

# ArAS News

NEWSLETTER

ARMENIAN ASTRONOMICAL SOCIETY (A r A S)



No. 89 (January 31, 2016)

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Editor: Sona FARMANYAN

ArAS Newsletter online at: <http://www.aras.am/ArasNews/arasnews.html>

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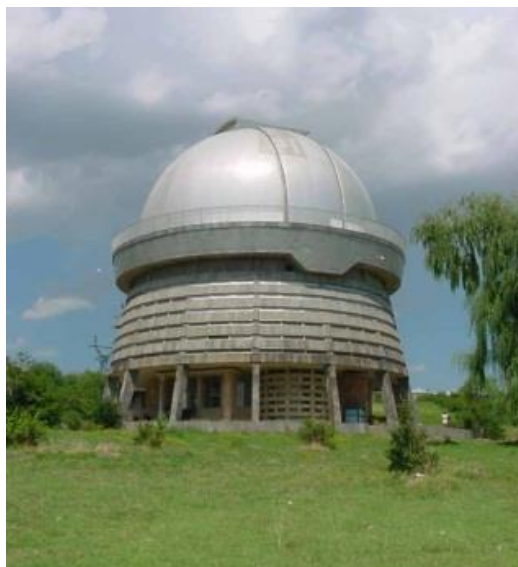
# CONTENTS

	1	<b>BAO Annual Report 2015</b>	3-39
	2	<b>Follow a Live Planet Hunt</b>	40
	3	<b>Astronomical Silk Road Conference Abstracts</b>	41-45
 <p><b>National Radio Astronomy Observatory</b> A facility of the National Science Foundation</p>	4	<b>Release of NRAO Newsletter December Issue</b>	46
	5	<b>Release of ESO Outreach Community Newsletter</b>	47
	6	<b>Release of IAU Astronomy Outreach Newsletter 2016 #1</b>	48
	7	<b>Anniversaries: Kaloghlian-85, Nikoghossian-75, Karapetian-60</b>	49-50
	8	<b>February Calendar of Astronomical Events</b>	51
	9	<b>February Calendar of Lunar Phases</b>	52

# Byurakan Astrophysical Observatory

## Annual Report 2015

### Introduction



In 2015, Byurakan astronomers continued and developed scientific projects related to **instability phenomena in the Universe** resulted in a number of important discoveries, active **international collaboration**, a number of **research grants** by Byurakan astronomers, organization of a number of meetings, etc. BAO scientists had 2 ANSEF grants in 2015, as well as a French-Armenian (CNRS-SCS) joint project for 2014-2015. 5 BAO astronomers were listed among the most productive scientists in Armenia. There have been **17 publications in refereed journals**, including most important international ones (*ApJ*, *A&A*, *MNRAS*), **3 electronic catalogs in Vizier**, **2 books** (Proceedings of meetings held in Byurakan), and **40 papers in Proceedings of meetings**, including 18 in the Proceedings of Byurakan-Abastumani Colloquium “*Instability and Evolution of Stars*” held in 2013 and 19 in the Proceedings of the meeting

“*Relation of Astronomy to other Sciences, Culture and Society*” held in 2014. There were **40 missions** for research and participation in meetings and schools.

Probably the most important event was the establishment in Armenia of the **IAU South West Asian Regional Office of Astronomy for Development (SWA ROAD)**. The Inauguration Ceremony was held on Oct 13, and an attached Workshop was organized with participation of representatives from IAU and IAU OAD Officers and regional countries (Armenia, Georgia, Iran, Israel, Jordan, Russia and Turkey). The Office will operate until 2021 with further extension plans to 2030.

A project of **Digitization and Scientific Usage of BAO Plate Archive** was conducted in April 2015. It is aimed at compilation, accounting, digitization of BAO observational archive photographic plates and films, as well as their incorporation in databases with modern standards and methods, providing access for all observational material and development of new scientific programs based on this material. The project pursues not only the maintenance task, but also it will serve as a source for new scientific research and discoveries.

Two important meetings were organized in October 2015; the symposium “**Astronomical Surveys and Big Data**” (**ASBD**) dedicated to Markarian Survey start 50<sup>th</sup> anniversary and Armenian Virtual Observatory (ArVO) foundation 10<sup>th</sup> anniversary and **Armenian-Iranian Astronomical Workshop** combined with ArAS XIV Annual Meeting. The first one combined astronomers and computer scientists with heavy involvement of astronomical surveys, catalogs, archives, databases and VOs. For the first time, the Proceedings will be published by ASP Conference Series. The second one was aimed at establishing mutual contacts between Armenian and Iranian astronomers, discussing and conducting joint research projects, and giving start to Armenian-Iranian astronomical collaboration. We also celebrated the **50<sup>th</sup> anniversary** of the journal **Astrofizika/Astrophysics**, both at NAS RA, Yerevan and BAO. **BAO annual summarizing meeting** was held on Dec 14, where the Director Haik Harutyunian reported 2014 results. Here we give more extended report on all kinds of activities.

## Structure of BAO and research staff

BAO is one of the institutions of the Armenian **National Academy of Sciences (NAS)** and is affiliated to its **Division of Physics and Astrophysics**. BAO is being funded from the state budget through the **Ministry of Education and Science (MES) State Committee for Science (SCS)** through Basic Program called *“Evolution of Cosmic Objects through their Activity”*. All researchers and the technical and administrative services, altogether 95 persons, are maintained due to this program. The administration consists of 3 persons: the **Director (Dr. Haik Harutyunian)**, the **Deputy Directors (Dr. Tigran Magakian, Dr. Areg Mickaelian, Dr. Tigran Movsessian)**, and the **Scientific Secretary (Dr. Elena Nikogossian)**.

There are several research groups headed by Haik Harutyunian, Edward Khachikian, Tigran Magakian, Norair Melikian, Areg Mickaelian, Elena Nikoghosyan, Elma Parsamian, and Artashes Petrosian. Altogether 44 scientists work in these groups. Three groups have been awarded state funding for 2014-2015 (PIs: Tigran Magakian, Elena Nikoghosyan, and Artashes Petrosian). Five BAO astronomers were included in the list of 100 most productive scientists in Armenia and receive additional salaries (Kamo Gigoyan, Tigran Magakian, Areg Mickaelian, Tigran Movsessian and Artashes Petrosian).

## Telescopes and infrastructure

During 2015, the project of reconstruction of BAO **2.6m telescope** was continued. During the last years, this telescope is the only one providing scientific results. Now new equipment is to be installed for science observations. Some works have been carried out also on **1m Schmidt telescope**. Having new focal system, this telescope may carry out new tasks.

The **small telescopes** may serve for smaller research projects and educational purposes, however they do not have modern receivers and other equipment. One of them is being used for visitors for promotional purposes.

BAO has a rich **Photographic plate archive** of some 37,500 plates obtained mostly with 0.5m and 1m Schmidt telescopes and the 2.6m one, and among them the First Byurakan Survey (FBS or Markarian survey) 2000 spectroscopic plates are the most valuable ones. It is now available in digital form (**Digitized First Byurakan Survey, DFBS**) and may be used for further efficient studies at high galactic latitudes. The **Armenian Virtual Observatory (ArVO)** operates based on this survey and other astronomical data obtained and being obtained with our telescopes, as well as data from all world databases and archives.

## Research at BAO

The main fields of investigation at BAO relate to non-stable phenomena in the Universe. This includes studies of non-stable stars and related objects in the Galactic Astronomy and activity in galaxies in the Extragalactic Astronomy, as well as search for new objects and large surveys. In addition, a group of theoreticians is always active in Byurakan working on topics initiated by V.A. Ambartsumian (radiative transfer theory, principle of invariance). Several recent directions have been introduced during 1990s and 2000s, such as the Large-Scale Structure of the Universe and (alternative) Cosmology, Infrared Astronomy, X-ray Astronomy, Solar physics, Exoplanets, Virtual Observatories (VOs). To describe the main results obtained during 2015, the abstracts of published papers are given.

*Stars and Nebulae (17)****Detailed kinematic investigation of Herbig-Haro objects in the northeast region of NGC 7129*****Movsessian, T. A.; Magakian, T. Y.; Moiseev, A. V.; Gevorgian, M. G.** (Astr. Bull. 70, 206, 04/2015)

Using the Fabry-Perot scanning interferometer at the SAO RAS 6-m telescope, we studied a number of Herbig-Haro objects in the northeast region of NGC7129. We detected a helicoidal flow in HH234, consisting of separate high-speed knots propagating within the cavity in the interstellar medium created by the outflow. HH235 consists of at least five knots, each of which form its own bow shock front. The direction of these fronts together with the NW-SE oriented high-velocity core of the flow indicate the location of a possible source. The origin of the objects HH105 and HH821 is discussed as well. Possible Herbig-Haro outflow sources in this region are located further north of the cluster center in the vicinity of the active star V350 Cep, except for HH234 with a known source. It can be considered ascertained that the NGC7129 region consists of several star-forming cores, in which multiple outflows from stars of different masses are present.

***Inner structure of the jets from YSO's*****Movsessian, T. A.; Magakyan, T. Yu.** (Proc. Byurakan-Abastumani Col., p. 42, 01/2015)

Even before the discovery of highly collimated stellar jets the determination of high proper motions of HH objects led to the basis of the current concept of their formation: HH objects are an optical manifestation of the outflows from young stars. This concept was fully confirmed when bipolar jets in outflowing systems were actually found. In some cases the already known HH objects were found to be the brightest parts of collimated flows, representing the symmetric bow-shape structures called “terminal working surfaces”.

***Multiple Star Systems in the Young Cluster IRAS 05137+3919*****Nikoghosyan, E. H.; Harutyunian, H. A.; Azatyan, N. M.** (Ap 58, 478, 12/2015)

Statistical analysis of a young stellar cluster surrounding the source IRAS 05137+3919 at a distance of 4.4 kpc reveals four binary objects and one triplet. These include a pair of Ae/Be Herbig stars. The percent content of multiple systems in the cluster is  $mf = 5-6\%$  and  $cp = 10-13\%$ . The masses of the components of the multiple systems range from  $\sim 1$  to  $8 M_{\odot}$  and  $\log P$  ( $P$  is the rotation period in years) ranges from 4.4 to 4.7. The median value of the mass ratio of the components is  $q = 0.86$ . The percentage and parameters of the multiple systems are similar to data on other star formation regions (ONC, Perseus, UScoA) for which the parameters  $mf$  and  $cp$  are comparable to the results obtained for the stellar population of the field.

***The cluster of PMS stars in the vicinity of IRAS 05137+3919*****Nikoghosyan, E. H.; Azatyan, N.** (Proc. Byurakan-Abastumani Col., p. 84, 01/2015)

We report the results of our study of the PMS stellar objects cluster in the vicinity of YSO CPM 15 which is associated with IRAS 05137+3919 source. The estimations of this cluster's distance are very inconsistent - from 4.3 kpc to 11 kpc. The KLF shows that nearer variant is more probable. Hence, with more probability, the pair of YSOs associated with CPM 15 is intermediate and not high mass objects, as was expected earlier.

***Statistical Analysis of Stars with H $\alpha$  Emission in the Cluster IC 348*****Nikoghosyan, E. H.; Vardanyan, A. V.; Khachatryan, K. G.** (Ap 58, 490, 12/2015)

Results are presented from a statistical analysis of  $\sim 200$  stars with H $\alpha$  emission in the cluster IC 348. The sample of emission objects extends to  $R \leq 20.0$ . The optical radius of the cluster is  $\sim 11'$ . The percentage of emission stars increases from bright to fainter objects and reaches 80% for objects within the interval  $13.0 \leq R - A_R \leq 19.0$ . The fraction of WTTS and CTTS is 64% and 36%, respectively. 70% of the x-ray sources are WTTS objects. The age of the WTTS and CTTS is  $\sim 2 \cdot 10^6$  yr. The non-emission stars with masses lower than that of the sun also have an age of  $\sim 2 \cdot 10^6$  yr, while the age of the brighter objects is  $\sim 7 \cdot 10^6$  yr. The most massive stars with a low level of activity are concentrated in a small dense central core of the cluster with a radius of  $\sim 1'$  and appear to have been generated in an earlier wave of star formation.

***The search of the stellar clusters in vicinity of YSOs with high and middle masses*****Azatian, N. M.; Nikoghosyan, E. H.** (arXiv150601053, 06/2015)

The results of the searching on the bases of GPS UKIDSS survey's data of dense compact stellar clusters in the vicinity of 20 YSOs with high and middle masses are presented. Totally we have revealed clusters in 13 areas. Around 5 objects (IRAS 18151-1208, IRAS 18316-0602, IRAS 19110+1045, IRAS 19213+1723, IRAS 20056+3350) they are newly detected. The radii and stellar density have significant gradient: from 0.2 to 2.7 pc and from 3 to 1000 stars/arcmin<sup>2</sup> respectively.

***New Ha emission stars in Cep OB3*****Melikian, N. D.; Gomez, J.; Karapetian, A. A.** (VizieR Online Data Catalog 016005701, 02/2015)

A search of emission stars has been done on the basis of digitized photographic plates received with the 40" Schmidt telescope of Byurakan Observatory equipped with a 4° objective prism. Forty-six new emission stars are found in a small area around the known FU Ori type variable V 733 Cep. Emission stars on the J - H - H - K diagram are situated on or in the neighborhood of T Tau locus. V, R, I photometry for some of the emission stars is performed as well. Three new variable stars are found in the region. A rapid brightness variation is detected on V 733 Cep.

***Continuous Emission in the Spectra of Stellar Flares*****Melikian, N. D.** (Proc. Byurakan-Abastumani Col., p. 55, 01/2015)

First spectral observations of the stellar flares testifying to the existence of continuous emission during stellar flares had been carried out in 1949. A few years later the data analysis led to the conclusion that the continuous emission during a flare of UV Ceti stars and the one observed in the various stages of the T Tau stars brightness variations have the same physical nature and are a result of the intrastellar energy release in the outer layers of stars.

***New H-alpha Objects in the Areas of Dark*****Karapetian, A. A.** (Proc. Byurakan-Abastumani Col., p. 60, 01/2015)

The results of a search for new emission Observations are carried out with the 40" and 2.6m telescopes of the Byurakan observatory. As a result nearly 300 new emission objects including T Tau type variables, HH objects, UV type flare stars, cometary nebulae and a new infrared nebula have been revealed.

***Investigation of Faint Galactic Carbon Stars from the First Byurakan Spectral Sky Survey. II. Early-Type Carbon Stars*****Gigoyan, K. S.; ...; Kostandyan, G.; ...; Abrahamyan, H.; Paronyan, G.** (Ap 58, 369, 09/2015)

In this paper, second in this series, we discuss the nature of 66 faint carbon (C) stars which have been discovered by scrutinizing the plates of the First Byurakan Survey (FBS). These plates display low-resolution spectra of objects located at high Galactic latitudes and have a limiting magnitude of about  $V = 16$ . Our sample of 66 objects is part of a total of 120 stars found in the FBS and confirmed spectroscopically to be C stars. These 66 objects are those which show early-type spectra (not N-type). To better characterize these objects, medium-resolution CCD spectra were obtained and are exploited for them all, together with consideration of their 2MASS near-infrared (NIR) colors and their optical variability. First, we establish criteria for getting a spectral classification by using our medium-resolution spectra. Then, 57 objects show spectral features which are typical of CH-giants, while four can be classified as a R-type stars. Five objects in our sample are reported to be probably carbon dwarfs according to previous studies. We derive effective temperatures from photometry. Finally, the optical variability of our objects are studied by using the data of the Catalina Sky Survey (CSS). It is found that the vast majority do not display variability. However, for some of them, the phased light curve may indicate the presence of a secondary component. We estimate the detection range (in kpc) for each class of carbon stars detected in the FBS. Finally, our studies of C stars found at high galactic latitude are discussed in the context of the Gaia mission.

***X-ray selected stars in HRC and BHRC catalogues*****Mickaelian, A. M.; Paronyan, G. M.** (Proc. Byurakan-Abastumani Col., p. 77, 01/2015)

A joint HRC/BHRC Catalogue has been created based on merging of Hamburg ROSAT Catalogue (HRC) and Byurakan Hamburg ROSAT Catalogue (BHRC). Both have been made by optical identifications of X-ray sources based on low-dispersion spectra of the Hamburg Quasar Survey (HQS) using ROSAT Catalogues. As a result, the largest sample of 8132 (5341+2791) optically identified X-ray sources was created having count rate (CR) of photons  $\leq 0.04$  ct/s in the area with galactic latitudes  $|b| \leq 20^\circ$  and declinations  $d \leq 0^\circ$ . There are 4253 AGN, 492 galaxies, 1800 stars and 1587 unknown objects in the sample. All stars have been found in GSC 2.3.2, as well as most of them are in GALEX, USNO-B1.0, 2MASS and WISE catalogues. In addition, 1429 are in SDSS DR9 and 204 have SDSS spectra. For these stars we have carried out spectral classification and along with the bright stars, many new cataclysmic variables (CV), white dwarfs (WD) and late-type stars (K-M and C) have been revealed. For all stars, statistical studies of their multiwavelength properties have been made. An attempt to find a connection between the radiation fluxes in different bands for different types of sources, and identify their characteristics was made as well.

***Physical and Chemical Parameters of HgMn Stars on the Basis of the Available Data*****Ghazaryan, S.** (Proc. Byurakan-Abastumani Col., p. 14, 01/2015)

For better understanding the details of physical processes affecting essentially the atmosphere of HgMn stars, I compiled the chemical abundances of nearly all the observed HgMn stars and compared them with Smith's review (1996). During this study for about 130 stars of the mentioned type, more than 65 elements' abundances were compiled and rescaled assuming solar abundances values given by Asplund (2009). This compilation results show that the heavy elements are systematically overabundant in HgMn stars (see Preston (1974) and Smith (1996)). The under abundance of HeI seems less pronounced than in Smith's review. For some elements (As, Br, Rh, Pd, Gd, Au, and U) no abundances have been shown by Smith while for the others, the results are mostly the same. Thus we arrive at a conclusion that these results are in good agreement with Smith's figure. But it is important to know that the created database is not homogenous because the HgMn stars were observed by different techniques and dissimilar methods. Consequently, the uncertainties need to be taken into account to be sure for each abundance value. It is planned also to combine the abundances of all observed A and B stars as well to be able to see the abundance stratifications changes because of the effective temperature. This work is in preparation and will be done in near future.

***Star formation regions in LDN 1667*****Gyulbudaghian, A. L.** (Ap 58, 380, 09/2015)

A group of three star formation regions in the dark cloud LDN 1667 is examined. All three of these regions contain Trapezium type systems.  $^{12}\text{C}(1-0)$  observations are made of the part of the molecular cloud LDN 1667 associated with one of the star formation regions. Three molecular clouds were detected, one of which (the main cloud) has a red and a blue outflow. Three stars from the star formation regions are found to have annular nebulae and one star has a conical nebula. The dark cloud LDN 1667 is associated with a radial system of dark globules which is formed by the star HD 57061.

***New radial systems of dark globules*****Gyulbudaghian, A. L.; Mendez, R. A.** (Rev. Mex. Astron. Astrofis. 51, 183, 10/2015)

We present the results of a systematic survey of ESO/SRC plates of the Southern Hemisphere aimed at discovering new radial systems of dark globules. During this survey, we found 16 new type 1 radial systems and 6 type 2 radial systems. We thus doubled the number of known radial systems. O-B2 type stars are situated at the centers of type 1 radial systems, but there are no early-type stars in the centers of type 2 radial systems. An attempt was done to provide an interpretation of the groups of starless condensations as radial systems of dark globules situated behind thick dark clouds, which would explain why these globules are seen only at submillimeter wavelengths.

***Radial systems in dark globules in Southern Hemisphere*****Gyulbudaghyan, A. L.** (Horizons of World Physics 285, 157, 2015)

Abstract not available.

***Two Cases of Unusual Molecular Outflows*****Gyulbudaghyan, A. L.** (Proc. Byurakan-Abastumani Col., p. 38, 01/2015)

Two cases of molecular outflows are considered. Both outflows are bipolar, but not as usual, that is one lobe is red shifted and the other lobe is blue shifted. In our outflows in one case both lobes of  $^{12}\text{CO}(1-0)$  outflow are red shifted (in the case of GRV 8) and in another case both lobes of  $^{12}\text{CO}(1-0)$  outflow are blue shifted (in the case of SNO 87). 1. Introduction. The molecular outflows can be divided in two groups: 1. Outflows connected with massive stars (or protostars) in large star forming regions (e. g. core of the Orion molecular cloud), 2. Outflows associated with stars of low and intermediate masses (e.g. T Tauri or Herbig Ae/Be type stars)[1]. The outflows as usual are bipolar: one lobe is red shifted and the other is blue shifted. In this paper we present two cases of second group of molecular outflows which are unusual: in the case of GRV 8 [2] both lobes of bipolar outflow are red shifted and in the case of SNO 87 [3] both lobes are blue shifted.

***Variability of Superflare Frequency of Sun Like Stars*****Akopian, A. A.** (Ap 58, 62, 03/2015)

This is a statistical study of the variability in the frequency of superflares in 46 stars of the solar type observed with the Kepler orbital observatory. Two possible scenarios for changes in the superflare frequency are examined. In the first, the time sequence of superflares is treated as a piecewise stationary Poisson process. 5 stars are found to have statistically significant changes by several times in their superflare frequency. The times at which the frequency changes are accompanied by changes in the behavior of a star's brightness outside the flares. For a short time the star's brightness becomes irregular, with a substantial reduction in its luminosity amplitude. In the second scenario, the time sequence of the superflares is treated as a Poisson process with a periodic parameter (the superflare frequency). This scenario confirms the existence of a possible periodicity of the superflare frequency with a period equal to the period of the star's orbital or axial rotation. The star KIC 7264976 is found to have a frequency periodicity with a period that is the same as the possible period of its orbital rotation. A frequency periodicity with a period equal to the probable axial rotation period is found for the star KIC 10422252.

***Extragalactic Astronomy (20)******Spectral Study of Some SBS Galaxies. Physical Conditions. Abundance of Oxygen and Nitrogen*****Gyulzadyan, M. V.** (Ap 58, 338, 09/2015)

Physical conditions and the oxygen and nitrogen abundances in 36 SBS galaxies with UV excesses and/or without UV excesses, but with emission lines, are determined using spectra from the SDSS DR7. It is found that SBS 0808+578 is an AGN, while the other objects are either HII galaxies or HII regions in galaxies. For all these objects the oxygen abundance  $12+\log(\text{O}/\text{H})$  lies within a range of 7.85-8.61, and the ratio  $\log(\text{N}/\text{O})$  lies within a range of -1.45 to -0.4. On an N/O-O/H diagram they occupy the same region as high-excitation HII regions. No galaxies with a high metal deficit were found. The star formation rates (SFR) of these galaxies were determined from their Ha fluxes and found to lie within a range of  $0.001\div 6 M_{\odot} \text{ year}^{-1}$ , close to the values for typical star formation regions in spiral and irregular galaxies.

***Galaxies of Lower Activity from Seven Selected Fields of the Second Byurakan Spectral Survey*****Hakopian, S. A.** (Proc. Byurakan-Abastumani Col., p. 120, 01/2015)

The aims, phases and course of implementation of a program for study of galaxies extracted from seven selected fields of the Second Byurakan Spectral Survey are presented.



***Multiwavelength studies of X-ray selected extragalactic sample***

**Mickaelian, A. M.; Paronyan, G. M.; Harutyunyan, G. S.; Abrahamyan, H. V.; Gyulzadyan, M. V.** (eprint arXiv:1511.07012, 11/2015)

The joint catalogue of Active Galactic Nuclei selected from optical identifications of X-ray sources was created as a combination of two samples: Hamburg-ROSAT Catalogue (HRC) and Byurakan-Hamburg-ROSAT Catalogue (BHRC). Both are based on optical identifications of X-ray sources from ROSAT catalogues using low-dispersion spectra of Hamburg Quasar Survey (HQS). However, HRC and BHRC contain a number of misidentifications and using the recent optical and multiwavelength (MW) catalogues we have revised both samples excluding false AGN and adding new genuine ones. Thus a new large homogeneous complete sample of 4253 X-ray selected AGN was created. 3352 of them are listed in the Catalogue of QSOs and Active Galaxies and 387 also are in Roma Multifrequency Catalogue of Blazars. 901 candidate AGN are subject for further study. We classified 173 of these objects using their SDSS DR12 spectra. Following activity types were revealed: 61 AGN, 21 HII galaxies, 12 emission-line galaxies without definite type, 71 absorption-line galaxies, 2 stars, and 6 were classified as "Unknown". A special emphasis is made on narrow-line Sy1.0-Sy1.5 galaxies and QSOs, as many of them have soft X-ray, strong FeII lines, and relatively narrow lines coming from BLR ("narrow broad lines"). As a result, the sample of genuine AGN was enlarged to 3413 objects. We have retrieved MW data from recent catalogues and carried out statistical investigations for the whole AGN sample. An attempt to find connections between fluxes in different bands for different types of sources, and identify their characteristics thus confirming candidate AGNs have been carried out. We have analyzed X-ray properties of these sources to find a limit between normal galaxies and X-ray AGN.

***Large homogeneous sample of X-ray selected AGN and its study***

**Mickaelian, A. M.; Paronyan, G. M.; Abrahamyan, H. V.** (IAU GA #29, id.2251358, 08/2015)

The combined catalogue of AGN (ROSAT BSC/FSC AGN) selected from optical identifications of X-ray sources based on Hamburg--ROSAT Catalogue (HRC) and Byurakan--Hamburg--ROSAT Catalogue (BHRC) is a homogeneous sample for statistical studies. Optically identified X-ray sources from ROSAT Bright Source Catalogue (BSC) and Faint Source Catalogue (FSC) are included, 4253 X-ray selected AGN in total. All these sources are confirmed or candidate AGN based on Hamburg Quasar Survey (HQS) low-dispersion spectra. 3352 of them are listed in the Catalogue of QSOs and Active Galaxies (Véron-Cetty & Véron (2010; 13th version) and 387 are in the Multifrequency Catalogue of Blazars (Roma--BZCAT) by Massaro et al. (2012). We carried out classification for 210 of these candidate sources based on available SDSS spectra and enlarged the sample of confirmed AGN to 3650. A special emphasis is made on narrow-line Sy1.0-Sy1.5 galaxies and QSOs, as many of them have soft X-ray, strong FeII lines, and relatively narrow lines coming from BLR ("narrow broad lines") we have classified 45 new AGN as such objects. We carried out statistical investigations of the sample, including study of luminosity function, flux-ratios for different ranges, luminosity evolution, etc. Multiwavelength SEDs have also been constructed to follow their behavior for different kinds of AGN and link these SEDs to classifications. The sample is a relevant sources for identification of new blazars.

***The Joint IRAS PSC/FSC catalogue as a tool for efficient studies for extragalactic IR sources***

**Mickaelian, A.; Abrahamyan, H.; Harutyunyan, G.** (Proc.Byurakan-Abastumani Col., p.109, 01/2015)

To increase the efficiency of using IRAS PSC and FSC, which contain a lot of common sources, one needs a joint catalogue of all IRAS point sources with improved data based on both catalogues. We have combined these two catalogs and obtained 345,163 sources, including 73,770 common associations with improved data. In addition, we have made cross-correlations with AKARI/IRC, AKARI/FIS and WISE catalogues. As a result we created a catalogue with high positional accuracy and with 17 photometric measurements from 1.25m to 160mwavelength range (based on 2MASS, WISE, IRAS, and AKARI). At least half of all sources are extragalactic ones, which include bright galaxies, AGN and especially many Starburst galaxies that are important for star-formation phenomena and in many cases for study of the interrelationship between starburst, interactions and nuclear activity.

***High-redshift quasars and blazars and their evolutionary relation to high-redshift galaxies*****Mickaelian, A. M.; Abrahamyan, H. V.; Paronyan, G. M.** (IAU GA #29, id.2251350, 08/2015)

High-redshift quasars and blazars are among the most powerful sources in the Universe and among the highest luminosity sources, as in optical, so as in X-ray, UV, IR and radio range. However, their evolutionary relation to high-redshift galaxies is not yet clear. Have they formed at the same epoch or there is an evolutionary transition between these objects? There are many similarities indicating such connections, such as the high luminosity, radio and X-ray emissions, jets, etc. We have investigated this subject on the basis of observational data to find relations and possible evolutionary links. We have created a full sample of blazars and high-redshift quasars ( $z > 2.3$ ) based on their lists from Véron-Cetty & Véron (2010) and Roma BZCAT (Massaro et al. 2012) catalogues and newly discovered objects from SDSS and other surveys. The inhomogeneity of data (optical photometry and fluxes at other wavelength ranges, variability, etc.) does not allow correct statistics of the physical parameters. Therefore we started from the creation of a homogeneous sample based on all parameters. A special emphasis is made on narrow-line QSOs, similar to NLS1s, as many of them have soft X-ray, strong FeII lines, and relatively narrow lines coming from BLR ("narrow broad lines"). The evolutionary relation of high-redshift quasars and blazars to high-redshift galaxies is discussed using the luminosity evolution.

***AGN Zoo and Classifications of Active Galaxies*****Mickaelian, A. M.** (Iranian J. Astron. Astrophys. 2, 1, 07/2015)

We review the variety of Active Galactic Nuclei (AGN) classes (so-called "AGN zoo") and classification schemes of galaxies by activity types based on their optical emission-line spectrum, as well as other parameters and other than optical wavelength ranges. A historical overview of discoveries of various types of active galaxies is given, including Seyfert galaxies, radio galaxies, QSOs, BL Lacertae objects, Starbursts, LINERs, etc. Various kinds of AGN diagnostics are discussed. All known AGN types and subtypes are presented and described to have a homogeneous classification scheme based on the optical emission-line spectra and in many cases, also other parameters. Problems connected with accurate classifications and open questions related to AGN and their classes are discussed and summarized.

***The energetic budget of AGN*****Ohanyan, G. A.** (Proc. Byurakan-Abastumani Col., p. 104, 01/2015)

One of the main problems of extragalactic astronomy is to understand how galaxies formed and evolved. There are two basic approaches to solve this problem. One called standard scenario is widely accepted in the literature, and the second less disseminate in the scientific literature, is Ambartsumian's concept. The role of AGN in above mentioned approaches is essentially different. In the standard scenarios, it is believed that injection of matter and other types of activity are secondary phenomena, and a primarily phenomenon is the gravitational energy released due to the accretion of matter onto galaxies nuclei, which contain super massive black holes (SMBHs). According to Ambartsumian's concept the source of energy is located in the nuclei of galaxies, and a mechanism by which it can be transferred is still open.

***The Luminosity Function of Galaxies*****Mahtessian, A. P.** (Proc. Byurakan-Abastumani Col., p. 136, 01/2015)

Abstract not available.

***Relation of Kinematical Properties of cD Clusters of Galaxies with Their Radiative Characteristics*****Harutyunyan, V. S.; Harutyunian, H. A.** (Proc. Byurakan-Abastumani Col., p. 143, 01/2015)

A possible correlation between the velocity dispersions of regular clusters of galaxies and their total luminosity is discussed. Based on the generally accepted hypothesis that regular clusters of galaxies are equilibrated systems, we attempt to find a relationship similar to the Faber-Jackson relation. The fact that no such relationship was found can be interpreted as a consequence of the incompleteness of the samples of galaxies that were used or, more likely, of the untenability of the assumption that these clusters are in equilibrium.

***Structure of the Magnetic Field near the Galactic Plane*****Andreasyan, R.; Balayan, S.; Movsesyan, V.** (Proc. Byurakan-Abastumani Col., p. 148, 01/2015)

A method is introduced for constructing two-color maps for the plane component of the magnetic field of our galaxy in  $(R, l)$  and  $(DM, l)$  coordinates. It is shown that, in agreement with the known models of the galactic magnetic field, the magnetic field in neighboring spiral arms reverses direction. However, the magnetic field in the spiral arm of Sagittarius differs significantly from the standard magnetic field model, with the major difference being that the magnetic fields in the southern and northern hemispheres are oppositely directed in the spiral arm of Sagittarius. It is proposed that this distribution of the magnetic field can be explained best by assuming that the spiral arm of Sagittarius, or, at least, a magnetic spiral arm in that region, is not symmetric with respect to the galactic plane and lies mainly in the northern hemisphere.

***The Ha Velocity Fields and Galaxy Interaction in the Quartet of Galaxies NGC 7769, 7770, 7771 and 7771A***  
**Yeghiazaryan, A. A.; Nazaryan, T. A.; Hakobyan, A. A.** (arXiv151000193, 10/2015)

The quartet of galaxies NGC 7769, 7770, 7771 and 7771A is a system of interacting galaxies. Close interaction between galaxies caused characteristic morphological features: tidal arms and bars, as well as an induced star formation. In this study, we performed the Fabry-Perot scanning interferometry of the system in Ha line and studied the velocity fields of the galaxies. We found that the rotation curve of NGC 7769 is weakly distorted. The rotation curve of NGC 7771 is strongly distorted with the tidal arms caused by direct flyby of NGC 7769 and flyby of a smaller neighbor NGC 7770. The rotation curve of NGC 7770 is significantly skewed because of the interaction with much massive NGC 7771. The rotation curves and morphological disturbances suggest that the NGC 7769 and NGC 7771 have passed the first pericenter stage, however, probably the second encounter has not happened yet. Profiles of surface brightness of NGC 7769 have a characteristic break, and profiles of color indices have a minimum at a radius of intensive star formation induced by the interaction with NGC 7771.

***On the Interaction in a Quartet of Galaxies*****Yeghiazaryan, A. A.; Hakobyan, A. A.; Nazaryan, T. A.** (arXiv151200634, 12/2015)

We performed the Fabry-Perot scanning interferometry of the quartet of galaxies NGC 7769, 7770, 7771 and 7771A in Ha line and studied their velocity fields. We found that the rotation curve of NGC 7769 is weakly distorted. The rotation curve of NGC 7771 is strongly distorted with the tidal arms caused by direct flyby of NGC 7769 and flyby of a smaller neighbor NGC 7770. The rotation curve of NGC 7770 is significantly skewed because of the interaction with much massive NGC 7771. The rotation curves and morphological disturbances suggest that the NGC 7769 and NGC 7771 have passed the first pericenter stage, however, probably the second encounter has not happened yet.

***Studies of the Jet in BL Lacertae. II. Superluminal Alfvén Waves*****Cohen, M. H.; Meier, D. L.; Arshakian, T. G.; et al.** (ApJ 803, id.3, 04/2015)

We study the kinematics of ridge lines on the parsec-scale jet of the active galactic nucleus BL Lacertae. We show that the ridge lines display transverse patterns that move superluminally downstream, and that the moving patterns are analogous to waves on a whip. Their apparent speeds  $\beta_{app}$  (units of  $c$ ) range from 3.9 to 13.5, corresponding to  $\beta_{wavegal}=0.981-0.998$  in the galaxy frame. We show that the magnetic field in the jet is well ordered with a strong transverse component, and assume that it is helical and that the transverse patterns are Alfvén waves propagating downstream on the longitudinal component of the magnetic field. The wave-induced transverse speed of the jet is non-relativistic ( $\beta_{tr}^{gal} \lesssim 0.09$ ). In 2010 the wave activity subsided and the jet then displayed a mild wiggle that had a complex oscillatory behavior. The Alfvén waves appear to be excited by changes in the position angle of the recollimation shock, in analogy to exciting a wave on a whip by shaking the handle. A simple model of the system with plasma sound speed  $\beta_s = 0.3$  and apparent speed of a slow MHD wave  $\beta_{app}$ ,  $S = 4$  yields Lorentz factor of the beam  $\Gamma_{beam} \sim 4.5$ , pitch angle of the helix (in the beam frame)  $\alpha \sim 67^\circ$ , Alfvén speed  $\beta_A \sim 0.64$ , and magnetosonic Mach number  $M_{ms} \sim 4.7$ . This describes a plasma in which the magnetic field is dominant and in a rather tight helix, and Alfvén waves are responsible for the moving transverse patterns.

***The link between broad emission line fluctuations and non-thermal emission from the inner AGN jet***

León-Tavares, J.; Chavushyan, V.; Lobanov, A.; Valtaoja, E.; **Arshakian, T. G.** (IAU Symp. #313, p. 43, 03/2015)

AGN reverberate when the broad emission lines respond to changes of the ionizing thermal continuum emission. Reverberation measurements have been commonly used to estimate the size of the broad-line region (BLR) and the mass of the central black hole. However, reverberation mapping studies have been mostly performed on radio-quiet sources where the contribution of the jet can be neglected. In radio-loud AGN, jets and outflows may affect substantially the relation observed between the ionizing continuum and the line emission. To investigate this relation, we have conducted a series of multi-wavelength studies of radio-loud AGN, combining optical spectral line monitoring with regular VLBI observations. Our results suggest that at least a fraction of the broad-line emitting material can be located in a sub-relativistic outflow ionized by non-thermal continuum emission generated in the jet at large distances ( $> 1$  pc) from the central engine of AGN. This finding may have a strong impact on black hole mass estimates based on measured widths of the broad emission lines and on the gamma-ray emission mechanisms.

***The parsec-scale structure, kinematics, and polarization of radio-loud narrow-line Seyfert 1 galaxies***

Richards, J. L.; Lister, M. L.; Savolainen, T.; ...; **Arshakian, T. G.**; ... (IAU Symp. #313, p. 139, 03/2015)

Several narrow-line Seyfert 1 galaxies (NLS1s) have now been detected in gamma rays, providing firm evidence that at least some of this class of active galactic nuclei (AGN) produce relativistic jets. The presence of jets in NLS1s is surprising, as these sources are typified by comparatively small black hole masses and near- or super-Eddington accretion rates. This challenges the current understanding of the conditions necessary for jet production. Comparing the properties of the jets in NLS1s with those in more familiar jetted systems is thus essential to improve jet production models. We present early results from our campaign to monitor the kinematics and polarization of the parsec-scale jets in a sample of 15 NLS1s through multifrequency observations with the Very Long Baseline Array. These observations are complemented by fast-cadence 15 GHz monitoring with the Owens Valley Radio Observatory 40 m telescope and optical spectroscopic monitoring with the 2 m class telescope at the Guillermo Haro Astrophysics Observatory in Cananea, Mexico.

***Spiral Galaxies with a Larger Fraction of Dark Matter in the Region of 3-10 Mpc around the Virgo and Fornax Clusters***

Kogoshvili, N. G.; Borchkhadze, T. M.; **Kalloghlian, A. T.** (Ap 58, 318, 09/2015)

This is a study of the dynamic characteristics of spiral galaxies with absolute magnitudes  $M \geq -20m.6$  at distances of 3 to 10 Mpc from the Virgo and Fornax clusters based on data from the Merged Catalog of Galaxies MERCG. The diameters of the galaxies are used to determine the radius  $R_D$  corresponding to the region with the greatest concentration of dark matter. Based on the condition of centrifugal equilibrium, the dynamic parameters of the spiral galaxies with  $M \geq -20m.6$  are calculated and compared with the dynamic characteristics of spiral galaxies with  $M \geq -20m.6$ . It is found that there are many fewer spiral galaxies with  $M \geq -20m.6$  and a larger fraction of dark matter in the regions surrounding these clusters, estimated at 12.7% in the vicinity of the Virgo cluster and 15.3% in the vicinity of the Fornax cluster.

***Disturbance levels of SNe host galaxies***

**Hakobyan, A. A.; Nazaryan, T. A.; Adibekyan, V. Z.; Petrosian, A. R.; Aramyan, L. S.; ...**  
(VizieR Online Data Catalog 74442428, 04/2015)

We present an analysis of the relative frequencies of different supernova (SN) types in spirals with various morphologies and in barred or unbarred galaxies. We use a well-defined and homogeneous sample of spiral host galaxies of 692 SNe from the Sloan Digital Sky Survey in different stages of galaxy-galaxy interaction and activity classes of nucleus. We propose that the underlying mechanisms shaping the number ratios of SNe types can be interpreted within the framework of interaction-induced star formation, in addition to the known relations between morphologies and stellar populations. We find a strong trend in behaviour of the NIa/NCC ratio depending on host morphology, such that early spirals include more Type Ia SNe. The NIbc/NII ratio is higher in a broad bin of early-type hosts. The NIa/NCC ratio is nearly constant when changing from normal, perturbed to interacting galaxies, then declines in merging galaxies, whereas it jumps to the highest value in post-merging/remnant galaxies. In contrast, the NIbc/NII ratio jumps to the highest value in merging galaxies and slightly declines in post-merging/remnant subsample. The interpretation is that the star formation rates and morphologies of galaxies, which are strongly affected in the final stages of interaction, have an impact on the number ratios of SNe types. The NIa/NCC (NIbc/NII) ratio increases (decreases) from star-forming to active galactic nuclei (AGN) classes of galaxies. These variations are consistent with the scenario of an interaction-triggered starburst evolving into AGN during the later stages of interaction, accompanied with the change of star formation and transformation of the galaxy morphology into an earlier type.

***Study of unconfirmed supernovae***

**Aramyan, L. S.; Petrosian, A. R.; Hakobyan, A. A.; ...; Nazaryan, T. A.** (Proc. Byurakan-  
Abastumani Col., p. 28, 01/2015)

We study the nature of 39 unconfirmed supernovae (SNe) from the sky area covered by Sloan Digital Sky Survey (SDSS) Data Release 8 (DR8), using available photometric and imaging data and intensive literature search. We confirm that 21 objects are real SNe, 2 are Galactic stars, 4 are probable SNe and 12 remain unconfirmed events. The probable types for 4 objects are suggested: 3 SNe are of probable type Ia and SN 1953H is probable type II SN. In addition, we identify the host galaxy of SN 1976N and correct the offsets/coordinates of SNe 1958E, 1972F, and 1976N.

***Supernovae in paired host galaxies***

**Nazaryan, T. A.; Petrosian, A. R.; Hakobyan, A. A.; ...; Aramyan, L. S.** (Proc. Byurakan-  
Abastumani Col., p. 99, 01/2015)

We investigate the influence of close neighbor galaxies on the properties of supernovae (SNe) and their host galaxies using 56 SNe located in pairs of galaxies with different levels of star formation (SF) and nuclear activity. The mean distance of type II SNe from nuclei of hosts is greater by about a factor of 2 than that of type Ibc SNe. For the first time it is shown that SNe Ibc are located in pairs with significantly smaller difference of radial velocities between components than pairs containing SNe Ia and II. We consider this as a result of higher star formation rate (SFR) of these closer systems of galaxies. SN types are not correlated with the luminosity ratio of host and neighbor galaxies in pairs. The orientation of SNe with respect to the preferred direction toward neighbor galaxy is found to be isotropic and independent of kinematical properties of the galaxy pair.

*Extrasolar Planets (2)****From stellar to planetary composition: Galactic chemical evolution of Mg/Si mineralogical ratio***Adibekyan, V.; Santos, N. C.; Figueira, P.; ...; **Hakobyan, A. A.**; ... (A&A 581, id.L2, 09/2015)

The main goal of this work is to study element ratios that are important for the formation of planets of different masses. We study potential correlations between the existence of planetary companions and the relative elemental abundances of their host stars. We use a large sample of FGK-type dwarf stars for which precise Mg, Si, and Fe abundances have been derived using HARPS high-resolution and high-quality data. A first analysis of the data suggests that low-mass planet host stars show higher [Mg/Si] ratios, while giant planet hosts present [Mg/Si] that is lower than field stars. However, we found that the [Mg/Si] ratio significantly depends on metallicity through Galactic chemical evolution. After removing the Galactic evolution trend only the difference in the [Mg/Si] elemental ratio between low-mass planet hosts and non-hosts was present in a significant way. These results suggest that low-mass planets are more prevalent around stars with high [Mg/Si]. Our results demonstrate the importance of Galactic chemical evolution and indicate that it may play an important role in the planetary internal structure and composition. The results also show that abundance ratios may be a very relevant issue for our understanding of planet formation and evolution.

***Identifying the best iron-peak and  $\alpha$ -capture elements for chemical tagging: The impact of the number of lines on measured scatter***Adibekyan, V.; Figueira, P.; Santos, N. C.; ...; **Hakobyan, A. A.**; ... (A&A 583, id.A94, 11/2015)

The main goal of this work is to explore which elements carry the most information about the birth origin of stars and, as such, which are best suited for chemical tagging. We explored different techniques to minimize the effect of outlier value lines in the abundances by using Ni abundances derived for 1111 FGK-type stars. We evaluate how the limited number of spectral lines can affect the final chemical abundance. Then we make an efficient even footing comparison of the [X/Fe] scatter between the elements that have a different number of observable spectral lines in the studied spectra. When several spectral lines are available, we find that the most efficient way of calculating the average abundance of elements is to use a weighted mean (WM), whereby we consider the distance from the median abundance as a weight. This method can be used effectively without removing suspected outlier lines. When the same number of lines are used to determine chemical abundances, we show that the [X/Fe] star-to-star scatter for iron group and  $\alpha$ -capture elements is almost the same. The largest scatter among the studied elements, was observed for Al and the smallest for Cr and Ni. We recommend caution when comparing [X/Fe] scatters among elements where a different number of spectral lines are available. A meaningful comparison is necessary to identify elements that show the largest intrinsic scatter, which can then be used for chemical tagging.

*Theoretical Astrophysics (6)****Growth of Accreting Supermassive Black Hole Seeds and Neutrino Radiation*****Ter-Kazarian, G. T.** (J. Astrophysics 2015, id.205367, 2015)

Abstract not available.

***Modified Theories of Gravitation behind the Spacetime Deformation*****Ter-Kazarian, G. T.** (Phys. Res. Intern. 2015, id.152846, 2015)

Abstract not available.

***Does the Dark Energy Interact with the Ordinary Baryonic Matter?*****Harutyunian, H. A.** (IAU GA #29, id.2257366, 08/2015)

The possible consequences resulted due to the interaction and energy exchange between the dark energy carrier and the ordinary baryonic matter is considered. We act on the premise that the acceleration of the Universe would be impossible if no such interaction did occur. Second point to be taken into account is the structural features of baryonic matter which consist of atoms with the most mass concentrated in their nuclei. On the other hand all the objects started with the atomic nuclei and up to planets and stars exist owing to their negative binding (nuclear or gravitational) energy. Then one should expect the objects made of baryonic matter to gain energy in average if the mentioned two substances really interact. Therefore the absolute value of binding energy seems to go down both for gravitationally bound objects and atomic nuclei, thus increasing their internal excessive energy and the probability of the spontaneous decay. Any self-consistent consideration based on the common physical concepts leads one to arrive at a conclusion that the gradual decrease of nuclear binding energy makes the mass of nucleons and nuclei should grow up. Moreover, due to the decrease of the nuclear binding energy the limit of instability or radioactivity gradually shifts towards the lighter nuclei. The cosmological consequences of such a possibility are considered in this report.

***The Reflection Properties of Atmosphere as Characteristics of the Radiation Diffusion inside It*****Nikoghossian, A. G.** (Proc. Byurakan-Abastumani Col., p. 18, 01/2015)

The subject of this report concerns one of fundamentals of theoretical astrophysics, the theory of radiative transfer. Difficulties to be dealt with in a variety of astrophysical problems when determining the field of radiation in scattering and absorbing atmospheres are well known. This is due to coupling that the multiple scattering establishes between the fields of radiation in different points of atmosphere, so that the state of the radiating volume is determined not only by its local thermodynamic parameters but also by radiation field in the entire atmosphere. In the classical treatment, such problems are usually formulated as boundary-value problems and are reduced, as a rule, to solution of integro-differential or integral equations. Because of the complexity of these problems it has been necessary to elaborate different techniques in order to make it somewhat easier to get the numerical solutions. To this end, in a series of papers [1-3] we used an approach referred to as 'invariant imbedding' [4, 5] to reformulate the transfer problems as the initial-value problems. Now it is of undoubted interest to give a profound comparing analysis between two mentioned approaches.

***Accelerated expansion of the Universe as the most powerful source of the energy release in cosmic objects*****Harutyunian, H. A.** (Proc. Byurakan-Abastumani Col., p. 89, 01/2015)

The available data on the expansion effects in the shorter scales are considered. It is mentioned that the prevailing opinion on the gravitationally bound states of the short-scale physical systems like solar system or galaxies is not provable but results from the a priori accepted ideas of their formation due to condensation. On the contrary, a lot of observational data speaks in favor of existence of Hubble expansion for all the scales. Some estimates of gravitational energy accumulation in cosmic objects owing to dark energy physical work are done. These estimates show that a cluster of galaxies could be formed from a pre-cluster via matter ejection during the Hubble time.

***Determination of the Internal Field of Radiation for a Non-Linear Problem of the Radiative Energy Transfer*****Pikichyan, H. V.** (Proc. Byurakan-Abastumani Col., p. 126, 01/2015)

Abstract not available.

## Surveys, Databases (2)

### *Astronomical Surveys and Big Data*

**Mickaelian, A. M.** (eprint arXiv:1511.07322, 11/2015)

Recent all-sky and large-area astronomical surveys and their catalogued data over the whole range of electromagnetic spectrum are reviewed, from Gamma-ray to radio, such as Fermi-GLAST and INTEGRAL in Gamma-ray, ROSAT, XMM and Chandra in X-ray, GALEX in UV, SDSS and several POSS I and II based catalogues (APM, MAPS, USNO, GSC) in optical range, 2MASS in NIR, WISE and AKARI IRC in MIR, IRAS and AKARI FIS in FIR, NVSS and FIRST in radio and many others, as well as most important surveys giving optical images (DSS I and II, SDSS, etc.), proper motions (Tycho, USNO, Gaia), variability (GCVS, NSVS, ASAS, Catalina, Pan-STARRS) and spectroscopic data (FBS, SBS, Case, HQS, HES, SDSS, CALIFA, GAMA). An overall understanding of the coverage along the whole wavelength range and comparisons between various surveys are given: galaxy redshift surveys, QSO/AGN, radio, Galactic structure, and Dark Energy surveys. Astronomy has entered the Big Data era. Astrophysical Virtual Observatories and Computational Astrophysics play an important role in using and analysis of big data for new discoveries.

### *The IRAS PSC/FSC Combined Catalogue*

**Abrahamyan, H. V.; Mickaelian, A. M.; Knyazyan, A. V.** (Astronomy & Computing 10, 99, 04/2015; Vizier On-line Data Catalog: II/338, 03/2015)

Optical identifications of a few thousands of IRAS sources showed that IRAS Point Source and IRAS Faint Source catalogues (PSC and FSC, respectively) contain many quasars and active galactic nuclei, late-type stars, planetary nebulae, variables, etc. To increase the efficiency of using IRAS PSC and FSC, which contain a lot of common sources, one needs a joint catalogue of all IRAS point sources with improved data based on both catalogues. However, cross-correlation of the catalogues is not so easy, as the association of many sources is relative, and not always it is obvious, whose source from one catalogue corresponds to the other one in the second catalogue. This problem exists in case of using standard cross-correlation tools like Vizier. Therefore, we have created a tool for cross-matching astronomical catalogues and we have applied it to IRAS PSC and FSC. Using this tool we have carried out identifications with a search radius corresponding to  $3\sigma$  of errors for each source individually rather than a standard radius for all sources. As a result, we obtained 73,770 associations. We showed that in case of cross-correlation of these catalogues by Vizier, we had to take 161.95 arcseconds radius not to lose any association; however, in this case a lot of false associations appear for many sources. In addition, we have made cross-correlations with AKARI-IRC, AKARI-FIS and WISE catalogues. As a result we created a catalogue with high positional accuracy and with 17 photometric measurements from 1.25 to 160  $\mu\text{m}$  range, providing a detailed catalogue for IRAS point sources.

## Meetings and events held in Byurakan and Yerevan

**Armenian Astronomical School Olympiad final phase**, 31 Mar 2015, Yerevan, Armenia

The final stage of the annual astronomical contest for school pupils and selection of candidates for International Olympiad of Astronomy and Astrophysics (IOAA) and International Astronomical Olympiad (IAO).

Organizers: Ministry of Education and Science of RA, Yerevan Phys.-Math. School, BAO.

Chair of Jury: Ashot Akopian.

**Workshop on Archaeoastronomy and Astronomy in Culture**, 17 July 2015, Byurakan, Armenia

BAO representatives (H. A. Harutyunian, A. M. Mickaelian, E. S. Parsamian and S. V. Farmanyanyan), NAS RA Division of Armenology and Social Sciences Academician-Secretary *Prof.* Suvaryan, directors and representatives of the Division, Vice-Minister of Culture of RA *Mrs.* Arev Samuelyan, ICOMOS Armenian Chair *Mr.* Gagik Gyurjyan, representatives of the creative unions were present.

Organizers: BAO, ArAS, NAS RA Division of Armenology and Social Sciences.



**Astrofizika – 50 meeting**, 18.09.2015, NAS RA and BAO, Yerevan / Byurakan

Celebration of the 50<sup>th</sup> anniversary of the journal Astrofizika/Astrophysics. Foreign guests, representatives of NAS RA and its institutions, BAO staff members were present.

Organizers: NAS RA, BAO, Astrofizika journal Editorial Board.

**Meeting "Astronomical Surveys and Big Data" (ASBD)** dedicated to Markarian Survey start 50th anniversary and Armenian Virtual Observatory (ArVO) foundation 10th anniversary, 5-8 Oct 2015, Byurakan, Armenia

The meeting combined astronomers and computer scientists with heavy involvement of astronomical surveys, catalogs, archives, databases and VOs. There were 28 Armenian and 16 foreign participants. 18 invited talks, 10 contributed talks and 8 posters were presented. IVOA and IPDA chairs, VO Project Managers, and other important people were present. The Proceedings will be published by ASP Conference Series.

Organizers: BAO, Ministry of Education and Science State Committee of Science (MES SCS), National Academy of Sciences of the Republic of Armenia (NAS RA), Armenian Virtual Observatory (ArVO).

**IAU / South West Asian Regional Office of Astronomy for Development (SWA ROAD)****Workshop**, 13 Oct 2015, Byurakan, Armenia

IAU Officers, namely IAU General Secretary Piero Benvenuti, IAU Strategic Plan 2010-2020 Coordinator George Miley, OAD Director Kevin Govender, regional representatives from Armenia, Georgia, Iran, Israel, Jordan, Russia, and Turkey, IAU SWA ROAD staff members took part.

Organizers: BAO, IAU OAD, IAU SWA ROAD.

**IAU SWA ROAD Inauguration Ceremony**, 13 Oct 2015, Byurakan

BAO staff members, NAS RA Presidium, NAS RA Institutions Directors, Foreign Ambassadors in Armenia, representatives of international organizations in Armenia, universities, creative unions, foreign guests (IAU Officers, regional representatives, participants of Armenian-Iranian Astronomical Workshop), other guests were present, in total some 100 people.

Organizers: BAO, IAU OAD, IAU SWA ROAD.

**Armenian-Iranian Astronomical Workshop and ArAS XIV Annual Meeting**, 13-16 Oct 2015, Byurakan, Armenia

The workshop was aimed at establishing mutual contacts, discussing and conducting joint research projects, giving start to Armenian-Iranian astronomical collaboration, which would include a number of forms of relations. There were 28 Armenian, 12 Iranian, 1 Georgian, 2 Jordanian, 1 Israeli, 1 Italian, and 1 USA participants. 17 invited talks, 22 contributed talks and 3 posters were presented.

Organizers: BAO, ArAS, Astronomical Society of Iran (ASI), Institute for Research in Fundamental Sciences.

**Second Byurakan Science Camp (2BSC)**, 26-30 Oct 2015, Byurakan

A science camp for 12-15 year-old pupils to get them acquainted to BAO, astronomy, and science in general. It was partially supported by Fund for Armenian Relief (FAR) and 16 pupils participated.

Organizers: A. M. Mickaelian, S. V. Farmanyan.

## Research grants, honours and awards

International research grants support the research at BAO and are a significant contribution compared to the low level of national funding. In 2015, following projects were active:

**ANSEF (2015):** “*The influence of various triggers of star formation on supernova rates*”, PI: **Levon Aramyan**; “*On the nature of various type emission structures in the jets from young stars*”, PI: **Tigran Movsessian**

**CNRS-SCS (2014-2015):** “*Abundance stratification, stellar oscillations and radiative transfer*”, PIs: **Haik Harutyunian** and **Georges Alecian** (*Observatoire de Paris-Meudon, France*)

Local grants are given by the Armenian Ministry of Education and Science (MES) State Committee for Science (SCS):

**Thematic grants 2014-2015.** PIs: Tigran Magakian, Elena Nikoghosyan, and Artashes Petrosian

**H2020 COST Action TD1403 BigSkyEarth:** Areg Mickaelian

**Most productive scientists of Armenia:** Kamo Gigoyan, Tigran Magakian, Areg Mickaelian, Tigran Movsessian, Artashes Petrosian

**Gold Medal of RA Ministry of Education and Science:** Marietta Gyulzadyan

**ArAS Annual Prize for Young Astronomers (Yervant Terzian Prize) 2015:** Artur Hakobyan

**Galileo Teacher Training Program (GTTP) certificate:** Hayk Abrahamyan

## Foreign Missions

Altogether, **19 Byurakan scientists had 40 foreign missions to astronomical centres of 14 countries** (USA, France, Germany, Italy, Spain, Sweden, Switzerland, Czech Republic, China, Indonesia, Iran, Jordan, Russia and Georgia). As before, most active collaboration was with French institutions (altogether 8 visits by 7 scientists). Twelve times Armenian scientists visited Russia, three times USA, Italy and China (each), twice – Czech Republic and Jordan (each). Out of the 40 visits, 8 have been accomplished for research work (France and USA), 21 for participation in meetings (including the most important IAU General Assembly XXIX and European annual meeting EWASS-2015), 4 for schools, 5 for discussions of collaboration, and 2 in international astronomical Olympiads (as the team supervisors). Compared to recent years, 2015 was most productive for foreign missions by the total number (see the table).

#	Scientists	Institution and Country	Duration	Dates	Purpose
1	Anahit Samsonyan	Cornell Univ., N.Y., USA	6 weeks	14.01-24.02.15	Research
2	Areg Mickaelian	Tehran, Iran	1 week	23-28.01.2015	Meeting
3	Areg Mickaelian	Rolle, Switzerland	1 week	04-06.02.2015	Meeting
4	Areg Mickaelian	Paris, France	1 week	09-13.02.2015	collab.-n
5	Haik Harutyunian	Rome/Pescara, Italy	1 week	09-14.02.2015	Meeting
6	Satenik Ghazaryan	Paris, France	3 weeks	02-19.05.2015	Research
7	Tigran Magakian	Moscow, Russia	1 week	25-30.05.2015	Meeting
8	Areg Mickaelian	Moscow, Russia	1 week	25-30.05.2015	Meeting
9	Anahit Samsonyan	Salerno, Italy	1 week	25-30.05.2015	School
10	Artur Hakobyan	IAP, Paris, France	3 weeks	28.05-18.06.2015	research
11	Arpi Karapetyan	IAP, Paris, France	3 weeks	28.05-18.06.2015	research
12	Areg Mickaelian	Marstrand, Sweden	1 week	01-05.06.2015	meeting
13	Tigran Movsessian	SAO, Russia	1 week	21-26.06.2015	collab.-n
14	Areg Mickaelian	La Laguna, Spain	1 week	21-28.06.2015	meeting
15	Kamo Gigoyan	Marseille, France	3 weeks	02-20.07.2015	research
16	Anahit Samsonyan	Moscow, Russia	2 weeks	13-24.07.2015	school
17	Marietta Gyulzadyan	Magelang, Indonesia	1 week	26.07-04.08.2015	Olympiad
18	Areg Mickaelian	Honolulu, USA	2 weeks	01-17.08.2015	meeting
19	Vazgen Gabrielyan	USA	2 weeks	03-15.08.2015	meeting
20	Haik Harutyunian	Paris, France	1 week	25-31.08.2015	research
21	Naira Azatyan	Brno, Czech Republic	2 weeks	31.08-14.09.2015	school
22	Hasmik Andreasyan	Brno, Czech Republic	2 weeks	31.08-14.09.2015	school
23	Haik Harutyunian	St. Petersburg, Russia	1 week	20-26.09.2015	meeting
24	Edward Khachikian	St. Petersburg, Russia	1 week	20-26.09.2015	meeting
25	Arthur Nikoghossian	St. Petersburg, Russia	1 week	20-26.09.2015	meeting
26	Hovhannes Pikichian	St. Petersburg, Russia	1 week	20-26.09.2015	meeting
27	Gurgen Paronyan	Pulkovo Obs., Russia	1 week	21-25.09.2015	meeting
28	Arthur Nikoghossian	Akhaltsikhe, Georgia	1 week	12-14.10.2015	meeting
29	Edward Khachikian	SAO, Russia	1 week	15-23.10.2015	meeting
30	Tigran Movsessian	SAO, Russia	1 week	15-23.10.2015	meeting
31	Marietta Gyulzadyan	Kazan, Russia	1 week	15-23.10.2015	Olympiad
32	Lilit Barkhudaryan	IAP, Paris, France	3 months	15.10.15-06.01.16	research
33	Ruben Andreasyan	Urumqi, China	1 week	24-31.10.2015	collab.-n
34	Hasmik Andreasyan	Urumqi, China	1 week	24-31.10.2015	collab.-n
35	Areg Mickaelian	ESO, Garching, Germany	1 week	04-06.11.2015	collab.-n
36	Artur Hakobyan	IAP, Paris, France	2 weeks	05-18.11.2015	research
37	Areg Mickaelian	Rome, Italy	1 week	09-13.11.2015	meeting
38	Haik Harutyunian	Amman, Jordan	1 week	01-05.12.2015	meeting
39	Areg Mickaelian	Amman, Jordan	1 week	01-05.12.2015	meeting
40	Areg Mickaelian	Beijing/Urumqi, China	1 week	08-17.12.2015	meeting

*Comparison of foreign missions in 2009-2015:*

<b>Year</b>	<b>Visits</b>	<b>Scientists</b>	<b>Countries</b>
2015	40	19	14
2014	36	19	18
2013	34	18	14
2012	35	21	14
2011	34	18	11
2010	33	17	13
2009	17	11	6

**Visits of foreign scientists and other guests**

There have been **68 visits during 2015**, including 13 visitors from Armenia (2 astronomers and 11 others) and **43 astronomers and 7 other scientists from 19 other countries** (USA, UK, Germany, France, Italy, Spain, Netherlands, Belgium, Switzerland, Czech Republic, Mexico, South Africa, Israel, Turkey, Iran, Jordan, Ethiopia, Russia and Georgia). Most guests were from Iran (12, due to Armenian-Iranian Astronomical Workshop). Don Barry, Oleg Malkov, Mustapha Meftah, Alain Sarkissian and Maya Todua visited BAO twice (each).

25-29 Mar 2015, participation in **H2020 ARM-SAT Project Twinings meeting:**

**Tamás Bányai** (Von Karman Institute, VKI, Belgium)

**Stéphane Beauvivre** (Systheia, Switzerland)

**Andre Chevalier** (Royal Meteorological Institute of Belgium, RMIB, Belgium)

**Alain Hauchecorne** (Laboratoire ATMospheres, Milieux, Observations Spatiales, LATMOS, Paris, France)

**Abdenour Irbah** (Laboratoire ATMospheres, Milieux, Observations Spatiales, LATMOS, Paris, France)

**Mustapha Meftah** (Laboratoire ATMospheres, Milieux, Observations Spatiales, LATMOS, Paris, France)

**Alain Sarkissian** (Laboratoire ATMospheres, Milieux, Observations Spatiales, LATMOS, Paris, France)

**Jan Thoemel** (Von Karman Institute, VKI, Belgium)

07 Apr 2015, **seminars at BAO:**

**Razmick Mirzoyan** (MPIP, Munich, Germany)

**Varoujan Gorjian** (JPL, Caltech, NASA, Pasadena, CA, USA)

18 May 2015, **seminar at BAO:**

**Gagik Tovmassian** (Instituto de Astronomia Sede Ensenada, UNAM, Mexico)

01 June 2015, **seminar at BAO:**

**Levon Episkoposyan** (NAS RA Institute of Molecular Biology, Armenia)

17 July 2015, for participation in **Archaeoastronomy and Astronomy in Culture (AAC) meeting:**

**Vardan Devrikyan** (NAS RA M. Abeghyan Institute of Literature, Armenia)

**Gagik Gyurjyan** (Erebuni Museum and ICOMOS, Armenia)

**Vazgen Hambardzumyan** (H. Acharian Institute of Language, Armenia)

**Edward Militonnyan** (RA Union of Writers, Armenia)

**Gevorg Poghosyan** (NAS RA Institute of Philosophy and Law, Armenia)

**Ruben Safrastyan** (NAS RA Institute of Oriental Studies, Armenia)

**Arev Samuelyan** (Ministry of Culture, Armenia)

**Yuri Suvaryan** (NAS RA Division of Armenology and Social Sciences, Armenia)

16-18 Sep 2015, participation in **journal Astrofizika 50<sup>th</sup> anniversary celebrations:**

**Georges Alecian** (OMSPM, Paris, France)

**Vladimir Grinin** (St. Petersburg State University, Russia)

**Giorgi Javakhishvili** (Georgian National Astronomical Observatory, GeNAO, Georgia)

**Natela Kapanadze** (Georgian National Astronomical Observatory, GeNAO, Georgia)

**Nino Kochiashvili** (Georgian National Astronomical Observatory, GeNAO, Georgia)

**Maya Todua** (Georgian National Astronomical Observatory, GeNAO, Georgia)

27 Sep – 15 Oct 2015, work on **BAO 1m Schmidt telescope:**

**Serguei Dodonov** (Special Astrophysical Observatory (SAO), Russia)

**Sergey Kotov** (Saint Petersburg State University, Russia)

5-8 Oct 2015, participation in **International Symposium “Astronomical Surveys and Big Data”:**

**Christophe Arviset** (ESA-ESAC, Spain)

**Serguei Dodonov** (Special Astrophysical Observatory (SAO), Russia)

**Jesus Falcon-Barroso** (Instituto de Astrofísica de Canarias, Spain)

**Don Barry** (Cornell University, Ithaca, N.Y., USA)

**Yikdem Entoto Gebrehiwot** (Observatory and Research center, Ethiopia)

**Eugene Kazakov** (Postgres Professional, Russia)

**Sergey Kotov** (Saint Petersburg State University, Russia)

**Andy Lawrence** (Royal Observatory Edinburgh, AstroGrid, United Kingdom)

**Oleg Malkov** (Institute of Astronomy, Russia)

**Mustapha Meftah** (LATMOS, Paris, France)

**Corinne Rossi** (Sapienza - Università di Roma, Italy)

**Alain Sarkissian** (LATMOS, Institute Pierre Simon Laplace, CNRS, France)

**Irakli Simonia** (Ilia State University, Georgia)

**Tsitsino Simonia** (Ilia State University, Georgia)

**Martin Topinka** (Czech Technical University, Czech Republic)

**Joachim Wambsganss** (Universitaet Heidelberg, Germany)

**Hrachya Astsatryan** (NAS RA Institute of Informatics and Automation Problems, IIAP, Armenia)

**Aram Knyazyan** (NAS RA Institute of Informatics and Automation Problems, IIAP, Armenia)

13 Oct 2015, participation in **IAU / SWA ROAD Workshop and IAU SWA ROAD Inauguration Ceremony:**

**Piero Benvenuti** (IAU General Secretary, Italy)

**George Miley** (IAU Strategic Plan *Astronomy for Development* 2010-2020 Coordinator, Netherlands)

**Kevin Govender** (IAU OAD Director, South Africa)

**Sinan Aliş** (Turkish Astronomical Society (TAD), Turkey)

**Noah Brosch** (Wise Observatory, Israel)

**Awni Khasawneh** (Arab Union for Astronomy & Space Sciences, Amman, Jordan)

**Oleg Malkov** (Russian National Committee for Astronomy, INASAN, Russia)

**Ibrahim Mousa** (Arab Union for Astronomy & Space Sciences, Amman, Jordan)

**Maya Todua** (Georgian National Astronomical Observatory, GeNAO, Georgia)

13-16 Oct 2015, participation in **Armenian-Iranian Astronomical Workshop:**

**Shahram Abbassi** (Ferdowsi University of Mashhad, FUM, Iran)

**Alireza Aghaee** (University of Sistan and Baluchestan, Iran)

**Zahra Bagheri** (Research Institute for Astronomy and Astrophysics of Maragha, RIAAM, Iran)

**Shant Baghran** (Sharif University of Technology, SUT, Iran)

**Amin Farhang** (Institute for Research in Fundamental Science, IPM, Iran)

**Habib Khosroshahi** (Institute for Research in Fundamental Science, IPM, Iran)

**Halime Miraghaei Jafari** (Institute for Research in Fundamental Science, IPM, Iran)

**Moein Mosleh** (Institute for Research in Fundamental Science, IPM, Iran)

**Sohrab Rahvar** (Sharif University of Technology, SUT, Iran)

**Mahmood Roshan** (Ferdowsi University of Mashhad, Iran)

**Vajihe Sabzali** (Research Institute for Astronomy and Astrophysics of Maragha, RIAAM, Iran)

**Mohammad Hossein Talezade Lari** (Research Institute for Astronomy and Astrophysics of Maragha, Iran)

**Kevin Govender** (IAU OAD Director, South Africa)

**Don Barry** (Cornell University, Ithaca, N.Y., USA)

**Noah Brosch** (Wise Observatory, Israel)

**Awni Khasawneh** (Arab Union for Astronomy & Space Sciences, Amman, Jordan)

**Ibrahim Mousa** (Arab Union for Astronomy & Space Sciences, Amman, Jordan)

**Corinne Rossi** (Sapienza – Università di Roma, Italy)

**Maya Todua** (Georgian National Astronomical Observatory, GeNAO, Georgia)

**Narek Sahakyan** (ICRANet, Armenia)

**Aram Saharyan** (Physics Department, YSU, Armenia)

26 Oct 2015, **seminar at BAO:**

**Armen Sedrakian** (ITP, Frankfurt-am-Main, Germany)

Jan-Dec 30 Russian team members working on Cosmic Debris project in collaboration with BAO.

### Participation in Meetings and Schools

During 2015, Byurakan astronomers have participated in **26 meetings, schools and other events**, including a number of important international ones, such as IAU General Assembly XXIX in Honolulu (Hawaii, USA), EWASS-2015 meeting in La Laguna (Tenerife, Canary Islands, Spain), EAAS XII General Meeting in Moscow (Russia), as well as other meetings in France, Italy, Sweden, Switzerland, Russia, China, Iran and Jordan, astronomical schools in Italy, Czech Republic and Russia, International Astronomical Olympiads in Indonesia and Russia, as well as meetings and seminars in Armenia: “*Astronomical Surveys and Big Data*” (ASBD), Armenian-Iranian Astronomical Workshop, IAU / SWA ROAD Workshop, 2BSC, etc. The list contains 4 meetings, 1 science camp and 1 Olympiad in Armenia, and 15 meetings, 3 schools, and 2 Olympiads abroad,

**Workshop “Galaxies; Inside and Out”, 25-28 Jan 2015, Tehran, Iran**

Areg Mickaelian

**European Astronomical Society (EAS) and Affiliated Societies Meeting, 4-6 Feb 2015, Rolle, Switzerland**

Areg Mickaelian

**H2020 ARM-SAT Project Twinings meeting**, 10 Feb 2015, Paris, France

Areg Mickaelian

**Governing Committee Meeting of the International Centre for Relativistic Astrophysics Network (ICRANet)**, 13 Feb 2015, Rome/Pescara, Italy

Haik Harutyunian

**Armenian Astronomical School Olympiad final phase**, 31 Mar 2015, Yerevan, Armenia

Jury members: Ashot Akopian (Chair), Avetik Grigoryan, Marietta Gyulzadian, Emilia Karapetian, Areg Mickaelian, Tigran Nazaryan, Ssergei Nersisyan, Ararat Yeghikian

**Euro-Asian Astronomical Society (EAAS) XII General Meeting and Scientific Conference “Astronomy from Our Cosmic Neighborhood to Deepest Cosmology”**, 25-30 May 2015, Moscow, Russia

Tigran Magakian, Areg Mickaelian

**1st Advanced School on Exoplanetary Science**, 25-29 May 2015, Vietri sul Mare (Salerno), Italy

Anahit Samsonyan

**Meeting “Galaxies of many colours: star formation across cosmic time”**, 1-5 June 2015, Marstrand, Sweden

Areg Mickaelian

**European Astronomical Society Annual Meeting (EWASS-2015)**, 22-26 June 2015, La Laguna, Tenerife, Canary Islands, Spain

Areg Mickaelian; also Garik Israelian and Avet Harutyunyan (both Spain) and Vahagn Harutyunyan (Italy)

**Summer School on Submillimeter Astronomy**, 12-24 July 2015, Moscow Institute of Physics and Technology, Moscow, Russia

Anahit Samsonyan

**Workshop on Archaeoastronomy and Astronomy in Culture**, 17 July 2015, Byurakan, Armenia

Sona Farmanyan, Haik Harutyunian, Areg Mickaelian, Elma Parsamian

**9<sup>th</sup> International Olympiad on Astronomy and Astrophysics (IOAA)**, 26 July – 4 Aug 2015,

Magelang / Semarang, Indonesia

Marietta Gyulzadian (Armenian Team Leader)

**IAU General Assembly XXIX**, 3-14 August 2015, Honolulu, Hawaii, USA

Areg Mickaelian, Sona Farmanyan

**ESO / OPTICON / IAU summer school on modern instruments, their science case, and practical data reduction**, 1-11 Sep 2015, Brno, Czech Republic

Hasmik Andreasyan, Naira Azatyan

**International Conference “Radiation mechanisms of astrophysical objects: classics and today”** dedicated to V. V. Sobolev’s 100<sup>th</sup> anniversary, 21-25 Sep 2015, St. Petersburg, Russia  
Edward Khachikian, Haik Harutyunian, Arthur Nikoghossian, Hovhannes Pikichian

**All-Russian Astrometry Conference (Pulkovo-2015)**, 21-25 Sep 2015, Pulkovo, Russia  
Gurgen Paronyan

**Meeting “Astronomical Surveys and Big Data” (ASBD)** dedicated to Markarian Survey start 50<sup>th</sup> anniversary and Armenian Virtual Observatory (ArVO) foundation 10<sup>th</sup> anniversary, 5-8 Oct 2015, Byurakan, Armenia

Areg Mickaelian, Kamo Gigoyan, Tigran Magakian, Norair Melikian, Elena Nikoghosyan (SOC members), Hayk Abrahamyan, Hasmik Andreasyan, Naira Azatyan, Sona Farmanyan, Knarik Khachatryan, Gor Mikayelyan, Gurgen Paronyan, Ani Vardanyan (LOC members), Armen Gyulbudaghian, Haik Harutyunian, Ararat Yeghikyan, Marietta Gyulzadyan, Susanna Hakopian, Gabriel Ohanian, Anahit Samsonyan (speakers), other BAO staff members

**IAU / South West Asian Regional Office of Astronomy for Development (SWA ROAD) Workshop**, 13 Oct 2015, Byurakan, Armenia

Haik Harutyunian, Areg Mickaelian, Naira Azatyan, Sona Farmanyan, Gor Mikayelyan

**Armenian-Iranian Astronomical Workshop and ArAS XIV Annual Meeting**, 13-16 Oct 2015, Byurakan, Armenia

Areg Mickaelian, Haik Harutyunian, Tigran Magakian, Arthur Nikoghossian, Elena Nikoghosyan, Elma Parsamian, Artashes Petrosian (SOC members), Knarik Khachatryan, Gor Mikayelyan, Gabriel Ohanian, Gurgen Paronyan, (LOC members), Grigor Broutian, Norayr Melikian, Tigran Movsessian, Ararat Yeghikyan, Hayk Abrahamyan, Hasmik Andreasyan, Norayr Asatrian, Naira Azatyan, Sona Farmanyan, Mkrtich Gevorgyan, Gayane Kostandyan, Anahit Samsonyan, Ani Vardanyan (speakers), other BAO staff members

**Conference “The Present and Future of Small and Medium Size Telescopes” (SMT-2015)**, 15-22 Oct 2015, SAO, Nizhnii Arkhyz, Karachay-Cherkes Rep., Russia  
Edward Khachikian, Tigran Movsessian

**20<sup>th</sup> International Astronomical Olympiad (IAO)**, 15-23 Oct 2015, Kazan, Russia  
Marietta Gyulzadian (Armenian Team Leader)

**Second Byurakan Science Camp (2BSC)**, 26-30 Oct 2015, Byurakan, Armenia

Areg Mickaelian, Sona Farmanyan, Hayk Abrahamyan, Gurgen Paronyan, Haik Harutyunian, Elena Nikoghosyan, Knarik Khachatryan, Ani Vardanyan, Marietta Gyulzadyan, Naira Azatyan

**European Society for Astronomy in Culture (SEAC) Annual Conference “Astronomy in Past and Present Cultures”**, 9-13 Nov 2015, Rome, Italy

Areg Mickaelian, Sona Farmanyan



**IAU Arab World ROAD Workshop**, 2-4 Dec 2015, Amman, Jordan

Haik Harutyunian, Areg Mickaelian

**International Conference on “Science and Civilization on the Silk Roads” (ICSCSR): Regional Preparatory Meeting of the World Humanities Conference**, 10-11 Dec 2015, Beijing, China

Areg Mickaelian, Sona Farmanyanyan

**“Astronomical Silk Road”: International Conference on Astronomy and Archaeoastronomy in China and Central Asia**, 14-15 Dec 2015, Urumqi, China

Areg Mickaelian, Sona Farmanyanyan

### Talks, posters and lectures presented at meetings and schools

During 2015, Byurakan astronomers presented plenary, invited, oral and poster contributions at 19 meetings held in 11 countries (USA, France, Italy, Spain, Sweden, Switzerland, China, Iran, Jordan, Russia and Armenia) and gave lectures at the 2<sup>nd</sup> Byurakan Science Camp (2BSC). Altogether, there was **1 plenary talk, 20 invited talks, 46 contributed oral talks, 1 poster with oral presentation, 8 posters, and 10 lectures.**

**Workshop “Galaxies; Inside and Out”**, 25-28 Jan 2015, Tehran, Iran (1 invited talk)

Areg Mickaelian: *The Emission Line Spectrum of Galaxies and AGN zoo*

**European Astronomical Society (EAS) and Affiliated Societies Meeting**, 4-6 Feb 2015, Rolle, Switzerland (1 oral talk)

Areg Mickaelian: *Astronomy in Armenia and ArAS activities in 2013-2014*

**H2020 ARM-SAT Project Twinings meeting**, 10 Feb 2015, Paris, France (1 oral talk)

Areg Mickaelian: *BAO and Armenian Space Agency*

**Euro-Asian Astronomical Society (EAAS) XII General Meeting and Scientific Conference “Astronomy from Our Cosmic Neighborhood to Deepest Cosmology”**, 25-30 May 2015, Moscow, Russia (1 plenary and 4 oral talks)

Areg Mickaelian: *Astronomical Surveys and Big Data* (plenary talk)

#### Section “Stars, Planetary Systems and Interstellar Medium”

Tigran Magakian: *HH-flows in the new remote star-formation region* (oral talk)

Tigran Magakian: *The inner structure of stellar jets* (oral talk)

Areg Mickaelian: *SDSS revised classification of X-ray selected star candidates* (oral talk)

#### Section “Extragalactic Astronomy”

Areg Mickaelian: *Large homogeneous sample of X-ray selected AGN and its study* (oral talk)

**Meeting “Galaxies of many colours: star formation across cosmic time”**, 1-5 June 2015, Marstrand, Sweden (1 oral talk)

Areg Mickaelian: *Star-formation rates for IR selected Byurakan-IRAS Galaxies*

**European Astronomical Society Annual Meeting (EWASS-2015)**, 22-26 June 2015, La Laguna, Tenerife, Canary Islands, Spain (2 oral talks, 1 poster with oral presentation, 1 poster)

**S3: Deconstructing Massive Galaxy Formation**

Areg Mickaelian: *Blazars and their evolutionary relation to radio and X-ray selected giant galaxies* (poster with oral presentation)

**SpS4: Galaxy studies in the mid-infrared from space and ground**

Areg Mickaelian: *Large IR galaxy sample for studies of nuclear and starburst activity* (oral talk)

**SpS7: Science with large spectroscopic surveys of Galactic OB stars: getting ready for Gaia**

Areg Mickaelian: *The spectroscopic database of the First Byurakan Survey (FBS) – a tool for search for OB stars and understanding Gaia spectra* (poster)

**SM6: Reaching Diverse Audiences in Europe through Astronomy Outreach**

Areg Mickaelian: *Astronomy outreach in Armenia and related regional activities* (oral talk)

**Workshop on Archaeoastronomy and Astronomy in Culture**, 17 July 2015, Byurakan, Armenia (1 oral talk)

Areg Mickaelian: *Archaeoastronomy and Astronomy in Culture (AAC)*

**IAU General Assembly XXIX**, 3-14 August 2015, Honolulu, Hawaii, USA (4 oral talks and 3 posters)

**IAU S319: Galaxies at high redshift and their evolution over cosmic time**

Areg Mickaelian: *High-redshift quasars and blazars and their evolutionary relation to high-redshift galaxies* (poster)

**IAU GA FM02: Astronomical heritage: progressing the UNESCO-IAU initiative**

Areg Mickaelian: *BAO Plate Archive digitization, creation of electronic database and its scientific usage* (oral talk)

Sona Farmanyan: *Astronomical Knowledge in Holy Books* (oral talk)

**IAU GA FM06: X-ray surveys of the hot and energetic cosmos**

Areg Mickaelian: *Large homogeneous sample of X-ray selected AGN and its study* (poster)

**IAU GA FM20: Astronomy for development**

Areg Mickaelian: *IAU South West Asian ROAD* (oral talk)

Areg Mickaelian: *Recent activities in Armenia related to IAU ROAD and strategic plan* (poster)

**IAU Division C Meeting**

Sona Farmanyan: *Archaeo- and Cultural Astronomy in Armenia* (oral talk)

**International Conference “Radiation mechanisms of astrophysical objects: classics and today”** dedicated to V. V. Sobolev’s 100<sup>th</sup> anniversary, 21-25 Sep 2015, St. Petersburg, Russia (4 oral talks)  
Edward Khachikian: *Problems of dualcore galaxies*

Haik Harutyunian: *Description of Frequency Redistribution Functions via Bilinear Expansions*

Arthur Nikoghossian: *On some directions of development of the radiative transfer theory*

Hovhannes Pikichian: *On linear properties of the nonlinear problem of radiation transfer*

**All-Russian Astrometry Conference (Pulkovo-2015)**, 21-25 Sep 2015, Pulkovo, Russia (1 oral talk)

Gurgen Paronyan: *BAO Plate Archive Digitization, Creation of Electronic Database and Its Scientific Usage*

**Meeting “Astronomical Surveys and Big Data” (ASBD)** dedicated to Markarian Survey start 50<sup>th</sup> anniversary and Armenian Virtual Observatory (ArVO) foundation 10<sup>th</sup> anniversary, 5-8 Oct 2015, Byurakan, Armenia (9 invited talks, 4 oral talks and 9 posters)

Kamo Gigoyan: *Cool Carbon Stars in the Halo* (invited talk)

Armen Gyulbudaghian: *Two Types of Radial Systems of Dark Globules* (invited talk)

Haik Harutyunian: *Brief Survey of Activity Phenomena in Cosmic Objects* (invited talk)

Tigran Magakian: *Searches of Herbig-Haro objects: history, current situation and perspectives* (invited talk)

Areg Mickaelian: *Astronomical Surveys, Catalogs, Databases and Archives* (invited talk)

Areg Mickaelian: *Search and studies of active galaxies at BAO* (invited talk)

Areg Mickaelian: *BAO plate archive digitization project and its scientific usage* (invited talk)

Elena Nikoghosyan: *The search and study of PMS stars with Ha emission* (invited talk)

Ararat Yeghikyan: *On survivability of ices in active galaxies* (invited talk)

Marietta Gyulzadyan: *The Spectral Investigation and Physical Properties of Markarian Galaxies from SDSS* (oral talk)

Susanna Hakopian: *Exploring the subsample of SBS galaxies. Current results* (oral talk)

Gabriel Ohanian: *The Existence of Ultra Massive Black Holes (UMBHs) in the Center of Radiogalaxies* (oral talk)

Anahit Samsonyan: *The Cornell Atlas of Spitzer/IRS Sources* (oral talk)

Hayk Abrahamyan: *Properties of IRAS PSC/FSC galaxies* (poster)

Hasmik Andreasyan: *The Galactic distribution of Normal pulsars* (poster)

Lidia Erastova: *The Tadpole Galaxies in SBS* (poster)

Lidia Erastova: *The Sample of Spectroscopic Binary Stars in the SBS Survey* (poster)

Lidia Erastova: *Revised and Updated Catalogue of the Second Byurakan Sky Survey* (poster)

Kamo Gigoyan: *Investigation of Variability of Faint Galactic Early-Type Carbon Stars from the First Byurakan Spectral Sky Survey* (poster)

Susanna Hakopian: *Revealing of HII-regions in galaxies with panoramic spectroscopy* (poster)

Gurgen Paronyan: *Multiwavelength studies of X-ray selected AGN* (poster)

Anahit Yeghiazaryan: *On the interaction in a quartet of galaxies* (poster)

**IAU / South West Asian Regional Office of Astronomy for Development (SWA ROAD)**

**Workshop**, 13 Oct 2015, Byurakan, Armenia (2 oral talks)

Haik Harutyunian: *Astronomy in Armenia*

Areg Mickaelian: *IAU SWA ROAD*

**Armenian-Iranian Astronomical Workshop and ArAS XIV Annual Meeting**, 13-16 Oct 2015, Byurakan, Armenia (9 invited talks, 12 oral talks and 2 posters)

Grigor Broutian: *The relation of 300-day and 360-day years in the oldest Armenian calendars* (invited talk)

Haik Harutyunian: *Byurakan Astrophysical Observatory and Viktor Ambartsumian* (invited talk)

Tigran Magakian: *Search for Young Stars in Byurakan Astrophysical Observatory* (invited talk)

Norayr Melikian: *The Study of Flare Stars in Byurakan Observatory* (invited talk)

Areg Mickaelian: *Armenian Astronomical Society (ArAS) activities* (invited talk)

Areg Mickaelian: *BAO Plate Archive and Armenian Virtual Observatory (ArVO)* (invited talk)

- Tigran Movsessian: *Observational Possibilities in BAO* (invited talk)  
 Arthur Nikoghossian: *Theoretical astrophysics in the Byurakan Observatory* (invited talk)  
 Ararat Yeghikyan: *Irradiation of ices inside molecular clouds in cosmic ray dominated regions of galaxies* (invited talk)  
 Hayk Abrahamyan: *Blazars properties* (oral talk)  
 Hasmik Andreasyan: *On the distribution of pulsars in the Galaxy* (oral talk)  
 Norayr Asatryan: *Simultaneous hour-timescale variations in the profiles of the broad Balmer lines of the Seyfert galaxy Markarian 6* (oral talk)  
 Naira Azatyan: *The search of the stellar clusters in vicinity of YSOs with high and middle masses* (oral talk)  
 Sona Farmanyan: *Cosmic Tree in Armenia and Iran* (oral talk)  
 Mkrtich Gevorgyan: *Integral field spectroscopy of HH161* (oral talk)  
 Haik Harutyunian: *“Pioneers’ Anomaly” and the Acceleration of the Universe* (oral talk)  
 Gayane Kostandyan: *Investigation of Faint Galactic Carbon Stars from the First Byurakan Spectral Sky Survey* (oral talk)  
 Areg Mickaelian: *AGN content of X-ray, IR and radio sources* (oral talk)  
 Elena Nikoghosyan: *The Multiple Systems in the Young Stellar Cluster IRAS 05137+3919* (oral talk)  
 Anahit Samsonyan: *Mid-Infrared [NeII] and [NeIII] Emission Line Profiles in Starbursts and AGN* (oral talk)  
 Ani Vardanyan: *The Statistical Analysis of stars with Ha emission in IC 348 Cluster* (oral talk)  
 Marietta Gyulzadian: *The Spectral Study of SBS Galaxies from SDSS* (poster)  
 Anahit Yeghiazaryan: *On Galaxies with UV excess from Kazarian lists* (poster)

**Conference “The Present and Future of Small and Medium Size Telescopes” (SMT-2015), 15-22 Oct 2015, SAO, Nizhnii Arkhyz, Karachay-Cherkes Rep., Russia (3 oral talks)**

- Tigran Movsessian: *Modernization of Byurakan Observatory 1m Schmidt telescope*  
 Tigran Movsessian: *Spectrophotometry of stars and galaxies in medium-band filters on Byurakan Observatory 1m Schmidt telescope: instrumental possibilities and tasks*  
 Tigran Movsessian: *Methods of investigation of compact star-formation regions on Byurakan Observatory 2.6m telescope*

**Second Byurakan Science Camp (2BSC), 26-30 Oct 2015, Byurakan, Armenia (10 lectures)**

- Haik Harutyunian: *Viktor Ambartsumian and Byurakan Astrophysical Observatory*  
 Areg Mickaelian: *The role of science for human society*  
 Areg Mickaelian: *Our understanding of the Universe*  
 Hayk Abrahamyan: *Solar System*  
 Elena Nikoghosyan: *Stars and Nebulae*  
 Knarik Khachatryan: *Extrasolar planets*  
 Ani Vardanyan: *The World of galaxies*  
 Marietta Gyulzadyan: *Armenian team in International Astronomical Olympiads*  
 Sona Farmanyan: *Astronomy and Mythology*  
 Areg Mickaelian: *Astronomy and Computer Science*

**European Society for Astronomy in Culture (SEAC) Annual Conference “Astronomy in Past and Present Cultures”,** 9-13 Nov 2015, Rome, Italy (2 oral talks)

Areg Mickaelian: *Armenian Archaeoastronomy and Astronomy in Culture*

Sona Farmanyan: *Ancient Cosmology in Armenian Highland*

**IAU Arab World ROAD Workshop,** 2-4 Dec 2015, Amman, Jordan (1 invited talk)

Areg Mickaelian: *IAU South West Asian ROAD*

**International Conference on “Science and Civilization on the Silk Roads” (ICSCSR): Regional Preparatory Meeting of the World Humanities Conference,** 10-11 Dec 2015, Beijing, China (2 oral talks)

Areg Mickaelian: *History of astronomy in Armenia and its traces in the cultural heritage*

Sona Farmanyan: *Earth and Sun in Ancient Armenia and its Impact on the World Cultures*

**“Astronomical Silk Road”: International Conference on Astronomy and Archaeoastronomy in China and Central Asia,** 14-15 Dec 2015, Urumqi, China (2 oral talks)

Areg Mickaelian: *Astronomy in the Middle East and IAU South West Asian ROAD*

Sona Farmanyan: *Moon and its Myths on the Silk Road*

*Scientists with 3 and more presentations during 2015:*

Scientists	Plenary talk	Invited talk	Oral talk	Poster w. oral pr.-tion	Poster	Lecture	All
Abrahamyan, H. V.			1		1	1	3
Erastova, L. K.					3		3
Farmanyan, S. V.			6			1	7
Gyulzadyan, M V.			1		1	1	3
Harutyunian, H. A.		2	3			1	6
Magakian, T. Yu.		2	2				4
Mickaelian, A. M.	1	7	15	1	4	3	31
Movsessian, T. A.		1	3				4
Nikoghosyan, E. H.		1	1			1	3

## Seminars

In total, 15 BAO seminars were held, including 10 by BAO scientists and 5 by visitors (from USA, Germany (2), Mexico and NAS RA Institute of Molecular Biology, Armenia). In addition, 4 foreign invited seminars were given in China.

Date	Speaker	Institution, country	Topic
02.02	Areg Mickaelian	BAO, Armenia	Workshop on galaxies in Tehran and future Armenian-Iranian collaboration
09.02	Edward Khachikian	BAO, Armenia	Physical properties of active galaxies
16.02	Edward Khachikian	BAO, Armenia	Some problems of physics of active galaxies
23.02	Areg Mickaelian	BAO, Armenia	European Horizon 2020 program opportunities
07.04	Razmick Mirzoyan	MPIP, Munich, Germany	Technical means and recent achievements of ground-based ultra-high energy gamma-ray astrophysics by means of Cherenkov atmospheric telescopes imaging
07.04	Varoujan Gorjian	JPL, Caltech, NASA, Pasadena, CA, USA	Variability in active galactic nuclei
20.04	Tigran Movsessian	BAO, Armenia	HH objects in a remote star formation region
04.05	Mkrtich Gevorgyan	BAO, Armenia	Detailed study the kinematics of North-Eastern region of the stellar cluster NGC 7129
11.05	Gagik Ter-Kazarian	BAO, Armenia	On the physical nature of the recently discovered ultra-high brightness X-ray pulsations
18.05	Susanna Hakopian	BAO, Armenia	Study of SBS 1539+597 galaxy based on 3D-spectroscopy
18.05	Gagik Tovmassian	Instituto de Astronomia, UNAM, Mexico	Bottleneck accretion in close detached binaries with magnetic components
01.06	Levon Episkoposyan	NAS RA Institute of Molecular Biology	Genetic mapping of historic Armenia
08.06	Elena Nikoghosyan	BAO, Armenia	Statistical analysis of stars with H $\alpha$ emission in the cluster IC 348
22.06	Naira Azatyan	BAO, Armenia	Search for stellar clusters in vicinity of YSOs with high and middle masses
26.10	Armen Sedrakian	ITP, Frankfurt-am-Main, Germany	Recent progress in the physics of compact stars

### Foreign seminars:

Oct 2015, Xinjiang Astronomical Observatory (XAO), CAS, China.

Ruben Andriasyan: “*Byurakan Observatory and its observational possibilities*”

Ruben Andriasyan: “*Study of galactic magnetic fields*”

Hasmik Andriasyan: “*Galactic distribution of normal radio pulsars*”

09.12.2015, Kavli Institute for Astron. and Astrophys. at Peking Univ. (KIAA-PKU), Beijing, China

Areg Mickaelian: “*Active galaxies among X-ray, IR and radio sources*”

## Publications

During 2015, Byurakan astronomers had **88** publications: **17 papers in 10 refereed journals** (including 7 in *Astrophysics*, 1 in *ApJ*, 2 in *A&A*, 1 in *Revista Mexicana de Astronomia y Astrofisica*, 1 in *Astrophysical Bulletin*, 1 in *Journal of Astrophysics*, 1 in *Iranian Journal of Astronomy and Astrophysics*, 1 in *Astronomy and Computing*, 1 in *Physics Research International* and 1 in *Horizons of World Physics*), **40 in proceedings of 4 meetings** (including 2 in *Proc. IAU Symp. #313*, 1 in *Highlights of Astronomy*, 18 in *Proc. Byurakan-Abastumani Colloquium*, and 19 in *Proc. Meeting Relation of Astronomy to other Sciences, Culture and Society*), **3 electronic catalogues**, **2 books** (*Proc. Byurakan-Abastumani Colloquium* held in 2013 and *Proc. Meeting Relation of Astronomy to other Sciences, Culture and Society* held in 2014), as well as **7 preprints** that will be published as papers and **19 abstracts** of papers presented at meetings. Numerous information materials and popular articles were published as well. Compared to 2014 and all other previous years, the number of refereed papers is less, though the total number is more than the average.

### Refereed Journals (17)

- Akopian, A. A.** – *Variability of Superflare Frequency of Sun Like Stars* // *Ap* 58, 62-76, 03/2015
- Abrahamyan, H. V.; Mickaelian, A. M.; Knyazyan, A. V.** – *The IRAS PSC/FSC Combined Catalogue* // *Astronomy & Computing* 10, 99-106, 04/2015
- Movsessian, T. A.; Magakian, T. Yu.; Moiseev, A. V.; Gevorgian, M. G.** – *Detailed kinematic investigation of Herbig-Haro objects in the northeast region of NGC 7129* // *Astrophysical Bulletin* 70, 206-213, 04/2015
- Cohen, M. H.; Meier, D. L.; **Arshakian, T. G.**; Clausen-Brown, E.; Homan, D. C.; Hovatta, T.; Kovalev, Y. Y.; Lister, M. L.; Pushkarev, A. B.; Richards, J. L.; Savolainen, T. – *Studies of the Jet in BL Lacertae. II. Superluminal Alfvén Waves* // *ApJ* 803, id.3, 04/2015
- Mickaelian, A. M.** – *AGN Zoo and Classifications of Active Galaxies* // *Iranian Journal of Astronomy and Astrophysics (IrJAA)* 2, 1-38, 07/2015
- Kogoshvili, N. G.; Borchkhadze, T. M.; **Kalloghlian, A. T.** – *Spiral Galaxies with a Larger Fraction of Dark Matter in the Region of 3-10 Mpc Around the Virgo and Fornax Clusters* // *Ap* 58, 318-327, 09/2015
- Gyulzadyan, M. V.** – *Spectral Study of Some SBS Galaxies. Physical Conditions. Abundance of Oxygen and Nitrogen* // *Ap* 58, 338-349, 09/2015
- Gigoyan, K. S.**; Sarkissian, A.; Russeil, D.; Mauron, N.; **Kostandyan, G.**; Vartanian, R.; **Abrahamyan, H. V.; Paronyan, G. M.** – *Investigation of Faint Galactic Carbon Stars from the First Byurakan Spectral Sky Survey. II. Early-Type Carbon Stars* // *Ap* 58, 369-379, 09/2015
- Gyulbudaghian, A. L.** – *Star formation regions in LDN 1667* // *Ap* 58, 380-387, 09/2015
- Adibekyan, V.; Santos, N. C.; Figueira, P.; Dorn, C.; Sousa, S. G.; Delgado-Mena, E.; Israelian, G.; **Hakobyan, A. A.**; Mordasini, C. – *From stellar to planetary composition: Galactic chemical evolution of Mg/Si mineralogical ratio* // *A&A* 581, id.L2, 09/2015
- Gyulbudaghian, A. L.**; Mendez, R. A. – *New radial systems of dark globules* // *Revista Mexicana de Astronomia y Astrofisica* 51, 183-187, 10/2015

- Adibekyan, V.; Figueira, P.; Santos, N. C.; Sousa, S. G.; Faria, J. P.; Delgado-Mena, E.; Oshagh, M.; Tsantaki, M.; **Hakobyan, A. A.**; Gonzalez Hernandez, J. I.; Suarez-Andres, L.; Israelian, G. – *Identifying the best iron-peak and  $\alpha$ -capture elements for chemical tagging: The impact of the number of lines on measured scatter* // *A&A* 583, id.A94, 11/2015
- Nikoghosyan, E. H.**; Harutyunian, H. A.; Azatyan, N. M. – *Multiple Star Systems in the Young Cluster IRAS 05137+3919* // *Ap* 58, 478-489, 12/2015
- Nikoghosyan, E. H.**; Vardanyan, A. V.; Khachatryan, K. G. – *Statistical Analysis of Stars with H $\alpha$  Emission in the Cluster IC 348* // *Ap* 58, 490-502, 12/2015
- Gyulbudaghyan, A. L.** – *Radial systems in dark globules in Southern Hemisphere* // *Horizons of World Physics* 285, 157, 2015
- Ter-Kazarian, G. T.** – *Growth of Accreting Supermassive Black Hole Seeds and Neutrino Radiation* // *Journal of Astrophysics* 2015, id.205367, 2015
- Ter-Kazarian, G. T.** – *Modified Theories of Gravitation behind the Spacetime Deformation* // *Physics Research International* 2015, id.152846, 2015

### *Proceedings of Meetings (40)*

- Richards, J. L.; Lister, M. L.; Savolainen, T.; Homan, D. C.; Kadler, M.; Hovatta, T.; Readhead, A. C. S.; **Arshakian, T. G.**; Chavushyan, V. – *The parsec-scale structure, kinematics, and polarization of radio-loud narrow-line Seyfert 1 galaxies* // *IAU Symp. #313: Extragalactic jets from every angle*, p. 139-142, 03/2015
- León-Tavares, J.; Chavushyan, V.; Lobanov, A.; Valtaoja, E.; **Arshakian, T. G.** – *The link between broad emission line fluctuations and non-thermal emission from the inner AGN jet* // *IAU Symp. #313: Extragalactic jets from every angle*, p. 43-47, 03/2015
- Mickaelian, A. M.** – *Armenia as a Regional Centre for Astronomy for Development activities* // *Highlights of Astronomy* 16, p. 565, 03/2015

**18 papers** in Proceedings of Byurakan-Abastumani Colloquium “*Instability and Evolution of Stars*” dedicated to L. V. Mirzoyan’s 90<sup>th</sup> anniversary, held 26-28 Aug 2013 in Byurakan, Armenia. Eds. Harutyunian, H. A.; Nikoghosyan, E. H.; Melikian, N. D.; Yerevan, NAS RA “Gityun” Publishing House, 158 p., 01/2015

- Ghazaryan, S.** – *Physical and Chemical Parameters of HgMn Stars on the Basis of the Available Data* // p. 14-17
- Nikoghossian, A. G.** – *The Reflection Properties of Atmosphere as Characteristics of the Radiation Diffusion inside It* // p. 18-20
- Aramyan, L. S.**; **Petrosian, A. R.**; **Hakobyan, A. A.**; Mamon, G. A.; Kunth, D.; Turatto, M.; Adibekyan, V. Zh.; **Nazaryan, T. A.** – *Study of unconfirmed supernovae* // p. 28-32
- Gyulbudaghian, A. L.** – *Two Cases of Unusual Molecular Outflows* // p. 38-41
- Movsessian, T. A.**; **Magakyan, T. Yu.** – *Inner structure of the jets from YSO's* // p. 42-46
- Melikian, N. D.** – *Continuous Emission in the Spectra of Stellar Flares* // p. 55-59
- Karapetian, A. A.** – *New H-alpha Objects in the Areas of Dark* // p. 60-65
- Mickaelian, A. M.**; **Paronyan, G. M.** – *X-ray selected stars in HRC and BHRC catalogues* // p. 77-83



- Nikoghosyan, E. H.; Azatyan, N.** – *The cluster of PMS stars in the vicinity of IRAS 05137+3919* // p. 84-88
- Harutyunian, H. A.** – *Accelerated expansion of the Universe as the most powerful source of the energy release in cosmic objects* // p. 89-93
- Nazaryan, T. A.; Petrosian, A. R.; Hakobyan, A. A.; Adibekyan, V. Zh.; Kunth, D.; Mamon, G. A.; Turatto, M.; Aramyan, L. S.** – *Supernovae in paired host galaxies* // p. 99-103
- Ohanyan, G. A.** – *The energetic budget of AGN* // p. 104-108
- Mickaelian, A. M.; Abrahamyan, H. V.; Harutyunyan, G. S.** – *The Joint IRAS PSC/FSC catalogue as a tool for efficient studies for extragalactic IR sources* // p. 109-115
- Hakopian, S. A.** – *Galaxies of Lower Activity from Seven Selected Fields of the Second Byurakan Spectral Survey* // p. 120-125
- Pikichyan, H. V.** – *Determination of the Internal Field of Radiation for a Non-Linear Problem of the Radiative Energy Transfer* // p. 126-135
- Mahtessian, A. P.** – *The Luminosity Function of Galaxies* // p. 136-142
- Harutyunyan, V. S.; Harutyunian, H. A.** – *Relation of Kinematical Properties of cD Clusters of Galaxies with Their Radiative Characteristics* // p. 143-147
- Andreasyan, R. R.; Balayan, S. K.; Movsesyan, V. H.** – *Structure of the Magnetic Field near the Galactic Plane* // p. 148-152
- 19 papers** in Proceedings of XIII Annual Meeting of Armenian Astronomical Society “*Relation of Astronomy to other Sciences, Culture and Society*” held 7-10 Oct 2014 in Byurakan, Armenia. Eds.: Harutyunian, H. A.; Mickaelian, A. M.; Farmanyan, S. V.; Yerevan, NAS RA "Gitutyun" Publishing House. 460 p., 07/2015:
- Martirosyan, R. M.; Mickaelian, A. M.** – *Astronomy as the Leader of Interdisciplinary and Multidisciplinary Sciences (Introductory talk)* // p. 14-32
- Yeghikian, A. G.** – *Was the Universe always a convenient place for the origin of life?* // p. 72-82
- Mickaelian, A. M.** – *The Problem of Extraterrestrial Civilizations and Extrasolar Planets* // p. 83-96
- Pikichyan, H. V.** – *An Application of the Cosmologic Concepts and Astronomical Symbols in the Ancient Medical Science and Astrology Systems* // p. 106-124
- Yeghiazaryan, A. A.** – *Astrology: Science, Art or Prophecy* // p. 125-130
- Mickaelian, A. M.; Grigoryan, A. E.** – *Dangerous Near-Earth Asteroids and Meteorites* // p. 148-160
- Nikoghosyan, E. H.** – *The Ecology of Near-Earth Space Environment* // p. 161-165
- Mickaelian, A. M.; Astsatryan, H. V.** – *Computational Astrophysics* // p. 188-201
- Mickaelian, A. M.** – *Armenian Virtual Observatory* // p. 202-212
- Harutyunian, H. A.** – *On a Possibility of Astrostatistics Methods' Application in the Literature* // p. 213-218
- Farmanyan, S. V.; Mickaelian, A. M.** – *Armenian Cultural Astronomy* // p. 223-237
- Farmanyan, S. V.** – *Ancient and Medieval Earth in Armenia* // p. 246-253
- Harutyunian, H. A.** – *Astronomical terms and names as an indicator of the science level* // p. 272-280
- Yeghikian, A. G.** – *Astrophysical terms in Armenian* // p. 281-286

- Mickaelian, A. M.; Farmanyan, S. V. – *Astroheraldry* // p. 287-298
- Broutian, G. H. – *The ancient Armenian calendars' connection with the celestial bodies* // p. 322-333
- Farmanyan, S. V.; Mickaelian, A. M. – *Scientific Journalism in Armenia* // p. 420-431
- Gyulzadyan, M. V. – *Astronomy Teaching Problems in Armenia* // p. 432-437
- Mickaelian, A. M. – *Armenian Astronomical Society Annual Activities in 2014* // p. 443-448

### Electronic Catalogs (3)

- Melikian, N. D.; Gomez, J.; Karapetian, A. A. – *New Ha emission stars in Cep OB3* // *VizieR Online Data Catalog, yCatp 016005701, 02/2015*
- Abrahamyan, H. V.; Mickaelian, A. M.; Knyazyan, A. V. – *The IRAS PSC/FSC Combined Catalogue* // *VizieR On-line Data Catalog: II/338, 03/2015*
- Hakobyan, A. A.; Nazaryan, T. A.; Adibekyan, V. Z.; Petrosian, A. R.; Aramyan, L. S.; Kunth, D.; Mamon, G. A.; de Lapparent, V.; Bertin, E.; Gomes, J. M.; Turatto, M. – *Disturbance levels of SNe host galaxies* // *VizieR Online Data Catalog, yCat 74442428, 04/2015*

### Books, Theses (2)

- Harutyunian, H. A.; Nikoghosyan, E. H.; Melikian, N. D. (Eds.) – *Instability and Evolution of Stars* // *Proc. Byurakan-Abastumani Colloquium dedicated to L. V. Mirzoyan's 90<sup>th</sup> anniversary, held 26-28 Aug 2013 in Byurakan, Armenia. Yerevan, NAS RA "Gitutyun" Publishing House, 158 p., 01/2015*
- Harutyunian, H. A.; Mickaelian, A. M.; Farmanyan, S. V. (Eds.) – *Relation of Astronomy to other Sciences, Culture and Society* // *Proc. XIII Annual Meeting of Armenian Astronomical Society, held 7-10 Oct 2014 in Byurakan, Armenia. Yerevan, NAS RA "Gitutyun" Publishing House. 460 p., 07/2015*

### Preprints (7)

- Nikoghosyan, E. H.; Harutyunyan, H. A.; Azatyan, N. M. – *The Multiple Systems in The Young Stellar Cluster IRAS 05137+3919* // *arXiv150106717, 01/2015*
- Azatyan, N. M.; Nikoghosyan, E. H. – *The search of the stellar clusters in vicinity of YSOs with high and middle masses* // *arXiv150601053, 06/2015*
- Yeghiazaryan, A. A.; Nazaryan, T. A.; Hakobyan, A. A. – *The Ha Velocity Fields and Galaxy Interaction in the Quartet of Galaxies NGC 7769, 7770, 7771 and 7771A* // *arXiv151000193, 10/2015*
- Mickaelian, A. M. – *Astronomical Surveys and Big Data* // *arXiv151107322, 11/2015*
- Mickaelian, A. M.; Paronyan, G. M.; Harutyunyan, G. S.; Abrahamyan, H. V.; Gyulzadyan, M. V. – *Multiwavelength studies of X-ray selected extragalactic sample* // *arXiv151107012, 11/2015*
- Nikoghosyan, E. H.; Vardanyan, A. V.; Khachatryan, K. G. – *The search and study of PMS stars with Ha emission* // *arXiv151202729, 12/2015*
- Yeghiazaryan, A. A.; Hakobyan, A. A.; Nazaryan, T. A. – *On the Interaction in a Quartet of Galaxies* // *arXiv151200634, 12/2015*

## Abstracts (19)

- Mickaelian, A. M.** – *Astronomical Surveys and Big Data* // EAAS XII General Meeting and Sci. Conf. “Astronomy from Our Cosmic Neighborhood to Deepest Cosmology”, p. 8-9, 05/2015
- Mickaelian, A. M.; Paronyan, G. M.; Abrahamyan, H. V.** – *Large homogeneous sample of X-ray selected AGNe and its study* // EAAS XII General Meeting and Sci. Conf. “Astronomy from Our Cosmic Neighborhood to Deepest Cosmology”, p. 35-35, 05/2015
- Magakian, T. Yu.; Movsessian, T. A.; Bally, J.** – *HH-flows in the new remote star-formation region* // EAAS XII General Meeting and Sci. Conf. “Astronomy from Our Cosmic Neighborhood to Deepest Cosmology”, p. 61-61, 05/2015
- Mickaelian, A. M.; Paronyan, G. M.; Abrahamyan, H. V.; Gigoyan, K. S.; Gyulzadyan, M. V.** – *SDSS Revised Classification of X-ray Selected Star Candidates* // EAAS XII General Meeting and Sci. Conf. “Astronomy from Our Cosmic Neighborhood to Deepest Cosmology”, p. 64-65, 05/2015
- Movsessian, T. A.** – *The inner structure of stellar jets* // EAAS XII General Meeting and Sci. Conf. “Astronomy from Our Cosmic Neighborhood to Deepest Cosmology”, p. 66-67, 05/2015
- Harutyunian, H. A.** – *Does the Dark Energy Interact with the Ordinary Baryonic Matter?* // IAU GA XXIX Abstracts, id.2257366, 08/2015
- Mickaelian, A. M.; Paronyan, G. M.; Abrahamyan, H. V.** – *Large homogeneous sample of X-ray selected AGN and its study* // IAU GA XXIX Abstracts, id.2251358, 08/2015
- Mickaelian, A. M.; Abrahamyan, H. V.; Paronyan, G. M.** – *High-redshift quasars and blazars and their evolutionary relation to high-redshift galaxies* // IAU GA XXIX Abstracts, id.2251350, 08/2015
- Mickaelian, A. M.** – *BAO Plate Archive digitization, creation of electronic database and its scientific usage* // IAU GA XXIX Abstracts, id.2251363, 08/2015
- Farmanyan, S. V.; Mickaelian, A. M.** – *Archaeo- and Cultural Astronomy in Armenia* // IAU GA XXIX Abstracts, id.2256634, 08/2015
- Farmanyan, S. V.; Mickaelian, A. M.** – *Astronomical Knowledge in Holy Books* // IAU GA XXIX Abstracts, id.2257073, 08/2015
- Mickaelian, A. M.** – *Recent activities in Armenia related to IAU ROAD and strategic plan* // IAU GA XXIX Abstracts, id.2251365, 08/2015
- Harutyunian, H. A.; Alecian, G.; Khachatryan, K. G.; Vardanyan, A. V.** – *Description of Frequency Redistribution Functions via Bilinear Expansions* // Int. Conf. “Radiation mechanisms of astrophysical objects: classics and today” dedicated to V. V. Sobolev’s 100<sup>th</sup> anniversary, p. 44, 09/2015
- Khachikian, E. Ye.** – *Problems of dualcore galaxies* // Int. Conf. “Radiation mechanisms of astrophysical objects: classics and today” dedicated to V. V. Sobolev’s 100<sup>th</sup> anniversary, p. 55, 09/2015
- Nikoghossian, A. G.** – *On some directions of development of the radiative transfer theory* // Int. Conf. “Radiation mechanisms of astrophysical objects: classics and today” dedicated to V. V. Sobolev’s 100<sup>th</sup> anniversary, p. 82, 09/2015
- Pikichian, H. V.** – *On linear properties of the nonlinear problem of radiation transfer* // Int. Conf. “Radiation mechanisms of astrophysical objects: classics and today” dedicated to V. V. Sobolev’s 100<sup>th</sup> anniversary, p. 88, 09/2015
- Gabrielyan, V. V.; Movsessian, T. A.** – *Modernization of Byurakan Observatory Im Schmidt telescope* // Proc. Conf. “The Present and Future of Small and Medium Size Telescopes” (SMT-2015), SAO, Russia, p. 36-38, 10/2015
- Dodonov, S. N.; Afanasiev, V. L.; Amirkhanian, V. R.; Movsessian, T. A.; Gabrielyan, V. V.** – *Spectrophotometry of stars and galaxies in medium-band filters on Byurakan Observatory Im Schmidt telescope: instrumental possibilities and tasks* // Proc. Conf. “The Present and Future of Small and Medium Size Telescopes” (SMT-2015), SAO, Russia, p. 44-44, 10/2015
- Movsessian, T. A.; Magakian, T. Yu.** – *Methods of investigation of compact star-formation regions on Byurakan Observatory 2.6m telescope* // Proc. Conf. “The Present and Future of Small and Medium Size Telescopes” (SMT-2015), SAO, Russia, p. 61-62, 10/2015

*Most productive authors have been (at least 2 refereed papers or at least 4 publications in total):*

Scientists	Refereed journals	Proc. meetings	Electronic catalogs	Books, Theses	Abstracts	Other	All
Abrahamyan, H. V.	2	1	1		4	1	9
Azatyan, N. M.	1	1				2	4
Gyulbudaghian, A. L.	3	1					4
Gyulzadyan, M V.	1	1			1	1	4
Hakobyan, A. A.	2	2	1			2	7
Harutyunian, H. A.	1	4		2	2	1	10
Magakian, T. Yu.	1	1			2		4
Mickaelian, A. M.	2	12	1	1	9	2	27
Movsessian, T. A.	1	1			5		7
Nikoghosyan, E. H.	2	2		1		3	8
Paronyan, G. M.	1	1			4	1	7
Ter-Kazarian, G. T.	2						2

*Publications by research groups:*

Head of group (number of members)	Refereed journals	Proc. meetings	Electronic catalogs	Books, Theses	Abstracts	Other	All
Harutyunian H. A. (4)	2	5		2	2	1	12
Khachikian E. Ye. (6)		3			1		4
Magakian T. Yu. (4)	1	1			5		7
Melikian N. D. (2)		2	1	1			4
Mickaelian A. M. (6)	4	12	1	1	9	2	29
Nikoghosyan E. H. (3)	2	2		1	1	3	9
Parsamian E. S. (4)	4	3					7
Petrosian A. R. (6)	2	2	1			2	7

### Isaac Newton Institute (INI) Armenian Branch

The President of the Isaac Newton Institute of Chile **Dr. Gonzalo Alcaino** established the INI Armenian Branch in 2000. **Dr. A. M. Mickaelian** is its Resident Director. Altogether in 2015, 3 papers were published in AJ, ApJ, A&A, and MNRAS, including 1 in frame of INI (in ApJ, listed in “Publications”). The research staff (25): H. V. Abrahamian, L. S. Aramyan, T. G. Arshakian, M. G. Avtandilyan, S. K. Balayan, L. K. Erastova, K. S. Gigoyan, A. L. Gyulbudaghian, A. A. Hakobyan, S. A. Hakopian, H. A. Harutyunian, L. R. Hovhannisyan, R. A. Kandalyan, T. Yu. Magakian, N. D. Melikian, A. M. Mickaelian, G. A. Mikayelyan, H. Kh. Navasardian, T. A. Nazaryan, A. G. Nikoghossian, E. H. Nikoghossian, A. R. Petrosian, L. A. Sargsyan, P. K. Sinamyan, A. A. Sinanian.

## Teaching, supervision of students

Following Byurakan scientists teach astrophysical subjects at the **YSU Department of Physics, Chair of General Physics and Astrophysics**: A. A. Akopian, H. A. Harutyunian, T. H. Movsessian, A. G. Nikoghossian, A. G. Yeghikyan. *Prof.* Atom Muradyan is the head of the Chair of General Physics and Astrophysics. E. H. Nikoghosyan teaches at Russian-Armenian (Slavonic) University and S. A. Ghazaryan teaches at Artsakh State University. Byurakan scientists have also been supervisors of B.Sc. and M.Sc. Diploma theses at YSU and Russian-Armenian (Slavonic) University.

At present BAO has 4 Ph.D. students: **Levon Aramyan** (supervisor: A. R. Petrosian), **Vahagn Harutyunyan** (supervisor: H. A. Harutyunian), **Hayk Abrahamyan** and **Gurgen Paronyan** (supervisor for both: A. M. Mickaelian). In addition, a few other Byurakan fellows are in the stage of preparation of their Ph.D. theses: N. S. Asatrian, A. G. Eghikian, G. R. Kostandyan, M. G. Gevorgyan, A. L. Samsonyan, N. M. Azatyan, K. G. Khachatryan, A. V. Vardanyan.

**Armenian Astronomical School Olympiad** was held on 31 March 2015 in Yerevan Phys.-Math. School (Chair of Jury: A. A. Akopian). The winners were selected for participation in international Olympiads. **9<sup>th</sup> International Olympiad on Astronomy and Astrophysics (IOAA)** was held on 26 July – 4 Aug 2015 in Indonesia, where Armenian pupils won 3 Bronze medals (team leaders: Marietta Gyulzadian and Emilia Karapetyan). **20<sup>th</sup> International Astronomical Olympiad (IAO)** was held on 15-23 Oct 2015 in Kazan, Russia, where Armenian pupils won 2 Bronze medals (team leaders: Marietta Gyulzadian and Emilia Karapetyan).

**Second Byurakan Science Camp (2BSC)**. On 26-30 Oct 2015, for the second time, BAO and ArAS organized a Science Camp for school pupils. 16 pupils participated. A. M. Mickaelian, H. A. Harutyunian, E. H. Nikoghosyan, M. V. Gyulzadyan, S. V. Farmanyanyan, H. V. Abrahamyan, K. G. Khachatryan and A. V. Vardanyan delivered lectures and K. S. Gigoyan and H. V. Abrahamyan delivered tutorials at the Camp.

## Membership

**International Astronomical Union (IAU, 22 members)**: A. A. Akopian, R. R. Andreasyan, K. S. Gigoyan, A. L. Gyulbudaghian, M. V. Gyulzadyan, A. A. Hakobyan, S. A. Hakopian, H. A. Harutyunian, A. T. Kalloghlian, E. Ye. Khachikian, T. Yu. Magakian, A. P. Mahtessian, N. D. Melikian, A. M. Mickaelian, T. A. Movsessian, A. G. Nikoghossian, E. H. Nikogossian, E. S. Parsamian, A. R. Petrosian, H. V. Pikichian, G. T. Ter-Kazarian, A. G. Yeghikian.

**European Astronomical Society (EAS, 17 members)**: A.S. Amirkhanian, R.R. Andreasyan, K.S. Gigoyan, A.A. Hakobyan, H.A. Harutyunian, M.A. Hovhannissian, S.G. Iskudarian, E.Ye. Khachikian, T.Yu. Magakian, N.D. Melikian, A.M. Mickaelian, T.H. Movsessian, E.H. Nikogossian, E.S. Parsamian, A.R. Petrosian, H.V. Pikichian, A.G. Yeghikian.

**Euro-Asian Astronomical Society (EAAS, 7 members)**: T.Yu. Magakian, N.D. Melikian, A.M. Mickaelian, A.G. Nikoghossian, G.B. Ohanian, E.S. Parsamian, A.R. Petrosian.

**American Astronomical Society (AAS, 1 member)**: A.M. Mickaelian.

**Armenian Astronomical Society (ArAS)**: 42 members from BAO.

## International Committees and Working Groups (WG)

**EAAS Executive Council, EAAS Vice-Chair:** A. M. Mickaelian

**EAAS Scientific-Technical Committee:** T. Yu. Magakian

**EAAS International Bureau:** A. M. Mickaelian

**IAU Com. C1 “Astronomy Education & Development”:** H. A. Harutyunian (Armenian Liaison)

**Internat. Centre for Relativistic Astrophysics (ICRANet) Board of Directors:** H. A.

Harutyunian

**International Virtual Observatory Alliance (IVOA) Executive Committee:** A. M. Mickaelian

**International Planetary Data Alliance (IPDA) Steering Committee:** A. M. Mickaelian

**Viktor Ambartsumian International Science Prize International Steering Committee**

**Scientific Secretary:** A. M. Mickaelian

**Large Telescopes Thematic Committee (KTBT):** E. Ye. Khachikian

**Sub-Regional European Astronomical Committee (SREAC):** A.M. Mickaelian

**Galileo Teacher Training Program (GTTP).** A. M. Mickaelian: GTTP Ambassador in Armenia,

M. V. Gyulzadyan: GTTP Coordinator in Armenia

## Journal *Astrofizika/Astrophysics*

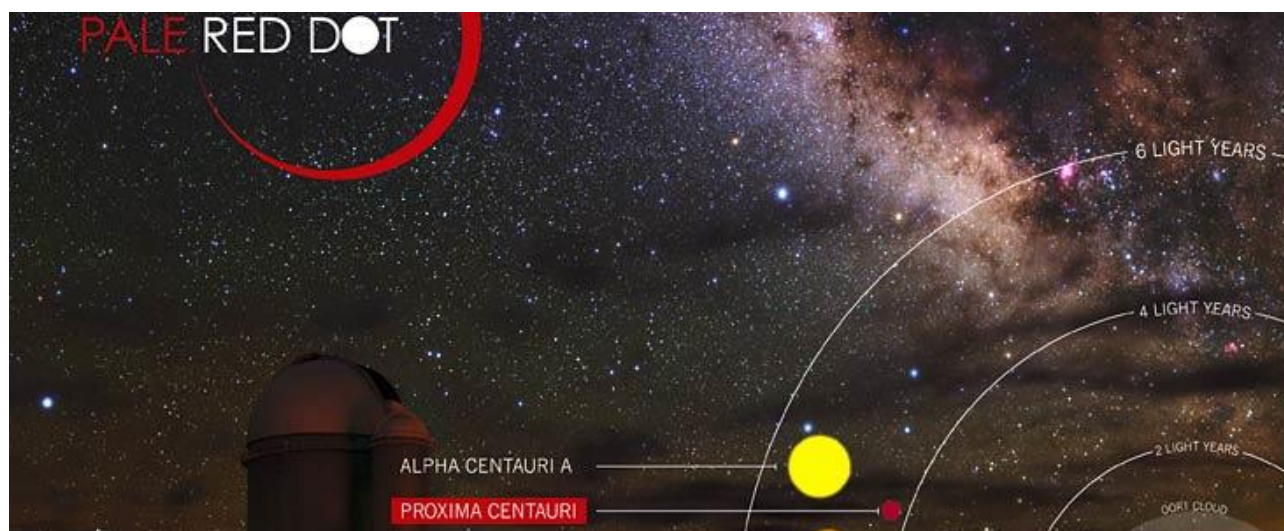
The journal *Astrofizika* (English translation: *Astrophysics*) is being published by the Armenian NAS. Five Byurakan astronomers are involved in the Editorial Board of *Astrofizika* (Editor-in-Chief: *Prof. D.M. Sedrakian* from the YSU): **A.G. Nikoghossian** (*Deputy Editor-in-Chief*), **A.T. Kalloghlian** (*Secretary-in-Chief*), **H.A. Harutyunian**, **E.Ye. Khachikian** and **E.S. Parsamian**. Four issues of Vol. 58 were published in Mar, June, Sep and Dec 2015 with 48 papers, including **7 (14.6%) from BAO** (compared to 16 out of 51(31.4%) in 2014, 17 out of 48 (35.4%) in 2013, 17 out of 52 (32.7%) in 2012, 21 out of 56 (37.5%) in 2011 and 20 out of 57 (35%) in 2010). The number of papers from BAO in 2015 has been significantly decreased. Other papers were from the YSU, other Armenian institutions, Russia, Ukraine, Georgia, China and other countries. 2015 was the 50<sup>th</sup> anniversary of the journal and a dedicated webpage was open at <http://www.aras.am/astrophysics/>.

## Armenian Astronomical Society (ArAS)

ArAS was created in 1999-2001 and at present is an active organization supporting astronomy/astrophysics and science in general in Armenia. Co-Presidents: **H.A. Harutyunian**, **A.M. Mickaelian**, **Ye. Terzian** (Cornell Univ, USA), Vice-President: **T.Yu. Magakian**, Secretary: **E.H. Nikoghossian**, Treasurer: **M.V. Gyulzadyan**, ArASNews Editor: **S.V. Farmanyan**, Webmaster: **G.A. Mikayelyan**. ArAS has **103 members from 21 countries**, including 58 from Armenia (9 new ArAS members were accepted, 1 was deceased). During 2015, **ArAS webpage** was updated, 12 issues (Nos. 77-88) of **ArAS Newsletter (ArASNews)** were released (for the first time since its publication), **ArAS XIV meeting** was held on October 14-15 combined with Armenian-Iranian Astronomical Workshop, **ArAS Annual prize for Young Astronomers** was awarded for the 12<sup>th</sup> time (2015 winner: Artur Hakobyan). ArAS was the organizer or co-organizer of almost all events held in Byurakan. During 2015, in frame of the **scientific journalism**, ArAS prepared and circulated 120 press-releases to Armenian mass media with information on sky events, international and local astronomical news that resulted in more than 500 publications.

*Areg Mickaelian*

## FOLLOW A LIVE PLANET HUNT



A unique outreach campaign has been launched that will allow the general public to follow scientists from around the globe as they search for an Earth-like exoplanet around the closest star to us, Proxima Centauri. The observing campaign will run from January to April 2016 and will be accompanied by blog posts and social media updates. No one knows what the outcome will be. In the months following the observations, the scientists will analyse the data and submit the results to a peer-reviewed journal.

At a distance of just 4.2 light-years from the Sun, and located in the constellation of Centaurus, Proxima Centauri is the closest known star to the Sun. Previous observations have provided tantalising, but weak hints of a small companion orbiting this red dwarf star, but this new campaign will make a more sensitive search for the telltale wobbles in the dwarf star's orbital motion that might reveal the presence of an Earth-like orbiting planet. Observations will be made with the High Accuracy Radial velocity Planet Searcher (HARPS), attached to ESO's 3.6-metre telescope at La Silla Observatory. The HARPS data will be complemented by images from an assortment of robotic telescopes located across the world.

The telescopes that comprise the Burst Optical Observer and Transient Exploring System (BOOTES) and the Las Cumbres Observatory Global Telescope Network (LCOGT) will support the search by measuring the brightness of Proxima Centauri every night during the two and a half month long project. These observations will help astronomers determine whether any detected wobbles in the star's motion are caused by features on its turbulent surface or by an orbiting planet.

*“We are taking a risk to involve the public before we even know what the observations will be telling us – we cannot analyse the data and draw conclusions in real time. Once we publish the paper summarizing the findings it's entirely possible that we will have to say that we have not been able to find evidence for the presence of an Earth-like exoplanet around Proxima Centauri. But the fact that we can search for such small objects with such extreme precision is simply mind-boggling,”* said Guillem Anglada-Escude, the Project Coordinator.

*“We want to share the excitement of the search with people and show them how science works behind the scenes, the trial and error process and the continued efforts that are necessary for the discoveries that people normally hear about in the news. By doing so, we hope to encourage more people towards STEM [3] subjects and science in general,”* adds Guillem.

## ASTRONOMICAL SILK ROAD CONFERENCE ABSTRACTS

Silk Road meeting entitled “**Astronomical Silk Road: International Conference on Astronomy and Archaeoastronomy in China and Central Asia**” was held on December 13-16, 2015 in China, Urumqi. The conference was aimed to promote research on astronomical exchange between civilizations on the Silk Road. The topics of the conference included: archaeoastronomy, star charts, instruments and observatories, cultural astronomy in China, Central Asia and West, etc. Here are the abstracts of the meeting.

### **The Trebizond-Tabriz Caravan and the Influence of the School of Maragha on Byzantine Astronomy**

**NICOLAIDIS, Efthymios**

*Director of research, National Hellenic Research Foundation, Greece*

Tabriz was a main city of the silk road during the 13th and 14th c. and at the same time an important scientific center where among others was taught the astronomy of the school of Maragha. One important branch of the silk road was the Tebizond-Tabriz caravan. Maragha-Tabriz astronomical knowledge spread in China but also in Byzantium. In about 1300 Gregory Chioniades travelled from Trebizond to Tabriz to learn astronomy from Shams Bukhari. Chioniades returned many times in Tabriz and inaugurated the Byzantine Persian astronomy. At the paper we will present the roads and methods of transmission of Maragha-Tabriz astronomical knowledge to Byzantium and from there to European renaissance. We also present the translation-adaptation of this knowledge to Greek and the debates around the introduction of Muslim astronomy in Byzantium.

### **Knowledge Circulation across East Asia in the Early Modern Period: Continental and Maritime Routes**

**JAMI, Catherine**

*Research Director, Centre National de la Recherche Scientifique (CNRS), France*

History of science plays an important role in linking the humanities to science, both intellectually and institutionally. In particular, it can contribute to our understanding of the ways in which knowledge has circulated across cultures, and how these circulations have in turned shaped both scientific knowledge and the societies involved. To illustrate this, I will discuss some recent research on knowledge exchanges between Europe and East Asia in the seventeenth and eighteenth centuries. At that time, Europeans who went from one end of the Eurasian continent to the other mostly travelled by sea, in some cases via America. However, one should not underestimate the importance of overland routes of travel and of knowledge transmission during that period. Taking these routes into account also sheds light on other aspects of knowledge exchange involving civilizations that lay between Europe and East Asia.



## Chinese and Islamic Influence on Korean Astronomical Instruments in the Early Joseon Dynasty

LEE, Eun-Hee

*Senior Researcher, Yonsei University Observatory, Korea*

In 1438, Korean royal observatory (called as Ganui-dae 簡儀臺) equipped with 15 kinds of astronomical instruments was completed. This achievement was the outcome of Ganui-dae project by the order of King Sejong 世宗(1418–1450). During this project, a special committee was organized for the construction of the observatory and astronomical instruments. Under this committee, a large-scale systematic collaboration was carried out by the members: official scholars, astronomers, and technicians. As a result, many kinds of instruments such as the armillary sphere, large and small simplified armillary, celestial globe, lofty bronze gnomon, sundials, and auto striking clepsydras etc. were constructed for celestial observations and time measurements in Seoul. Most of these equipment were re-made based on the records of ancient literatures such as historical annals, *Yuan-shi* 元史. However, we notice that there were many kinds of creative inventions and innovations in the astronomical and horological devices. Through this project, Chinese and Islamic science and technology were absorbed, mixed, and developed in Korea. Particularly, in this talk, we introduce and discuss the several kinds of innovative and remodeled instruments and clocks made in the early Joseon period.

## Equatorial or Ecliptical: A Comparative Study of the Guo Shoujing and the Ulugh Beg Star Catalogues

SUN, Xiaochun (孙小淳) & YANG, Fan (杨帆) & ZHAO, Yongheng (赵永恒)

*Professor, University of Chinese Academy of Sciences, China*

The Chinese Star Catalogue by Guo Shoujing (1231-1316) contained equatorial coordinates of 678 stars, more than doubled the number of stars in previous Chinese star catalogues. In the period 1420-1437, using astronomical instruments at Samarkand Observatory, Ulugh Beg (1394-1449) made independent observations and determined star positions of 1018 stars. An analysis of two star catalogues will show the observational techniques behind them and their accuracies. Both astronomers tried to increase accuracy of measurement by enlarging the astronomical instruments. The Chinese catalogue gives equatorial coordinates of stars. The coordinates were directly read off the armillary sphere, which was mounted equatorially mounted. Sun Xiaochun (1996) suggested that the data of the existent Guo Shoujing catalogue was actually observed around 1380, at the beginning of the Ming dynasty. The Ulugh Beg catalogue gives ecliptic coordinates of stars. Does this mean they were directly measured using an ecliptic instrument? Using Fourier analysis we discover a 3 arc minute systematic error in the declinations, which are derived from the ecliptic coordinates, suggesting the data might be first measured equatorially and then converted to ecliptic coordinates, following Ptolemaic tradition. The 3 arc minute systematic error was caused by the misalignment of the instrument's pole and celestial North Pole. And the comparative study might throw some light on transmission of astronomical knowledge and techniques between China and Central Asia in medieval times.

## The Marāghah Observatory and Illustrated Books on Islamic Scientific Instruments in Yuan and Ming

FUNG, Kam-Wing (冯锦荣)

*Professor, University of Hong Kong, Hong Kong, China*

Construction work beginning on 4th of Jumāda al-ūlā, A.H. 657 (29th December, 1259), the Marāghah Observatory of Ilkhanate was a scientific institution with a library to be completely built by the end of 1261 or the beginning of 1262. The Ilkhanate khan Hulāgū (1218-1265) and Nāsir al-Dīn al-Tusī (1201-1274), head of the observatory, were both ambitious to develop the observatory, as well as its library, into an academic centre comparable to Bayt al-Hikma (House of Wisdom) of Baghdad, the renowned centre of learning established by the 4th caliph al-Ma'mūn ibn Harun (813-833) of Abbāsīd Dynasty of the Muslim Empire. To accomplish the mission, Hulāgū and Nāsir al-Dīn al-Tusī collected over 40,000 volumes of books or manuscripts of Greek, Roman and Islamic astronomy, mathematics and mechanical water clocks from Mosul, Baghdad, Khorasan, Syria and Al-Jazīra. When Islamic scientific works were later spread to China between Mongolian Yuan and mid-Ming, there were numerous illustrated manuscripts or books on scientific instruments. Wang Shidian 王士點 (?-1359?) and Shang Qiweng 商企翁 (fl. 1341-1367) edited Yuan mishujian zhi 元秘書監志 (Records of the Imperial Secretariat of the Yuan Dynasty, 1342-1363) has recorded a detailed bibliographical listings of 242 volumes of Islamic books and related instruments being preserved in the Islamic astronomical bureau (Huihui sitiantai 回回司天臺) at the Mongolian upper capital Shangdu 上都 (now in Inner Mongolian Autonomous Region) in the tenth month of the tenth year of the Ziyuan 至元 reign (1273), include 9 books on astronomical instruments and 2 on horological devices. This paper attempts to give an account on the transmission route of Islamic astrolabes and mechanical horological devices into China based on existing books and objects of Islamic scientific instruments.

## Exchange of astronomical and mathematical ideas between India and China

RAMASUBRAMANIAN, Krishnamurthi

*Professor, Indian Institute of Technology Bombay, India*

Paramount evidences are available to show that there have been a good amount of exchange of ideas (philosophical, spiritual, astronomical, mathematical, etc.) between India and China starting from very early times till at least the end of Tang period (late 9th century). To put it graphically in the words of P. Thomas: "all the countries of Asia from Persia to Japan, from Mongolia to Ceylon formed one cultural commonwealth with India at its centre and fountainhead." Several scholars like Bapat, Chou, Needham and Yabuuti have elaborated on various aspects of these exchange of thoughts. During the talk we would like to focus particularly on the exchange of astronomical and mathematical ideas between India and China during the first millennium CE.

## Joint Research Center for History of Astronomy in China and Central Asia

LI, Jingjing (李晶静)

*Research assistant, Xinjiang Astronomical Observatory, CAS, China*

Introduce Xinjiang Astronomical Observatory newly established "Joint Research Center for History of Astronomy in China and Central Asia". Central Asia and Xinjiang, located in the hinterland of the Eurasian continent, from ancient time to the present, it is considered as the junction and the link of different ancient civilizations, such as the ancient Chinese culture represented by the Central Plains Cultural, the India culture represented by the Buddhist culture and the European culture represented by the cultures in ancient Greek and ancient Rome, as well as, the Islamic culture based on the Arab and Persia cultures.

Astronomy, as one of the important carriers of human civilization, it was one of the most active and prosperous natural science in interflow and exchange between science and technology of Eastern and Western, it writes a great chapter in world's history of astronomy. Xinjiang was called Western Regions in ancient, which used to be an important passage of interflow between oriental and European civilizations. The communication of astronomy between east and west through Xinjiang has been long-standing, the astronomical calendar in ancient China, spread to the ancient Central Asia, India, and even Europe through Xinjiang, and enriched the knowledge of Western astronomy. At the same time, the Western astronomical instruments and astronomical books spread through Xinjiang to China, and promoted the astronomy knowledge of China. The history of Astronomy in Central Asia and Xinjiang was not only the important part of world History of Astronomy, but also the most important part of the history of communication of East and West. Xinjiang astronomy observatory was the only comprehensive astronomical research institutions in northwest of China, has an favorable geographical location and plenty of ancient astronomical relics and literature resources. Therefore, Xinjiang astronomy observatory established the "Joint Research Center for History of Astronomy in China and Central Asia". It includes three research directions, history of astronomy in western regions, including Central Asia and Xinjiang; Ancient astronomical document of Central Asia and Xinjiang collection and general research, as well as, the standardization and research in astronomical terminology of Xinjiang minority languages. We build up this joint research center aimed to research the history of astronomy in Central Asia and Xinjiang, to understand the scientific and cultural exchanges between the ancient Eastern and Western countries, and to further explore the profound connotation of the ancient Silk Road.

## **Astronomy in the Middle East and IAU South West Asian ROAD**

**MICKAELIAN, Areg M.**

*Astrophysicist, Byurakan Astrophysical Observatory (BAO), Armenia*

A review on activities and achievements of astronomy in the Middle East is given, where Armenia plays a major role both for archaeoastronomy / cultural astronomy heritage and modern astronomy/astrophysics. Present activities are connected with Byurakan Astrophysical Observatory (BAO; 2.6m classic reflector and 1m Schmidt telescope, active international collaborations), Armenian Astronomical Society (ArAS; Electronic Newsletters, Annual Meetings, Annual Prizes, etc.), Armenian Virtual Observatory (ArVO; Digitized First Byurakan Survey, DFBS, BAO Plate Archive Project, etc.), Byurakan International Summer Schools (BISS), Viktor Ambartsumian International Prize, and recently established IAU South West Asian Regional Office of Astronomy for Development (SWA ROAD). Beside Armenia, at present Georgia and Iran have joined to IAU SWA ROAD and new possible members are Israel, Turkey, and Pakistan. The Office is established in BAO with 4 staff members; Director, two Program Coordinators and Webmaster. ROAD work will be organized through three Task Forces (TF): TF1 Universities and Research, TF2 Children and Schools, and TF3 Astronomy for the Public. A number of projects are foreseen for 2016-2020. Astronomical education and outreach matters in the region are discussed as well.

## **Moon and its Myths on the Silk Road**

**FARMANYAN, Sona, V**

*PHD Student, M. Abeghyan, Institute of Literature, Armenia*

The Moon and its worship is found in many Silk Road cultures, it has played an important role in shaping our life on the Earth since the dawn of time, and until now in Silk Road countries some habits and superstitions are connected to the Moon. Since the beginning of human existence, civilizations have established religious beliefs that involved the Moon's significance to some extent. As new civilizations and religions developed, many spiritual beliefs were based on those from the past so that there has been an evolution of the Moon's significance throughout cultural development. For comparing and finding the origin of the Moon as a term we made a table of a number of languages and compared the roots of the words. For finding out from where these roots came from, we also made a table of Moon Gods and Goddesses and proved the direct crossing of language and mythology.

## **The missing late-17th Century records of the elusive supernova Cassiopeia A**

**RICHARD De Grijs**

*Professor, Kavli Institute for Astronomy and Astrophysics, Peking University*

Some time during the second half of the 17th Century, the Cassiopeia A supernova must have exploded. However, to date it is unclear whether contemporary astronomers actually saw and recorded the event. Western records seem inconclusive, while Chinese and Japanese records appear to have missed the event completely. Confusion abounds, but we recently stumbled upon possible evidence of the Cas A supernova in the Chinese imperial records, a tantalizing hint of a violent event that shook the heavens more than 300 years ago.

## **A comparative study of "the season by the vibration of flutes" and "Houfeng Seismograph"**

**WANG, Yuming (王玉民)**

*Researcher, Beijing Planetarium, China*

The season by the vibration of flutes was an experiment involving astronomy, temperament, meteorology and other subjects which lasted nearly two thousand years. In undertaking the project of Chinese Academy of Sciences, *the studies about ancient Chinese "the season by the vibration of flutes" theory, experiment and communication*, I made a comparative study of "Houqi" and Zhang Heng seismograph. More than half a century the study of the seismograph is carried out only from the aspects of modern seismology, therefore the original "principle" of Zhang Heng is ignored. This paper finds that the Zhang Heng seismograph was the "waiting for wind" experiment, in other words, waiting for the earthquake's arrival, and the season by the vibration of flutes was "waiting for gas". So they were on the same principle, and the two experiments were very similar to the "column" and "pipe", "like wineglass" and "close room", "eight directions" and so on. And the other conclusion is: In the studies of history of science, we must grasp the ancients scientific system accurately and completely, reduce the original meaning of these knowledge and inventions, instead of copying an ancient science experiment lonely and carrying forward the "ancient scientific achievement" simply.

## **Astronomic Equipments from Taosi Site**

**HE, Nu (何努)**

*Doctor, Archaeology Institute Chinese Academy of Social Science, China*

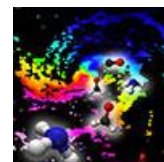
According to archaeological evidences from Taosi Site, one can suggest that Taosi State might have constructed the earliest observatory (4100 BC.) in stone circle style, obtaining the first 20-terms solar calendar across the world. The earliest gnomon and shadow template (4300~4100 BC.) was used at Taosi. It determined the Earth Center as well as the first Central State, causing the ideology of Earth Center to be rooted into Chinese mind till nowadays. It is possible that the Cooper syzygy wheel (4000 BC.) from Taosi may indicate Taosi also composed lunisolar calendar with cooper lunar and solar wheels.

## RELEASE OF NRAO NEWSLETTER



### **Call for Abstracts: NAASC Workshop on Molecular Gas in Galactic Environments**

The NRAO – NAASC is delighted to announce a Call for Abstracts for the [2016 NAASC Workshop on Molecular Gas in Galactic Environments](#) to be held 4 – 7 April 2016 in Charlottesville, Virginia, USA.



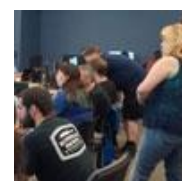
### **Half A Decade of ALMA: Cosmic Dawns Transformed**

This international four-day conference will highlight ALMA results at the threshold of the array's fifth year of science operations and bring together researchers from around the world to motivate collaborations for ALMA Cycle 5.



### **NRAO Live! Proposal Workshops Coming to an Auditorium Near You**

In advance of the ALMA Cycle 4 Call for Proposals, we will have a series of *NRAO Live!* events at a number of North American institutions. The goal of these events is to provide users with the knowledge they need to carry out cutting-edge scientific research using NRAO facilities.



### **VLA Data Reduction Workshop**

The main goal of this Workshop, which will be held from 14-18 March 2016, is to assist observers with the challenges of Jansky VLA Data Reduction posed by the increased flexibility and complexity of the instrument.



## RELEASE of IAU ASTRONOMY OUTREACH NEWSLETTER 2016 #1 & #2



The Astronomy Outreach Newsletter December 2016 #1 and #2 are now online. It is produced by the IAU Office for Astronomy Outreach and brings the general public the latest information about events and other outreach-related activities around the globe — and beyond. Some highlights of this issue:

- Astronomy Outreach Volunteer Program for the 2016 Total Solar Eclipse in Indonesia
- SETI Summer Programme
- Crash Course Astronomy with Phil Plait
- IAU Commission CC1 — Astronomy Education and Development Newsletter
- Follow a live planet hunt! — Pale Red Dot campaign launched
- Robotic Telescopes in Education workshop

### Links

- [Outreach Newsletter 2016 #1 \(January 2016 #1\)](#)
- [Outreach Newsletter 2016 #2 \(January 2016 #2\)](#)
- [Past Outreach Newsletters](#)

### Contacts

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## RELEASE OF ESO OUTREACH COMMUNITY NEWSLETTER



Read in January issue of ESO Outreach Community Newsletter:

### ESO ANNOUNCEMENTS

Follow a Live Planet Hunt! - Pale Red Dot campaign launched  
Insight Astronomy Photographer of the Year 2016 Competition Dates  
ESO and CERN Sign Cooperation Agreement  
The Messenger No. 162 Now Available  
New Space Scoop Website Launched  
See latest ESO announcements on <http://www.eso.org/public/announcements/>

### STARS@ESO

See latest Stars@ESO on <http://www.eso.org/public/events/starsateso/>

### ESOCAST

ESOCast 80: Follow a Live Planet Hunt  
View more ESOCasts on <http://www.eso.org/public/videos/archive/category/esocast/>

### ESO PRESS RELEASES

The Turbulent Birth of a Quasar  
First Light For Future Black Hole Probe  
ALMA Reveals Planetary Construction Sites  
XXL Hunt for Galaxy Clusters  
VLT Revisits a Curious Cosmic Collision  
More news on <http://www.eso.org/public/news/> , including translations into 18 different languages.

### ONGOING EVENTS

Café & Kosmos in Munich

### ESO PICTURES OF THE WEEK

18 January 2016: ESO Telescopes Spy a Rare Relic  
See more on <http://www.eso.org/public/images/potw1603a/>

## Arsen KALLOGHLIAN – 85



When our generation of astronomers came to Byurakan Astrophysical Observatory Dr. Arsen Kalloghlian was around 40 and he was one of the principal researchers of the Observatory. For us he was also one representing the first generation of astronomers in Byurakan. With the laps of time the real difference of ages transformed into delusive philosophical concept and seemingly disappeared ultimately. But now he turned 85 and this event returned us again to the reality. 85 years ago (on January 10) he was born in Aleppo, Syria in one of many Armenian families living in 1930s of last century. Obtaining his primary education in a local Armenian school in 1948 he repatriated with his family when he was 15. His family was among the first repatriates to move to Armenia. In the next two years he completed his higher education in Yerevan. Since 1945 the Department of Astrophysics was opened at Yerevan State University (YSU) by Prof. Victor Ambartsumian. Arsen Kalloghlian entered this University in 1948 for studying astrophysics and graduated it in 1953. Then he began his post-graduate courses in 1955 under supervision of Victor Ambartsumian. Starting from the very beginning he is studying various problems of Extragalactic Astronomy. His scientific papers are devoted to detailed studies of barred spirals, galaxies with UV-continuum, groups and clusters of galaxies etc. He was the first to study the barred spirals in detail including the environmental features of these galaxies. Many papers were devoted to the study of morphological and photometrical properties of Markarian galaxies. The great deal of his papers has been completed and published in cooperation with colleagues from Armenia, Germany, France, Italy, Georgia and Bulgaria. Dr. Kalloghlian is a founding member of ArAS, member of the International Astronomical Union (IAU), he was a member of the Scientific Council of the Byurakan Astrophysical Observatory, about 40 years he was serving as the Executive Secretary of the journal *Astrofizika* (Astrophysics), about six decades he has undertaken many tasks for the benefit of the Observatory. All his colleagues are congratulating him and wish him Caucasian health.

*Haik Harutyunian*

## Arthur NIKOGHOSSIAN – 75



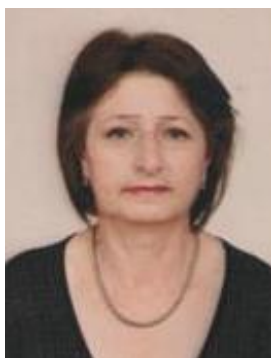
On January 9, the Principal scientist of Byurakan Astrophysical Observatory Dr. Arthur Nikoghossian celebrated his 75<sup>th</sup> anniversary. He is one of the first members of a small group of theorists organized by Victor Ambartsumian in 1960s of the last century. He started his scientific career under Ambartsumian's supervision working in the field of radiation transfer theory. In his candidate's thesis he has considered a rather complex problem of non-linear transfer using Ambartsumian's principle of invariance. Starting in early 1970s he began new series of investigations related to the radiation transfer with general laws of frequency redistribution in spectral lines. These studies were based on two basic issues – the principle of invariance and bilinear expansion of the redistribution functions.



At the same time he started also a series of studies connected with the spectral transformation of spectra owing to photon-electron interactions. The results obtained in these fields became the base of his doctoral thesis in 1986. Very important results have been obtained owing to application of the Lagrangian formalism to the problems of the radiation transfer theory. This new for the transfer theory formalism allowed him in definition of generalized invariance principle. This approach was very essential to show that there exists only one principle of invariance and other relations sometimes presented as “principles of invariance” are just various forms written for three dimensional media. He has obtained completely new result also for interpretation of solar upper atmosphere spectral features. A new theory is elaborated for explanation of spectral lines features in multicomponent media which are active stochastically and dynamically. This new theory jointly with other methods elaborated earlier in the radiation transfer theory allowed him make estimates of velocity fields in quiescent prominences. Many new results have been obtained in other fields of astrophysics as well. One should recall his papers on Z-pinch model in red dwarf stars, on the influence of turbulences of various scales on the spectral properties of radiating plasma, on the application of group theory in the field of radiation scattering and others. Dr. Nikoghossian gives the course of Theoretical astrophysics for students of the Yerevan State University (YSU) for nearly three decades; he was the supervisor of four Candidate (PhD) theses devoted to various problems of astrophysics. Last ten years he serves as a member of Editorial Board of the magazine *Astrofizika* and since 2005 he is the vice-chairman of the Scientific Council for defending theses in the field of astrophysics and radioastronomy. We all congratulate him in occasion of his birthday and wish to be healthy and successful for upcoming decades.

*Haik Harutyunian*

## **Emilia KARAPETIAN – 60**



On January 17, Dr. Emilia Karapetian celebrated her 60th anniversary. In 1978 she has graduated from Yerevan State University (YSU) at Physics Department and just after the graduation she started working at YSU as a laboratory assistant, after a while she got position of senior laboratory assistant and head of educational laboratory. And since 1995, she works as a lecturer at YSU. She has led academic courses of Astronomy, High Energy Astrophysics and Extragalactic Astronomy. In 2006, she took her Ph.D. at Byurakan Astrophysical Observatory on the “Spectral and morphological study of galaxies with UV-excess” (supervisor: Prof. M. A.

Kazarian). Dr. Karapetian’s research interests include surveys, UV-Excess galaxies and AGN. She has published about 20 papers in *Astrofizika/Astrophysics* and *Communications of Byurakan Astrophysical Observatory*. She has participated to local and international conferences (including IAU symposia) and supervised Armenian teams at International School Olympiads. Since 2001 Dr. Karapetian is a member of ArAS. She is a member of YSU Physics Department Scientific Council. We all congratulate her and wish to be healthy and successful for upcoming decades.

# ASTRONOMICAL CALENDAR OF FEBRUARY

Monthly Calendar of Astronomical Events  
FEBRUARY 2016

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1 Lunar crescent (last quarter)	2	3	4	5	6	7
8 New Moon	9	10	11	12	13	14
15	16 Lunar crescent (first quarter)	17	18	19	20	21
22	23	24	25	26	27	28
29	30	1	2	3	4	5

Additional events from the calendar:  
 - Full moon: Friday, February 22  
 - European NEON School (Chile): Saturday, February 23  
 - ArAS Newsletter #90 release: Friday, February 29

# LUNAR PHASES OF FEBRUARY

