS
Poland	PAS	(NCBiR)
Romania	RAS	RSA
Serbia	AO	no
Slovakia	SAS	Astronomical Institute, SAS
Slovenia	SRA	SRA
Ukraine	NASU	NASU

Membership in European organisations for telescopes

There are a number of European organisations for research infrastructure. Some examples are mentioned here. For optical and infrared, there is for example OPTICON, having a transnational access programme allocating time to the participating telescopes through a single international peer review. In radioastronomy there is a similar network, RADIONET, where Torun in Poland is a

⁵ According to ESA website:
http://spaceimages.esa.int/Images/2013/02/ESA_Member_States_and_Cooperating_States

member⁶, and EVN, the European VLBI Network. For solar observations, there is the European Association for solar telescopes, EAST, where Czech Republic, Croatia, Hungary, Poland and Slovakia are members⁷ and SOLARNET⁸, where there are consortium members from the Czech Republic, Croatia, Poland and Slovakia. In the International Virtual Observatory Alliance, IVOA, Hungary and Ukraine are members.

Research infrastructure

On the territory of Central and Eastern European countries, there is a few medium size and many small size ground-based optical telescopes. In many cases they were constructed during sixtieth of the last century and lag behind the up-to-date standards. There are radio-telescopes in Latvia, Poland and Ukraine, some of them are parts of VLBI.

Bulgaria

- 2-m RCC telescope,
- 50/70 cm Schmidt telescope,
- 60 cm Cassegrain telescope,
- 15 cm Coronagraph
- 60 cm Cassegrain telescope, Astronomical Observatory Belogradchik

Czech Republic

- 2-m Ondřejov Observatory – spectrograph;
- 65cm Ondřejov Observatory – photometr;
- fireball network – all-sky cameras;
- 10-m radio disc Ondřejov Observatory– radio spectrograph;
- 1-m – Klet' Observatory - camera;
- 1.54-m La Silla (NBI) - photometr

Estonia

- 1,5-meter reflector telescope in Tartu Observatory, equipped with a Cassegrain focus grating spectrograph;
- 0,6-meter reflector telescope in Tartu Observatory, equipped with a CCD photometer;
- 0,5-meter reflector telescope in Tallinn University of Technology, equipped with a CCD photometer (not in active use at the moment).

Hungary

- 1 m RCC telescope;
- 60/90 cm Schmidt telescope;
- Several smaller (max 50 cm diameter of mirror) for CCD photometry.

Latvia

- 1.2 m Schmidt system telescope (correction plate 80 cm) and 1 m laser telescope of the Astronomical Institute, University of Latvia.
- 32 and 16 m radio telescopes of VIRAC and 2 m satellite receiver

Lithuania

- Moletai Astronomical Observatory of ITPA VU. 3 telescopes: 165 cm, 63 cm and Maksutov system telescope 31/51 cm.

⁶ According to <http://www.radionet-eu.org/radionet-partners>

⁷ See <http://www.astro-east.org/index.php?id=217>

⁸ According to <http://www.solarnet-east.eu/consortium>

Poland

- 32-m radio telescope, Uniwersitet Mikolaja Kopernika w Toruniu;
- 10-m SALT;
- 1.3-m Las Campanas - camera;

Romania

- 50-cm Cassegrain telescope
- Solar refractor for photosphere observations (1950/130 mm)
- Solar refractor for chromosphere observations (1200/80 mm) with a Solar Observer S-1.5 H alpha filter (0.3 +/- 0.05 A)

Serbia

- 40-cm MEADE telescope used for the photometry of asteroids, located in Belgrade
- 60-cm Cassegrain telescope by Astro Optic, located on the mountain of Vidojevica (south Serbia) used for photometry and imaging.

Slovakia

- 60-cm Skalnaté pleso – fotometer;
- 60-cm Stara Lesna – fotometer;
- Solar coronagraph Lomnický štít.

Ukraine

Optical:

- The Academician Shajn 2.6-meter reflector, Crimea, Ukraine;
- 2-meter ZEISS telescope at the Peak Terskol, North Caucasus, Russia;
- AZT-11 (Crimean Astrophysical Observatory) is 1.25-m Ritchey-Cretien reflector, Ukraine;
- The 1.24-m Ritchey-Cretien reflector (Simeiz, Crimean Astrophysical Observatory), Ukraine;
- Main Astronomical Observatory NASU – AZT-2 (80cm), GPS station (1m), Axial Meridian Circle, Twin astrograph (0.7 m);
- Crimean Astrophysical Observatory – AZT (0.5 m), MTM-500 (0.5 m), AZT-8 (0.7 m);
- – 1 m and 0.6 m telescopes, two 0.8 m telescopes, two 0.5 m telescopes (Astronomical Observatory I.I. Mechnikov National University of Odesa);
- Institute of Astronomy V.N. Karazin National University of Kharkiv – AZT-8 (0.7 m);
- Mykolaiv Astronomical Observatory – Axial Meridian Circle, Multi-Channel Telescope ;
- Astronomical Observatory I.Franko National University of L'viv – AZT-14 (0.8 m), SRL.

Radio:

- The UTR-2, Ukrainian T-shape Radio telescope;
- A decametric Very Long Baseline Interferometry, VLBI, network URAN;
- The 70-meter dish radio telescope RT-70 near Evpatoria in Crimea.
- The RT-22 radio telescope (<http://crao.crimea.ua/rt22/main.htm> /) operating at mm and cm radio wavelengths located in Simeiz, Crimea.

Publication data analysis

The publication data for each country in the years 2008-2012 was retrieved from the ADS¹, by using their affiliation search form. Only articles in refereed journals were considered (ADSLabs was used to select only the articles in refereed journals). Some articles that were not in astronomy/astrophysics were then manually removed. However, articles with high relevance to astronomy/astrophysics were retained.

Publications and national journals

For every country the most common journals in where astronomers publish their results has been investigated. In **Bulgaria**, for which 482 articles were found, 20% were in other fields than astronomy. The top three journals to publish astronomy articles are the Bulgarian Astronomical Journal where 27% were published, followed by A&A on 17% and ApJ 14 %. Of the 248 articles found for **Croatia**, about 7% were not in astronomy/astrophysics. Of the articles in the field 28% were in ApJ, 21% in A&A, and 5% in each of MNRAS and PRD. For the **Czech Republic** 1131 articles were found, 20% in other or related fields (such as space physics), of the ones in astronomy/astrophysics 30% were in A&A, 12 % in ApJ and 6,5 % in MNRAS. Of the 137 articles found from **Estonia**, 10% were not directly in astronomy/astrophysics. Of the ones in the field, 33% were in A&A, 18% in Baltic Astronomy, 9% in each of PRD and ApJ 8%. Of the 722 articles found from **Hungary**, 11% were not directly in astronomy/astrophysics, of the ones in the field 19% were published in ApJ, 17 % in A&A, and 15% in MNRAS. For **Latvia** only 35 articles were found, less than a handful not in astronomy/astrophysics. Most of the articles in astronomy/astrophysics were found in Baltic Astronomy 27%, followed by Latvian Journal of Physics and Technical Sciences 15% and A&A and ApJ with 12% each. 94 articles were found for **Lithuania**, approximately 10% outside the field. Of those in the field 57% were in Baltic Astronomy, 15 % in MNRAS, and 12% in A&A. Of the 2026 articles found for **Poland**, 8% were in other fields. Of the rest 23% were in A&A, 19% in ApJ, and 17% in MNRAS. For **Romania**, only about 60% of the papers could be found through the ADS affiliation search, as many papers were published in the Romanian Astronomical Journal²: Of the articles found (292, of which about 15 % not in astronomy), about 9 % were published in ApJ, 8% in Astroparticle Physics and 7% A&A. For **Serbia**: 223 articles were found, 14 % in other fields (such as history of astronomy). Of the ones in astronomy/astrophysics 19% in Serbian Astronomical Journal, 10% in Baltic Astronomy 10% and 9% in each of MNRAS and A&A. Of the 326 articles found for **Slovakia** 8% were in other fields. The remaining articles were foremost published in A&A 19%, Contributions of the Astronomical Observatory Skalnaté Pleso 13% and MNRAS 9 %. Of the 752 articles found for **Ukraine**, about 10% were in other fields (e.g physics and space physics). In astronomy/astrophysics: 22% were in A&A, 15 % in MNRAS, 12% in ApJ.

For each country, there was a long tail of journals where 1-2 articles were published.

Local journals

Noteworthy was that for some of the countries, a large fraction of the articles were published in local journals such as:

- Baltic Astronomy

¹ NASA's Astrophysics Data System: <http://adsabs.harvard.edu/index.html>

² This may lead to us missing some papers in other countries as well. In the ADS search, almost 300 articles were found, of which about 15% not in astronomy.

- Bulgarian Astronomical Journal
- Contributions of the Astronomical Observatory Skalnaté Pleso , Slovak republic
- Romanian Astronomical Journal
- Serbian Astronomical Journal
- Latvian Journal of Physics and Technical Sciences

This is especially true for Bulgaria, Romania, Serbia. A smaller number of articles were found for Latvia and Lithuania, but also in those countries the local journals were the main place to publish. In the case of Estonia 18% were published in *Baltic Astronomy* and in Slovakia 13 % percent of the articles were published in *Contributions of the Astronomical Observatory Skalnaté Pleso*. In Croatia, Czech Republic, Hungary, Poland and Ukraine, the main journals are *A&A*, *ApJ* and *MNRAS*.

Membership of A&A

The following countries in the region are members of A&A: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Lithuania, Poland, Slovakia

Research areas

The articles found in the author affiliation search were classified, according to the title of the article into the following categories:

Category 1 – Research related to the extremes of the universe

Accretion and jets; Astroparticle physics; Compact objects; Early universe; Gravitational waves; Relativity; Cosmology, dark matter and dark energy; CMB; Pulsars and supernovae; Quasars and AGN

Category 2 – Research related to stars and galaxies

Astrometry; Circumstellar disks; Extra solar planetary systems; Formation and evolution of galaxies and clusters; Gravitational lenses; Interstellar matter; Multiple stellar systems; Star formation and young stellar objects; Stars and stellar atmospheres, evolution and pulsations; Stellar clusters; Instrumentation

Category 3 – Research related to the Sun and the solar system

In situ measurements of interplanetary plasmas; Celestial mechanics; Laboratory studies; Solar activity, coronal mass ejections, magnetic field reconnection etc; Solar system planets; Space weather; Minor planets, asteroids, NEOs, small bodies of the solar system

Category 4 – Other

Astronomical archives and data-mining; Computational astrophysics; Nuclear astrophysics and atomic astrophysics; Virtual Observatory

For the countries with around 500 and more articles found, an analysis of the percentage of articles in the four different categories was done.

For **Bulgaria**, about half of the articles belonged to category 2, a third to category 1 and about 10% to category 3. The last, slightly less than 10% of the articles were in category 4, and articles were articles to all four keywords, Astronomical archives and data-mining; Computational astrophysics; Nuclear and atomic astrophysics; Virtual observatory, were found. The articles for the **Czech Republic** were

divides as follows: slightly less than a third in category 1, the same for category 2, close to one third in category 3 and about 5 percent in category 4. The **Hungarian** articles were about 35% in category 1, 40% in category 2, about 15 % in category 3 and almost 10% in category 4. The **Polish** articles were mostly in category 1 (about 45 %) and 2 (about 40%), and less in category 3 (just above 10%) and 4 (around 5 %). Ukrainian articles were mostly in category 2 (around 40%) and 1 (about a third of the articles), 25 % of the articles were in category 3, and a few percent in category 4.

Concluding remarks

Two countries can be considered to be more or less fully integrated into mainstream European astronomy; Poland and the Czech Republic. Poland is however not yet a member of ESO, which would be the next logical step. These countries can benefit from further strengthening their involvement in great European infrastructure projects and to a greater extent offering their expertise in European projects. In Estonia, already involved with ESA through the PECS agreement, there is a Government plan for research infrastructures where Estonian membership in ESO is foreseen.

Increasing the involvement in European projects would be beneficial for all countries in this report. An advantage with participating in large international projects is that one can draw on the national expertise in instrument development, as well as data development and scientific interpretation. This should also be of interest for more general research and development strategies in these countries, and may in the long run benefit local industry. In many cases for these countries, a lack of funding seems to be the main issue. The funding situation will be investigated further in the next report.

Infrastructure

In many of the countries in the survey, the main issue is access to up-to-date infrastructure. Many countries have their own telescopes, which can be an asset, but are also costly to maintain and upgrade. A recommendation is for each country to make a careful analysis, considering the local astroclimate, weighing the costs of joining ESA and ESO against the cost of keeping internationally competitive national facilities. In the cases where one decides on joining ESA and/or ESO instead of keeping a national facility, one should make sure that the instrument development know-how stays in the country by contributing to the instrument development on international projects. Countries with optical/IR telescopes may consider joining OPTICON.

Countries that are already members of ESA, sometimes for other reasons than astrophysics, could consider how to make sure that their membership in ESA further benefits astrophysics. For example, in Romania, astrophysics could gain from being part of the upcoming GAIA mission.

Countries with facilities in the radio astronomy domain, such as Ukraine, could consider joining the LOFAR consortium, building on the existing expertise. Involvement in SKA would also be a significant step for Ukraine.

International visibility of research results

In some countries a sizable fraction of the publications are published in local journals, which have lower impact factor than international journals, such as for example the European journal *Astronomy & Astrophysics*. Some countries with their own journals may evaluate the international visibility and consider whether joining A&A would be beneficial.

Mobility

A way to increase the international visibility and further the level of research and the exchange of research ideas is to increase the mobility of researchers. Young researchers should be encouraged to spend significant time abroad, and one should generally avoid continuing their professional career in the same group as where their PhD-work was performed. However, one has to make sure that an increased mobility does not lead to a “brain-drain”. Repatriation grants for young researchers could be considered to remedy this, together with an effort to recruit foreign researchers.

Another way to encourage young scientists to return to their country, which also may help to attract foreign researchers when recruiting staff, is to ensure good access to relevant international research infrastructure.

Part B Detailed description of each country

To provide background information, the contact persons were asked to provide updates of the information they have sent in response to the ASTRONET I report D29: Report on the management of the European Astronomy: Eastern European Countries. In this previous report eight countries were described: Bulgaria, Czech Republic, Lithuania, Latvia, Poland, Serbia, Hungary, Estonia. They were asked to answer the following questions:

1. Brief general description of the complete research system used in the country.
2. Who are the actors in Astronomy in the country?
3. Funding agencies contribution to Astronomy research.
4. Do strategic plans for Astronomy research exist?
5. Description of the Astronomy domain in the country.
6. International collaboration within the framework of Astronomy Research
7. Funding across the various agencies.
8. Personnel involved in Astronomy research.

In this part updated information is presented. Only the part of the responses that pertain to research areas are presented here. An extended description of the funding system will be presented in Deliverable 3.2 of ASTRONET II. New responses were retrieved from Croatia, the Former Yugoslav Republic of Macedonia, Romania, Slovakia and Ukraine. The responses to a second questionnaire where the contact persons were also asked to provide further information about the research areas, according to the subject division of the ASTRONET Infrastructure Roadmap – A strategic plan for astronomy:

- A: High energy astrophysics, Astroparticle Astrophysics and Gravitational Waves
- B: Ultraviolet, Optical, Infrared and Radio/mm Astronomy
- C: Solar Telescopes, Solar System Missions, Laboratory Studies
- D: Theory, Computing Facilities and Networks, Virtual Observatory

The persons who provided the working group with the information presented in this appendix are:

Bulgaria: Evgeni Semkov
Croatia: Krešimir Pavlovski
Czech Republic: Petr Hadrava and Jan Palouš
Estonia: Laurits Leedjärv
The Former Yugoslav Republic of Macedonia: Gordanna Aposolovska
Hungary: Lajos Balázs
Latvia: Ilgmars Eglitis
Lithuania: Gražina Tautvaišienė
Poland: Maria Bojanowska and Bożena Czerny
Romania: Nedelia Popescu
Serbia: Zoran Knežević
Slovak Republic: Ján Rybák
Ukraine: Peter Berczik and Irina Vavilova

No response was received from Slovenia.

Bulgaria

Research areas

In Bulgaria, research related to Astronomy/Astrophysics is conducted in the following fields:

- Stellar astrophysics, optical photometry and spectroscopy with the telescopes of Bulgarian observatories. Massive, high luminosity stars; mass transfer; accretion discs; binary systems; sub-stellar systems; extrasolar planets; early stages of stellar evolution; stellar magnetism.
- Solar system studies, physical and chemical properties and processes in comets, rotational characteristics of asteroids, NEOs and TNOs
- Galaxies, physical processes and chemical abundance in galaxies; disk profiles and starformation in galaxies; Nova stars search in nearby galaxies.
- Active Galactic Nuclei, photometric variability of quasars and blazars,
- Heliophysics, the appearance of active structures – prominences and spots.
- Nucleosynthesis and chemical evolution of the light elements, neutrino oscillations.
- Stellar radioastronomy.

B: Ultraviolet, Optical, Infrared and Radio/mm Astronomy

Optical and near infrared photometry and spectroscopy, stellar astrophysics, galaxies, AGNs, blazers. Stellar radioastronomy.

Solar system studies, physical and chemical properties and processes in comets, rotational characteristics of asteroids.

C: Solar Telescopes, Solar System Missions, Laboratory Studies

15 cm Coronagraph at NAO Rozhen, solar prominences and spots.

D: Theory, Computing Facilities and Networks, Virtual Observatory

Development of Virtual Observatory, an archive of photographic and CCD observations in NAO Rozhen.

Main actors

Research in Bulgaria is concentrated in the institutes and laboratories of the Bulgarian Academy of Sciences (BAS). After the reorganization in 2010, BAS consists of 42 research institutes and 5 specialized academic units. About 17% of the scientists in Bulgaria are working in these institutes, but they produce more than 50% of scientific publications. The remaining part is dominated by scientists in universities and there are very few scientists working in laboratories in industry.

Research Institutes:

- Institute of Astronomy and National Astronomical Observatory (IA and NAO) of the Bulgarian Academy of Sciences, www.astro.bas.bg

Universities:

- Department of Astronomy, Faculty of Physics at University of Sofia, www.phys.uni-sofia.bg
- Astronomical Center at Shumen University, <http://shu-bg.net/>

Research facilities:

- National Astronomical Observatory – Rozhen, operated by the IA and NAO at BAS, 2-m RCC telescope, 50/70 cm Schmidt telescope, 60 cm Cassegrain telescope, 15 cm Coronagraph <http://www.nao-rozhen.org/>

- Astronomical Observatory Belogradchik, operated by the IA and NAO at BAS, 60 cm Cassegrain telescope, <http://www.astro.bas.bg/~aobel/>

Personnel

Researchers: 65

Associates: 22

Full professors: 6

Temporary positions (Postdocs, Phd, etc.): 8

Ratio of female researchers to the total number of researchers: 31 %

Female: 20 and male: 45

Funding

Ministry of Education, Youth and Science

The Department “Science” in the Ministry plans the funding for the BAS and universities and in this way implicitly decides on research in astronomy. The same department coordinates the development of research infrastructures. In 2009, as a result of this coordination, a project (Regional Astronomical Center for Research and Education, RACIO) was submitted which aims at integrating the main actors in astronomy in BG. In 2010 the project was included in the Bulgarian national roadmap for the development of research infrastructure.

<http://www.nrri-bg.com/infrastructures/racio>

National Science Fund

The NSF organizes annually competitions for different types of research projects (centers of excellence, development of infrastructures, Ideas, etc.). The projects are evaluated by international and national experts. The main actors in astronomy have had several successful projects funded by the NSF. At this stage NSF has financed the first step in the realization of RACIO, the preliminary feasibility study. More details at:

<http://www.bulfund.com/>

The funding for the BAS and for the state universities comes from the Ministry for Education, Youth and Science and from the National Science Fund (NSF). The Ministry is the source of the funding and the NSF organizes competitions for research projects on an annual basis.

Long term plans

The institutions responsible for the preparation of long term, strategic plans in astronomy/astrophysics are the *Institute of Astronomy and National Astronomical Observatory, BAS* and *The Bulgarian Astronomical Society (BAS)*, the members of which are researchers from all astronomical institutions in Bulgaria.

Presently, the project RACIO, contains elements of strategic planning for the future development of Astronomy in BG, based mainly on the integration of the existing research and educational institutions and their modernization.

International collaboration

In Europe:

Institute of Astronomy and National Astronomical Observatory, BAS

The collaborations can be divided in two groups:

- International projects carried out by scientists/scholars in the framework of the Academy’s bilateral agreements – Slovakia, Romania, Russia, Czech Republic, Germany, France, Belgium, Poland, Austria, Serbia, Hungary and Ukraine.

- Direct bilateral institute-to-institute agreements, bilateral intergovernmental scientific cooperation, EU and NATO agreements – Germany, Greece, Slovenia, Finland, Belgium.

Outside Europe:

Bilateral intergovernmental scientific cooperation – India.

USA, Chile, Canada, Japan: occasionally, individual scientists.

The Department of Astronomy at University of Sofia has cooperation agreements with Germany, UK, India and USA.

The Astronomical Center at Shumen University has cooperation with Poland.

Croatia

Research areas

In Croatia, research related to Astronomy/Astrophysics is conducted in the following fields:

- Gamma-ray astronomy: Croatian researchers are involved in gamma astronomy through MAGIC collaboration.
- Stellar Physics: observations, theory and modeling. The main topics are close binary stars, symbiotic stars, Be stars, T Tauri and Herbig-Haro stars.
- Exoplanets: observations, modeling.
- Radio-interferometry (evolution of galaxies, AGNs, observational cosmology)
- Solar Physics: observations and theory (solar activity, solar rotation, Solar-terrestrial relations, space weather)
- Gravitation, dark matter, black hole physics, astroparticles, cosmology
- Nuclear astrophysics (theoretical)

A: High energy astrophysics, Astroparticle Astrophysics and Gravitational Waves

Croatian researchers are involved in gamma astronomy through MAGIC collaboration

B: Ultraviolet, Optical, Infrared and Radio/mm Astronomy

Stellar Physics: observations, theory and modeling. The main topics: close binary stars, symbiotic stars, Be stars, T Tauri and Herbig-Haro stars, Radio-interferometry (evolution of galaxies, AGNs, observational cosmology)

C: Solar Telescopes, Solar System Missions, Laboratory Studies

Solar Physics: observations and theory (solar activity, solar rotation, Solar-terrestrial relations, space weather)

D: Theory, Computing Facilities and Networks, Virtual Observatory

Gravitation, dark matter, black hole physics, astroparticles, cosmology , Nuclear astrophysics (theoretical)

Main actors

Research Institutes:

- Rudjer Boskovic Institute, Zagreb

Universities:

- University of Zagreb, Department of Physics, gives education in astronomy and astrophysics on all levels, from introductory courses, through master and doctoral levels.
- University of Rijeka, University of Split, University of Osijek, all provide introductory courses in astronomy and astrophysics

Research facilities:

- Hvar Observatory

Research areas at the institutes

- Gamma-ray astronomy: Croatian researchers are involved in gamma astronomy through the MAGIC collaboration. Croatian MAGIC consortium was founded including groups from Rudjer Boskovic Institute in Zagreb (3 researchers), University of Split (2 researchers) and

University of Rijeka (1 researcher plus 1 PhD student). For the majority of the researchers this is only part-time research.

- Stellar Physics: observations, theory and modeling. The main topics are close binary stars, symbiotic stars, Be stars, T Tauri and Herbig-Haro stars. Groups involved are: University of Zagreb, Department of Physics (1 full professor, 1 postdoc, 1 PhD student), University of Zagreb, Hvar Observatory (1 researcher, 2 postdocs), University of Rijeka (1 full professor, 1 associate professor, 1 PhD student), University of Split (1 assistant professor)
- Exoplanets: observations, modeling. University of Rijeka (1 assistant professor, 1 PhD student)
- Radio-interferometry (evolution of galaxies, AGNs, observational cosmology) University of Zagreb, Department of Physics (1 assistant professor)
- Solar Physics: observations and theory (solar activity, solar rotation, Solar-terrestrial relations, space weather) University of Zagreb, Hvar Observatory (3 researchers, 1 observer)
- Gravitation, dark matter, black hole physics, astroparticles, cosmology, University of Zagreb, Department of Physics (2 full professor, 1 professor emeritus, 2 assistant professors, 1 PhD student), University of Zagreb, Faculty of Electrical Engineering, Physics dept. (1 associate professor, 1 assistant professor, 1 PhD student), Institute Rudjer Boskovic, Zagreb (2 researchers, 1 PhD student)
- Nuclear astrophysics (theoretical) University of Zagreb, Department of Physics (1 full professor, 1 associate professor, 1 assistant professor)

Personnel¹

Researchers, observers and associates: 23

Full professors: 5 (+1)

Temporary positions (Postdocs, Phd, etc.): 10

Funding

No information provided

Long term plans

No information provided

International collaboration

No information provided

¹ This table is obtained summarizing information given per research area and institute above

Czech Republic

Research areas

In the Czech Republic, research related to Astronomy/Astrophysics is conducted in the following fields:

- celestial mechanics
- astrometry
- space geodesy
- meteoroids, asteroids
- solar and heliospheric physics
- stellar spectroscopy
- formation of stars and evolution of galaxies
- compact objects
- relativistic astrophysics
- history of astronomy

Main actors

Research in the Czech Republic is carried out mainly at the Academy of Sciences of the Czech Republic and at various universities.

Research Institutes:

- Astronomical Institute, v.v.i., Academy of Sciences of the Czech Republic: Solar physics group (27 scientists, 4 PhD), Stellar physics group (13 scientists, 5 PhD), Interplanetary Matter & Asteroids (10 scientists, 2 PhD), Galaxies & Planetary Systems (24 scientists, 10 PhD).
- Institute of Atmospheric Physics, v.v.i. Academy of Sciences of the Czech Republic.
- Institute of Physics, v.v.i., Academy of Sciences of the Czech Republic.
- Astronomical Institute of the Charles University, Prague.
- Masaryk University, Brno.
- Silesian University, Opava.

Research facilities:

- Observatory Ondrejov - 2m telescope with spectrograph;
 - 65 cm telescope with photometer;
 - fireball network – all-sky cameras;
 - 10 m radio disk with radio spectrograph.
- La Silla – ESO – operated in collaboration with Niels Bohr Institute
 - 1.54 m telescope with photometer.
- Brno Observatory.
- Klet Observatory - 1 m telescope – camera.
- ESO

Personnel

Researchers: approx. 90

Associates: approx. 10

Full professors: 3

Temporary positions (Postdocs, Phd, etc.): approx. 50

Ratio of female researchers to the total number of researchers: ~ **15%**

Funding

- Grant Agency of the Czech Republic.
- Academy of Sciences of the Czech Republic.

- Ministry of Education, Youth and Sports.

The principal funding is provided by the government, separately for the Academy and for universities. On top of that, additional funding comes from national and foreign grants (including FP7 etc.) and collaborative projects. In the case of astronomy and space research, funding also comes via the Czech membership in ESO and ESA. Some extra funding is also provided by ministries, as e.g. funding of international cooperation, funding of temporary research Centres or support of selected technical developments.

Long-term plans for astronomy and astrophysics

Institutions responsible for the preparation of long term plans in astronomy and astrophysics:

- Ministry of Education, Youth and Sports
- Academy of Sciences of the Czech Republic
- National Committee for Astronomy

Long-term plans for astronomy and astrophysics are not yet available.

International collaboration

In Europe:

- Collaborations with individuals in all European countries
- Bilateral agreements of the Astronomical Institute with partner organisation in Europe
- Bilateral agreements of the Academy of Sciences with partner organisation in Europe
- Projects of EU FP7 programme
- Membership in ESO and ESA
- GREGOR – Large Solar Telescope

Outside Europe:

- Pierre Auger Observatory – Argentina – Institute of Physics, Academy of Sciences of the Czech Republic
- HESS – Charlers University
- NASA
- JAXA

Estonia

Research areas

In Estonia, research related to Astronomy/Astrophysics is conducted in the following fields:

- Cosmology
- stellar physics
- remote sensing of the Earth

A: High energy astrophysics, Astroparticle Astrophysics and Gravitational Waves

Astroparticle Astrophysics, simulations of large-scale structure of the Universe, modeling dark matter haloes etc. Data from WMAP, Fermi, Planck etc. are used, as well as Grid computations. The activities fit the Science Vision Question 2.2 - What is dark matter and dark energy?

B: Ultraviolet, Optical, Infrared and Radio/mm Astronomy

The main areas of research are cosmology, physics of galaxies and stellar physics, with both observational and theoretical work carried out. The cosmology research includes observations of galaxies and groups of galaxies, studies of clusters and super clusters, and theoretical cosmology. In stellar physics, there is work on stellar evolution and stellar atmospheres, stellar winds and astrophysical plasmas, preparations for the Gaia Data Analysis and Processing.

D: Theory, Computing Facilities and Networks, Virtual Observatory

Theory is developed and high-performance computing is used both in stellar physics and in cosmology.

Main actors

Research Institutes:

- Tartu Observatory: This is practically the only astronomical research institution in Estonia. It has four scientific departments: cosmology (about 15 researchers), stellar physics (about 18 researchers), remote sensing of the Earth (about 18 researchers) and space technology (about 10 researchers and engineers).

Universities:

- University of Tartu, Institute of Physics: one full professor who is responsible for teaching astronomy at the University. Many lectures are given and these are supervised by researchers from Tartu Observatory.
- Tallinn University of Technology, Institute of Physics: two part-time astronomers.

Research facilities:

- 1,5-meter reflector telescope in Tartu Observatory, equipped with a Cassegrain focus grating spectrograph.
- 0,6-meter reflector telescope in Tartu Observatory, equipped with a CCD photometer.
- 0,5-meter reflector telescope in Tallinn University of Technology, equipped with a CCD photometer (not in active use at the moment).

Personnel

Researchers: 21

Associates: 6

Full professors: 5

Temporary positions (Postdocs, Phd, etc.): 7

Ratio of female researchers to the total number of researchers: ~ **20%**

Funding

At the political level, the **Research and Development Council** is an expert consultative body that advises the Government on R&D and innovation matters. The State Chancellery's Strategy Office is an active intermediary in the R&D-related strategy and policy consultations, and acts as a secretariat of the Government's Research and

Development Council. Together they provide policy coordination and direction to the national RDI system. The Government lays down the main principles and policy foresight. Policy design and evaluation is carried out principally by the **Ministry of Economic Affairs and Communications** (MEAC) and the **Ministry of Education and Research** (MER). The former oversees support for and funding of industrial R&D, as well as planning coordination and implementation of innovation policy, the latter is responsible for research and education policies, the financing and evaluation of research institutes and coordination of international cooperation in research. **The Research Policy Committee** provides advice to the MER and the **Innovation Policy Commission** advises the MEAC. In the domain of MER, the **Estonian Research Council (ERC)** is the major foundation, providing institutional research funding and personal and post-doctoral research grants. ERC also coordinates international activities, runs science communication activities, etc. The **Archimedes Foundation** is responsible for national activities related to the ERA, EC Framework Programmes and the EU structural funds.

Most of the research funding is allocated on a competitive basis. The share of astronomy in recent years has been about 0.6 MEUR per year. In addition, the institutions receive some core (basic) funding, about 0.1 MEUR/year for Tartu Observatory, and funding for maintaining the infrastructure, about 0.3 MEUR/year for Tartu Observatory.

Finally, in the recent and coming years rather large investments into the Estonian research system are to be made from the European structural funds. Tartu Observatory has benefited quite a lot from them.

Long term plans

There is no specific strategic plan for astronomy/astrophysics on a state level. As Tartu Observatory is practically the only astronomy research organization in Estonia, its Development Plan can be considered to some extent to be the plan for the development of astronomical research in Estonia. A new Development Plan for 2014-2020 is being elaborated. In June 2010 a Roadmap for strategic research infrastructures in Estonia was compiled and approved by the Government. It includes participation of Estonia in international research organizations, among others it foresees the membership of Estonia in the European Southern Observatory and in the European Space Agency.

International collaboration

In Europe:

No formal involvements as yet. About 20 astronomers are individual members of the European Astronomical Society (and the Estonian Astronomical Society, its affiliated society).

Many individual collaborations. The most important partners on an institutional level are, for example, Tuorla Observatory (Finland), Astrophysical Institute Potsdam (Germany), University of Valencia (Spain), Toruń Centre for Astronomy (Poland) etc.

Outside Europe:

International Astronomical Union – Estonia is a national member with the Estonian National Committee on Astronomy (5 members). There are 26 individual IAU members. Estonia is a member of the Astronomy & Astrophysics journal since 1998.

Individual collaboration with astronomers from Harvard-Smithsonian Center for Astrophysics, University of Chicago et al. (USA), Toronto (Canada), etc.

Observing experience in South Africa and Chile.

Membership in ESO and ESA is foreseen. Estonia already has a European Cooperating State (PECS) agreement with ESA. The first astronomy related PECS project started in early 2011. Full membership in ESA is expected in 2015 or 2016. Informal contacts with ESO have been established.

The Former Yugoslav Republic of Macedonia

Research areas

Research activities at the Institute of Physics and Institute of Mathematics, Faculty of Science, University Cyril and Methodius in Skopje cover the following topics:

- dynamics of asteroids
- stellar structure
- radiative transfer
- solar and stellar atmospheres
- pulsars
- archeoastronomy

Main actors

Research in the Former Yugoslav Republic of Macedonia is concentrated in the universities. The funding for universities comes from the Ministry for Education and Science, but mainly for salaries and education activities.

Universities:

Number of universities offering Astronomy

- Ss. Cyril and Methodius University of Skopje (Faculty of Natural Sciences, Institute of Physics)

Other:

Societies:

1. Macedonian Astronomical Association
<http://astronomija-mkd.com/>
2. Skopje Astronomical Society
<http://astronomija.com.mk/>
3. Planetarium, Youth Cultural Centre

Research facilities

The first initiation for building of an astronomical observatory in the Former Yugoslav Republic of Macedonia exist before 1956 when the government in Yugoslavia (it was in that period part of the republic of Yugoslavia) decide to build astrophysical observatory in order to be prepared for the Geophysical year. After lots of bureaucracy, the process started at the location Zajčev Rid, by that time a suburb of the capital Skopje. The unfinished observatory had the bad luck of being demolished by the strong earthquake in 1963. In that way, this pioneer period for development of professional astronomy in the Former Yugoslav Republic of Macedonia has come to its end. Due to severe lack of funds for that purpose, the University was forced to (unwillingly) withdraw from the initiative for building a new observatory. Although there were many initiatives no astronomical (scientific, university or public) observatory has been built by today.

- Reflector Orion 8 inch equator mount 1000 mm f-5
- Reflector Orion 6 inch equator mount 1200 mm f-8
- Refractor Bresser 4 inch equator mount 1000 mm f-10
- Refractor Scopus 560/80 APOrefractor Secretan 8 inch 3000 mm f-15 (still under construction)
- Refractor Scopus 80mm ED, mount Celeston CGEM

Those telescopes are property of Faculty of Science in Skopje, Skopje astronomical society and in private property of amateur astronomers.

Personnel

Researchers: 1

Associates: 1

Full professors: 0

Temporary positions (Postdocs, Phd, etc.) : 0

The ratio of female researchers to the total number of researchers: 100%

Funding agencies

The role of main funding agency should be the government through its Ministry of Education and Science, but GERD/GDP which was 0.23 (Unesco, 2008) and now is probably less make the funding very symbolic.

Long term plans

The *Institute of Physics, Faculty of Science, University Cyril and Methodius* in Skopje is the only place where graduate and postgraduate studies in the field of Astronomy and Astrophysics are performed, and where group of professors in physics and two professional astronomers are employed. The Ministry is, in general, responsible for the long-term strategy in science in RM, but research activities are only performed in this institution and it is responsible for strategic planning and common projects in astronomy and astrophysics.
No strategic plan is available

International collaboration

In Europe:

There are collaborations with observatories and institutes in: Bulgaria, Serbia, Greece and Poland. The collaboration is particularly important with South East of Europe.

Outside Europe:

1 astronomer from RM is the member of International Astronomical Union;

Hungary

In Hungary, research related to Astronomy/Astrophysics is conducted in the following fields:

Research areas

- Stellar astrophysics
- Young stellar objects
- Physics of interstellar matter
- Solar physics
- Exoplanets
- Physics of interplanetary plasmas
- Small bodies in the Solar System
- Celestial mechanics,
- Early Universe
- Extragalactic astrophysics
- Gravitational waves
- Very Long Baseline Interferometry

A: High energy astrophysics, Astroparticle Astrophysics and Gravitational Waves

Study of different properties (gamma, X-ray and optical) of Gamma Ray Bursts (GRBs); phase transitions and elementary particle processes in the early Universe; Brane Models; theoretical studies of gravitational waves, participation in the LIGO and VIRGO projects.

B: Ultraviolet, Optical, Infrared and Radio/mm Astronomy

Comprehensive study of stellar pulsation and activity; search and follow up of extrasolar planets, participation in HAT (Hungarian-made Automated Telescope) project; theoretical works in celestial mechanics (e.g. 3 body problem, stability of exoplanet systems, “habitable zones”); properties of interstellar dust particles; VLBI observations of quasars and active galactic nuclei; spectroscopic and photometric study of supernovae; spectroscopic and infrared properties of Young stellar objects; different properties of circumstellar disks and planetary formation; investigation of interplanetary plasmas by in situ measurements.

C: Solar Telescopes, Solar System Missions, Laboratory Studies

MHD study of turbulence and magnetic fields in the solar interior and photosphere; development and maintenance of a comprehensive database of optical images and several features of the full solar disk; discovery and follow up of minor planets and comets; detailed investigation of cometary nuclei; far infrared study of trans Neptunian objects (TNO); laboratory studies of the properties of meteoritic materials.

D: Theory, Computing Facilities and Networks, Virtual Observatory

Hungary has a national Virtual Observatory organization, the HVO (<http://hvo.elte.hu/>). Hungarians are participating in US VO activities, and an electronic journal published at Konkoly Observatory (the Information Bulletin on Variable Stars, <http://www.konkoly.hu/IBVS/IBVS.html>) uses VO techniques for providing enhanced services to its readers.

Main actors

In Hungary the basic research is conducted at Universities and research institutes of the Hungarian Academy of Sciences.

Research Institutes:

- Konkoly Observatory of the Hungarian Academy of Sciences;
- Astronomical Observatory of Bács-Kiskun County.

Universities:

- Eötvös University of Sciences;
- University of Szeged.

Research facilities:

- 1 m RCC telescope;

- 60/90 cm Schmidt telescope;
- Several smaller (max 50 cm diameter of mirror) for CCD photometry.

Research areas at the institutes

Konkoly Observatory of HAS: *Stellar astrophysics, Solar physics, Small bodies in the Solar System, Exoplanets*

Eötvös University:

- Dept. of Astronomy: *Celestial mechanics, Physics of interstellar matter, Solar physics*
- Inst. of physics: *Early Universe, Extragalactic astrophysics, Gravitational waves*
- Gothard Astrophysical Observatory: *Young stellar objects*

University of Szeged: *Stellar astrophysics, Small bodies in the Solar System*

Institute of Geodesy: *Very Long Baseline Interferometry*

Research Institute for particle and nuclear physics: *Physics of interplanetary plasmas*

Personnel

Researchers: about 60

Associates: /

Full professors: 4

Temporary positions (Postdocs, Phd, etc.): ~ 20

Ratio of female researchers to the total number of researchers: ~ **30 %**

Funding

There is no funding agency specialized for Astronomy. There are agencies, however, where Astronomy is eligible.

Funding is distributed via the **Hungarian Scientific Research Fund** to selected proposals from research calls. The decision is made by an independent panel on the basis of peer review reports. The money distributed is formally a part of the annual budget of HAS and approved by the parliament.

National Office for Research and Technology: Same scheme as above. The money distributed is part of the budget of the Ministry of National Development and approved annually by the parliament.

Long term plans

The institution responsible for the preparation of long term, strategic plans in astronomy/astrophysics is the *Hungarian Academy of Sciences*. Strategic plans are not yet available

International collaboration

In Europe:

PECS – ESA,

EU FP7,

HAS - bilateral contracts with academies,

Universities' bilateral contracts,

Outside Europe:

HAS – JSPS,

HAS - bilateral contracts with academies, Universities' bilateral contracts.

Latvia

Research areas

In Latvia, research related to Astronomy/Astrophysics is conducted in the following fields:

- stars at a late stage of evolution
- bodies of the Solar system
- high precision satellite laser ranging in the framework of global coordinated programs for geodynamics
- radio telescopes, radio interferometry and radioastronomy; technical developments related to EVN
- Solar observations in the microwave range
- Satellite imaging and satellite navigation signals: detection, analysis and processing
- astrochemistry
- space debris investigations based on VLBI
- emerging - ionosphere research

B: Ultraviolet, Optical, Infrared and Radio/mm Astronomy

Investigations of carbon stars (C stars). Low resolution (~500) near infrared spectroscopy of potential C stars. Evaluation of them distances, absolute and bolometric magnitude.

Classification and obtaining the main parameters of atmospheres (effective temperature, C/O and so on) of C stars. Updating of General catalog of Galactic carbon stars. High resolution spectroscopy and research of AGB (especially carbon) stars with model atmospheres and synthetic spectra methods.

Studies on the effect of dust on the formation of certain molecules, including the process of computer modeling. Spectral line studies of hot, tenuous environments.

Monitoring of minor planets of Solar system.

Design of precision optical systems with apertures up to 35 cm for astronomy, laser ranging, remote sensing and other applications, including newly equipment for light emission and sensitive detection.

International radio interferometric and radio astronomic research. The research of efficiency of electric drive control and adaptation of antenna control and data registration software for radio telescopes. Sun C) Observations in microwave range.

D: Theory, Computing Facilities and Networks, Virtual Observatory

Digitalization of 25 000 astronomical photo negatives (1966-2005) of Baldone wide field Schmidt type telescope. The creation of database astronomical photo negatives and the program of reduction of scans of large format (1Gb). The creation of spectrum extraction and automatic processing program on the CCD images.

Main actors

Research Institutes:

- Institute of Astronomy, University of Latvia (AI LU) (16 researchers, 5 operating personel).
- Ventspils International Radio astronomy Center, Ventspils University College (VIRAC) (26 researchers 17 operating personnel).

Universities:

- University of Latvia, faculty of physics and mathematics (9 researchers).
- Daugavpils University, faculty of natural sciences and mathematics (1-3researchers, approx.).

Research facilities:

- 1.2 m Schmidt system telescope (correction plate 80 cm) and 1 m laser telescope of the Astronomical Institute, University of Latvia.
- 32 and 16 m radio telescopes of VIRAC and 2 m satellite receiver

Personnel

Researchers: 16 AI LU; 26 VIRAC, 9 LU faculty of physics and mathematics,

Associates professors: 0 AI LU, 2 VIRAC,

Full professors: 2 VIRAC

Temporary positions (Postdocs, Phd, etc.): Postdocs 1 AI LU, Postdocs 2 VIRAC, Phd 6 AI LU, doctorands 3 AI LU, doctorands 11 VIRAC.

Ratio of female researchers to the total number of researchers: ~ 25 %

Funding

Funding scientific astronomical research in Latvia is made in three ways: (1) via core funding allocated by the Ministry of Education and Science; (2) via research grants, after examination by experts from the Latvian Council of Science; (3) via contracts with different organizations: EC, etc.

(Latvian Council of Science. See more on: <http://www.lzp.lv/index.php?mylang=english>

Latvian Ministry of Education and Science. See more on: <http://izm.izm.gov.lv/58.html>)

Long term plans

The institutions responsible for the preparation of long term, strategic plans in the astronomy/astrophysics are the *Institute of Astronomy of University of Latvia* and *VIRAC*, strategic plan on the development of astronomy for years 2007-2013 exists, confirmed by an Institute academic council. They are not available on the WEB at the moment.

The national space development strategy is being developed.

International collaboration

In Europe:

Member of the Consortium of European Satellite Laser Ranging (SLR) Stations.

EUREF Permanent GNSS network.

Bilateral contracts between the Institute of Astronomy and the Institute of Theoretical Physics and Astronomy, Vilnius University (Lithuania) on research of Small Solar System bodies, funded by the Latvian Ministry of Education and Science through grant accepted by the Latvian Council of Science.

Participation of VIRAC in FP6 and FP7 projects "RadioNet: Advanced Radio Astronomy in Europe" and FP7 "NEXPRES: Novel EXplorations Pushing Robust e-VLBI Services". Funding is originates both from the EC and the Latvian Ministry of Education.

Bilateral agreements – Latvian funding from Latvian Ministry of education and private companies as sponsors: "On Development the University Nanosatellite Venta-1" - University of Applied Sciences Bremen, Ventspils University College, Ventspils High Technology Park, Ventspils International Radio Astronomy Centre, Ventspils University College.

"Research on AIS microsatellite technologies, its use and building capacities in Latvia" - Academic Program Agency, EEZ grants, Institute of Aerospace Technology, University of Applied Science Bremen and Ventspils International Radio Astronomy Centre, Ventspils University College.

LU AI is a member of consortium Fotonika-LV supported by the FP7-REGPOT-CT-2011 project "Unlocking and Boosting Research Potential for Photonic in Latvia - Towards Effective Integration in the European Research Area.

Outside Europe:

Membership in International Laser Ranging Service (ILRS), International GNSS Service (IGS)

Informal (there is not any official agreement, contract etc.) close collaboration with the Radioastrophysical research institute of the Russian Federal Agency for Science and Innovations, Nizhniy Novgorod, Russia and Low Frequency VLBI network (Main facilities in Russia, China, Italy, Ukraine – radio observations of sun, space debris, near Earth Asteroids).

Lithuania

Research areas

The following fields are present in Lithuania:

- stellar photometry and spectroscopy,
- classification of stars,
- Galactic structure and dynamics,
- interstellar extinction,
- modeling of stellar systems,
- orbits of small bodies of the Solar system etc.

B: Ultraviolet, Optical, Infrared and Radio/mm Astronomy

Stellar photometry and spectroscopy, classification of stars, Galactic structure and evolution, interstellar extinction, modeling of stellar systems, orbits of small bodies of the Solar system. Involvement in Kepler and Gaia Space missions.

D: Theory, Computing Facilities and Networks, Virtual Observatory

Grid computing, development of astrophysical applications for Grid computing,

Main actors

Research in astronomy/astrophysics is carried out in 2 universities and 1 research centre. State research centres and institutes intend to carry out high quality research on the national economy and culture. Universities focus mainly on basic research and provide the research basis for university education and for doctoral studies. In the course of the science and study system reform most former state institutes were incorporated into the universities.

The fraction of researchers working in astronomy/astrophysics is less than 0.2% of the total number of researchers in Lithuania (about 16000 according to Eurostat). However, the number of scientific publications in peer-reviewed journals constitutes about 1% of the total number of publications in Lithuania. The Institute of Theoretical Physics and Astronomy of Vilnius University (ITPA VU) publishes the international journal “Baltic Astronomy”. Lithuanian astronomers collaborate with many researchers in other countries; international summer schools, supported by the NordForsk and by the Lithuanian Government are organized every three years at the Moletai Astronomical Observatory.

Research Institutes:

- Center for Physical Sciences and Technology, Department of fundamental research, Mega Systems Physics Laboratory; number of researchers 5, operating personnel 2.

Universities:

- Vilnius University;
- The Institute of Theoretical Physics and Astronomy of Vilnius University (ITPA VU), Astronomical Observatory; number of researchers 15, PhD students 8, operating personnel 9.
- Faculty of Physics, Astronomical Observatory; number of researchers 8, PhD students 2, operating personnel 1.
- Lithuanian University of Education, Department of Physics and Information Technologies; number of researchers 1.

Research facilities:

- Moletai Astronomical Observatory of ITPA VU. 3 telescopes: 165 cm, 63 cm and Maksutov system telescope 31/51 cm.

Personnel

Researchers: 27 (20 PhD)

Associates: 4

Full professors: 3

Temporary positions (Postdocs, Phd, etc.): 1 PostDoc, 10 PhD students.

Ratio of female researches to the total number of researches: ~ **25%**

Funding

The Ministry of Education and Science coordinates R&D funding (consisting of institutional funding and grant funding, administrated by the Research Council of Lithuania and the Agency for International Science and Technology Development Programs in Lithuania). The State universities and institutes are financed through lump sums. There has been a change in the funding scheme in recent years towards more performance-based funding, whereby the lump sums are allocated according to publications and contract research for industry as well as public project grants. This part constituted 15% of public funding until 2009 and is increasing (40% in 2010, 50% in 2011 and 2012). At the moment the science and study system reform is ongoing, with the goal of concentrating human and infrastructure resources in certain research centres (valleys and S&T parks).

The main contributor to astronomy research is the Ministry of Education and Science, but institutional funding is mainly aimed at maintaining existing structures and payments for the scientific staff, and it is not targeted for astronomy research. However, in 2011 Moletai astronomical observatory was included into the roadmap for research infrastructures of Lithuania and a new high-quality echelle-spectrometer with the resolving power of $R=25000-60000$ is planned for the 165 cm telescope in 2015. The agency responsible for R&D grants is the Research Council of Lithuania, which accepts applications of institutions, individual scientists or their groups from all scientific disciplines. Decisions are taken by review panels.

The major part (more than 90%) of astronomy/astrophysics funding is the public institutional funding. Competitive calls, managed by the Research Council of Lithuania, usually result in small (about 50 000 - 100 000 Euros), temporary (two-three years) grants for groups of scientists.

Long term plans

The institution responsible for the preparation of long term, strategic plans in astronomy/astrophysics is *The Lithuanian Astronomical Society*. The strategic plans are not available.

International collaboration

The ITPA VU has usually 2-3 temporary bilateral contracts with institutions in other countries. At present, bilateral contracts with the Latvian University and with the Astronomical observatory of Odessa National University (Ukraine) exist. Individual scientists of ITPA VU are members of the project of GAIA, take part in the network of Whole Earth Telescope (WET), have good relations and co-author papers with astronomers from USA, Denmark, Germany, Italy, Japan, Vatican and other countries.

Poland

Research Topics

In Poland, research related to Astronomy/Astrophysics is conducted in the following fields:

- cometary physics
- planets of the Solar System
- extrasolar planets
- photometry and modelling of variable stars
- stellar atmospheres
- high energy astrophysics
- neutron stars
- cosmology
- observation of radio and X-ray emission from the Sun
- extragalactic radio sources
- active galactic nuclei
- interstellar and intergalactic medium
- galactic physics
- magnetic fields in the Universe and the large-scale structure of the Universe
- radioastronomy
- astroseismology
- space physics, plasma physics
- heliophysics etc.

Main actors

17 universities and institutes from 13 different cities play a role in Astronomy in Poland. The most important ones are:

Universities:

Uniwersytet Wrocławski <http://www/astro.uni.wroc.pl>

Uniwersytet Warszawski <http://www.astro.uw.edu.pl>

Uniwersytet Mikołaja Kopernika w Toruniu <http://www.astro.umk.pl>

Uniwersytet im. A. Mickiewicza w Poznaniu <http://www.astro.amu.edu.pl>

Uniwersytet Jagielloński w Krakowie <http://oa.uj.edu.pl>

Uniwersytet Łódzki <http://www/wfis.uni.lodz.pl>

Uniwersytet Gdański <https://www.iftia.univ.gda.pl>

Uniwersytet Pedagogiczny, Kraków, <http://wmft.up.krakow.pl/>

Uniwersytet Opolski, Opole, <http://www.fizyka.uni.opole.pl/>

Uniwersytet Śląski, Katowice, <http://if.us.edu.pl/>

Uniwersytet Szczeciński, <http://www.fiz.univ.szczecin.pl/>

Uniwersytet Zielonogórski, <http://astro.ia.uz.zgora.pl/>

Akademia im. J. Długosza, Częstochowa, <http://www.if.ajd.czyst.pl/>

Uniwersytet im. J. Kochanowskiego, Kielce, <http://www.ujk.edu.pl/ifiz/pl/index.php>

Uniwersytet w Białymstoku, <http://physics.uwb.edu.pl/>

Research Institutes:

Centrum Astronomiczne im. Mikołaja Kopernika PAN w Warszawie (CAMK) <http://www.camk.edu.pl>

Centrum Badań Kosmicznych PAN w Warszawie <http://www.cbk.waw.pl>

Centrum Fizyki Teoretycznej PAN <http://www.cft.edu.pl>

Research facilities:

Observatories: Chorzów, Grudziądz, Kraków, Łódź, Olsztyn, Opole, Poznań, Wrocław, Toruń, Warszawa,

Zielona Góra.

Private foundations:

Fundacja Astronomii Polskiej, Warszawa.

Fundacja im. Mikołaja Kopernika we Fromborku.

Fundacja Przyjaciół Planetarium i Muzeum Mikołaja Kopernika w Toruniu.

Other:

Societies:

Polskie Towarzystwo Astronomiczne (PTA) www.pta.edu.pl

Polskie Towarzystwo Miłośników Astronomii (PTMA) ptma.astronomia.pl

Klub Astronomiczny Almukantarat almu.astronet.pl

Pałucko-Pomorskie Stowarzyszenie Astronomiczno-Ekologiczne "Grupa Lokalna" (PPSAE) ozma.astronomia.pl

Pracownia Komet i Meteorów (PKiM) www.pkim.org

Polskie Towarzystwo Meteorytowe (PTM) www.ptmet.org.pl

Stowarzyszenie Polaris OPP www.polaris.org.pl

Towarzystwo Obserwatorów Słońca im. Wacława Szymańskiego (TOS) tos.astrowww.pl

Planetariums: 19 planetariums operate in Poland.

Personnel

Researchers: ~150

Associates: ~70

Full professors: ~20

Temporary positions (Postdocs, Phd, etc.) : ~100

Ratio of female researchers to the total number of researchers: ~ **38%**

Funding

Research funding is now provided either directly by the Ministry of Science and Higher Education or through the two agencies: the National Center for Research and Development and the National Science Center.

Ministry of Science and Higher Education funds research through the following schemes: (1) core funding for statutory R & D activities, i.e. institutional funds provided selectively to designated research establishments, units and university departments for covering the costs of their own research activities; (2) investments in R&D infrastructure; (3) peer-reviewed research grants based on research proposals, presented by small research teams or individual researchers (“bottom-up”) within special dedicated schemes like “Narodowy Program Rozwoju Humanistyki” or “Diamantowy grant”; (4) subsidies for international scientific and technological cooperation resulting from intergovernmental agreements.

National Centre for Research and Development/Narodowe Centrum Badań i Rozwoju (NCBiR) – This Polish government-funded agency was established in July 2007. It fulfills its mission mainly by funding and managing strategic scientific research and experimental developmental programs in applied science (“top-down approach”). The Centre is responsible for: specifying research tasks, selecting on a competitive basis organizations (companies, research institutes, universities) to perform these tasks, supervising their implementation and the use of their results into practical application; supporting commercialization and other forms of transferring the results of scientific research to economy; supporting the development of the research staff and implementation of international mobility programs for scientists; ERA-NET projects and EU initiatives art. 169 related (AAL, Eurostars) implementation.

National Science Center (NCN) This Polish government-funded agency was established in August 2010. It is responsible for funding basic research in all areas (Art, Humanities and Social Sciences; Physical Sciences and Engineering; Life Sciences) in “bottom-up” approach. The best projects are selected by panels of scientists, with the help of external reviewers, in particular from abroad. The only criterion is the excellence.

Long term plans:

The Polish Ministry of Science and Education established in 2011 The Road Map for the Polish Research Infrastructure, which contains 33 projects, including 4 projects in Physics and 3 projects in Astronomy

(participation in CTA, LOFAR and a large 90 m radiotelescope).

The current stage of the update of the Road Map for the Polish Research Infrastructure can be found at the website:

<http://www.nauka.gov.pl/komunikaty/ogloszenie-wynikow-ewaluacji-propozycji-projektow-do-polskiej-mapy-drogowej-infrastruktury-badawczej-po-i-etapie-oceny.html>

It contains one new astronomy-related position (Polish participation in VIRGO project)

International cooperation

In Europe:

Collaboration with many European faculties, observatories and institutes in: Austria, United Kingdom, Belgium, Czech Republic, Denmark, Finland, France, Netherlands, Spain, Germany, Russia, Romania, Sweden, Italy, Ukraine, Slovakia, Bulgaria, Hungary.

A large number of bilateral cooperation agreements (e.g. CBK PAN has bilateral agreements with 36 different institutions from 36 countries).

Cooperation among individual scientists.

FP6 and FP 7 Projects.

HELAS Network Cooperation (European Helio - and Asteroseismology Network).

LIGO/VIRGO

WET (Whole Earth Telescope)

BRITE

Einstein Telescope

SALT (South Africa Large Telescope),

LSST (Large Synoptic Spectroscopic Survey) etc.

Outside Europe:

USA, Taiwan, South Korea, Chile, China.

Romania

Astronomy domains

In Romania, the main research fields are related to:

- Solar physics and heliosphere,
- Space weather (SW),
- Stellar Astrophysics,
- Exoplanets,
- Extragalactic Astronomy and Cosmology,
- Celestial mechanics,
- Astrometry,
- Space geodesy,
- Space debris, objects in the Solar System (planets, satellites, NEO, NEA, asteroids, comets),
- Compact objects,
- Relativistic astrophysics,

There is also research in related areas, such as history of astronomy and education in astronomy.

A: High energy astrophysics, Astroparticle Astrophysics and Gravitational Waves

-Space Science Laboratory (Theoretical Physics and Astrophysics; Mathematical Physics; Cosmology and Astroparticle Physics; High Energy Astrophysics and Advanced Technology);

- Space Engineering Laboratory (Space Plasma and Magnetometry; Applications of Space and Communication Technology to Society)

- Gravitation Laboratory (Gravity, Microgravity and Nanosatellites)

B: Ultraviolet, Optical, Infrared and Radio/mm Astronomy

Excitation and damping in Beta Cephei stars, Participation to the CoRoT Space Mission,

Observations: current observations using the 50 cm Cassegrain telescope. Extragalactic Astronomy:

Formation and Evolution of Galaxies and Clusters (using UV, optical and near-infrared data from astronomical databases). Astrometry: CCD observations of approaches ICRF sources and

NEAsteroids: Improving relative positions of reference stars around ICRF radiosources,"Modern Astrometry for Dynamics of the Small Solar System Bodies".

C: Solar Telescopes, Solar System Missions, Laboratory Studies

Dynamics of solar atmosphere and heliosphere: Data analysis, interpretation and modeling;

Multiwavelengths active regions study; Filaments evolution; Coronal mass ejection: onset, evolution, solar sources; Interplanetary mass ejection investigations ,Romanian contributions to the Sun-Heliosphere Studies using SOHO and Ulysses space missions, Study of configurations observed in the solar atmosphere susceptible to give CMEs and other instabilities; The follow up of a CME from an active region to the interplanetary space; Interplanetary mass ejections registered by Ulysses; Magnetic topologies susceptible to give instabilities (CMEs).

Solar instruments:

Solar refractor for photosphere observations (1950/130 mm)

Solar refractor for chromosphere observations (1200/80 mm) with a Solar Observer S-1.5 H alpha filter (0.3 +/- 0.05 A)

D: Theory, Computing Facilities and Networks, Virtual Observatory

Solar MHD numerical simulations of solar active phenomena (filaments, coronal streamers, coronal mass ejections)

Stellar Astrophysics, Theory: Stellar Formation and Evolution, Stellar Seismology, Eclipsing Binaries, Exoplanets.

Extragalactic Astronomy: Formation and Evolution of Galaxies.

Cosmology: Large Scale Structure of the Universe, Baryonic Acoustic Oscillations; Gravitational Lenses.

HPC Supercomputing in the field of Cosmology (N-body codes with SPH, CFD codes); Extragalactic Astronomy (Neural Network codes); Stellar Seismology (Genetic algorithms); Stellar Formation and Evolution; Eclipsing binaries codes.

The SGI supercomputing system in the Bucharest site/node of the Astronomical Institute of the Romanian Academy consists of an SGI ALTIX 3700 Supercomputer with 40 Intel ITANIUM 2 processors, ~250 G flops top speed, 80Gb RAM, 2Tb HDD Storage system.

1. Studies of dynamics of celestial bodies with qualitative and quantitative methods.
2. Digitization of astrophotographical plates of Bucharest: digitization of Bucharest Plate Archive and integration in the Virtual Observatory infrastructure. Data-mining with application for asteroids and natural satellites astrometry.

Main actors in astronomy research

Academic research in Romania is carried out mainly at the Romanian Academy (Astronomical Institute of the Romanian Academy). In space research we have a national space agency (ROSA) and a separate institute (Institute of Space Research) affiliated to the National Institute of Physics.

Research Institutes:

- Astronomical Institute of the Romanian Academy (AIRA) (34, 3 PhD);
- Institute of Space Science (ISS) (77).

Research facilities:

- Bucharest Observatory (telescope 50cm, solar refractor);
- Cluj-Napoca Feleacu Observatory (telescope 40cm);
- Timisoara Observatory (telescope 30cm).

Personnel

Researchers (AIRA and ISS): 111.

Funding

The principal funding agencies are:

- National Agency for Scientific Research (ANCS), Ministry of Education
- National Agency for Scientific Research in Universities (UEFISCDI)
- Romanian Space Agency (ROSA).

ANCS, UEFISC and ROSA organize annually competitions for different types of research projects (EU structural funds, centers of excellence, development of infrastructures, Ideas). The Projects are evaluated by international and national experts. The main actors in astronomy have several successful projects funded by the Agencies. More details at: www.ancs.ro, uefiscdi.gov.ro, www.rosa.ro.

For the Astronomical Institute the principal funding comes from the Romanian Academy. Additional funding comes from national and foreign grants and collaborative projects. In the case of astronomy and space research, funding also comes from ESA.

Long term plans

Separate strategic plans (2014-2020) for AIRA and ISS.

ROSA Strategic plan (2014-2020) for space research is being developed.

UEFISCDI and ANCS Strategic plans (2014-2020) are being developed, with two separate fields: Space (including Astronomy and Space Research), and Security (including Space Situational Awareness - Space debris, NEO and NEA and SW).

National strategic plan in Astronomy (2014-2020) is not yet published.

International collaboration

Within Europe:

- Romania is a member of ESA
- ESO, ENO (ING telescopes)
- SREAC
- Bulgaria, Czech Republic, Hungary, Ukraine, Greece, Germany, Italy, France, Belgium, Spain, Denmark (Kepler/Kasc Consortium), Poland, Serbia

Outside Europe:

- US/NASA (Kepler Space Mission, IRTF telescope/Hawaii)
- Pierre Augier Observatory
- Antares

Serbia

Research areas

In Serbia, research related to Astronomy/Astrophysics is conducted in the following fields:

- Dynamical astronomy: Solar system bodies, double stars, Earth rotation; dynamics of asteroids, motion of artificial satellites
- Astrophysics: Solar physics, close binary stars, astronomical spectroscopy,
- Galactic astronomy, extragalactic astronomy, cosmology, astrobiology;
- stellar kinematics and dynamics
- stellar structure
- radiative transfer
- solar and stellar atmospheres
- radio-astronomy
- supernova remnants
- active galactic nuclei
- particle and nuclear astrophysics
- nucleosynthesis: cosmic rays, lithium problem
- gamma rays
- astronomical spectroscopy

Main actors

Research Institutes:

- Astronomical Observatory of Belgrade (AOB).
- Institute of Physics, Zemun.

Universities:

- University of Belgrade (Department of Astronomy, Faculty of Mathematics)
- University of Novi Sad (Department of Physics, Faculty of Sciences)
- University of Kragujevac (Department of Physics, Faculty of Sciences)
- University of Niš (Department of Physics, Faculty of Sciences).
- University of Priština in Kosovska Mitrovica (Department of Physics, Faculty of Sciences).

Research facilities:

There is one professional observatory AOB (<http://www.aob.bg.ac.yu>) and several amateur observatories in Serbia.

Eight classical instruments constitute the observational basis of the AOB:

1. Large Refractor - equatorial Zeiss 650/10550 mm;
2. Solar Spectrograph (monochromator) Littrow type (Bausch and Lomb grating, 600 l/mm, R~130000 in the fourth order), collimator lens 200/9000 mm, attached to the Zeiss equatorial 200/3020 mm, two astro-cameras Tessar and Petzval 100/800 mm for guiding and
3. projecting;
4. Large Transit Instrument Askania 190/2578 mm equipped with two vacuum meridian marks and Opton collimator;
5. Large Vertical Circle Askania 190/2578 mm;
6. Zeiss Astrograph 160/800 mm;
7. Photovisual Refractor Askania 135/1000 and 125/1000 mm;
8. Transit Instrument Bamberg 100/1000 mm;
9. Zenith - Telescope Askania 110/1287 mm.

The building of a new astronomical station of the AOB on the mountain Vidojevica near Prokuplje at an altitude of 1155 m is completed. The station is currently equipped with the Astro Optik (D=60 cm) reflector, and the preparations for purchasing of a 1.5m class telescope are under way. There are also several small public and university observatories in Belgrade, Novi Sad, Kragujevac etc.

Research activities at the **Astronomical Observatory** cover a wide range of topics and are carried out within 9 research projects, mostly in:

- Dynamical astronomy: Solar system bodies, double stars, Earth rotation;
- Astrophysics: Solar physics, close binary stars, astronomical spectroscopy,
- Galactic astronomy, extragalactic astronomy, cosmology, astrobiology;
- History of astronomy.

Research activities at the **Department of Astronomy of the Faculty of Mathematics, University of Belgrade**, cover the following topics:

- Earth's rotation
- dynamics of asteroids
- motion of artificial satellites
- stellar kinematics and dynamics
- stellar structure
- radiative transfer
- solar and stellar atmospheres
- radio-astronomy
- supernova remnants
- active galactic nuclei
- history of astronomy

Research at the **Department of Physics, Faculty of Sciences, University of Novi Sad**, comprises:

- particle and nuclear astrophysics
- nucleosynthesis: cosmic rays, lithium problem
- gamma rays.

The Department of Physics, Faculty of Sciences, **University of Kragujevac** is specialized in Astronomical spectroscopy

Personnel

Researchers: about 70 in total of which

Associates: 20

Full professors: 10

Temporary positions (Postdocs, Phd, etc.) : 40

The ratio of female researchers to the total number of researchers: 40%

Funding agencies

The funding system is project-based. Projects typically involve several researchers and last four years. Projects are evaluated on a regular basis and the continuation of funding and the amount of support depends on the achieved results.

The role of main funding agency plays the government through its Ministry of Education and Science. There are 4 departments in the Ministry which are involved with science, including one for basic sciences. Minister and the two deputy ministers (state secretaries) with heads of the departments (assistant ministers) are responsible for the management, but there are also different advisory bodies, from the supreme National Board for Science, through numerous commissions, to local boards for each research area (e.g. geoscience and astronomy).

Long term plans

Ministry of Education and Science is in general, responsible for the long-term strategy in science in Serbia. However, as research activities are mainly performed in two institutions, *the Astronomical Observatory in Belgrade* and the *Faculty of Mathematics, Univ. of Belgrade*, these two institutions are responsible for strategic planning and common projects in astronomy and astrophysics.

The current strategic plan is the *Science and technological development strategy of the Republic of Serbia 2009-2014*.

International collaboration

In Europe:

17 astronomers from Serbia are the members of European Astronomical Society; There are collaborations with many European faculties, observatories and institutes in: France, Italy, Russia, Germany, Spain, Greece, Bulgaria, Hungary, Romania, Bosnia, Macedonia, Turkey, Ukraine, etc. There are a number of bilateral cooperation agreements, however, cooperation between individual scientists prevail. The collaboration is particularly important with South East of Europe.

Outside Europe:

Serbia is member of the IAU with 41 individual members.

Collaborations exist with colleagues from the USA, Australia, Brazil, Argentina, mostly based on bilateral contacts. The responsible for these collaborations are research institutions and individual scientists.

The Slovak Republic

Research areas

In the Slovakia, research related to Astronomy/Astrophysics is conducted in the following fields:

- astrometry, photometry and dynamics of the small bodies in the Solar system
- solar physics
- stellar photometry and spectroscopy of binary stars and extrasolar planets

A: High energy astrophysics, Astroparticle Astrophysics and Gravitational Waves

These research areas are not covered directly in Slovakia. The only one exception is the group located at the Department of Space Physics, Institute of Experimental Physics SAS, Kosice.

The group is engaged in research of physical processes in the space, particularly those that can be investigated by cosmic energetic particles, including the cosmic rays. A continuous registration of cosmic rays is provided by a Neutron Monitor at altitude 2633 m above the sea level.

B: Ultraviolet, Optical, Infrared and Radio/mm Astronomy

Astrometry, photometry and dynamics of the small bodies in the Solar system are performed at the Astronomical Institute of SAS, Tatranska Lomnica which operates Skalnaté Pleso and Stará Lesná Observatories, and at Comenius University, Bratislava operating the Modra-Piesky Observatory.

Stellar photometry and spectroscopy of binary stars and extrasolar planets are performed at the Astronomical Institute of SAS, Tatranska Lomnica (using observatories mentioned above) and at the Pavol Jozef Šafárik University in Kosice.

C: Solar Telescopes, Solar System Missions, Laboratory Studies

In Slovakia there is operated a unique Lomnický Peak Observatory (Astronomical Institute of SAS, Tatranska Lomnica) with twin 20cm ZEISS solar coronagraphs devoted to the spectroscopic observations of the solar emission corona and solar prominences. Recently, new coronal polarimeter CoMP-S has been installed at one of the coronagraphs.

Other smaller telescopes at several places in Slovakia (e.g. Slovak Central Observatory at Hurbanovo, public observatories operated by local municipalities) are used for registration of the sunspots only.

Slovakia is not involved directly in any solar system missions. Nevertheless Department of nuclear physics and biophysics of the Faculty of Mathematics, Physics and Informatics, Comenius University in Bratislava is involved in interactions of the cosmic rays and solar system bodies.

Laboratory studies of the cometary material are also performed at the Astronomical Institute of SAS, Tatranska Lomnica in cooperation with foreign partners.

D: Theory, Computing Facilities and Networks, Virtual Observatory

Modelling of the solar system including the Oort cloud, galactic tide, and interaction of solar system bodies is performed at the Astronomical Institute of SAS, Tatranska Lomnica.

Cluster computing facility located at Astronomical Institute of SAS, Tatranska Lomnica is in operation since 2011 and access to the European grid computing facilities is used as well.

Main actors

Academic research in natural sciences in the Slovak Republic is carried out at the Slovak Academy of Sciences (SAS) and at universities.

Research Institutes:

- Astronomical Institute, Slovak Academy of Sciences (AISAS): Department of Solar Physics (9 scientists, 1 PhD student), Stellar department (11 scientists, 1 PhD student), Department of Interplanetary Matter (8 scientists, 2 PhD students).
- Comenius University in Bratislava (CUB) (11 scientists, 1 PhD student)
- Pavol Jozef Safarik University in Kosice (2 scientists)
- Slovak Central Observatory in Hurbanovo (SCO) (4 scientists)

Research facilities:

- Observatory Skalnaté Pleso (AISAS)
- Lomnický štít Observatory (AISAS)
- Stará Lesná Observatory (AISAS)
- Astronomical and geophysical observatory in Modra (CUB)
- Hurbanovo Observatory (SCO)

Personnel

Researchers: ~ 45

Associates: ~ 10

Full professors: 1

Temporary positions (Postdocs, Phd, etc.): ~ 6

Ratio of female researchers to the total number of researchers: ~ 10%

Funding

The principal funding sources are provided by the government directly for the SAS and for universities. Besides of that additional funding comes from national and international grant agencies (EU FPX, etc.). At the moment Slovakia is not a member of ESA or ESO and therefore no funding comes for astronomy and space research by these channels. Extraordinary investments to astronomical infrastructure are now given using the structural funds of the EU.

- Grant Agency VEGA,
- Grant Agency SRDA,
- Slovak Academy of Sciences,
- Ministry of Education, science, research and sport of the Slovak Republic

Long term plans

Institutions responsible for the preparation of long term, strategic plans in astronomy/astrophysics:

- Slovak Academy of Sciences,
- Ministry of Education, science, research and sport of the Slovak Republic
- National Committee for Astronomy.

Available strategic plans: Not yet

International collaboration

- EAST – European Association for Solar Telescopes
- EST – European Solar Telescopes
- JOSO – Joint Organization for Solar Observations

Ukraine

Astronomy domains in the country

Main research areas in Astronomy in Ukraine:

- Formation and evolution of galaxies, cosmology
- Physics of stars
- Solar physics, Solar-Earth interactions
- Ground-based support of space missions, Space physics
- Physics and Kinematics of Solar System Bodies and exoplanets
- Positional astronomy and geodynamics
- High-energy astrophysics
- Radio Astronomy, Gamma-astronomy
- Virtual Observatory

Main actors

Ukraine is a large astronomical country in Europe. In total, about twenty five astronomical observatories and departments at various scientific institutions and universities are engaged in astronomical research. As to the qualitative factors, i.e. number of publications in world recognized journals, citation index, research facilities etc., the situation is not so clear. Research at Ukrainian observatories covers a wide range of disciplines. In the case of observational programs, access to modern astronomical facilities is rather limited. As a result in many cases theoretical interpretations of observations conducted at other observatories still prevails. On the other hand, Ukraine has developed its own astronomical infrastructure which is widely used for the international programs (see section **Research facilities**).

There are 7 Research Institutes in the structure of the National Academy of Sciences of Ukraine (NAS of Ukraine), 2 Research Institutes in the structure of the Ministry of Education and Science, Youth and Sport of Ukraine (MESYS of Ukraine); 15 astronomical observatories and Departments in the structure of the Universities of the MESYS of Ukraine; 1 Private Astronomical Observatory play a main role in the development and teaching Astronomy in Ukraine.

Research Institutes of the National Academy of Sciences of Ukraine

- Main Astronomical Observatory of the NAS of Ukraine <http://www.mao.kiev.ua>
- Institute of Radio Astronomy of the NAS of Ukraine <http://www.ri.kharkov.ua>
- International Center for Astronomical, Medical and Ecological Research <http://www.terkol.com>
- S.I. Subbotin Institute of Geophysics of the NAS of Ukraine,
- Poltava Gravimetric Observatory <http://www.igph.kiev.ua/eng/structure/poltava.html>
- N.N. Bogolyubov Institute of Theoretical Physics of the NAS of Ukraine <http://www.bitp.kiev.ua>
- Astrophysics and Elementary Particle Department <http://bitp.kiev.ua/en/aep.html>
- Ya.S. Pidstryhach Institute for Applied Problems of Mechanics and Mathematics of the NAS of Ukraine <http://www.iapmm.lviv.ua>
- Differential Equations and Theory of Functions Department <http://www.iapmm.lviv.ua/12/index.htm>
- National Scientific Center “Kharkov Institute of Physics and Technology” of the NAS of Ukraine <http://www.kipt.kharkov.ua/en>

- Akhiezer Institute for Theoretical Physics, Department of group-theory properties of elementary particles, nuclear theory and nonlinear mechanics
<http://www.kipt.kharkov.ua/en/itp.html#structure>

Research Institutes of the Ministry of Education and Science, Youth and Sport of Ukraine

- SRI “Crimean Astrophysical Observatory” <http://www.crao.crimea.ua>
- SRI “Mykolaiv Astronomical Observatory” <http://www.nao.nikolaev.ua>

Universities

- Taras Shevchenko National University of Kyiv <http://www.univ.kiev.ua>
 - Astronomical Observatory <http://observ.univ.kiev.ua>
 - Astronomy and Space Physics Department of the Physical Faculty
http://space.univ.kiev.ua/viewpage.php?page_id=5
- V.N. Karazin National University of Kharkiv <http://www.univer.kharkov.ua>
 - Scientific Research Institute of Astronomy <http://www.astron.kharkov.ua>
 - Astronomy Department of the Physical Faculty http://www-physics.univer.kharkov.ua/ua/chairs/k_a.html
- Ivan Franko National University of L'viv <http://www.lnu.edu.ua>
 - Astronomical Observatory <http://astro.franko.lviv.ua/>
 - Astrophysics Department of the Physical Faculty
<http://www.physics.wups.lviv.ua/depts/KAF/index.htm>
- I.I. Mechnikov National University of Odessa <http://onu.edu.ua>
 - RSI “Astronomical Observatory” <http://www.astro-observ.odessa.ua>
 - Astronomy Department of the Physical Faculty
<http://onu.edu.ua/en/structure/faculty/phys/astronomy>
- V.I. Vernadsky Taurida National University <http://www.tnu.crimea.ua/eng/index.html>
 - Astronomy and Methodology of Physics Department of the Physical Faculty
http://www.ccssu.crimea.ua/tnu/eng/structure/physic_fac/astronom/index.html
- Uzhgorod National University <http://www.univ.uzhgorod.ua/en/>
 - Laboratory of Space Research of the RSL Problem Physics Electronics of the Physical Faculty
<http://www.univ.uzhgorod.ua/static/ndi/pndl/index.html>
- Oles Gonchar National University of Dnipropetrovs'k <http://www.dnu.dp.ua/>
 - Theoretical Physics Department of the Physics, Electronics and Computer Systems Faculty
<http://www.dnu.dp.ua/view/ffeks>
- T.G. Shevchenko State Pedagogical University of Chernigiv <http://www.chnpu.edu.ua/>
 - Physics and Astronomy Department of the Physical-Mathematical Faculty
<http://fizmat.chnpu.edu.ua/index.php?pg=kaf-one&id=fa>
- V.O. Sukhomlinsky Mykolaiv National University <http://mdu.mk.ua/#>
 - N.D. Kalinenkov Astronomical Observatory of the Mechanical-Mathematical Faculty
<http://mdu.mk.ua/cats/view/86#>
- N.P. Dragomanov National Pedagogical University <http://www.npu.edu.ua/index.php?lang=en>
 - Experimental and Theoretical Physics & Astronomy Department of the Institute of Physics and Mathematics <http://www.fmi.npu.edu.ua/>
- M. Kotsubynsky State Pedagogical University of Vinnitsa <http://www.vspu.edu.ua>
 - Physics and Training of Physics, Informatics and Astronomy Department of the Institute of Physical, Mathematical and Technological Education <http://vspumetodika.com/>

Private foundations

- Andrushivka Astronomical Observatory, Zhytomyr region, found by Yuri N. Ivashchenko (<http://lfvn.astronomer.ru/optic/andrushevka/index.htm>). Main field of research – Solar System Small bodies, main telescope – Zeiss-600.

Research facilities

Ukrainian astronomical institutions possess a wide range of telescopes. Many of them were constructed 30 and more years ago, but are still in use. The main problem is to upgrade these telescopes and equip them with modern detectors and other devices for making observations and obtaining results of sufficient quality.

Largest Telescopes and Networks:

- The UTR-2, Ukrainian T-shape Radio telescope, (www.ira.kharkov.ua/utr2, <http://www.ri.kharkov.ua/decameter/utr2.php>), is the largest array in the world operated at the decameter wavelengths, extremely low frequencies <25 MHz. This telescope belongs to the Institute of Radio Astronomy of the NASU (S.Ya. Braude Decameter Radio Observatory). It is located near Grakovo village, about 80 km from Kharkiv (northeastern Ukraine). The effective area of the UTR-2 (152,000 sq. m) is more than the effective area of all existing radio astronomical telescopes put together. The resolution is about of 40'x40' at the middle frequency, 16.7 MHz. At present the UTR-2 is under up-grading, namely the development of economic 25-elements antenna-grid from the active dipoles at 8-70 MHz as the first stage to be modified into Giant Ukrainian Radio Telescope (<http://www.ri.kharkov.ua/decameter/gurt.php>)
- A decametric Very Long Baseline Interferometry, VLBI, network URAN was built with the UTR-2 as the basis. Besides UTR-2 it consists of four additional radio telescopes with sizes 5 to 10 times less than that of UTR-2: URAN-1 near Kharkiv (www.ri.kharkov.ua/decameter, <http://www.shukach.com/ru/node/9181>), URAN-2 near Poltava (<http://astronomy.pl.ua/poltava/uran2.htm>), URAN-3 near L'viv (<http://www.ipm.lviv.ua/dp.php?dep=33&type=e&menu=1&language=en>), and URAN-4 near Odesa (<http://www.astro-observ.odessa.ua/index.php?go=Content&id=27>). They are electrically phased steering arrays operating from 10 to 30 MHz. Baselines from 40 km to 900 km provide an angular resolution from several minutes to one second of arc. The angular resolution of 1 arcsec corresponds to the fundamental limit imposed by scattering at these frequencies in the interstellar medium. These network telescopes also belong to the Institute of Radio Astronomy of the NASU.
- The 70-meter dish radio telescope RT-70 is a highly efficient fully tracking instrument located near Evpatoria in Crimea. Its effective area is of 2500 sq. m and its beam width is 2.5 arcmin at the 5-cm radio wave length. There are only 10 antennas of such size in the world. This telescope is being up-graded to provide astronomical research at wavelengths 92, 18.6, and 1.35 cm for future work in the European VLBI network (EVN). This antenna belongs to the National Space Agency of Ukraine, NSAU (<http://www.ri.kharkov.ua/decameter/rt70.php>, <http://ru.wikipedia.org/wiki/%D0%9F-2500>).
- The RT-22 is a radio telescope (<http://crao.crimea.ua/rt22/main.htm/>) operating at mm and cm radio wavelengths located in Simeiz, Crimea. It has a Cassegrain and prime focus feed system on an azimuth-elevation mount and its characteristics are: diameter 22 m, surface tolerance (root mean square) 0.25 mm, wavelength limit 2 mm, and focal length 9.525 m. RT-22 is included in VLBI astrophysical and geodetic projects with the European and USA networks. This instrument belongs to the SRI “Crimean Astrophysical Observatory” of the MESU.
- The Academician Shajn 2.6-meter reflector (<http://www.crao.crimea.ua/~dshakh/>) is the largest optical telescope in Ukraine. The telescope was built in 1961. Its equatorial mount supports a 2.6-m parabolic primary with several optical systems: primary (F/4 and with a focal reducer F/2.6), Cassegrain (f/16), Nasmyth (f/16), and two f/40 Coude foci, direct and bent.

- 2-meter ZEISS telescope at the Peak Terskol, North Caucasus, Russia (www.allthesky.com/observatories/terskol.html). It belongs to the ICAMER.

Moderate-size Telescopes.

- AZT-11 (Crimean Astrophysical Observatory) is 1.25-m Ritchey-Cretien reflector, built 1981. Focus length is 16 m, available foci are Main Cassegrain and Auxiliary Cassegrain. An offset photoelectric auto guider is provided for the Main focus. A TV guider with a 30-cm refractor and a 40 arcmin field-of-view also is available. Objects brighter than 15 mag can be resolved. A computer based control system provides automated pointing with 15 arcsec precision and other services, i.e. fine tracking of fast moving objects (comets, asteroids), access to object catalogues, and dome-telescope synchronization.
- The Tower Solar Telescope TST-1 (Crimean Astrophysical Observatory http://solar.crao.crimea.ua/rus/telescopes.htm#bst_1). A 120 cm coelostat and a 90 cm spherical primary mirror feed the telescope to provide f/56 or f/78 Cassegrain foci equipped with spectrographs.
- ACU-5 (Main Astronomical Observatory of the NASU, www.mao.kiev.ua/sol/sol_w1.html) consists of a 440-mm coelostat and an additional mirror, 440/17500-mm main mirror and 200-mm Cassegrain mirror system with a 60-m equivalent focal length. The spectrograph camera and collimator mirrors are made out of one single block of glass of 500/7000-mm, the grating has a ruled area of 140x150 mm with 600 lines per mm.
- Solar ACU-26 telescope (MAO NASU, www.mao.kiev.ua/sol/sol_w2.html) was constructed at the Peak Terskol in 1989. The diameter of the main spherical mirror is 650 mm with a focal length of 17750 mm. The telescope is equipped with a 5-camera spectrograph permitting simultaneous observations in five spectral regions. The diameter of the collimator and cameras is 300 mm, the focal length 8000 mm. The 250 mm x 200 mm grating, 600 lines/mm, permits dispersion in fourth order of 21.9 mm/nm at 395.0 nm and 33.0 mm/nm at 650.0 nm.
- Two Satellite Laser Ranging telescopes (SLR) at MAO NASU and at Crimean Laser Observatory in Katsiveli, Crimea, are the 100-cm telescopes with Ritchey-Cretien and Coude systems on an English mounting. The equivalent focal length of Ritchey-Cretien system is 13.3 m and of the Coude system is 36.5 m. A CCD-camera with 256 x 256 pixels allows positional and photometric observations. A satellite ranging laser is mounted at the Coude focus. The both SLRs are the members of a SLR world network and participate in the majority of international programs observing satellites.
- The gamma ray telescope GT-48 (Crimean Astrophysical Observatory) is designed for searching and investigating sources of very high energy (VHE) gamma radiation (~1012 eV) by measuring Cherenkov flashes in the Earth atmosphere on moonless nights. The installation GT--48 consist of two independent alt-azimuth arrays 20 m apart. Each array consists of six 1.2-m telescopes with a common focus. Three of them are designed for detection of short ultraviolet Cherenkov radiation initiated by cosmic radiation, gamma-rays as well as charged particles, and have solar blind photomultipliers in their focal planes. The other 3 telescopes image the flashes with 37 photomultipliers (imaging camera).
- The 1.24-m Ritchey-Cretien reflector (Simeiz, Crimean Astrophysical Observatory), diameter of the second mirror is 0.35. Focus length is 14.5 m. English mounting (EM-2). For guiding a synchronous driving gear is used with quartz stabilizator.

Small Telescopes. Small-size telescopes are listed below:

Main Astronomical Observatory NASU – AZT-2 (80cm), GPS station (1m), Axial Meridian Circle, Twin astrograph (0.7 m);
Crimean Astrophysical Observatory – AZT (0.5 m), MTM-500 (0.5 m), AZT-8 (0.7 m);
Astronomical Observatory, Shevchenko National University of Kyiv – AZT-3 (40cm), Horizontal Solar Telescope (0.8m) ;
Astronomical Observatory I.I. Mechnikov National University of Odesa – 1 m and 0.6 m telescopes, two 0.8 m telescopes, two 0.5 m telescopes;
Institute of Astronomy V.N. Karazin National University of Kharkiv – AZT-8 (0.7 m);
Mykolaiv Astronomical Observatory – Axial Meridian Circle, Multi-Channel Telescope ;
Astronomical Observatory I.Franko National University of L'viv – AZT-14 (0.8 m), SRL.

Others:

NGO Scientific Astronomical Societies:

Ukrainian Astronomical Association (UAA) <http://ukraastro.org.ua>

Ukrainian Society for Gravity, Relativistic Astrophysics, and Cosmology

Odessa Astronomical Society

Planetariums: 7 planetariums operate in Ukraine, namely in Donetsk, Kharkiv, Kherson, Kyiv, L'viv, Odessa, Uman.

Personnel

Astronomers (total): 614 of which

Researchers: 239

Professors: 81

Funding

Governmental

National Academy of Science of Ukraine.

Ministry of Education and Science, Youth and Sports.

State Space Agency of Ukraine.

State Fund of Fundamental Research of Ukraine.

National Center “Constellation”

National Center “Mala Academy of Sciences”

International

Science-Technological Center in Ukraine.

Civil Research Development Foundation in Ukraine.

Private

Viktor Pinchuk Foundation, “Zavtra.ua” Program (<http://old.pinchukfund.org/zavtra/>)

Charity foundation “Presidential Foundation of Leonid Kuchma “Ukraine”, “Program for Support of Talented Youth” (<http://www.kuchma.org.ua/fund/programs/122/>)

Long term plans for Astronomy

The planning of research is conducted in frame of the three-years or five-years programs, which are approving by NASU or MESYSU for each of astronomical institutions. Based on these plans, astronomical institutions form their respective plans of activity. Ukrainian Astronomical Association and Coordination Council for Astronomy of the NASU play a central role in the expertize of these plans. Ukrainian Astronomical Association at their meetings (every three years) discusses the strategic plans for development of astronomy and gives these proposals to the NASU and MESYSU, State Space Agency.

Though it is a very difficult task to compose a realistic research planning document taking into account the economic situation in Ukraine, the scientific and investment priorities for Ukrainian astronomy usually were being specified after discussions, both short-term, medium-term as well as strategic ones. The last meeting was in 2009, the next UAA meeting will be at the autumn of 2012.

For details see papers:

Pavlenko Ya. V.; Vavilova I. B.; Kostiuk T. Astronomy in Ukraine. In: Organizations and Strategies in Astronomy, Volume 7, Edited by André Heck. Volume 343 of the Astrophysics and Space Science Library, published by Springer, Dordrecht, THE Netherlands, 2006, p.71 (<http://arxiv.org/pdf/astro-ph/0512442v1.pdf>)

Yatskiv Ya. S.; Vavilova I. B. Astronomy in Ukraine: Overview of the situation and strategic planning for 2004-2011. Kinematika i Fizika Nebesnykh Tel, vol. 19, no. 6, p. 569-573. (<ftp://ftp.mao.kiev.ua/pub/kfnt/19/6/kfnt-19-6-2003-08.pdf>)

International cooperation

Ukraine has at least two forms of the collaboration with foreign colleagues:

- Participation in international projects in the form of individual grants or projects, as collaborators. As a rule, coordinators or principal investigators are foreign scientists. Ukrainian participants obtain some financial support for short time periods (up to three months) and travel abroad.
- Collaborative projects are conducted within the framework of international research programs (for example, FP6, FP7, SFFR of Ukraine, NASU programs at the bilateral basis).

Within Europe:

Collaboration with many European faculties, observatories and institutes in:

Austria, Belgium, Bulgaria, Czech Republic, Estonia, Finland, France, Italy, Germany, Hungary, Latvia, Netherlands, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, United Kingdom.

Outside Europe:

Brazil, Canada, Chile, China, India, Japan, Mexico, South Korea, USA.

Appendix List of abbreviations used in the text

National organisations and institutes

BAS	Bulgarian Academy of Sciences
CASA	Croatian Academy of Science & Arts
CAS	Academy of Sciences of the Czech Republic
EAS	Estonian Academy of Sciences
HAS	Hungarian Academy of Sciences
UL	University of Latvia
LAS	Lithuanian Astronomical Society
PAS	Polish Academy of Sciences
RAS	Romanian Academy of Sciences
AO	Astronomical Observatory, Serbia
SAS	Slovak Academy of Sciences
NASU	National Academy of Sciences of Ukraine
ERC	Estonian Research Council
MSES	Ministry of Science, Education and Sports, Croatia
RSA	Romanian Space Agency
SRA	Slovenian Research Agency

International or European organisations

IAU	International Astronomical Union
OPTICON	The Optical Infrared Co-ordination Network for astronomy
RADIONET	is an Integrated Infrastructure Initiative in Radio astronomy
EVN	The European VLBI Network
SOLARNET	is a network for the major European research infrastructures in the field of high-resolution solar physics
EAST	European Association for Solar Telescopes
IVOA	International Virtual Observatory Alliance
ESA	European Space Agency
ESO	European Southern Observatory

Other

PECS	Plan for European Cooperating States (ESA agreement designed to help countries)
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Journals

A&A	Astronomy & Astrophysics
ApJ	The Astrophysical Journal
MNRAS	Montly Notices of the Royal Astronomical Society
PRD	Physical Review D