

## REGIONAL ACTIVITIES RELATED TO IAU STRATEGIC PLAN AND INTEGRATION OF ARMENIA IN EUROPEAN ASTRONOMY

A. M. MICKAELIAN

*Byurakan Astrophysical Observatory, Byurakan 0213, Armenia  
E-mail: aregmick@yahoo.com*

**Abstract.** Armenia is one of the candidates to host a Regional Office of Astronomy for Development, according to the IAU Strategic Plan for 2014-2020 and further years. Armenian astronomers are rather integrated in the international and European astronomical communities, as well as BAO is one of the most important astronomical centres in the Middle East area. The Armenian Astronomical Society is one of the 25 EAS affiliated members and is rather active in organizing various events. The Armenian Virtual Observatory is a member of the International Virtual Observatory Alliance. We have started a series of Byurakan International Summer Schools for regional and European students with involvement of a number of European lecturers. Viktor Ambartsumian International Prize is one of the important international astronomy awards. Armenian astronomy integrated into the European one may serve much more efficiently both for Armenia, Middle East region, as well as Europe, particularly establishing a link between Europe and Eastern Partnership countries.

### 1. INTRODUCTION

During the International Year of Astronomy in 2009 (IYA-2009), IAU developed a long-term educational plan that would focus on using astronomy to stimulate capacity building and further sustainable global development. A world Office of Astronomy for Development (OAD) was established in South Africa and Regional Offices of Astronomy for Development (ROAD) will be established. Armenia is one of the candidates to host such an office in the Middle East region. Its activities include:

- Management and coordination of the IAU programs; Coordination of contacts between the IAU and national authorities; Establishment of the new IAU endowed lectureship program and organization of seminars and public lectures for the IAU lecturers; Liaison with other international unions
- Organization of regional scientific meetings; Support in organization of Byurakan International Summer Schools with an emphasis on regional students; Organization of regional astronomical Olympiads for pupils
- BSc/MSc/PhD studies for regional students at BAO, Yerevan State University (YSU), and Armenian National Academy of Sciences; Support to Galileo Teacher Training Program (GTTP); Production/publication of educational and



Figure 1: Byurakan Astrophysical Observatory and Viktor Ambartsumian.

promotional materials; Creation of an educational webpage for remote interactive regional teaching

- European Eastern Partnership liaison (collaboration with Europe, particularly with Eastern European countries, Sub-Regional European Astronomical Committee, SREAC, etc.)

## 2. BYURAKAN ASTROPHYSICAL OBSERVATORY

Byurakan Astrophysical Observatory (BAO) is a research institution of the Armenian National Academy of Sciences (NAS RA). It was founded in 1946 by the outstanding scientist of the XX century Viktor Ambartsumian (1908-1996) who became its first director and served until 1988. Main achievements of the Armenian astronomy are connected with him. He was the IAU President in 1961-64, twice elected ICSU President (1968-72), he was foreign or honorary member of 28 academies and societies. Ambartsumian was the President of the Armenian Academy of Sciences during 1947-1993 and the Director of BAO during 1946-1988.

Five important observational instruments are installed at BAO, the larger ones being 2.6m Cassegrain telescope (ZTA-2.6) and 1m Schmidt (the one used for the famous Markarian survey) telescopes.

The first studies at BAO related with the instability phenomena taking place in the Universe, and this trend became the main characteristic of the science activity in Byurakan. Discovery of stellar associations in 1947 (Ambartsumian 1949), hypothesis about activity of galactic nuclei in mid-1950s (Ambartsumian 1958), discovery and study of many Seyfert galaxies and QSOs, more than 1000 flare stars, dozens of SNe, hundreds of HH objects and cometary nebulae, works in the field of radiative transfer theory, are the main scientific achievements. The First and Second Byurakan surveys (FBS, 1965-1980, and SBS, 1978-1991) conducted due to Benjamin Markarian (1913-1985) brought to the well-known Markarian galaxies (Markarian et al. 1989) and SBS objects (Stepanian 2005). Surveys and search for new objects are traditional for Armenian astronomers: Markarian, Arakelian (1975) and Kazarian (Kazarian et al.

2010) galaxies, Shahbazian groups (Shahbazian 1996), cometary nebulae (Parsamian & Petrosian 1979) are well-known, as well as searches for blue stellar objects (BSO, Mickaelian 2008) and late-type stars (Gigoyan & Mickaelian 2012); optical identifications of IR, radio and X-ray sources.

Recently, in 2012, the Armenian Government awarded BAO a status of National Value. It is well-known not only for its scientific achievements; BAO can also be considered as an educational and touristic centre, unique architectural ensemble and it has a rich botanical garden. In 2011, FBS and its Digitized version (DFBS) were included in UNESCO Memory of the World international register. BAO collaborates with scientists from the USA, UK, France, Italy, Germany, Spain, Russia, Georgia, Bulgaria, Japan, China, Mexico, Australia, and other countries.

Armenia also has a rich tradition of organization of many international meetings since 1950s. A number of important scientific meetings have been held, including five IAU Symposia (1966, 1986, 1989, 1998, and 2013) and an IAU Colloquium (2001), and 5 international schools. BAO was one of the main organizers of the Joint European and National Astronomical Meeting in 2007 (JENAM-2007). The first international symposium on CETI also was organized in Byurakan in 1971.

### 3. ARMENIAN ASTRONOMICAL SOCIETY

Armenian Astronomical Society (ArAS) is a Non-governmental organization (NGO) founded in 1999 and officially registered at the Armenian Ministry of Justice in 2001. It is an Affiliated Society in the European Astronomical Society (EAS), it is the official representative of the Euro-Asian Astronomical Society (EAAS) in Armenia, and the official representative of the International Astronomical Olympic Committee in Armenia. ArAS is based at BAO. ArAS has 95 members from 18 countries.

ArAS main activities are the establishment of contacts between astronomers and other scientists, establishment of contacts between BAO and other scientific organizations and NGOs, meetings, summer schools, public lectures, Electronic Newsletters, Annual Prizes for young astronomers, Astronomy and World Heritage, astronomical educational matters in Armenia, lectures by astronomers at schools, amateur astronomers, and popularization of astronomy in Armenia, webpage with a large number of astronomical information, etc. ArAS took most of the responsibilities for IYA-2009 activities in Armenia, as well as Beyond-IYA. ArAS was the main organizer of the Joint European and National Astronomical Meeting (JENAM-2007). Altogether, 13 ArAS annual meetings and seven summer schools for young astronomers and students, as well as a Conference for Young Astronomers have been organized. ArAS maintains at its webpage most of the information concerning BAO and the Armenian astronomy.

### 4. DIGITIZED FIRST BYURAKAN SURVEY AND ARMENIAN VIRTUAL OBSERVATORY

Markarian survey or FBS (1965-1980; Markarian et al. 1989) was the first systematic objective-prism survey in the world and it was a new method of search for AGN. Until now, it is the largest objective-prism survey of the Northern sky (17,000 sq. deg). It resulted in the discovery of 1515 UV-excess (UVX) galaxies, as well as to classification of Seyferts into Sy1 and Sy2 (Weedman & Khachikian 1971), into

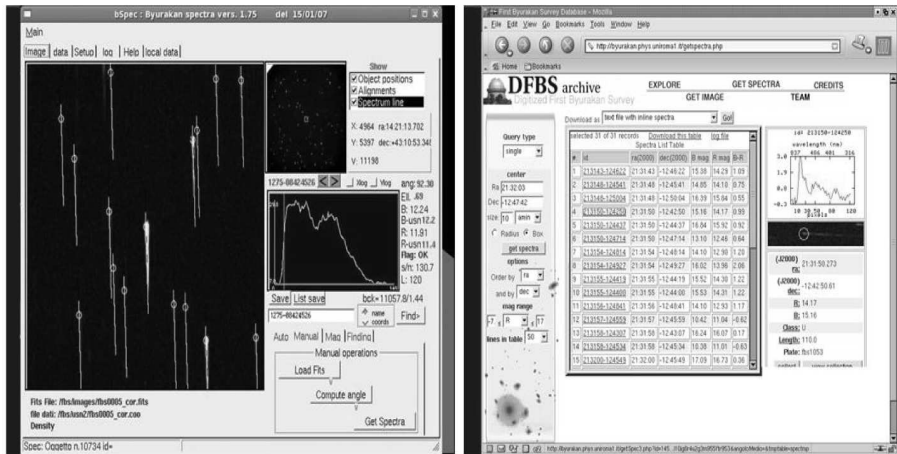


Figure 2: DFBS spectra extraction and analysis software bSpec and DFBS webpage.

definition of Starburst galaxies (Weedman 1977). FBS also led to other projects, including FBS BSOs, late-type stars, optical identification of IRAS point sources: Byurakan-IRAS Galaxies (BIG) and Byurakan-IRAS Stars (BIS).

In 2002-2005, FBS plates were digitized (Mickaelian et al. 2007) in frame of collaboration between BAO, Universita di Roma “La Sapienza” (Italy) and Cornell University (USA). 1874 plates now have their FITS files and are available for users.

In 2005, Armenian Virtual Observatory (ArVO) was created based on DFBS. ArVO is one of the 19 national VO projects forming the International Virtual Observatories Alliance (IVOA) and is the only VO project in the region. Besides building of VO environment for efficient astrophysical research, VO serves as educational tool for the regional students and astronomers in general. A number of science projects have been proposed and are being accomplished based on DFBS and ArVO, such as: Search for new AGN, Search for variable objects in DFBS, Search for emission-line stars, Optical identification of X-ray, IR and radio sources, Search for asteroids in DFBS and others.

## 5. ASTRONOMICAL EDUCATION IN ARMENIA

The astronomical education in Armenia consists of 4 levels (school education, university B.Sc. and M.Sc. studies, and Ph.D. We also organizes annual astronomical Olympiads. During the IYA-2009, an Armenian Galileo Teacher Training Program (GTTP) was conducted to implement new methods in astronomy education and to train Galileo teachers in Armenia. A new initiative, Byurakan Science Camp, was organized recently in 2014 to encourage knowledge and science among school pupils.

BAO also has a tradition of teaching international PhD students under supervision of Armenian astronomers. Such a program started in 1960s. PhD students from Russia, Ukraine, Bulgaria, Hungary, Georgia, Uzbekistan, Azerbaijan, Jordan and some others spent several years at BAO and received their Ph.D. degrees from Armenia.



Figure 3: Byurakan International Summer Schools.

During 2006-2012, we have organized 4 Byurakan International Summer Schools (BISS), where more than 130 students from 21 countries (Europe, Middle East, FSU) participated. There were lecturers from 11 countries (USA, Germany, France, Italy, Spain, Belgium, Estonia, Russia, India, Australia, and Armenia). There is a series of Byurakan Summer Schools for YSU students as well (BSS). Based on our experience of astronomical summer/winter schools in the world, including the name, organizers, countries, location, periodicity, duration, number of participants, level (BSc, MSc, PhD or other) links to the upcoming events, etc..

Armenian pupils participate in International Astronomical Olympiads (IAO) and International Olympiads of Astronomy and Astrophysics (IOAA). We have participated in 15 out of 19 IAO and 2 out of 8 IOAA. Armenian team is one of the best and has won altogether 9 gold, 7 silver, and 21 bronze medals. There are astronomical groups at some specialized schools, where Olympic teams are being trained.

## 6. AMATEUR AND POPULAR ASTRONOMY IN ARMENIA

There are thousands of amateur astronomers in Armenia, however they need both professional and organizational support from astronomers, and BAO and ArAS have started to provide such a support. There are plans to create an individual association of amateur astronomers in 2015. ArAS has initiated Scientific Journalism in Armenia and regular press-releases are being circulated to mass media on various topics of astronomy and astronomical events. Public Outreach Activities include public lectures at schools, universities, etc., informing public about astronomical events (Calendar of Events on ArAS webpage), scientific journalism affairs: mailing list, FB group, press-releases, seminars, prizes, online popular astronomy journal, digital book library on ArAS webpage, popular articles on astronomical hot topics ArAS webpage, etc.

## 7. EUROPEAN EASTERN PARTNERSHIP

The Eastern Partnership (EaP) is an initiative of the European Union (EU) governing its relationship with the post-Soviet states of Armenia, Azerbaijan, Belarus, Georgia,

Moldova, and Ukraine. Having objectives to start collaboration between different regions and support each other for astronomy development, we have established contacts with astronomers from Poland, Serbia, Bulgaria and some other EU and Eastern European countries. Visits to Poland (Warsaw, Torun) and Serbia (Belgrade) have been accomplished by Areg Mickaelian during Dec 2013 and Sep 2014, respectively. Talks were given and discussions were held with the interested people. A mailing list was created to continue discussions. It is regarded that Armenia may play a role of the link between Europe and Eastern countries.

## 8. SUMMARY AND CONCLUSIONS

Summarizing, here we give the main features of Armenian astronomy that make a good basis for hosting IAU ROAD, including those described above and some others:

- BAO; 2.6m and 1m Schmidt telescopes; Viktor Ambartsumian was IAU (1963-1966) and ICSU (1968-1972) president; Markarian survey was the 1st systematic objective prism survey and 1st search for AGN
- ArAS is one of the 25 EAS affiliated societies; Armenian is one of 4 ICRANet member states; ArVO is one of the 19 national projects in frame of IVOA; DFBS is one of the largest spectroscopic databases
- Six IAU meetings were organized in Armenia in 1966-2013; JENAM-2007 was organized in Armenia; BISS are one of regular astronomical summer schools in the world
- Many foreign astronomers have defended their PhD thesis in BAO; Armenia is one of the most successful teams in International Astronomical Olympiads
- Viktor Ambartsumian International Prize is one of the major astron. prizes

There is a number of supporting organizations, such as Ministry of Education and Science, Ministry of Culture, State Committee of Science, and National Academy of Sciences, as well as a number of international organizations and countries, such as IAU, IVOA, International Centre for Relativistic Astrophysics Network (ICRANet), EAAS, Sub-Regional European Astronomical Committee (SREAC), Georgia, Iran, and Bulgaria (Wide-Field Plate Database).

## References

- Ambartsumian, V. A.: 1949, *Astron. Zh.*, **26**, 3.  
Ambartsumian, V. A.: 1958, *Proc. Solvay Conf. 1958*, Ed. Stoops, Bruxelles, p. 241.  
Arakelian, M. A.: 1975, *Commun. BAO*, **47**, 3.  
Gigoyan, K. S., Mickaelian, A. M.: 2012, *MNRAS*, **419**, 3346.  
Kazarian, M. A., Adibekyan, V. Zh., McLean, B. et al.: 2010, *Astrophysics*, **53**, 57.  
Markarian, B. E., Lipovetski, V. A., Stepanian, J. A. et al.: 1989, *Commun. SAO*, **62**, 5.  
Mickaelian, A. M.: 2008, *AJ*, **136**, 946.  
Mickaelian, A. M., Nesci, R., Rossi, C. et al.: 2007, *A&A*, **464**, 1177.  
Parsamian, E. S., Petrosian, V. M.: 1979, *Commun. BAO*, **51**, 3.  
Shahbazian, R. K.: 1996, *VizieR Catalog: Compact groups of compact galaxies*, VII/89B.  
Stepanian, J. A.: 2005, *Revista Mexicana Astron. Astrofis.*, **41**, 155.  
Weedman, D. W.: 1977, *Vistas in Astronomy*, **21**, 55.  
Weedman, D. W., Khachikian, E. Ye.: 1971, *Astrophysics*, **7**, 389.