THE BYURAKAN OBSERVATORY

5th Edition

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Byurakan Astrophysical Observatory

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GENERAL INFORMATION

Institution:	**Byurakan Astrophysical Observatory (BAO)**
Affiliation:	National Academy of Sciences of Armenia (NAS RA)
Founded in:	1946
Location:	Southern slope of Mt. Aragatz, near village Byurakan, 30 km Northwest of Yerevan
Geographic longitude:	$2^h57^m10^s$ E
Geographic latitude:	40°20′07″ N
Altitude:	1405 m
Number of astronomers:	48
Total number of employees:	87
Main instruments:	2.6 m telescope (ZTA-2.6), 1 m Schmidt telescope, PDS microdensitometer
Address:	Byurakan 0213, Aragatzotn province, Republic of Armenia
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A BRIEF HISTORY OF THE BYURAKAN OBSERVATORY

The **Byurakan Astrophysical Observatory (BAO)** is one of the most important astronomical centres in Eastern Europe and Middle East region, both by its scientific instruments and achievements. The Observatory was founded in 1946 on the initiative of **Viktor Ambartsumian**, the famous Armenian scientist of the 20th century. BAO is situated on the southern slope of Mt. Aragatz (with highest peak at 4090 m altitude), near village Byurakan, some 30 km Northwest to Yerevan, the capital of Armenia. The geographic coordinates are $2^h57^m10^s$ E, 40°20′07″ N, and the altitude is 1405m. BAO is affiliated to the Armenian National Academy of Sciences (NAS RA) and is one of its most important institutions.

V.A. Ambartsumian became the first director of the observatory, and main directions of astrophysical investigations were determined by him. First studies at the Byurakan Observatory related to the instability phenomena taking place in the Universe, and this trend became the main characteristic of the science activity in Byurakan.

Haik Badalian, Beniamin Markarian, Ruben Sahakian, Grigor Gurzadian, Ludwik Mirzoyan, Nina Ivanova, Vagharshak Sanamian, Marat Arakelian, Edward Khachikian, Karlos Grigorian were among the first astronomers, who began their scientific life with the observatory and continued it for many years.

In 1946 ***Communications of the Byurakan Observatory*** were founded as the main journal for Byurakan astronomers. Ambartsumian became its first editor-in-chief.

The building works began in the spring of 1946 under the supervision of famous architect **Samvel Safarian**. The first structures were the central building, hotel and the towers of the first astronomical instruments: 5″ double astrograph, 8″/12″ Schmidt telescope, 10″ telescope-spectrograph, nebular spectrograph, 16″ Cassegrain telescope and 21″/21″ (53 cm) Schmidt telescope. They were built up in 1951-55. The 21″/21″ telescope was the main instrument for those years, being used for the investigation of structure and radiation properties of galaxies.

Since 1950 works on construction of **radiotelescopes** began. Two synphased antennas for observations in 4.2 m wavelength and two synphased antennas for 1.5 m wavelength were constructed. In 1950-1951 the laboratories of instrument-making, radioastrophysics, stellar astronomy and spectroscopy, as well as observatory's library were organized.

Scientific results came just after the foundation of the Byurakan Observatory. In 1947 stellar systems of new type, **stellar associations** were discovered by V.A. Ambartsumian. It was proved that at present star-forming processes are going on in the Universe, and stars are being formed by groups. Ambartsumian put forward an idea of star-forming in stellar associations together with gas and dust.

In November 1951, the first scientific meeting was held in the Byurakan Observatory. *Stellar Associations* were the subject of the conference. The observatory was not entirely built yet, but the investigations of Byurakan astronomers became well-known to the international astronomical community.

On September 19, 1956, the official opening of the Byurakan Observatory was celebrated by holding a conference on *Non-stable stars*. J. Greenstein, G. Herbig, G. Haro, E. Schatzman, P.L. Kapitsa, B.V. Kukarkin, V.V. Sobolev and other prominent scientists were among the guests.

In the mid-50s Ambartsumian gave a new explanation for radiogalaxies radiation and proposed a new conception on the activity of galactic nuclei. By the time, it was accepted by all the astronomers, and at present most of the astrophysical observatories have the subject of **Active Galactic Nuclei (AGN)** as one of their main research areas.

The discovery of stellar associations and Ambartsumian's idea about activity of galactic nuclei, as well as investigations on radiation transfer theory, based on Ambartsumian's principle of invariance, elucidated the further development of

the research activities in Byurakan Observatory.

V.A. Ambartsumian and R.K. Shahbazian found in nearby galaxies concentrations of young stars, which they called *superassociations*, as well as blue companions around some galaxies, which might be thrown out from them. Later on, they found **compact groups of compact galaxies** (named after Shahbazian); objects that are subject for detailed studies up to present days.

In early 1960s, V.A. Ambartsumian and G.S. Sahakian (YSU) studied possible states of **superdense matter** and proved the possibility of existence of baryonic and hyperionic configurations with nuclear-like densities and of several Solar masses.

In 1960, a new **Schmidt telescope** with 40″ (102 cm) correcting plate and 52″ (132 cm) mirror was installed in Byurakan. Soon, in 1965, B.E. Markarian started a survey with a goal of revealing UV-excess galaxies (***First Byurakan Survey – FBS***, co-authors V.A. Lipovetski and J.A. Stepanian). It was continued for 15 years and became one of the most famous surveys in modern astronomy. As a result, 1500 galaxies with UV-excess, named now Markarian galaxies, were discovered. Up to now, Byurakan Schmidt is one of the largest and one of the most efficient Schmidt telescopes in the world. The Markarian survey was the first systematic survey for AGN, and until now is the largest spectroscopic survey in the world.

Observations of Markarian galaxies in the Byurakan and other observatories revealed a lot of new interesting objects. E.Ye. Khachikian, together with D. Weedman (USA), discovered many new Seyfert-type galaxies and for the first time made a classification of these AGN. H.M. Tovmassian and colleagues discovered and studied the radio emission of many Markarian galaxies. More active galaxies were discovered from the lists compiled by M.A. Arakelian, who selected and published galaxies with high surface brightness. Later on Markarian galaxies have been studied by K.A. Sahakian, A.R. Petrosian, et al.

In 1964 and 1971 conferences on extraterrestrial civilizations were held. The meeting of 1971 was the first international symposium on the problem of *Extraterrestrial Civilizations and Communication with Them.* Many prominent scientists, including astronomers, physicists, chemists, biologists, philosophers, and specialists of other related fields participated in the symposium.

In 1965 an all-Union astrophysical journal, ***Astrofizika*** *(*English translation: *Astrophysics)* was founded, and Byurakan astronomers began to publish their papers mainly in it. The *Astrofizika* became the main astrophysical journal of the Soviet Union as well.

IAU Symposium No. 29 in May 1966 on *Non-Stable Phenomena in Galaxies* will remain as one of the most interesting events during the history of the observatory. J. Oort, F. Zwicky, G. Burbidge, E. Burbidge, M. Schmidt, and many other well-known scientists were present.

In 1960, H.S. Badalian carries out classification of **cometary nebulae**. E.S. Parsamian discovered many new cometary nebulae and published their catalogs (1965, 1979). Later on, A.L. Gyulbudaghian and T.Yu. Magakian found and studied the variability of some cometary nebulae. Together with colleagues, later on they discovered and studied many other young stellar objects and stellar jets.

In 1968, for its great merit to the development of science, the Byurakan Observatory was awarded the highest prize of the Soviet Union, Lenin Order. A conference was held, devoted to V.A. Ambartsumian's 60-years anniversary. He presented a new work on **statistical investigation of flare stars**, estimating the real number of these objects, and predicted that all dwarf stars pass through the stage of flare activity.

Beginning with the late 60s, the investigation of **flare stars** became one of the main subjects of the Byurakan Observatory. Hundreds of flare stars in star clusters and associations (Pleiades, Orion, Hyades, Praesepe, Cygnus, Coma, etc.) were discovered by L.V. Mirzoyan, E.S. Parsamian, H.S. Chavushian, L.K.

Erastova, et al. Early stages of evolution of dwarf non-stable stars were investigated.

A project on **space astronomy** studied in Byurakan in late 60s. Under the supervision of G.A. Gurzadyan, Byurakan scientists designed and built two ultraviolet *"Orion"* space observatories that operated onboard Soviet spacecrafts in 1971 and 1973. Later on, H.M. Tovmassian designed and built *"Glazar"* space observatory, which operated in 1987 onboard Soviet space station "Mir".

A.G. Nikoghossian, M.A. Mnatsakanian, and N.B. Yengibarian in late 1960s and 1970s obtained new solutions in **radiation transfer theory** with application of principle of invariance for finite thickness layers and plain-parallel medium. They also obtained new results in various fields of mathematical physics.

The installation of the **2.6 m telescope** (one of the largest telescopes in the world at that time) was rather important event in the observatory's life. The opening of the telescope in October 1976 was accompanied by a symposium on *Flare Stars*. Scientific meetings on these and related objects were held in 1979 and 1984, too.

Since 1977, a **specialized council** for theses defenses functions. Ambartsumian was its chairman in 1977-96. The council accepts theses on astronomy, astrophysics and theoretical physics. More than 50 scientists have defended Ph.D. (Candidate) and Doctoral theses during these years.

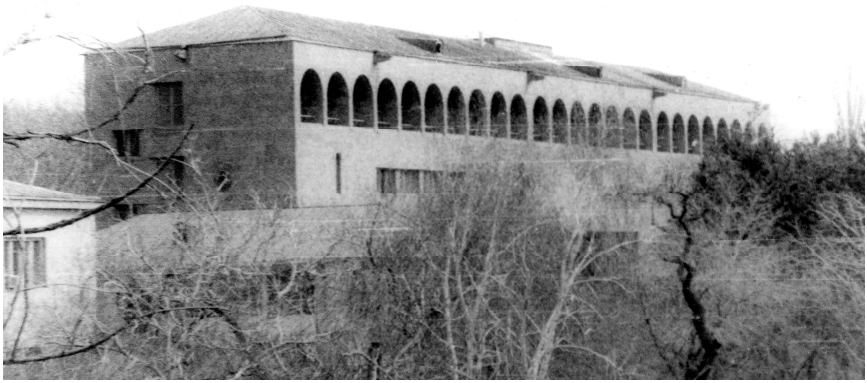
In 1978 the ***Second Byurakan Survey (SBS)*** was conducted by B.E. Markarian, J.A. Stepanian, et al. The main goal was to obtain a homogeneous sample of quasars, emission-line and UV-excess galaxies for further cosmological investigations. More than 600 deep-limit plates were obtained during 15 years and some 3600 interesting objects were discovered.

In October 1981, a Symposium on *Principle of Invariance and its Applications* was held. It was devoted to the 40^{th} anniversary of the Principle of invariance, Ambartsumian's theory, which found many applications in various fields of science.

In 1980s two **IAU symposia** were organized in Byurakan. IAU Symposium No. 121 on *Observational Evidences of Activity in Galaxies* (June 1986) gathered many outstanding astrophysicists from 17 countries. Many aspects of Ambartsumian's hypothesis and the classical theory of AGN were discussed. IAU Symposium No. 137 on *Flare Stars in Star Clusters, Associations and Solar Vicinity* was held in October 1989 and gathered specialists of the

corresponding field. Byurakan Observatory was recognized as one of the world main centres of investigations on flare stars.

In 1987 the *Second Part* of the *First Byurakan Survey (FBS)* was conducted, search and studies of the FBS stellar objects; both blue (UV excess) stellar objects (BSOs) and red (late-type) stars. It was carried out by H.V. Abrahamian, A.M. Mickaelian, and K.S. Gigoyan and resulted in discovery of 1103 BSOs (including bright QSOs, Seyferts, white dwarfs, cataclysmic variables, etc.) and nearly 1000 red stars (late M-type and C stars).



In 1986 the research divisions were abolished and small research groups were formed for more efficient scientific work. The divisions were re-established in 1995 and exist together with groups, each including a few of them. In 1988 V.A.Ambartsumian retired from the position of director of the observatory, and E.Ye. Khachikian occupied it. Ambartsumian remained the honorary director of BAO until his death in 1996. In 1993-94 H.A. Harutyunian was the acting director, in 1994-1999, the director was A.R. Petrosian, and in 1999-2003, E.Ye. Khachikian became the director for the second term. Since 2003, H.A. Harutyunian is the director of BAO.

After the disintegration of the Soviet Union, the Byurakan astronomers underwent difficult situation in economy and science, however, in a few years a new activity began in mid-90s with some re-organizational process and new international collaborations. Due to French astronomers, the 2.6m telescope was equipped with new instrumentation and started to give new interesting results.

Two meetings (*French-Armenian Astronomical Colloquium* in 1995 and an

International Symposium, devoted to the 50th anniversary of the Byurakan Observatory in October 1996) showed that astronomers of the Byurakan Observatory continue to develop Ambartsumian's ideas and have achieved new interesting results.

In August 1998, the IAU Symposium No. 194 on *Activity in Galaxies and Related Phenomena*, dedicated to Ambartsumian's 90th anniversary, was held in Byurakan. More than 100 astronomers – the most known specialists of the field from 24 countries, presented and discussed their results and prospects in this area.

A new important meeting, IAU Colloquium 184 on *AGN Surveys* was organized in Byurakan in June 2001. 95 scientists from 20 countries took part. The meeting was devoted to B.E. Markarian, the scientist who carried out the first systematic survey for active galaxies and opened a new era of investigations.

One of the important activities in Byurakan is the organization of **summer schools** and **astronomical Olympiads** (competitions for pupils and students). Several such events were organized in 1995-2005, and the First Byurakan International Summer School was held in August-September 2006, where 8 foreign lecturers and some 30 students participated. The next school was organized in September 2008. The Byurakan International Summer Schools will be held regularly once in each two years, and an IAU International School for Young Astronomers (ISYA) is planned for 2010.

In 2002-2005, in collaboration with Università di Roma "La Sapienza" (Italy) and Cornell University (USA) teams, the Markarian survey (First Byurakan Survey) plates were digitized and the **Digitized First Byurakan Survey (DFBS)** database was created. It is one of the largest spectroscopic databases in the world and the largest astronomical database in Armenia.

In August 2007, the Byurakan Observatory, together with the European and Armenian astronomical societies and Yerevan State University, was one of the organizers of the **JENAM-2007** in Yerevan, the Joint European and National Astronomy Meeting. It was the largest scientific event ever organized in Armenia; 8 parallel EAS symposia and 5 special parallel sessions were organized. 248 scientists from 31 countries participated, and 358 plenary, invited, oral, and poster contributions were presented.

Due to obtained results the Byurakan Observatory is recognized by the scientific community as one of the main centres for astrophysical research. The conceptions and ideas proposed in Byurakan have found their further elaboration in many observatories, a few thousands of new objects discovered in

Byurakan are observed worldwide by famous astrophysicists.

Byurakan astronomers have participated in all large international astronomical meetings: *International Astronomical Union* (*IAU*) General Assemblies, Symposia, and Colloquia. Many of them are members of various IAU Commissions. V.A. Ambartsumian was IAU President in 1961-64 and Vice-President in 1948-55, B.E. Markarian and E.Ye. Khachikian have been the Presidents of the IAU Commission No. 28 (*Galaxies*), each for 3 years.

The prestige of the Byurakan Observatory was enhanced by the many-years fruitful research work and is on high level during its 60-years history. Many international scientific meetings have been held in Byurakan and dozens of astronomical institutions all over the world collaborate with the Byurakan Observatory, including observatories and astronomical institutes of Australia, France, Germany, Italy, Japan, Mexico, Russia, Spain, UK, USA, etc. Nobel Prize winners Pablo Neruda, Subrahmanian Chandrasekhar, Charles Towns, Francis Krik, Freeman Dyson and Tomonaga, outstanding scientists J. Oort, F. Zwicky, J. Greenstein, G. Herbig, G. Haro, H. Arp, B. Bok, E. Burbidge, G. Burbidge, M. Schmidt, P.L. Kapitza, V.M. Keldish, Y.B. Zeldovich, V.L. Ginzburg, and many others and other honorary guests have visited the Byurakan Observatory to make an acquaintance of famous astronomical centre, study its scientific program, discuss different scientific problems with Byurakan astronomers and to take part in joint investigations.

Since 1998 the Byurakan Observatory bears the **name of V.A.Ambartsumian** – its founder and scientific leader for many years. It is now more than 60 years that the Byurakan Observatory is among the world astronomical centers and successfully continues its new discoveries and high-level research.

V.A. AMBARTSUMIAN - FOUNDER OF THE BYURAKAN OBSERVATORY

Viktor Amazasp Ambartsumian was born in September 18, 1908, in Tbilisi. After the graduation of the Leningrad (Saint-Petersburg) University and post-graduate studentship in Pulkovo Observatory, he founded at the University the first Department of Astrophysics in the Soviet Union. In 1943, V.A. Ambartsumian was one of the founding members of the Armenian Academy of Sciences and its Vice-President. Soon, in 1947, he became the President of the Academy, and since 1993 he was its honorary president.

In 1946 the Byurakan Astrophysical Observatory of the Academy of Sciences of Armenia was founded. Since the first days till 1988 V.A. Ambartsumian was the director and scientific leader of the Byurakan Observatory. And since 1988 he was its honorary director. Thanks to Ambartsumian's and his colleagues' works it became one of the known observatories in the world. Ambartsumian's works are distinguished in perfection and almost every time opened new directions in astrophysics. His works on physics of gaseous nebulae and radiation transfer theory are classic. They played important role in this field, in particular, in the theory of multiple light scattering. The invariance principle, formulated in these works for the first time, had a wide application in a number of other fields of the science. Ambartsumian's investigations on the problem of stellar evolution brought in 1947 to revealing of stellar systems of new type, stellar associations. The existence of stellar associations in the Galaxy, dynamically non-stable and disintegrating systems, was the first observational evidence in favour of continuing at present star-formation in it. Ambartsumian put forward a hypothesis about the joint origin of the diffuse matter and stars of dense matter of unknown nature, protostars. Ambartsumian's studies of early stages of evolution of stars and stellar systems are rather significant. It was shown, that in the early stages of the evolution, the instability of state reveals itself, being the regular phase of the cosmogonic processes. Among these results the conclusions about the existence of stellar systems of positive total energy in the Galaxy, non-thermal nature of ultraviolet stellar radiation of T Tauri type and flare stars, are to be mentioned. New principle results were achieved by V.A. Ambartsumian in study of evolution of galaxies. It was shown for the first

time that the central regions of galaxies, their nuclei, play decisive role in the phenomena of instability, observed in galaxies. Besides the stars and diffuse matter they must contain dense massive bodies of unknown nature. The activity of galactic nuclei defines their evolution. At present the active galactic nuclei (AGN) are the most intensively studied objects in extragalactic astronomy.

Ambartsumian has carried out some other investigations of great importance in astrophysics as well, such as the study of interstellar absorbing matter in the Galaxy (the idea of its clumpy structure, the theory of fluctuations of light of the Milky Way), works on stellar dynamics (establishing of the basis of new, statistical mechanics of stellar systems), statistical investigations of flare stars, and others. Ambartsumian was an outstanding organizer of science, who significantly promoted the international scientific cooperation. In 1948-1955 he was the Vice-President, and in 1961-64, the President of the International Astronomical Union (IAU), in 1968 and 1970 he was twice elected the President of the International Council of Scientific Unions (ICSU). His many-sided activity accepted high estimate. He was awarded governmental prizes, orders and medals of a number of countries (Twice Hero of Socialist Labour in 1968 and 1978, USSR State Prizes in 1946 and 1950, Russian State Prize in 1995, National Hero of Armenia in 1994), gold medals of a number of academies and scientific societies. He was elected honorary and foreign member of 28 Academies of Sciences, including USA, UK, France, Italy, Holland, Belgium, Denmark, Sweden, Greece, Czechoslovakia, India, Argentina, and other National Academies, honorary member of scientific societies of many countries, honorary doctor of the Universities of Canberra (Australia), La Plata (Argentina), Warsaw and Torun (Poland), Prague (Czechoslovakia), Liege (Belgium) and Sorbonne (France). V.A. Ambartsumian has published about 20 books and booklets, more than 200 scientific papers, numerous popular articles.

Victor A. Ambartsumian passed away in August 12, 1996 in Byurakan. He will remain forever as one of the most outstanding scientists of the XX century.

OTHER FAMOUS ASTRONOMERS, FORMER BAO ASSOCIATES

Beniamin MARKARIAN (1913-1985). Beniamin E. Markarian was one of the greatest Armenian astronomers who conducted and accomplished the famous Byurakan Surveys (FBS and SBS) with the 1 m Schmidt telescope using objective prisms that revealed UVX galaxies and contributed in many discoveries, including understanding of the AGN phenomenon. Markarian's survey (FBS) was the first systematic spectroscopic survey in the world and until now is the largest one. Markarian galaxies are well-known as they are among most important objects in any field of extragalactic astronomy. It was found that among the objects having UV excess, there appear objects with various evidence of activity; QSOs, Seyfert galaxies, BL Lac objects, sources of radio, infrared and X-ray radiation. Markarian's other achievements include study of stellar associations. He worked out a new classification of stellar clusters and made up the first systematic catalogue of O-associations with mentioning of stellar clusters in them. Markarian has made up an *"Atlas of stellar clusters"*, which was used widely by astronomers of many observatories. Markarian published over 100 scientific papers. In 1965 Markarian was elected a Corresponding member of the Armenian Academy of Sciences, and in 1971, its Full member. In 1973-1976 Markarian was the Vice-President, and in 1976-1979, the President of the IAU Commission #28 *"Galaxies"*. In 1950 Markarian was awarded the USSR State Prize, and in 1961, the title of Deserved Figure of science of Armenia.

Grigor GURZADYAN (b. 1922). Another great Armenian astronomer, Grigor A. Gurzadyan is famous for his pioneer works in the field of space astronomy. He has designed space orbital observatories; Orion-1, the first space telescope with an objective prism worked onboard the first space station Salyut 1 in April, 1971, and the highlight was Orion 2 space observatory operated onboard the spacecraft Soyuz 13 in December 1973. Spectra of thousands of stars to as faint as 13^m were obtained, as well as the first satellite UV spectrogram of a planetary nebula. In 1990s he developed the theory of common chromospheres (roundchromes) of close binary stars and of evolution of binary globular clusters. Gurzadyan has contributed in the fields of flare stars (theory of flares) and planetary nebulae (theory of origin of nebulae). He has published over 200 papers and a number of monographs, including *Radioastrophysics* (1956), *Planetary Nebulae* (1962, 1970), *Flare Stars* (1973, 1980), *Stellar Chromospheres* (1984), *Physics and Dynamics of Planetary Nebulae* (1988, 1997), *Theory of Interplanetary Flights* (1996), *Space Dynamics* (2002). He is a member of the Armenian Academy of Sciences (1986; corresponding member 1965), Doctor of Science, 1955, headed the branch of Byurakan observatory on space research (1973-1992) and Garni Space Astronomy Institute (1992-2004).

Ludwik MIRZOYAN (1923-1999). *Prof.* Ludwik V. Mirzoyan's was a rare scientist who could combine scientific, administrative, organizational, editorial, and pedagogical works. Mirzoyan's important scientific results are: a new method for measuring of the interstellar selective absorption; a method of "synthetic" association and proving of expansion of OB-associations; measurement of the A-constant of the rotation of our Galaxy; study of the problem of K-effect; discovery and study of hundreds of flare stars in Orion, Pleiades and other systems and in solar vicinity, etc. Mirzoyan was an author of 271 publications, including 15 books and booklets. Mirzoyan was the Scientific Secretary of BAO (1953-1959), its Deputy Director for science (1959-1986), the Head of the Department of Physics of Stars and Nebulae (1965-1999), Head of a research group (1986-1999. He was doctor of science (1968), Professor of the YSU (1970), Honored Worker of Science of Armenian SSR (1974), Editor-in-Chief of the journal *Astrofizika* (1988-1999), Corresponding Member of the Armenian NAS (1986), and Academician of the Armenian NAS (1996). He was a member of the International Astronomical Union (1958), the Astronomical Council of the USSR (1970), Corresponding member of the International Astronautics Academy (1970), advisory member of Institute d'Astrophysique de Paris (1970-1975), and member of the European Astronomical Society (1990).

Marat ARAKELIAN (1929-1983). Marat A. Arakelian is one of the well-known Byurakan astronomers, the author of famous Arakelian galaxies, which are target of many-sided studies for many astronomers, as well as Space telescopes. Arakelian was known as a prominent specialist in extragalactic astronomy. He proved the extragalactic origin of quasars, suggested a new method of definition of space density of extragalactic objects. In collaboration with specialists of the Sternberg Astronomical Institute (SAI, Moscow) he measured radial velocities of 800 faint galaxies and quasars. He observed and studied a few hundred Markarian galaxies and discovered more than 40 new Seyfert galaxies (together with E.A. Dibai and V.F. Esipov). The *"Catalogue of high surface brightness galaxies"* created by Arakelian is well known. The objects of his Catalogue (so called Arakelian galaxies) have been observed in optical wavelengths, radio and X-rays. Arakelian carried out a number of other investigations as well, such as the classification of the central regions of 711 galaxies, study of the dependence of emission-line intensities in Seyfert galaxies on color index, studies of Seyfert galaxies in clusters (with V.Yu. Terebizh), statistical work on morphological types of isolated galaxies and components of pairs, etc. Arakelian was doctor of science (since 1976), IAU member (1973). He published about 100 scientific papers.

Hrant TOVMASSIAN (b. 1929). *Prof.* Hrant M. Tovmassian is one of the most famous Armenian astronomers, the leader in the field of radioastronomy. He worked at BAO in 1953-1992 and since 1992 is a senior scientist at INAOE in Mexico. Tovmassian's main research fields are radiogalaxies, radio properties of Markarian galaxies, space astronomy, Shakhbazian and Hickson compact galaxy groups, etc. He detected radio emission from many galaxies with abnormal spectra and colors, and proved Markarian's suggestion that these galaxies partly have non-thermal optical emission. Tovmassian showed that compact groups (CG) of galaxies are real physical formations and that they are embedded in loose groups in their surroundings. He concluded that CGs are stable, and rotating configurations. He published more than 210 papers, and 12 books. Tovmassian was Scientific Secretary of BAO (1969-1972), its Deputy Director for Science (1979-1986), Head of Laboratory (since 1972), Doctor of Science (1970), Head of Laboratory (1972-1986), Head of a research group (since 1986), Professor of YSU (1967-1995). He initiated and headed *"Glazar"* (launched on the Mir Space Station in 1987) and *"Ashot"* space observatories projects. Editor-in-Chief of *Communications of the Byurakan Observatory* (1986-1991), member of IAU (1967), EAS (1990), Mexican Scientific Society (1994), and ArAS (2002).

Rudolf MURADIAN (b. 1936). *Prof.* Rudolf M. Muradian, a famous theoretician physicist, worked at BAO as a Leading research associate from 1984 till mid 90s when he left for Universidad Federal de Baya in Brazil. He is known for his works in the field of elementary particles, large-scale structure of the Universe and cosmology, superdense matter, and mathematical physics. On the basis of the properties of interactions of elementary particles, he suggested the scale invariance hypothesis in high energy physics resulting particularly in so-called quark formula. Muradian suggested a cosmological hypothesis based on V.A. Ambartsumian's cosmologic theory, which allows quantitatively explaining the origin of the rotation of celestial objects (stars, galaxies, etc.) based on relation between torque and mass known in physics of elementary particles. Muradian has graduated from Moscow State University in 1959, worked in 1962-1979 in the Laboratory of Theoretical Physics of the United Institute for Nuclear Research in Dubna (Russia), in 1979-1986 he was the Head of the Ray Research Department of the Yerevan Institute of Physics. Doctor of Physical-Mathematical Sciences (1970), Academician of NAS RA (1996), Lenin Prize Winner (1988).

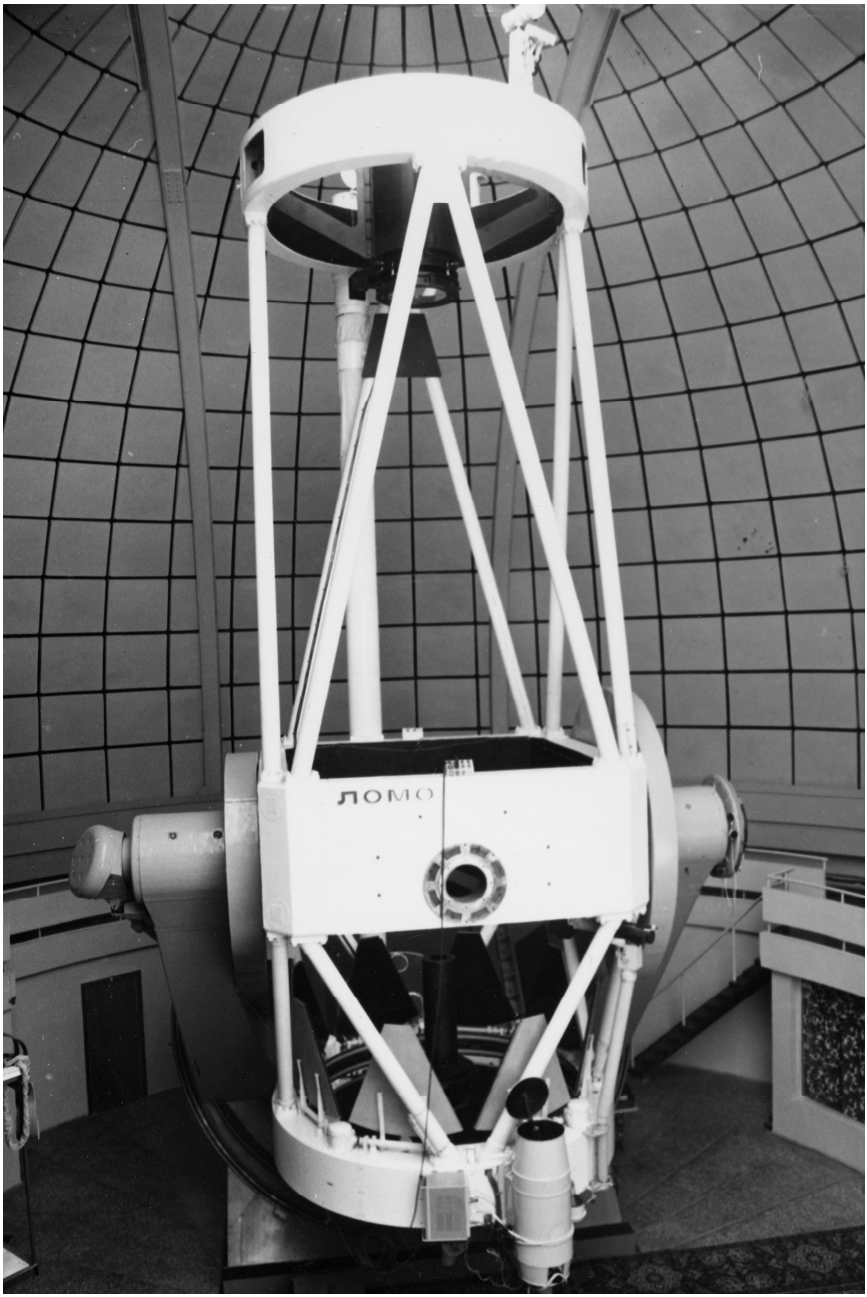
THE TELESCOPES

2.6m TELESCOPE

In operation	since 1975 (first light in 1976)
Altitude	1406 m
Constructed by	Leningrad (St. Petersburg) Optical Equipment Works
Chief designer	Bagrat K. Ioannissian
Mounting	Equatorial
Mounting type	Fork
Aperture	260 cm
Aperture ratio (D/F)	1:3.85
Primary focus	
Focal length	10 m
Field	45′ (with corrector) and 2′ (without corrector)
Size of plates:	16×16 cm
Scale	20.6 /mm
Cassegrain focus	
Focal length	40 m
Field	4′
3 Nasmyth foci	
Focal length	40 m
Field	12′
Coudé focus	
Focal length	105.4 m
Field	1′40″
Mirror material	Sitall
Optic by	Leningrad (St. Petersburg) Optical Equipment Works

Being one of the largest telescopes in European, Asian and African region, the Byurakan 2.6m telescope allows to make detailed spectral, photometric and other investigations of interesting faint objects.

The 2.6m telescope (often called **ZTA-2.6**, in Russian, Armenian (or Ambartsumian) Mirror Telescope of 2.6m size) was installed in 1975 (its altitude is 1406m above sea level) and is in operation since 1976. It was constructed by the Leningrad (St. Petersburg) Optical Equipment Works (LOMO) and the chief designer was **Bagrat K. Ioannissian**, who was also the chief designer of the SAO 6m and Crimean 2.6m telescopes. The mounting of the telescope is equatorial, and the mounting type is American (fork). It is a


ЛОМО

classical Cassegrain system telescope. Its 4 tons parabolic primary mirror is made of "sitall" (pyroceramics) and has a diameter of 264 cm (104 inch), and the pure aperture is 260 cm. The primary focal length is 10 m, and the aperture ratio (D/F) is 1:3.85. The telescope's useful field is 45′ (with corrector) and 2′ (without corrector). The scale is 20.6″/mm. The Cassegrain (and 3 Nasmyth) focal lengths are 40 m (1:15.4 focal ratio), and the fields are 4′ and 12′, respectively. The telescope also has a Coudé focus with 105.4 m focal length (1:40.5 focal ratio) and 1′40″ field. However, mainly the primary and Cassegrain foci have been used.

During 1976-1991, the primary observations have been carried out on Kodak and Orwo plates on the morphological study of Markarian galaxies, investigation of star clusters, groups and clusters of galaxies. The spectroscopic observations have been carried out at Cassegrain focus. The UAGS spectrograph with or without image tubes provided dispersions of 50, 100, and 200 Å/mm. The observed 5000 slit spectra on this telescope are of stellar objects of the First Byurakan Survey, T Tau and flare stars, objects of the Second Byurakan Survey, etc.

During 1996-1999, works on re-organization and re-functioning of the telescope were carried out. The new equipment was designed and assembled in the Marseille Observatory (France), in frame of the French-Armenian collaboration PICS/Jumelage. The optical design was further improved in the Byurakan Observatory. The new equipment, installed at the prime focus, is called ByuFOSC - Faint Object Spectral Camera for the Byurakan 2.6m telescope, and after its modification, ByuFOSC-2. It consists of the pointing and auto guiding system «Bonnette», focal reducer (similar to ESO's EFOSC) and CCD detector (Thomson 1060x1028 pix, 19μ pixel size). Focal reducer provides the parallel beam for the spectral and interferometric modes. The focal length of the collimator is 150mm and the focal length of the camera is 92mm. In 2000, another new instrument, spectral camera SCORPIO (Spectral Camera with Optical Reducer for Photometric and Interferometric Observations) was built for the 2.6m telescope at the Russian Special Astrophysical Observatory (SAO) in frame of the Russian-Chinese-Armenian trilateral collaboration. The focal length of the collimator is 146mm and the focal length of the camera is 106mm. A new 2063x2058 pix Loral CCD (16μ pixel size) was also attached to this camera. A unique instrument, the VAGR ("tiger") integral field unit (IFU) was built in the Byurakan Observatory in frame of the French-Armenian collaboration as well. The focal length of the collimator is 250mm and the focal length of the camera is 110mm. The micro-lenses array consists of 40×40 lenses, and a 600 groves grism is being used. The recorded data cube has 40×40×250 size.

During the observations of 1996-2007, new interesting results have been obtained. Faint objects in a 1° field are being observed to find high-redshift primordial galaxies. Hundreds of IRAS and SBS galaxies, as well as many non-stable stars and young stellar objects have been studied spectroscopically. A systematic search for emission-line objects is being carried out with the 2.6m telescope, too.

At present the following modes are being used at the 2.6m telescope:

Imagery. ByuFOSC-2: 11′×6.3′ field, 0.63 arcsec/pix scale; SCORPIO: 14′×14′ field, 0.42 arcsec/pix scale. B,V,R,I and narrow-band (interferometric) filters, limiting magnitude for 1 hour exposure and 2 arcsec seeing: $V=24.5^m$; $R=25.0^m$; $I=22.5^m$.

Spectroscopy. ByuFOSC-2: 2″×5′ slit; 2.7 Å/pix dispersion, spectral range 4200-6900Å, 9Å resolution with the "green" grism; and 2.1 Å/pix dispersion, spectral range 5400-7650Å, 6Å resolution with the "red" grism; approximate limiting magnitude for 1 hour exposure: 18^m; SCORPIO: 2″×6′ slit; 1.5 Å/pix dispersion, spectral range 3950-7250Å, 5Å resolution with the "green" grizm; and 1.3 Å/pix dispersion, spectral range 5100-8050Å, 4Å resolution with the "red" grism.

3D spectroscopy (integral field spectroscopy)**.** VAGR (multi-pupil fiberless 3D spectrograph). Field: 20×40 arcsec, scale: 1.2 arcsec/pupil, spectral range: 400 Å, resolution: 1.75 Å/pixel (R=1800).

A scanning Fabry-Perot interferometer was also used for a few years (a guest instrument from the Marseille Observatory). It had spectral resolution of R=20000, spectral range of about 8.2 A, and a step of about 0.3 A.

1m SCHMIDT TELESCOPE

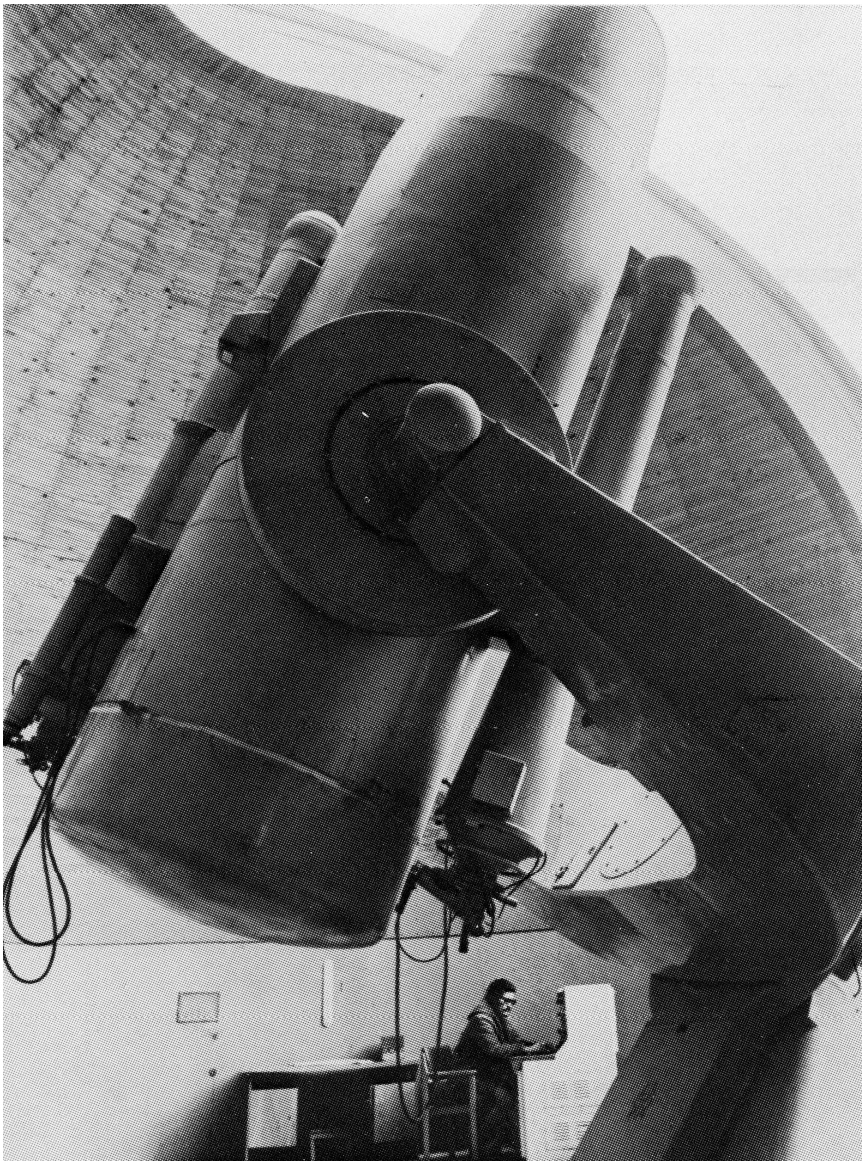
In operation	since 1960 (first light in 1961)
Altitude	1397 m
Constructed by	Leningrad (St. Petersburg) Optical Equipment Works
Mounting type	Fork
Correcting lense	102 cm (40″)
Mirror	132 cm (52″)
Focal length	213 cm (84″)
Aperture ratio (D/F)	1:2.1
Field	4.1°×4.1°
Plate size	16.1×16.1 cm
Scale	96.8 ″/mm
Mirror material	Pyrex
Optic by	Leningrad (St. Petersburg) Optical Equipment Works
Objective prisms	1.5° (1800 Å/mm)
(dispersion near Hγ)	3° (900 Å/mm)
	4° (285 Å/mm)

The BAO 1m Schmidt telescope is one of the largest Schmidt-type telescopes in the world and one of the most efficient astronomical telescopes in general.

The telescope was installed in 1960 at an altitude of 1397 m in the main territory of the Byurakan Observatory. It was constructed by the Leningrad (St. Petersburg) Optical Equipment Works (LOMO), however the mirror was made in Germany. The mounting type is fork. The telescope's correcting lens has 102 cm (40″) diameter, and the Pyrex mirror's diameter is 132 cm (52″). The focal length is 213 cm (84″), and the aperture ratio (D/F) is 1:2.1. The telescope has 4.1°×4.1° non-vignette field. 16.1×16.1 cm size photographic plates have been used. The scale is 96.8 ″/mm. Due to a Piazzi-Smith lens the telescope has a flat field. The optics is made of uviol glass and the optical system is corrected for the blue spectral range.

One of the 1m Schmidt telescope's advantages was the presence of its three objective prisms (1.5°, 3°, and 4°), which made possible wide-field spectroscopic observations with various dispersions: 1800 Å/mm, 900 Å/mm, 285 Å/mm dispersion near Hγ for 1.5°, 3°, and 4° prisms, respectively. The objective prisms can rotate in the position angle that allows obtaining spectra of any orientation.

The First Byurakan Survey (FBS) is the most famous work done with this telescope. More than 2000 photographic plates were obtained. 1500 objects

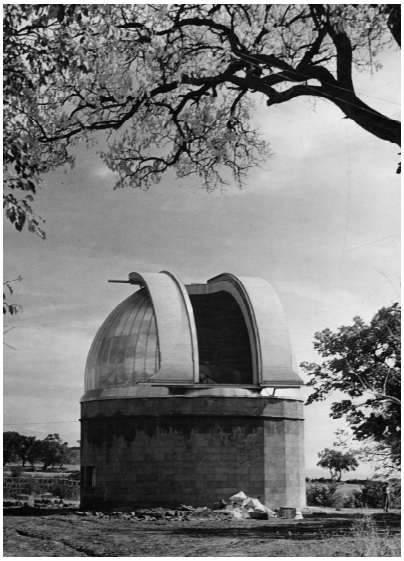


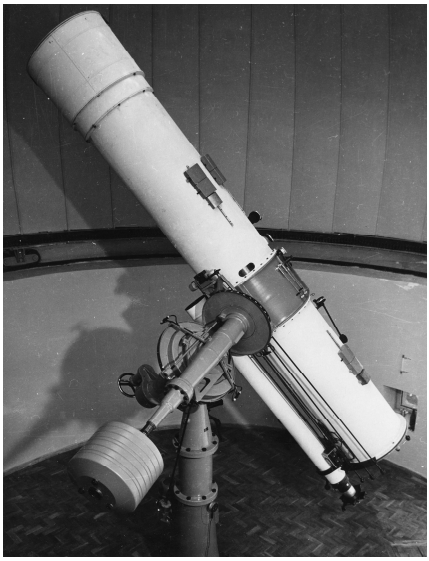
were selected, which are known at present as Markarian galaxies. The continuation of the FBS is *Second Byurakan Survey* (SBS) carried out with 1m Schmidt telescope. Total number of the discovered peculiar objects is about 3000, about 1600 of which are stellar and 1400 are non-stellar objects. The SBS is one of the most effective surveys in respect of discovery of bright QSOs. Extensive work on discovery and investigation of flare stars in open stellar clusters and associations has been also carried out with the help of 1m Schmidt telescope. Since 1969 more than 500 flare stars have been discovered. Detailed colorimetry of bright galaxies has been carried out on this telescope as well.

In 1991, the 1m Schmidt telescope was stopped and since then no observations have been carried out. Recently, a project for reconstruction of this telescope was put forward in collaboration with the Russian Special Astrophysical Observatory (SAO), including equipping it with a contemporary detector and advanced controlling system. Photometry in wide-band filters and slitless spectroscopy with objective prisms will be the main observing modes. The re-equipment of 1m telescopes must include the installation of a CCD camera in the focus with pixel size of about 1 arcsec and field of view of ~2 deg^2; constitution of a set of middle and broad band filters covering all visible range (3400–10000Å); creation of fully-automated control and monitoring system of the telescope including guiding system, control of CCD, feeding of filters to the telescope focus, controlling of the dome, etc. The principal purpose of the re-equipment of the telescopes is the creation of possibility to obtain samples of objects up to $R\sim23^m$ with signal-to-noise ratio of ~5 and images better than 2″. Such data ensure the successful classification of objects and measurement of redshifts by analysis of energy distribution in the objects spectra.

53 cm SCHMIDT TELESCOPE

There are a few other telescopes and a number of other astronomical instruments at BAO that have been used for research work. The 53 cm Schmidt telescope is installed at an altitude of 1398m. It has both 53 cm (21 inch) correcting lens and mirror. The focal length is 180 cm (71 inch), and the aperture ratio (D/F) is 1:3.4. The field of view is 25 deg^2 (5°×5°), and the scale is 114.6 ″/mm. First studies on this telescope were the detailed colorimetric observations of galaxies. Color distribution in nearby galaxies was investigated. A survey of relatively nearby galaxies to determine the degree of compactness of their nuclei was carried out. Search for flare stars in star clusters and associations were carried out in 1970s and 1980s.





50 cm and 40 cm CASSEGRAIN TELESCOPES

The 50 cm Cassegrain telescope has focal length of 8 m and aperture ratio (D/F) of 1:16. Mainly electrophotometric and polarimetric observations of non-stable red giants and supergiants, investigation of flare stars and long-period variables have been carried out. The 40 cm Cassegrain telescope has focal length of 4 m and aperture ratio of 1:10. Like the 50cm telescope, here too mainly electrophotometric and polarimetric observations of non-stable red giants and supergiants, and investigation of flare stars were carried out. The polarization of light of Crab Nebulae was proved on this telescope, and the variability of polarization of light from the variable red giant star μ Cep was discovered. At present it is used for observations of fast flares with high resolution in time.

OTHER INSTRUMENTS AND FACILITIES

PDS 1010A MICRO-DENSITOMETER

The PDS 1010A micro-densitometer is one of the unique instruments. It was installed in late 1970s. The microdensitometer system operates with PDP8 computer. The micro-densitometer system is designed to take very accurate readings of the density information of very small areas of photographic plates or film and determine the precise location of these areas in reference to each other. These readings are converted to bits of information which are stored on the storage unit of computer. PDS 1010A consists essentially of three systems: one to measure density or transmission information, one to move the stages in either or both X and Y axes, and one to generate precise stage position information. The position accuracy is 1 micron on both X and Y axes. The maximal speed of the stage motion is 40 mm/sec. The PDS has various actual scanning apertures. The PDS allows to digitize astronomical images of sizes up to 250×250mm. For about 15 years, PDS 1010A stayed as most heavily used equipment in the observatory. Thousands images and spectra have been measured on it for spectrophotometric study of stars and galaxies and surface photometry of galaxies.

COMPUTATIONAL EQUIPMENT

The Byurakan Observatory is equipped with modern computational techniques, including several SUN Sparcstations, and some 30 PCs that are connected in local area network. Internet connection allows having access to any program or database, kept in any archive, and carry out research work on modern level. There are numerous catalogs, dictionaries, and sets of programs at the computer centre, as well as the Digital Sky Survey (DSS) on 101 CDs. Both Windows and Unix operational systems are applicable. BAO is connected to world basic astronomical sites and the Armenian Virtual Observatory (ArVO) is a part of the International Virtual Observatory Alliance (IVOA) that allows a quick and standard access to any astronomical database and catalog.

SCIENTIFIC LIBRARY AND LIBRARY OF PHOTOGRAPHIC PLATES

The Byurakan Observatory has a rich scientific library, which is organized in 1951. It contains some 15,000 books, more than 60,000 periodicals and some 70,000 preprints. More than two-thirds of them are in English.

The library of photographic plates was organized in 1986. It keeps the observational material of all the Byurakan telescopes, including about 2000 plates of the First Byurakan Survey (FBS). Altogether, 20,000 plates are collected at present. The users may have access to the plates in right ascension or declination, author name, plate numbers, as well as in epoch of observation. One of the ArVO's tasks is the digitization of all these plates and creation of an electronic plate database for further efficient work with them.

OBSERVATIONAL MATERIAL: BYURAKAN SURVEYS

Byurakan surveys provide unique observational material for discovery, classification and investigation of various types of objects. The **First Byurakan Survey (FBS)** is the largest spectral survey in the world. It covers about 17,000 deg^2 of all the Northern Sky and part of the Southern Sky at high galactic latitudes. More than 2000 photographic plates of Kodak IIaF and 103aF types and of 16cm×16cm (4°×4°) sizes are obtained in 1965-80 by B.E. Markarian, V.A. Lipovetski, and J.A. Stepanian on the Byurakan 1 m Schmidt telescope with 1.5° objective prism. Each plate contains low-dispersion (1800 Å/mm near H) spectra of about 15-20 thousand objects. The spectral range of 3400-6900Å is covered and the spectra are divided into two parts by a gap near 5300 Å. The limiting magnitudes vary from 16.5^m to 18.5^m and the scale is 97″/mm. There have been a few projects accomplished with the FBS. The most important was the **Markarian survey** itself, search for UV-excess (UVX) galaxies. 1515 UVX (Markarian) galaxies were discovered. Later on, the FBS plates were used to search and study of blue (UVX) stellar objects, FBS BSOs. 1103 BSOs wre selected, including new QSOs, Sy, WD, sd, CV, etc. The survey for FBS late-type stars led to revealing more than 1000 M-type and carbon stars. At last, optical identifications of 1577 IRAS sources resulted in BIG and BIS objects, revealing many new AGN and starburst galaxies, as well as late-type stars.

The **Second Byurakan Survey (SBS)** was carried out by B.E. Markarian, J.A. Stepanian, L.K. Erastova, et al. in 1978-1991 on the Byurakan Observatory 102/132/213cm Schmidt telescope with 1.5°, 3° and 4° prisms, in combination with hypersensitized Kodak IIIaJ and IIIaF plates and filters, giving different ranges of spectrum (λ3500 – 5400 Å, λ4950 – 5400 Å and λ6300 – 6950 Å,

respectively). Altogether, 550 plates have been obtained in 65 fields, 4°×4° each. SBS covers 965 deg^2 area at high galactic latitudes (|b|>30°) with $07^h43^m<\alpha<17^h15^m$ and +49°<δ<+61°. The limiting magnitude differs in the range of 18^m-20^m in V, and the survey is complete to 17.5^m. 7 fields (covering 112 deg^2) have limiting magnitudes 19.5^m-20^m (so-called Selected Fields of the SBS), and are of special interest. The dispersion near H-γ for spectra obtained with 1.5°, 3° and 4° prisms is 1800 Å/mm, 900 Å/mm, and 280 Å/mm, respectively (and 1000 Å/mm near H-α for 4° prism). SBS covers 3 zones of the FBS, with central declinations +51°, +55° and +59°. In average, each SBS plate contains low-dispersion spectra of some 50,000 objects, and there are some 3,000,000 objects in the whole survey. In SBS all interesting types of objects have been selected: fainter UVX galaxies, QSO, Sy, and BCDG candidates, all emission-line galaxies and stars, UVX and other peculiar stars. The SBS revealed some 3600 peculiar objects, including ~1600 galaxies and ~2000 stellar objects (both QSOs and stars). New QSOs and Seyferts, BL Lac objects, BCDGs, LINERs, SBN and HII galaxies, double nuclei galaxies; cataclysmic variables, white dwarfs, subdwarfs, etc. have been discovered.

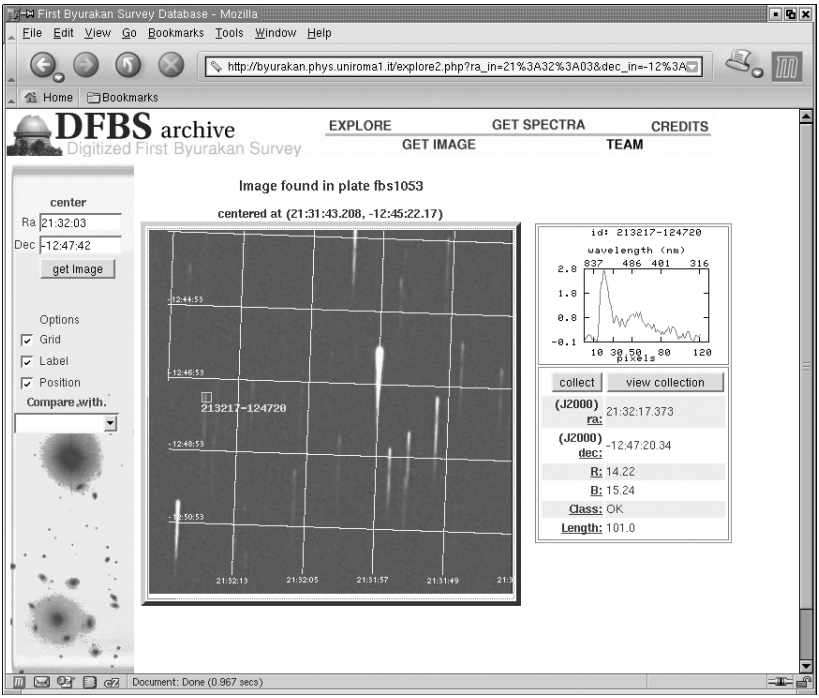
THE DIGITIZED FIRST BYURAKAN SURVEY (DFBS)

The **Digitized First Byurakan Survey (DFBS)** is the digitized version of the Markarian survey (or FBS). It is a collaborative effort of the Byurakan Astrophysical Observatory, Università di Roma "La Sapienza" and MIGG s.r.l. (Italy), Cornell University (USA), and Hamburger Sternwarte (Germany). It included scanning of the plates, high accuracy (1″ rms) astrometric solution, extraction software for images and spectra, photometric and wavelength calibration of the spectra, classification, creation of DFBS catalog and database, construction of user interface and webpage. Later on, the Armenian Institute of Informatics and Automation Problems (IIAP) also joined the project to reproduce the DFBS database in Armenia in frame of the Armenian VO project. 1874 FBS plates have been scanned with EPSON Expression 1680 Pro scanner with 16 bit dynamical range and 1.542″/pix sampling obtaining 9601×9601 pix 180 MB FITS file for each plate. The low-dispersion spectra are 107×5 pix. A dedicated software *bSpec* was written for the extraction and analysis of the DFBS spectra. For the classification, templates for main types of objects discovered from FBS have been used; UVX galaxies, QSOs, white dwarfs, subdwarfs, cataclysmic variables, carbon stars, as well as stars of all spectral types (from O to M). The DFBS database is presently stored on a dedicated PC at Università di Roma "La Sapienza" and can be accessed through web interface (*http://byurakan.phys.uniroma1.it/*).

The user interface (the DFBS web portal) provides access to general information on the FBS and DFBS. It presently allows the following operations:

1) Sky coverage: in a RA, DEC rectangular sky map shows the position on the sky of each plate. Basic data about each plate are available.

2) Plate list: the list of the plates is shown; it can be sorted by several parameters and downloaded. Basic data about each plate are available.



3) Explore: it allows the display of a portion of plate around a given central RA, DEC position, comparison of the DFBS with the same portion of DSS1/DSS2, interactive selection of one or more spectra, their collection and downloading.

4) Get Image: allows users to select a portion of a plate in FITS format and all the spectra of this portion present in the database for downloading, as well as downloading of the whole selected field.

5) Get Spectra: allows downloading all the spectra in the database within a given distance from a selected central position (cone search); the query may be either interactive or in batch mode (by an uploaded list).

MAIN SCIENTIFIC MEETINGS HELD IN BYURAKAN

November 12-16 1951	**STELLAR ASSOCIATIONS** A Conference of Astronomical Council of Academy of Sciences of the USSR
September 20-22 1956	**NON-STABLE STARS** A Symposium Devoted to the Official Inauguration of the Byurakan Astrophysical Observatory
May 20-23 1964	**EXTRATERRESTRIAL CIVILIZATIONS** First All-Union Conference on the Problem of Extraterrestrial Civilizations
May 4-12 1966	**NON-STABLE PHENOMENA IN GALAXIES** Symposium #29 of the International Astronomical Union
September 16-19 1968	**STARS, NEBULAE, GALAXIES** Symposium Devoted to the 60th Anniversary of V.A. Ambartsumian
September 6-11 1971	**COMMUNICATION WITH EXTRATERRESTRIAL INTELLIGENCE** First International Symposium on the Problem of Extraterrestrial Civilizations and Communication with Them
October 5-8 1976	**FLARE STARS** An International Symposium Devoted to the Official Opening of the 2.6 m telescope
October 2-5 1978	**CONFERENCE OF YOUNG ASTROPHYSICISTS** An All-Union Conference Devoted to the 70th Anniversary of V.A. Ambartsumian
May 22-24 1979	**FLARE STARS, FUORS AND HERBIG-HARO OBJECTS** Symposium of the Multilateral Research Cooperation of the Academies of Sciences of the Socialist Countries on the Problem of "Stellar Physics and Evolution"
June 9-14 1981	**IV SOVIET-FINNISH ASTRONOMICAL MEETING** Conference on Various Problems of Galactic and Extragalactic Astronomy
October 26-30 1981	**PRINCIPLE OF INVARIANCE AND ITS APPLICATIONS** An All-Union Symposium Devoted to the 40th Anniversary of the Principle of Invariance Introduction to the Radiation Transfer Theory
October 16-19 1984	**FLARE STARS AND RELATED OBJECTS** An International Symposium
June 3-7 1986	**OBSERVATIONAL EVIDENCE OF ACTIVITY IN GALAXIES** Symposium #121 of the International Astronomical Union

September 22-28 1987	**OBSERVATIONS WITH LARGE TELESCOPES** An International School for Young Astronomers, organized jointly by ESO and the Byurakan Observatory
September 27-30 1988	**OBSERVATIONAL EVIDENCES OF INSTABILITY PHENOMENA AND THEIR INTERPRETATION** A Conference of Young Astrophysicists Devoted to the 80th Anniversary of V.A. Ambartsumian
October 23-27 1989	**FLARE STARS IN STAR CLUSTERS, ASSOCIATIONS AND SOLAR VICINITY** Symposium #137 of the International Astronomical Union
September 29 - October 4 1995	**FRENCH-ARMENIAN ASTRONOMICAL COLLOQUIUM** A Colloquium, held in Frame of the French-Armenian Collaboration in Astronomy
October 4-9 1996	**INSTABILITY PHENOMENA AND THEIR ROLE IN THE EVOLUTION OF COSMIC OBJECTS** An International Symposium Devoted to the 50th Anniversary of the Byurakan Observatory
August 17-21 1998	**ACTIVITY IN GALAXIES AND RELATED PHENOMENA** Symposium #194 of the International Astronomical Union (Dedicated to the 90th anniversary of V.A. Ambartsumian)
June 18-22 2001	**AGN SURVEYS** Colloquium #184 of the International Astronomical Union (Dedicated to the memory of B.E. Markarian)
August 26 – September 3 2006	**OBSERVATIONAL ASTROPHYSICS** First Byurakan International Summer School for Young Astronomers
September 1-3 2006	**ACTIVE UNIVERSE** International Meeting devoted to the 60th Anniversary of the Byurakan Observatory
September 15-18 2008	**EVOLUTION OF COSMIC OBJECTS THROUGH THEIR PHYSICAL ACTIVITY** International Conference devoted to the 100th Anniversary of V.A. Ambartsumian
September 20-30 2008	**PRACTICAL ASTROPHYSICS** Second Byurakan International Summer School for Young Astronomers

A number of conferences, plenums and colloquia are held as well, such as:

- meeting of the IAU Executive Committee in 1962, plenums of the Astronomical Council of the USSR Academy of Sciences in 1970 and 1978, plenum of the Commission on physics of stars and nebulae of the Astronomical Council in 1960, plenums of the Council on Coordination of Work of Large Astronomical Instruments in 1965, 1967, 1970 and 1971;

- joint colloquium of the Byurakan Observatory and Astronomical Council in 1975, joint Byurakan - Astronomical Council - Leningrad University - Abastumani colloquium in 1988, joint Byurakan - Leningrad University - Abastumani colloquiums in 1983 and 1985, joint Byurakan - Abastumani colloquia in 1974, 1977, 1979, 1983, 1985, 1998, 2001, and 2003;

- B.E. Markarian's 85th anniversary meeting in 1998, symposium devoted to the 10th anniversary of Astrofizika journal in 1975, conference on problems of astronomical instrument-making in 1970, conference organized by the commission of 6 m telescope in 1978, seminar on radioastronomy in 1975, school for cosmonauts in 1981, seminar-report on the 2.6m telescope observational programs in 2000;

- Armenian Astronomical Society (ArAS) annual meetings in 2002-2007 (partially combined with other meetings);

- Summer Schools for students and pupils in 1995 and 2005, astronomical school Olympiads in 1980-1981, 1995, and annually since 1999.

BAO also was one of the main organizers of the Joint European and National Astronomy Meeting (**JENAM-2007**) "**OUR NON-STABLE UNIVERSE**", held at the Yerevan State University (YSU) on August 20-25, 2007. JENAM-2007 consisted of 8 EAS Symposia and 5 Special Sessions.

PROCEEDINGS OF MEETINGS HELD IN THE BYURAKAN OBSERVATORY

The Non-Stable Stars; Proceedings of a Symposium held in Byurakan on September 20-22, 1956. *Ed.* M.A. Arakelian // *Publishing House of the Armenian Academy of Sciences, Yerevan, 1957, 188 p.* (in Russian).

Extraterrestrial Civilizations; Proceedings of an All-Union Conference held in Byurakan on May 20-23, 1964. *Ed.* H.M. Tovmassian // *Publishing House of the Armenian Academy of Sciences, Yerevan, 1965, 152 p.* (in Russian and English).

Non-Stable Phenomena in Galaxies; Proceedings of the International Astronomical Union Symposium No. 29 held in Byurakan on May 4-12, 1966. *Ed.* M.A. Arakelian // *Publishing House of the Armenian Acad. Sci., Yerevan, 1968, 480 p.* (in Russian).

Stars, Nebulae, Galaxies; Proceedings of a Symposium held in Byurakan on September 16-19, 1968. *Ed.* V.V. Sobolev // *Publishing House of the Armenian Academy of Sciences, Yerevan, 1969, 296 p.* (in Russian).

Communication with Extraterrestrial Intelligence (CETI); Proceedings of an International Conference held in Byurakan on September 6-11, 1971, *Ed.* Carl Sagan // *Cambridge, 1973* (in English).

Flare Stars; Proceedings of an International Symposium held in Byurakan on October 5-8, 1976, *Ed.* L.V. Mirzoyan // *Publishing House of the Armenian Academy of Sciences, Yerevan, 1977, 232 p.* (in Russian).

Flare Stars, Fuors and Herbig-Haro Objects; Proceedings of an International Symposium held in Byurakan on May 22-24, 1979, *Ed.* L.V. Mirzoyan // *Publishing House of the Armenian Academy of Sciences, Yerevan, 1980, 328 p.* (in Russian).

Principle of Invariance and its Applications; Proceedings of an All-Union Symposium held in Byurakan on October 26-30, 1981, *Eds.* M.A. Mnatsakanian & H.V. Pikichian // *Publishing House of the Armenian Academy of Sciences, Yerevan, 1989, 522 p.* (in Russian).

Flare Stars and Related Objects; Proceedings of an International Symposium held in Byurakan on October 16-19, 1984, *Ed.* L.V. Mirzoyan // *Publishing House of the Armenian Academy of Sciences, Yerevan, 1986, 336 p.* (in Russian).

Observational Evidence of Activity in Galaxies; Proceedings of the International Astronomical Union Symposium No. 121 held in Byurakan on June 3-7, 1986, *Eds.* E.Ye. Khachikian, K.J. Fricke, & J. Melnick // *D. Reidel Publishing Company, Dordrecht / Boston / Lancaster / Tokyo, 1987, 600 p.* (in English).

Flare Stars in Star Clusters, Associations and the Solar Vicinity; Proceedings of the International Astronomical Union Symposium No. 137 held in Byurakan on October 23-27, 1989, *Eds.* L.V. Mirzoyan, B.R. Pettersen, & M.K. Tsvetkov // *Kluwer Academic Publishers, Dordrecht / Boston / London, 1990, 410 p.* (in English).

Proceedings of the **French-Armenian Astronomical Colloquium** held in Byurakan on September 29 - October 4, 1995, *Eds.* L.V. Mirzoyan & A.T. Kalloghlian // *Astrofizika, 1995, Vol. 38, No. 4, 228 p.* (in English).

Active Galactic Nuclei and Related Phenomena; Proceedings of the International Astronomical Union Symposium No. 194 held in Byurakan on August 17-21, 1998, *Eds.* Y. Terzian, D. Weedman, & E. Khachikian // *ASP, 1999, 480 p.* (in English).

AGN Surveys; Proceedings of the International Astronomical Union Colloquium No. 184 held in Byurakan on June 18-22, 2001, *Eds.* R.F. Green, E.Ye. Khachikian, & D.B. Sanders // *ASP Conference Series, Vol. 284, 2002, 452p.* (in English).

INTERNATIONAL SCIENTIFIC COLLABORATION

Countries	Observatories and Institutes
Australia	Radioastronomical Obs., Parkes
Bulgaria	National Astronomical Obs., Rozhen Obs.
Finland	Observatory and Astrophysical Laboratory (Helsinki)
France	Obs. Marseille, IAP, Obs. Paris-Meudon, Obs. Haute-Provence, Obs. Pic-Du-Midi, Univ. Montpellier II, Obs. Lyon, Obs. Grenoble, Service d'Aeronomie
Georgia	Abastumani Astrophysical Observatory
Germany	Tautenburg Obs., Astrophysical Institute Potsdam, Max-Planck-Institut für Astronomie (Heidelberg), Max-Planck-Institut für Radioastronomie (Bonn), Hamburger Sternwarte
Hungary	Konkoly Observatory (Budapest)
India	Tata Institute of Fundamental Research (Mumbai), Indian Institute of Astrophysics (Bangalore)
Italy	Asiago Astrophysical Obs, Padova Astronomical Obs., University di Roma "La Sapienza"
Mexico	Tonantzintla Observatory, INAOE (Puebla), UNAM
Russia	Leningrad (Saint-Petersburg) University, Special Astrophysical Obs. (SAO), Institute of Astronomy (Moscow), Euro-Asian Astronomical Society
Serbia	Belgrade Astronomical Observatory
UK	Institute of Astronomy (Cambridge), Armagh Obs.
Ukraine	Crimean Astrophys. Obs.
USA	Mount Palomar Obs., Lick Obs., Cornell Univ., Stanford Univ., Space Telescope Science Institute, McDonald Obs., Dyer Obs.

OBJECTS OF INVESTIGATION

GALACTIC ASTRONOMY	EXTRAGALACTIC ASTRONOMY
Stellar associations	Active galactic nuclei
Star clusters	UV-excess galaxies
T Tau stars	Seyfert galaxies
Flare stars	LINERs
Herbig-Haro objects	Quasars
Fuors	Blue compact dwarf galaxies
Young stellar objects	Starburst galaxies
Optical jets	Double-nuclei galaxies
Early-type stars	Multiple-nuclei galaxies
White dwarfs	Barred galaxies
Cataclysmic variables	Lacertides (BL Lacs)
Hα-stars	Radiogalaxies
Novae	Megamasers
Luminous blue variables	IRAS galaxies
Late M-type stars	Spitzer Space Telescope sources
Carbon stars	Superassociations
Long-period variables	Extragalactic Supernovae
Pulsars	Extragalactic HII-regions
Circumstellar shells	Groups of galaxies
Cometary nebulae	Shahbazian groups
Diffuse nebulae	Clusters of galaxies
Dark nebulae	Superclusters of galaxies
Globules	Large-scale structure
Stellar atmospheres	
Compact cosmic objects	

METHODS OF INVESTIGATION

GALACTIC ASTRONOMY
surveys, spectroscopy, photometry, spectrophotometry, polarimetry, statistics

EXTRAGALACTIC ASTRONOMY
surveys, spectroscopy, photometry, spectrophotometry, morphologic study, statistics

THEORETICAL ASTROPHYSICS
radiation transfer theory, direct and inverse problems, mathematical physics, mathematical modeling

PERSONNEL

Administration

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Scientific Staff

Doctors of Science:	7
Candidates of Science:	25
Ph.D. students / Assistant Astronomers:	16
Scientific-auxiliary staff:	7
Technical staff:	10
Book-keeping staff:	3
Economic staff:	19
Total number of employees	87

PRESENT RESEARCH GROUPS AND LABORATORIES

Research subject or laboratory	**Principal investigator / Head of Laboratory**
Non-Stable Objects and Nebulae	*Prof.* E.S. Parsamian
Young Stars with Anisotropic Activity and Optical Jets	*Dr.* T.Yu. Magakian
Discovery and Investigation of Hα Objects, Mira Ceti Type Stars	*Dr.* N.D. Melikian
Investigation of Active Galactic Nuclei	*Prof.* E.Ye. Khachikian
Study of Systems of Galaxies	*Dr.* A.P. Mahtesian
Study of Star-Forming Galaxies	*Dr.* A.R. Petrosian
Interpretation of Spectra of Cosmic Objects	*Prof.* A.G. Nikoghossian
Armenian Virtual Observatory (ArVO)	*Dr.* A.M. Mickaelian
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PUBLICATIONS

The Byurakan Observatory astronomers publish 40-50 scientific papers annually, including 15-20 in the international scientific periodicals. *Communications of the Byurakan Observatory* and *Astrofizika* have been the main journals for publication. ***Communications of the Byurakan Observatory*** have been published in 1946-91. V.A. Ambartsumian (1946-1985) and H.M. Tovmassian (1986-1991) have been the Editors-in-chief. 63 issues have been published (in Russian).

Astrofizika is being published in Russian quarterly since 1965 by the Armenian Academy of Sciences. V.A. Ambartsumian was the editor-in-chief in 1965-1987, L.V. Mirzoyan was in 1988-1999, and D.M. Sedrakian is since 1999. The journal is translated into English (***Astrophysics***) and is published by *Springer Verlag* Publishing Company. Up to now (2008) 51 volumes with 186 issues have been published.

Beside these two journals, the Byurakan scientists publish their papers in *Astrophysical Journal (ApJ)*, *Astronomical Journal (AJ)*, *Astronomy & Astrophysics (A&A)*, *Monthly Notices of the Royal Astronomical Society* (*MNRAS*), *Astrophysics and Space Science (ApSS)*, *Astronomische Nachrichten (AN)*, *Astronomical & Astrophysical Transactions* (*AATr*), *Астрономический Журнал* (*АЖ, Astronomy Report*), *Письма в Астрономический Журнал* (*ПАЖ, Astronomy Letters*), and others. There are plans to conduct publication of Annual Reports of the Byurakan Observatory and Preprints of the Byurakan Observatory. Byurakan astronomers have published more than 100 books as well, including monographs, textbooks, proceedings of scientific meetings, popular books, and booklets.

SOME IMPORTANT BOOKS PUBLISHED BY THE BYURAKAN OBSERVATORY SCIENTISTS AND/OR ABOUT THEM

Ambartsumian V.A., Theoretical Astrophysics // *Leningrad-Moscow, GONTI, Techn.-theor. Literature Eds., 1939, 255p.* (in Russian).

Ambartsumian V.A., Mustel E.R., Severny A.B., Sobolev V.V., Theoretical Astrophysics // *Phys.-Math. Literature Publishers, Moscow, 1952, 635p.* (in Russian).

Markarian B.E., Atlas of stellar clusters of various types // *Astron. Council Publishing House, Moscow, 1952* (in Russian).

Ambartsumian V.A., Cosmogony // *Publishing House of the Yerevan State University, Yerevan, 1954* (in Russian).

Gurzadyan G.A., Radioastrophysics // *Publishing House of the Armenian Academy of Sciences, Yerevan, 1956* (in Russian).

Ambartsumian V.A., Scientific works. Vol. 1-2. Ed. V.V.Sobolev // *Publishing House of the Armenian Academy of Sciences, Yerevan, 1960, Vol. 1: 430p., Vol. 2: 362p.* (in Russian).
Arzumanian A.M., Byurakan's Eye // *Yerevan, "Haypethrat", 1962, 403p.* (in Armenian).
Gurzadyan G.A., Planetary Nebulae // *Phys.-Math. Literature Publishers, Moscow, 1962. 392p.* (in Russian).
Ambartsumian V.A., Galaxies // *Yerevan, 1966, 76p.* (in Armenian).
Ambartsumian V.A., Problems of evolution of the Universe // *Publishing House of the Armenian Academy of Sciences // Yerevan, 1968, 294p.* (in Armenian and Russian).
Gurzadyan G.A., Flare Stars // *"Nauka", Moscow, 1968* (in Russian).
Ambartsumian V.A., Mirzoyan L.V., Sahakian G.S., Vsekhsvyatskiy S.K., Kazutinskiy V.V., Problems of Modern Cosmogony // *"Nauka", Moscow, 1969, 351p.* (in Russian).
Arzumanian A.M., Byurakan's Eye // *"Hayastan", Yerevan, 1969* (in Russian).
Sahakian K.A., Young astronomer's handbook // *Publishing House of the Armenian Academy of Sciences, Yerevan, 1969* (in Armenian).
Toumanian B.E., History of the calendar // *Publishing House of the Armenian Academy of Sciences, Yerevan, 1970* (in Armenian).
Mirzoyan L.V., M.A.Arakelian, A.T.Kalloghlian, H.M.Tovmassian, Astronomy (textbook for the 10th form of the secondary school) // *"Luys", Yerevan, 1970, 207p.; 1971, 206p.; 1973, 202p.* (in Armenian).
Ambartsumian V.A., Problems of Modern Cosmogony, Second Edition // *"Nauka", Moscow, 1972, 472p.* (in Russian).
Ambartsumian V.A., Philosophical problems of the science about the Universe // *Publishing House of the Armenian Academy of Sciences, Yerevan, 1973, 428p.* (in Russian).
Tovmassian H.M., Radioastronomy (textbook for the University students) // *Publishing House of the Yerevan State University, Yerevan, 1976, 380p.* (in Armenian).
Problems of Physics and Evolution of the Universe, Ed. L.V.Mirzoyan // *Publishing House of the Armenian Academy of Sciences, Yerevan, 1978, 444p.* (in Russian).
Toumanian B.E., Mirzoyan L.V., Astronomy (textbook for the University students) // *Publishing House of the Yerevan State University, Yerevan, 1978, 338p.* (in Armenian).
Mirzoyan L.V., Instability and evolution of stars // *Publishing House of the Armenian Academy of Sciences, Yerevan, 1981, 380p.* (in Russian).
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