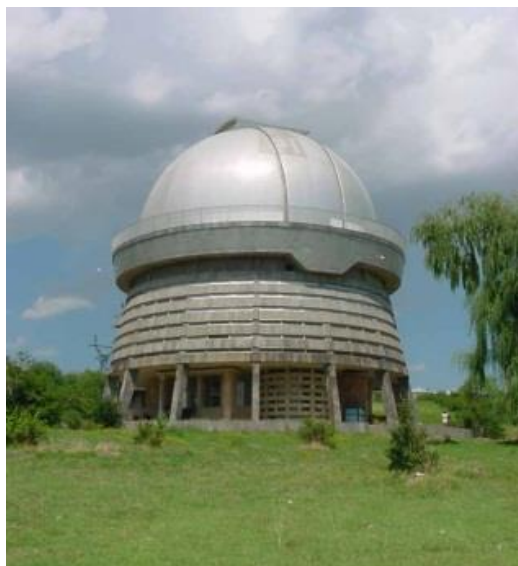


BYURAKAN ASTROPHYSICAL OBSERVATORY IN 2016: ANNUAL REPORT

Introduction



In 2016, 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 4 RA State Committee of Science Thematic grants and 2 ANSEF grants in 2016, as well as a funded project of young scientists was active. 3 BAO astronomers and 1 young researcher were listed among the most productive scientists in Armenia. There have been **38 publications in refereed journals**, including most important international ones (*ApJ*, *ApJS*, *A&A*, *MNRAS*), **5 electronic catalogs in VizieR**, **4 books** (Proceedings of meetings held in Byurakan and BAO booklet), and **61 papers in Proceedings of meetings**, including 28 in the Proceedings of the meeting

Astronomical Surveys and Big Data (ASBD), 24 in the *Armenian-Iranian Astronomical Workshop* held in 2015 and 9 in Proceedings of other meetings. There were **47 missions** for research and participation in meetings and schools.

In 2016, we celebrated the **70th anniversary of BAO's foundation**. A solemn meeting at NAS RA in Yerevan, an international conference “*Non-Stable Universe: Energetic Resources, Activity Phenomena and Evolutionary Processes*”, the 5th Byurakan International Summer School (BISS), a science camp (3BSC), ArAS School Lectures in Yerevan and RA provinces, and several other events were organized. Many guests visited BAO during 2016.

The **IAU South West and Central Asian Regional Office of Astronomy for Development (SWA ROAD)** located in Byurakan continued its activities in 2016. Kazakhstan and Tajikistan joined our ROAD during 2016. Active contacts were maintained with these countries and our first members, Georgia and Iran. The Office will operate until 2021 with further extension plans to 2030.

The project of **Digitization and Scientific Usage of BAO Plate Archive** was conducted in April 2015 and continued in 2016. 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. Thousand of astronomical plates were scanned and stored in 2016.

BAO annual summarizing meeting was held on Dec 12, where the Director Haik Harutyunian reported 2016 results. Here we give more extended report on all kinds of activities. Another meeting, **Summary of the Astronomical Year 2016**, took place at NAS RA on Dec 21, where a number of awards were delivered; ArAS Annual Prize for Young Astronomers, GTTP Certificates, BAO-70 Scientific Journalism prizes, etc.

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 102 persons, are maintained due to this program. The administration consists of 5 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 Artur Hakobyan, Haik Harutyunian, Edward Khachikian, Tigran Magakian, Norair Melikian, Areg Mickaelian, Elena Nikoghosyan, and Elma Parsamian. Altogether 39 scientists work in these groups. Four groups have been awarded state funding for 2015-2017 (PIs: Ashot Akopian, Artur Hakobyan, Tigran Magakian, and Areg Mickaelian). Three BAO astronomers were included in the list of 100 most productive scientists in Armenia and receive additional salaries (Tigran Magakian, Areg Mickaelian, and Tigran Movsessian) and Artur Hakobyan was included in the list of 50 most productive young scientists in Armenia.

Telescopes and Infrastructure

The project of reconstruction of BAO **2.6m telescope** was finished and regular observations started since March 2016. A new receiver was installed build at SAO, Russia. In frame of the Armenian-Spanish-Russian project; the CCD is sensitive from blue to near-IR range. For the first time a speckle interferometer was installed on our 2.6m telescope and the first results were obtained.

Some works have been carried out also on **1m Schmidt telescope**. Having new focal system, this telescope may carry out new tasks. By means of narrow-band filters, test observations were carried out in collaboration with SAO (Russia) to study the Spectral Energy Distribution (SED) and search for quasars. Regular observations will start soon that will consist of 2-3 principal projects.

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.

A device All-Sky was purchased and installed on the BAO main administrative building showing the state of the sky from Byurakan in online mode.

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.

BAO participates in the **Russian project on tracking space debris** and 3 small telescopes have been installed in Saravand area of BAO. Regular observations of Near-Earth Objects (NEOs) were continued in 2016. Eight BAO researchers (mainly young ones) participate in this project and are supported additionally.

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 2016, the abstracts of published refereed papers are given.

Stars and Nebulae (11)

A new star-forming region in Canis Major

Magakian, T. Yu.; Movsessian, T. A.; Bally, J., *MNRAS* 460, 489, 2016.

A new southern star-formation region, located at an estimated distance of ~ 1.5 kpc in the Lynds 1664 dark cloud in Canis Major, is described. Lynds 1664 contains several compact star clusters, small stellar groups and young stars associated with reflection nebulae. Narrow-band H α and [S II] images obtained with the 4-m telescope at the Cerro Tololo Inter-American Observatory reveal more than 20 new Herbig-Haro objects associated with several protostellar outflows.

A new star-forming region in CMA

Magakian, T. Yu.; Movsessian, T. A.; Bally J., *AApTr* 29, 317, 2016.

The area around the dark clouds L 1664 with center $l = 238^\circ.48$, $b = -4^\circ.13$ was explored with narrow-band interference filters and a CCD Mosaic system on 4-m telescope of CTIO. Despite the fact that it contains a number of small reflection nebulae and other such objects described more than 30 years ago, this area has not practically undergone a detailed study. Analysis of our images has led to the discovery of more than 20 HH-clots forming several HH-streams. In general, these currents are distributed in a zone having the form of an elongated ellipse, suggesting an idea of star formation caused by the collision of clouds. Special interest is a separate insulated HH-stream from the IR source, deeply immersed in a dark cloud. They have been identified as new reflection nebulae and a group of young stars. Very small apparent size of the HH-clots and other symptoms point to a fairly large distance of this new region of active star formation in the L 1664. The issue of more accurate estimation of the distance is still open, but in any case, it is not less than 1.5 kpc, if this region is in association Vela OB1.

Inner structure of the jets from YSO's

Movsessian, T. A.; Magakian, T. Yu., *AApTr* 29, 2016.

Jets from young stellar objects are strongly collimated emission structures of collisional excitation with typical nodular structure. These structures may be of different physical nature, and to clarify the mechanisms of their formation one needs to get a full kinematic picture, comparing radial and tangential velocities. For high-resolution maps of the radial velocities and full spatial coverage we used the results of the observation with a scanning Fabry-Perot interferometer on the RAS SAO 6m telescope. These data allowed kinematically highlight structures with different morphology. For example, in the jet associated with the star HL Tau, high-speed and low-speed components with different morphologies were revealed, namely high-speed compact and low-speed arc-shaped structures. With the aim of obtaining the complete kinematic picture, a technique was developed to measure proper motions of spectrally isolated structures from observations in two different eras. These data led to the conclusion that clots in HL Tau jet did not arise due to non-stationary phenomena in a continuous stream, but are the result of incidental matter emissions from the source. Similar investigation of the jet at FS Tau B revealed, apart arcuate, also structures that are formed due to shot in a collision with the flow of dense gas and dust wall. Thus, it can be argued that the jets contain structures with different physical characteristics. Among them: a heated with blow substance of episodic emissions, arched shock fronts ahead of them, as well as ionized in a collision with a stream of gas-dust structures with zero tangential velocity.

Detailed Study of Emission Structures in the Vicinity of LkH α 198**Gevorgyan, M. H.; Movsessian, T. A.; Andreasyan, H. R.; Magakian, T. Yu.,** *Ap* 59, 354, 2016.

Results from a study of collimated flows near the star LkH α 198 are reported. Observations were made using the VAGR multipupil spectrograph installed on the 2.6-m telescope at the Byurakan Astrophysical Observatory. The morphology and kinematics of emission structures in the vicinity of LkH α 198, including HH 161, were studied and electron density charts obtained. Besides the HH 161 object, our data revealed an arc-shaped emission structure with LkH α 198 at its apex. A shape of this kind is usually a direct indication of the presence of a cavity in a dark cloud blown out by a directed outflow. In addition, a faint "tail" extending in the direction of the central star is observed in HH 161. A comparison of these results with radio frequency observations shows that the probable source of HH 161 is the binary system LkH α 198.

Search for Compact Stellar Groups in the Vicinity of IRAS Sources**Azatyan, N. M.; Nikoghosyan, E. H.; Khachatryan, K. G.,** *Ap* 59, 339, 2016.

The results of a search for compact clusters in the vicinity of 19 IRAS sources based on data from the GPS UKIDSS and Spitzer GLIMPSE surveys are presented. Overall, clusters have been identified in 15 regions. Clusters are identified for the first time in 4 regions (IRAS 18151-1208, IRAS 18316-0602, 18517+0437, 19110+1045). In 5 regions (IRAS 05168+3634, 05358+3543, IRAS 18507+0121, IRAS 20188+3928, IRAS 20198+3716) the compact groups we have identified are substructures within more extended clusters. The radii of the identified groups and the surface star density are widely scattered with ranges of 0.3-2.7 pc and 4-1360 stars/pc², respectively. In 11 of the clusters, the IRAS sources are associated with a pair or even a group of YSOs. The groups identified in the NIR range include representatives of a later II evolutionary class among the stellar objects associated with the IRAS sources.

Two Interesting Southern Objects**Gyulbudaghian, A. L.,** *Ap* 59, 256, 2016.

Two southern objects are studied. The first, the planetary nebula PK 349-01.1, is of interest because it has a chain of jets ejected from the central star. ¹²C(1-0) observations of the vicinity of this object reveal red- and blue-shifted molecular outflows. The second object is a star formation region consisting of two groups of IR stars. These groups have a trapezium-like configuration. Two stars in one of these groups are associated with a ring-shaped nebulae. This star formation region is associated with a new radial system of dark globules.

The Object CLN 138 - a Double Star-Formation Region**Gyulbudaghian, A. L.,** *Ap* 59, 360, 2016.

A double star formation region associated with the biconical cometary nebula CLN 138 is studied. ¹²CO(1-0) observations of a molecular cloud associated with this object reveal the existence of several molecular clouds in this region, as well as the existence of red and blue molecular outflows. Several new Herbig-Haro objects are found, two of which have undergone a luminosity increase of at least 8m. The first star formation region is basically embedded in the molecular cloud; most of the stars in it are infrared stars and many have dust envelopes. The second star formation region has already left the molecular cloud; it has no IR stars and few of its stars have dust clouds.

New Emission Stars in B Cyg OB7**Melikian, N. D.; Karapetian, A. A.; Gomez, J.,** *Ap* 59, 484, 2016.

This is a continuation of a search for and study of emission objects in known dark clouds and star formation regions. New results are presented from a search for emission stars in the region of Cyg OB7 where 36 new emission stars have been discovered previously. The current observations were made adjacent to previously studied regions in the vicinity of the object HH 448. 26 new emission stars were found in three small regions with a combined area of 0.11 sq. deg. On an (H-K)-(J-H) two-color diagram these stars lie among the classical T Tau stars (CTTS) and T Tau stars with weak lines (WTTS). A strong change in brightness was recorded for one of the emission stars.

The variable V381 Lac and its possible connection with the R CrB phenomenon**Rossi, C.; Dell'Agli, F.; Di Paola, A.; Gigoyan, K. S.; Nesci, R.,** *MNRAS* 456, 2550, 2016.

We have performed new medium resolution spectroscopy, optical and near-infrared photometry to monitor the variability of the asymptotic giant branch (AGB) carbon star V 381 Lac. Our observations revealed rapid and deep changes in the spectrum and extreme variability in the optical and near-infrared bands. Most notably we observed the change of Na I D lines from deep absorption to emission, and the progressive growing of the [N II] doublet 6548-6584 Å emission, strongly related to the simultaneous photometric fading. V381 Lac occupies regions of Two Micron All-Sky Survey and Wide-field Infrared Survey Explorer colour-colour diagrams typical of stars with dust formation in the envelope. The general framework emerging from the observations of V381 Lac is that of a cool AGB carbon star undergoing episodes of high mass ejection and severe occultation of the stellar photosphere reminiscent of those characterizing the RCB phenomenon. Comparing the spectral energy distribution obtained with the theoretical model for AGB evolution with dust in the circumstellar envelope, we can identify V381 Lac as the descendant of a star of initial mass $\sim 2 M_{\odot}$, in the final AGB phases, evolved into a carbon star by repeated Third Dredge Up episodes. According to our model, the star is moderately obscured ($\tau_{10} \sim 0.22$) by dust, mainly formed by amorphous carbon (~ 80 per cent) and SiC (~ 20 per cent), with dust grain dimensions around ~ 0.2 and $0.08 \mu\text{m}$, respectively.

Statistical analysis from recent abundance determinations in HgMn stars

Ghazaryan, S.; Alecian, G., *MNRAS* 460, 1912, 2016.

To better understand the hot chemically peculiar group of HgMn stars, we have considered a compilation of a large number of recently published data obtained for these stars from spectroscopy. We compare these data to the previous compilation by Smith. We confirm the main trends of the abundance peculiarities, namely the increasing overabundances with increasing atomic number of heavy elements, and their large spread from star to star. For all the measured elements, we have looked for correlations between abundances and effective temperature (T_{eff}). In addition to the known correlation for Mn, some other elements are found to show some connection between their abundances and T_{eff} . We have also checked if multiplicity is a determinant parameter for abundance peculiarities determined for these stars. A statistical analysis using a Kolmogorov-Smirnov test shows that the abundances anomalies in the atmosphere of HgMn stars do not present significant dependence on the multiplicity.

The nature of X-ray selected star candidates

Mickaelian, A. M.; Paronyan, G. M.; Abrahamyan, H. V.; Gigoyan, K. S.; Gyulzadyan, M. V.; Kostandyan, G. R., *AApTr* 29, 2016.

Joint HRC/BHRC catalogue of optical identifications of ROSAT BSC and FSC X-ray sources is 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. HRC/BHRC contains a sample of 8132 (5341+2791) optically identified X-ray sources with count rate (CR) of photons ≥ 0.04 ct/s in the area of the low-dispersion Hamburg Quasar Survey (HQS), $|b| \geq 20^{\circ}$ and $\delta \geq 0^{\circ}$. Based on low-dispersion spectral classification, there are 4253 AGN, 492 galaxies, 1800 stars and 1587 unknown objects in the sample. 1800 star candidates include 1429 objects listed in SDSS DR12 photometric catalogue and 433 given in SDSS spectroscopic catalogue. Using these spectra, we have carried out classification of these star candidates to reveal new interesting objects, as well as define the true content of our sample. 34 cataclysmic variables (including 7 new ones), 19 white dwarfs, 19 late-type stars (K-M and C types), 16 early type stars (O-B), 40 hot coronal stars (A-F types), 2 composite spectrum objects, and 17 bright stars have been revealed, as well as 286 objects turned to be extragalactic ones; 75 emission-line galaxies (HII/SB and AGN, including QSOs, Seyferts, and LINERs) and 211 absorption line galaxies were revealed (wrong classifications in HRC/BHRC due to their faint images and low-quality spectra). We have retrieved multiwavelength data from recent catalogues and carried out statistical investigations of the multiwavelength properties for the whole sample of stars. 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. Relations between the radiation fluxes in different bands from X-ray to radio for different types of sources are studied and analysis of their characteristics is made. X-ray selected stars are an important complement to the stellar populations of our Galaxy in solar neighbourhood and beyond.

Extragalactic Astronomy (7)

Neon and [C III] 158 μm Emission Line Profiles in Dusty Starbursts and Active Galactic Nuclei

Samsonyan, A.; Weedman, D.; Lebouteiller, V.; Barry, D.; Sargsyan, L., *ApJS* 226, id. 11, 2016.

A sample of 379 extragalactic sources is presented that has mid-infrared, high-resolution spectroscopy from the Spitzer Infrared Spectrograph (IRS) and also spectroscopy of the [C ii] 158 μm line from the Herschel Photodetector Array Camera and Spectrometer (PACS). The emission line profiles of [Ne ii] 12.81 μm , [Ne iii] 15.55 μm , and [C ii] 158 μm are presented, and intrinsic line widths are determined (full width half maximum of Gaussian profiles after instrumental correction). All line profiles, together with overlays comparing the positions of PACS and IRS observations, are made available in the Cornell Atlas of Spitzer IRS Sources. Sources are classified from active galactic nucleus (AGN) to starburst based on equivalent widths of the 6.2 μm polycyclic aromatic hydrocarbon feature. It is found that intrinsic line widths do not change among classifications for [C ii], with median widths of 207 km s^{-1} for AGNs, 248 km s^{-1} for composites, and 233 km s^{-1} for starbursts. The [Ne ii] line widths also do not change with classification, but [Ne iii] lines are progressively broader from starburst to AGN. A few objects with unusually broad lines or unusual redshift differences in any feature are identified.

Dusty Quasars at High Redshifts

Weedman, D.; Sargsyan, L., *ApJ* 828, id. 43, 2016.

A population of quasars at $z \sim 2$ is determined based on dust luminosities $\nu L_{\nu}(7.8 \mu\text{m})$ that includes unobscured, partially obscured, and obscured quasars. Quasars are classified by the ratio $\nu L_{\nu}(0.25 \mu\text{m})/\nu L_{\nu}(7.8 \mu\text{m}) = \text{UV/IR}$, assumed to measure obscuration of UV luminosity by the dust that produces IR luminosity. Quasar counts at rest-frame 7.8 μm are determined for quasars in the Boötes field of the NOAO Deep Wide Field Survey using 24 μm sources with optical redshifts from the AGN and Galaxy Evolution Survey (AGES) or infrared redshifts from the Spitzer Infrared Spectrograph. Spectral energy distributions are extended to far-infrared wavelengths using observations from the Herschel Space Observatory Spectral and Photometric Imaging Receiver (SPIRE), and new SPIRE photometry is presented for 77 high-redshift quasars from the Sloan Digital Sky Survey. It is found that unobscured and obscured quasars have similar space densities at rest-frame 7.8 μm , but the ratio $L_{\nu}(100 \mu\text{m})/L_{\nu}(7.8 \mu\text{m})$ is about three times higher for obscured quasars than for unobscured, so that far-infrared or submillimeter quasar detections are dominated by obscured quasars. We find that only $\sim 5\%$ of high-redshift submillimeter sources are quasars and that existing 850 μm surveys or 2 mm surveys should already have detected sources at $z \sim 10$ if quasar and starburst luminosity functions remain the same from $z = 2$ until $z = 10$.

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., *J. Astrophys. Astron.* 37, id.1, 2016.

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 H α 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 the 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.

Supernovae and their host galaxies – III. The impact of bars and bulges on the radial distribution of supernovae in disc galaxies

Hakobyan, A. A.; Karapetyan, A. G.; Barkhudaryan, L. V.; Mamon, G. A.; Kunth, D.; Petrosian, A. R.; Adibekyan, V.; Aramyan, L. S.; Turatto, M., *MNRAS* 456, 2848, 2016.

We present an analysis of the impact of bars and bulges on the radial distributions of the different types of supernovae (SNe) in the stellar discs of host galaxies with various morphologies. We use a well-defined sample of 500 nearby (≤ 100 Mpc) SNe and their low-inclined ($i \leq 60^\circ$) and morphologically non-disturbed S0-Sm host galaxies from the Sloan Digital Sky Survey. We find that in Sa-Sm galaxies, all core-collapse (CC) and vast majority of SNe Ia belong to the disc, rather than the bulge component. The radial distribution of SNe Ia in S0-S0/a galaxies is inconsistent with their distribution in Sa-Sm hosts, which is probably due to the contribution of the outer bulge SNe Ia in S0-S0/a galaxies. In Sa-Sbc galaxies, the radial distribution of CC SNe in barred hosts is inconsistent with that in unbarred ones, while the

distributions of SNe Ia are not significantly different. At the same time, the radial distributions of both types of SNe in Sc-Sm galaxies are not affected by bars. We propose that the additional mechanism shaping the distributions of Type Ia and CC SNe can be explained within the framework of substantial suppression of massive star formation in the radial range swept by strong bars, particularly in early-type spirals. The radial distribution of CC SNe in unbarred Sa-Sbc galaxies is more centrally peaked and inconsistent with that in unbarred Sc-Sm hosts, while the distribution of SNe Ia in unbarred galaxies is not affected by host morphology. These results can be explained by the distinct distributions of massive stars in the discs of early- and late-type spirals.

Supernovae and their host galaxies – IV. The distribution of supernovae relative to spiral arms

Aramyan, L. S.; Hakobyan, A. A.; Petrosian, A. R.; ...; Nazaryan, T. A.; ..., *MNRAS* 459, 3130, 2016.

Using a sample of 215 supernovae (SNe), we analyse their positions relative to the spiral arms of their host galaxies, distinguishing grand-design (GD) spirals from non-GD (NGD) galaxies. We find that: (1) in GD galaxies, an offset exists between the positions of Ia and core-collapse (CC) SNe relative to the peaks of arms, while in NGD galaxies the positions show no such shifts; (2) in GD galaxies, the positions of CC SNe relative to the peaks of arms are correlated with the radial distance from the galaxy nucleus. Inside (outside) the corotation radius, CC SNe are found closer to the inner (outer) edge. No such correlation is observed for SNe in NGD galaxies nor for SNe Ia in either galaxy class; (3) in GD galaxies, SNe Ibc occur closer to the leading edges of the arms than do SNe II, while in NGD galaxies they are more concentrated towards the peaks of arms. In both samples of hosts, the distributions of SNe Ia relative to the arms have broader wings. These observations suggest that shocks in spiral arms of GD galaxies trigger star formation in the leading edges of arms affecting the distributions of CC SNe (known to have short-lived progenitors). The closer locations of SNe Ibc versus SNe II relative to the leading edges of the arms supports the belief that SNe Ibc have more massive progenitors. SNe Ia having less massive and older progenitors, have more time to drift away from the leading edge of the spiral arms.

Baldwin Effect and Additional BLR Component in AGN with Superluminal Jets

Patiño Álvarez, V.; Torrealba, J.; Chavushyan, V.; ...; Arshakian, T.; ..., *Fr. Astron. Sp. Sci.* 3, id.19, 2016.

We study the Baldwin Effect (BE) in 96 core-jet blazars with optical and ultraviolet spectroscopic data from a radio-loud AGN sample obtained from the MOJAVE 2cm survey. A statistical analysis is presented of the equivalent widths W_{λ} of emission lines H beta 4861, Mg II 2798, C IV 1549, and continuum luminosities at 5100, 3000, and 1350 angstroms. The BE is found statistically significant (with confidence level c.l. > 95%) in H beta and C IV emission lines, while for Mg II the trend is slightly less significant (c.l. = 94.5%). The slopes of the BE in the studied samples for H beta and Mg II are found steeper and with statistically significant difference than those of a comparison radio-quiet sample. We present simulations of the expected BE slopes produced by the contribution to the total continuum of the non-thermal boosted emission from the relativistic jet, and by variability of the continuum components. We find that the slopes of the BE between radio-quiet and radio-loud AGN should not be different, under the assumption that the broad line is only being emitted by the canonical broad line region around the black hole. We discuss that the BE slope steepening in radio AGN is due to a jet associated broad-line region.

Multiwavelength studies of X-ray selected extragalactic sample

Mickaelian, A. M.; Paronyan, G. M.; Harutyunyan, G. S.; Abrahamyan, H. V.; Gyulzadyan, M. V., *AApTr* 29, 333, 2016.

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 subjects 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 to identify their characteristics thus confirming candidate AGNs has been carried out. We have analyzed X-ray properties of these sources to find a limit between normal galaxies and X-ray AGN.

Extrasolar Planets (2)

ζ^2 Reticuli, its debris disk, and its lonely stellar companion ζ^1 Ret. Different T_c trends for different spectra
Adibekyan, V.; Delgado-Mena, E.; Figueira, P.; ...; **Hakobyan, A. A.**, *A&A* 591, id.A34, 2016.

Several studies have reported a correlation between the chemical abundances of stars and condensation temperature (known as T_c trend). Very recently, a strong T_c trend was reported for the ζ Reticuli binary system, which consists of two solar analogs. The observed trend in ζ^2 Ret relative to its companion was explained by the presence of a debris disk around ζ^2 Ret. Our goal is to re-evaluate the presence and variability of the T_c trend in the ζ Reticuli system and to understand the impact of the presence of the debris disk on a star. We used very high-quality spectra of the two stars retrieved from the HARPS archive to derive very precise stellar parameters and chemical abundances. We derived the stellar parameters with the classical (nondifferential) method, while we applied a differential line-by-line analysis to achieve the highest possible precision in abundances, which are fundamental to explore for very tiny differences in the abundances between the stars. We confirm that the abundance difference between ζ^2 Ret and ζ^1 Ret shows a significant ($\sim 2\sigma$) correlation with T_c . However, we also find that the T_c trends depend on the individual spectrum used (even if always of very high quality). In particular, we find significant but varying differences in the abundances of the same star from different individual high-quality spectra. Our results for the ζ Reticuli system show, for example, that nonphysical factors, such as the quality of spectra employed and errors that are not accounted for, can be at the root of the T_c trends for the case of individual spectra.

Abundance trend with condensation temperature for stars with different Galactic birth places

Adibekyan, V.; Delgado-Mena, E.; Figueira, P.; ...; **Hakobyan, A. A.**, *A&A* 592, id.A87, 2016.

Context. During the past decade, several studies reported a correlation between chemical abundances of stars and condensation temperature (also known as T_c trend). However, the real astrophysical nature of this correlation is still debated. Aims: The main goal of this work is to explore the possible dependence of the T_c trend on stellar Galactocentric distances, R_{mean} . Methods: We used high-quality spectra of about 40 stars observed with the HARPS and UVES spectrographs to derive precise stellar parameters, chemical abundances, and stellar ages. A differential line-by-line analysis was applied to achieve the highest possible precision in the chemical abundances. Results: We confirm previous results that $[X/Fe]$ abundance ratios depend on stellar age and that for a given age, some elements also show a dependence on R_{mean} . When using the whole sample of stars, we observe a weak hint that the T_c trend depends on R_{mean} . The observed dependence is very complex and disappears when only stars with similar ages are considered. Conclusions: To conclude on the possible dependence of the T_c trend on the formation place of stars, a larger sample of stars with very similar atmospheric parameters and stellar ages observed at different Galactocentric distances is needed. Based on observations collected with the HARPS spectrograph at the 3.6-m telescope (program ID: 095.D-0717(A)), installed at the La Silla Observatory, ESO (Chile), with the UVES spectrograph at the 8-m Very Large Telescope (program ID: 095.D-0717(B)), installed at the Cerro Paranal Observatory, ESO (Chile). Also based on data obtained from the ESO Science Archive Facility.

Theoretical Astrophysics (9)

Groups in the radiative transfer theory

Nikoghossian, A. G., *JQSRT* 183, 90, 2016.

The paper presents a group-theoretical description of radiation transfer in inhomogeneous and multi-component atmospheres with the plane-parallel geometry. It summarizes and generalizes the results obtained recently by the author for some standard transfer problems of astrophysical interest with allowance of the angle and frequency distributions of the radiation field. We introduce the concept of composition groups for media with different optical and physical properties. Group representations are derived for two possible cases of illumination of a composite finite atmosphere.

An algorithm for determining the reflectance and transmittance of inhomogeneous and multi-component atmospheres is described. The group theory is applied also to determining the field of radiation inside an inhomogeneous atmosphere. The concept of a group of optical depth translations is introduced. The developed theory is illustrated with the problem of radiation diffusion with partial frequency distribution assuming that the inhomogeneity is due to depth-variation of the scattering coefficient. It is shown that once reflectance and transmittance of a medium are determined, the internal field of radiation in the source-free atmosphere is found without solving any new equations. The transfer problems for a semi-infinite atmosphere and an atmosphere with internal sources of energy are discussed. The developed theory allows to derive summation laws for the mean number of scattering events underwent by the photons in the course of diffusion in the atmosphere.

Addition Laws for Intensities of Radiation Emerging from Scattering Atmospheres Containing Energy Sources

Nikoghossian, A. G.; Kapanadze, N. G., *Ap 59, 11, 2016.*

A group theoretical approach is developed for solving astrophysical radiative transfer problems described in a previous series of papers. Addition laws for observed radiative intensities are derived for the case in which atmospheres not only absorb and scatter radiation incident on them, but radiate themselves because of energy sources contained within them. As an illustration of the application of these laws, several special radiative transfer problems which we believe are of practical interest are discussed.

On the linear properties of the nonlinear radiative transfer problem

Pikichyan, H. V., *JQSRT 183, 113, 2016.*

In this report, we further expose the assertions made in nonlinear problem of reflection/transmission of radiation from a scattering/absorbing one-dimensional anisotropic medium of finite geometrical thickness, when both of its boundaries are illuminated by intense monochromatic radiative beams. The new conceptual element of well-defined, so-called, linear images is noteworthy. They admit a probabilistic interpretation. In the framework of nonlinear problem of reflection/transmission of radiation, we derive solution which is similar to linear case. That is, the solution is reduced to the linear combination of linear images. By virtue of the physical meaning, these functions describe the reflectivity and transmittance of the medium for a single photon or their beam of unit intensity, incident on one of the boundaries of the layer. Thereby the medium in real regime is still under the bilateral illumination by external exciting radiation of arbitrary intensity. To determine the linear images, we exploit three well known methods of (i) adding of layers, (ii) its limiting form, described by differential equations of invariant imbedding, and (iii) a transition to the, so-called, functional equations of the "Ambartsumian's complete invariance".

Internal Radiation Field in the Nonlinear Transfer Problem for a One-Dimensional Anisotropic Medium.

I

Pikichyan, H. V., // *Ap 59, 114, 2016.*

Ambartsumian's invariance principle is applied to the nonlinear radiative transfer problem of determining the internal radiation field in a one-dimensional, anisotropic, scattering and absorbing medium when both of its boundaries are illuminated by intense radiative fluxes. Formulas are derived for adding and imbedding layers in media with finite geometrical thicknesses. It is shown that to find the internal radiation field in the nonlinear case, as in the linear case, it is not necessary to solve any new equations: it is sufficient to use only the explicit expressions and quantities found by solving the particular problem of the radiation emerging from the medium, i.e., the diffuse reflection and transmission problem. Then a complete set of differential equations is found for invariant imbedding. The standard two-point nonlinear boundary value problem for radiative transfer reduces to an initial value problem—the Cauchy problem. A new Cauchy problem, in which the spatial variables appear only as fixed parameters, is formulated by eliminating derivatives with respect to the layer thickness. In this way, we arrive at a semilinear system of the Ambartsumian's complete invariance.

Internal Radiation Field in the Nonlinear Transfer Problem for a One-Dimensional Anisotropic Medium.

II

Pikichyan, H. V., *Ap 59, 272, 2016.*

It is shown that for the nonlinear boundary value problem of determining the radiation field inside a one-dimensional anisotropic medium illuminated from outside at its boundaries on both sides, the formulas for adding layers in semilinear systems of differential equations for radiative transfer, invariant embedding, and total Ambartsumian invariance can be used to reduce the equations for the problem to separable equations with initial conditions. The fields travelling to the left and right are thereby found independently of one another. In addition, when one of them has been determined, the other can be found directly using an explicit expression. A general equivalence property of operators with respect to a certain mathematical form, expression, or functional is formulated mathematically. New equations, referred to as kinetic equations of equivalency, are derived from the mutual equivalence of the differential operators of the Boltzmann kinetic equation (the equations of radiative transfer) and the functional equation of the Ambartsumian's complete invariance. Besides separability, these new equations also have the property of linearity. Formulas are also introduced for special problems of single sided illumination of a medium that in this case serve as supplementary information in the initial conditions for formulating Cauchy problems.

Bilinear Expansion for Redistribution Functions

Harutyunian, H.; Alecian, G.; **Khachatryan, K.;** Vardanyan, A., *JQSRT 183, 64, 2016.*

We suggest here a method for construction of a bilinear expansion for an angle-averaged redistribution function. This function describes the elementary act of a photon scattering by a model two-level atom with the upper level broadened due to radiation damping. An eigenvalue and eigenvector determination problem is formulated and the relevant matrices are found analytically. Numerical procedures for their computations are elaborated as well. A simple method for the numerical calculations accuracy evaluation is suggested. It is shown that a family of redistribution functions describing the light scattering process within the spectral line frequencies can be constructed if the eigenvalue problem for the considered function is solved. It becomes possible if the eigenvalues and eigenvectors with the appropriate basic functions are used. The Voigt function and its derivatives used as basic functions are studied in detail as well.

On the physical nature of the source of ultraluminous X-ray pulsations

Ter-Kazarian, G., *Ap&SS 361, id.11, 2016.*

To reconcile the observed unusual high luminosity of NuSTAR X-ray pulsations from M82X-2 with the most extreme violation of the Eddington limit, and in view that the persistent X-ray radiation from M82X-2 almost precludes the possibility of common pulsars, we tackle the problem by the implications of microscopic theory of black hole (MTBH). The preceding developments of MTBH are proved to be quite fruitful for the physics of ultra-high energy (UHE) cosmic-rays. Namely, replacing a central singularity by the infrastructures inside event horizon, subject to certain rules, MTBH explains the origin of ZeV-neutrinos which are of vital interest for the source of UHE-particles. The M82X-2 is assumed to be a spinning intermediate mass black hole resided in final stage of growth. Then, the thermal blackbody X-ray emission, arisen due to the rotational kinetic energy of black hole, escapes from event horizon through the vista to outside world, which is detected as ultraluminous X-ray pulsations. The M82X-2 indeed releases $\sim 99.6\%$ of its pulsed radiative energy predominantly in the X-ray bandpass 0.3-30 keV. We derive a pulse profile and give a quantitative account of energetics and orbital parameters of the semi-detached X-ray binary containing a primary accretor M82X-2 of inferred mass $M \approx 138.5-226 M_{\odot}$ and secondary massive, $M_2 > 48.3-64.9 M_{\odot}$, O/B-type donor star with radius of $R > 22.1-25.7 R_{\odot}$, respectively. We compute the torque added to M82X-2 per unit mass of accreted matter which yields the measured spin-up rate.

Rotating black holes in microscopic theory: the implications for periodic source M82X-2

Ter-Kazarian, G., *Advances in Astrophysics 1, 201, 2016.*

In previous paper [1], we employ the microscopic theory of black hole to study the observed unusual high luminosity of NuSTAR X-ray pulsations from M82X-2 without the need for significant breaking of Eddington limit. Exploring a spontaneous breaking of gravitation gauge symmetry at huge energies, this theory has smeared out a central singularity of black hole replacing it by the equilibrium, so-called, superdense proto-matter core (SPC), subject to certain rules. In this framework, we think of a M82X-2 as being a spinning intermediate mass black hole. However, for rigorous theoretical solutions, in present report we analytically treat the microscopic model of stationary and axisymmetric rotating black hole. A ring singularity of the Kerr black hole cannot occur, which is now replaced by equilibrium SPC. We calculate the corrections to previous model, introduced by the rotation, of the characteristic phase profile of M82X-2.

Wavelet-based cross-correlation analysis of structure scaling in turbulent clouds

Arshakian, T. G.; Ossenkopf, V., *A&A* 585, *id.A98*, 2016.

Aims: We propose a statistical tool to compare the scaling behaviour of turbulence in pairs of molecular cloud maps. Using artificial maps with well-defined spatial properties, we calibrate the method and test its limitations to apply it ultimately to a set of observed maps. **Methods:** We develop the wavelet-based weighted cross-correlation (WWCC) method to study the relative contribution of structures of different sizes and their degree of correlation in two maps as a function of spatial scale, and the mutual displacement of structures in the molecular cloud maps. **Results:** We test the WWCC for circular structures having a single prominent scale and fractal structures showing a self-similar behaviour without prominent scales. Observational noise and a finite map size limit the scales on which the cross-correlation coefficients and displacement vectors can be reliably measured. For fractal maps containing many structures on all scales, the limitation from observational noise is negligible for signal-to-noise ratios $\gtrsim 5$. We propose an approach for the identification of correlated structures in the maps, which allows us to localize individual correlated structures and recognize their shapes and suggest a recipe for recovering enhanced scales in self-similar structures. The application of the WWCC to the observed line maps of the giant molecular cloud G 333 allows us to add specific scale information to the results obtained earlier using the principal component analysis. The WWCC confirms the chemical and excitation similarity of ^{13}CO and C^{18}O on all scales, but shows a deviation of HCN at scales of up to 7 pc. This can be interpreted as a chemical transition scale. The largest structures also show a systematic offset along the filament, probably due to a large-scale density gradient. **Conclusions:** The WWCC can compare correlated structures in different maps of molecular clouds identifying scales that represent structural changes, such as chemical and phase transitions and prominent or enhanced dimensions.

Surveys, Databases (2)

Astronomical surveys and big data

Mickaelian, A. M., *Baltic Astronomy* 25, 75, 2016.

Recent all-sky and large-area astronomical surveys and their catalogued data over the whole range of electromagnetic spectrum, from γ -rays to radio waves, are reviewed, including such as Fermi-GLAST and INTEGRAL in γ -ray, ROSAT, XMM and Chandra in X-ray, GALEX in UV, SDSS and several POSS I and POSS II-based catalogues (APM, MAPS, USNO, GSC) in the optical range, 2MASS in NIR, WISE and AKARI IRC in MIR, IRAS and AKARI FIS in FIR, NVSS and FIRST in radio range, and many others, as well as the 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, with Astrophysical Virtual Observatories and Computational Astrophysics playing an important role in using and analyzing big data for new discoveries.

Multiwavelength astronomy and big data

Mickaelian, A. M., *Astron. Rep.* 60, 857, 2016.

Two major characteristics of modern astronomy are multiwavelength (MW) studies (from γ -ray to radio) and big data (data acquisition, storage and analysis). Present astronomical databases and archives contain billions of objects observed at various wavelengths, both galactic and extragalactic, and the vast amount of data on them allows new studies and discoveries. Astronomers deal with big numbers. Surveys are the main source for discovery of astronomical objects and accumulation of observational data for further analysis, interpretation, and achieving scientific results. We review the main characteristics of astronomical surveys, compare photographic and digital eras of astronomical studies (including the development of wide-field observations), describe the present state of MW surveys, and discuss the Big Data in astronomy and related topics of Virtual Observatories and Computational Astrophysics. The review includes many numbers and data that can be compared to have a possibly overall understanding on the Universe, cosmic numbers and their relationship to modern computational facilities.

Meetings and events held in Byurakan and Yerevan

Armenian Astronomical School Olympiad final phase, 29 Mar 2016, Phys.-Math. School, 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.

Young Scientists Conference *Cultural Astronomy in the Armenian Highland*, 20-23 June 2016, NAS RA, Yerevan, Armenia

The Conference was devoted to the role of astronomy in culture and other fields of human activity. The meeting contributed on Astronomical heritage of Armenian, Ancient astronomy, Astronomy in the Middle Ages, Astronomy in ancient cultures, Ethnoastronomy, Astronomical bases of Philosophy, Religion and Astronomy, the problem of Extraterrestrial Intelligence, Astronomy and Astrology, Astronomy in Folklore and Poetry, Astronomy in Arts, Astronomy in Fashion, Astrolinguistics, Astroheraldry, etc. Organizers: NAS RA, ArAS, Young Scientists Support Programme, and BAO. Chair of SOC: Areg Mickaelian, Chair of LOC: Sona Farmanyan.

3rd Byurakan Science Camp (3BSC), 22-27 Aug 2016, Byurakan, Armenia

A science camp (already regular) for 12-15 year-old pupils to get them acquainted to BAO, astronomy, and science in general. It was partially supported by the Fund for Armenian Relief (FAR) and 25 pupils participated. Organizers: Areg Mickaelian (Chair of the Organizing Committee) and Sona Farmanyan (Coordinator).

5th Byurakan International Summer School (5BISS), 12-23 Sep 2016, Byurakan, Armenia

The school was the 5th in the series of BISS that started in 2006. 27 students from 6 countries (Armenia, Georgia, Iran, Russia, Turkey, and Ukraine), as well as 15 lecturers from 9 countries (Armenia, China, Georgia, Germany, Ireland, Portugal, Russia, USA, and Uzbekistan) took part. The organizers were BAO, Ministry of Education and Science State Committee of Science (MES SCS) and ArAS. Areg Mickaelian is the Director of BISS and was the Chair of SOC of 5BISS, Hayk Abrahamyan and Anahit Samsonyan were the Co-Chairs of LOC.

International Conference *Non-Stable Universe: Energetic Resources, Activity Phenomena and Evolutionary Processes* dedicated to the 70th anniversary of Byurakan Astrophysical Observatory (BAO), 19-23 Sep 2016, Yerevan and Byurakan, Armenia

A number of outstanding scientists, astronomers having tight relations to BAO, representatives of regional countries with an involvement of BAO traditional research areas related to instability phenomena in the Universe, both observational and theoretical, were invited. There were 76 participants from 17 countries (Armenia, Belarus, China, Estonia, France, Georgia, Germany, Iran, Ireland, Italy, Portugal, Russia, Spain, Turkey, Ukraine, USA, and Uzbekistan). 35 invited talks, 13 contributed talks and 12 posters were presented. The Proceedings will be published by ASP Conference Series. The organizers were BAO, Ministry of Education and Science State Committee of Science (MES SCS), National Academy of Sciences of the Republic of Armenia (NAS RA) and ArAS. Co-Chairs of SOC: Haik Harutyunian and Areg Mickaelian, Chair of LOC: Elena Nikoghosyan.

Summary of Astronomical Events 2016, 21 Dec 2016, NAS RA, Yerevan, Armenia

A meeting summarizing the astronomical year 2016. Haik Harutyunian reported about most important BAO activities in 2016, then Areg Mickaelian summarized the most important events at the international level and gave an overview on astronomical educational and public outreach events in 2016. Then a number of awards and presentations followed: ArAS Annual Prize for Young Astronomers, GTTP international certificates, BAO-70 Scientific Journalism Prizes and Certificates to Mass Media. The Proceedings of the Conference “Cultural Astronomy in the Armenian Highland” and the documentary film “Byurakan Astrophysical Observatory” were presented.

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 2016, following projects were active:

ANSEF (2016): “*Radio properties of active galaxies*”, PI: **Hayk Abrahamyan**; “*Multiwavelength studies of blazars*”, PI: **Areg Mickaelian**

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

Thematic grants 2015-2017. PIs: Ashot Akopian, Artur Hakobyan, Tigran Magakian and Areg Mickaelian

SCS/YSSP Young Scientists Thematic grant. PI: Satenik Ghazaryan

BAO Young Scientists Grant 2016. PI: Naira Azatyan

H2020 COST Action TD1403 BigSkyEarth: Areg Mickaelian

Most productive scientists of Armenia: Tigran Magakian, Areg Mickaelian and Tigran Movsessian

Most productive young scientists of Armenia: Artur Hakobyan

ArAS Annual Prize for Young Astronomers (Yervant Terzian Prize) 2016: Anahit Samsonyan

Galileo Teacher Training Program (GTTP) certificates: Levon Aramyan and Sona Farmanyan

Foreign Missions

Altogether, **20 Byurakan scientists had 47 foreign missions to astronomical centres of 22 countries** (USA, France, Germany, Italy, Vatican, Austria, Belgium, Spain, Czech Republic, Greece, Bulgaria, Macedonia, South Africa, India, Iran, Oman, Russia, Georgia, Kazakhstan, Uzbekistan, Tajikistan and Artsakh). Most often, 6 times, BAO scientists visited Georgia, 4 times – Russia and Greece (each), 3 times – USA, France, Spain and Kazakhstan (each), twice – Germany, Italy, South Africa, Iran, Uzbekistan and Tajikistan (each), and once to 9 different countries. Out of the 47 visits, 5 have been accomplished for research work (Areg Mickaelian to Italy and France, Anahit Samsonyan to USA, Artur Hakobyan to France and Kamo Gigoyan to France), 22 for participation in meetings (including IAU Symposia in Spain and Italy and European annual meeting EWASS-2016 in Greece), 4 for participation in summer/winter schools, 13 for discussions of collaboration, 1 for lectures, and 2 in international astronomical Olympiads (as the team supervisors). Compared to recent years, 2016 was most productive for foreign missions by the total number and visited countries (see the table).

#	Scientists	Institution and Country	Duration	Dates	Purpose
1	Tigran Movsessian	SAO, Russia	1 week	28.01-04.02.2016	collab.-n
2	Areg Mickaelian	Cape Town, South Africa	1 week	28.02-08.03.2016	meeting
3	Sona Farmanyan	Cape Town, South Africa	1 week	28.02-08.03.2016	meeting
4	Susanna Hakopian	Toledo, Spain	1 week	11-20.03.2016	meeting
5	Areg Mickaelian	Tbilisi/Abastum., Georgia	1 week	27.03-02.04.2016	collab.-n
6	Susanna Hakopian	Tbilisi/Abastum., Georgia	1 week	27.03-02.04.2016	collab.-n
7	Sona Farmanyan	Tbilisi/Abastum., Georgia	1 week	27.03-02.04.2016	collab.-n
8	Gor Mikayelyan	Tbilisi/Abastum., Georgia	1 week	27.03-02.04.2016	collab.-n
9	Gor Mikayelyan	Oberpfaffenhofen, Germ.	1 week	03-11.04.2016	school
10	Haik Harutyunian	Vienna, Austria	1 week	04-08.04.2016	meeting
11	Areg Mickaelian	Naples, Italy	1 week	07-12.04.2016	collab.-n
12	Areg Mickaelian	Brno, Czech Republic	1 week	13-17.04.2016	meeting
13	Areg Mickaelian	Tashkent, Uzbekistan	4 days	12-17.05.2016	collab.-n
14	Elena Nikoghosyan	Tashkent, Uzbekistan	4 days	12-17.05.2016	collab.-n
15	Areg Mickaelian	Almaty, Kazakhstan	4 days	17-20.05.2016	collab.-n
16	Elena Nikoghosyan	Almaty, Kazakhstan	4 days	17-20.05.2016	collab.-n
17	Areg Mickaelian	Dushanbe, Tajikistan	4 days	20-23.05.2016	collab.-n
18	Elena Nikoghosyan	Dushanbe, Tajikistan	4 days	20-23.05.2016	collab.-n
19	Ani Vardanyan	Vatican Obs., Vatican	1 month	28.05-25.06.2016	school
20	Levon Aramyan	Silicon Valley, CA, USA	10 days	18-27.06.2016	meeting
21	Anahit Samsonyan	Cornell Univ., NY, USA	7 weeks	16.06-03.08.2016	collab.-n
22	Artur Hakobyan	IAP, Paris, France	3 weeks	19.06-12.07.2016	collab.-n
23	Gurgen Paronyan	Alakol, Kazakhstan	2 weeks	01-14.07.2016	school
24	Areg Mickaelian	Tenerife, Canarias, Spain	1 week	25.06-02.07.2016	meeting
25	Sona Farmanyan	Tenerife, Canarias, Spain	1 week	27.06-01.07.2016	meeting
26	Areg Mickaelian	Athens, Greece	1 week	02-09.07.2016	meeting
27	Artur Hakobyan	Athens, Greece	1 week	04-08.07.2016	meeting
28	Hayk Abrahamyan	Athens, Greece	1 week	04-08.07.2016	meeting
29	Kamo Gigoyan	Marseille, France	6 weeks	08.07-21.08.2016	collab.-n
30	Mkrtich Gevorgyan	SAO, Russia	1 week	18-25.07.2016	collab.-n
31	Naira Azatyan	Heidelberg, Germany	1 week	08-12.08.2016	meeting
32	Areg Mickaelian	RIAAM, Maragheh, Iran	1 week	15-18.08.2016	meeting
33	Sona Farmanyan	RIAAM, Maragheh, Iran	1 week	15-18.08.2016	meeting
34	Gagik Ter-Kazarian	Mascot, Oman	4 months	04.09-29.12.2016	lectures
35	Areg Mickaelian	Denver, Colorado, USA	1 week	10-14.09.2016	meeting
36	Areg Mickaelian	Ochrid, Macedonia	1 week	24-29.09.2016	meeting
37	Tigran Magakian	SAO, Russia	1 week	29.09-06.10.2016	meeting
38	Tigran Movsessian	SAO, Russia	1 week	29.09-06.10.2016	meeting
39	Hasmik Andriasyan	Paralia Katerini, Greece	10 days	01-10.10.2016	school
40	Marietta Gyulzadyan	Plovdiv, Bulgaria	10 days	04-14.10.2016	Olympiad
41	Areg Mickaelian	Tbilisi, Georgia	1 week	05-08.10.2016	meeting
42	Haik Harutyunian	Stepanakert, Artsakh	1 week	06-08.10.2016	collab.-n
43	Areg Mickaelian	Sorrento, Italy	1 week	19-27.10.2016	meeting
44	Areg Mickaelian	Paris, France	1 week	02-08.11.2016	collab.-n
45	Areg Mickaelian	Brussels, Belgium	3 days	08-10.11.2016	meeting
46	Levon Aramyan	Tbilisi, Georgia	3 days	09-12.11.2016	meeting
47	Marietta Gyulzadyan	Bhubaneswar, India	10 days	09-19.12.2016	Olympiad

Comparison of foreign missions in 2009-2016:

Year	Visits	Scientists	Countries
2016	47	20	22
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 **54 visits by 51 guests during 2016**, including 5 visitors from Armenia (2 astronomers/physicists and 3 students) and 46 **astronomers from 17 other countries**. The highest number of guests – 43, was at the International Conference *Non-Stable Universe: Energetic Resources, Activity Phenomena and Evolutionary Processes*, as well as 25 at 5BISS (22 guests took part in both events). Serguei Dodonov has visited BAO thrice and Sergey Kotov – twice. The distribution by countries is as follows: Armenia – 5, Belarus – 1, China – 1, Estonia – 1, France – 3, Georgia – 6, Germany – 1, Iran – 7, Ireland – 1, Italy – 2, Jordan – 1, Portugal – 1, Russia – 11, Turkey – 1, Ukraine – 5, USA – 3, Uzbekistan – 1).

28.02-13.03.2016, work on **BAO 1m Schmidt telescope**:

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

Sergey Kotov (Saint Petersburg State University, Russia)

31.05.2016, collaboration visit

Khalil Konsul (Jordanian Astronomical Society, Jordan)

27.06.2016, research and **seminar at BAO**:

Vladimir Airapetian (GSFC, NASA, USA)

01-08.09.2016, research and **seminar at BAO**:

Sofia Mitronova (Special Astrophysical Observatory (SAO), Russia)

12-23.09.2016, participation in the **Fifth Byurakan International Summer School (5BISS)**:

Vardan Adibekyan (Institute of Astrophysics and Space Sciences (IA), Portugal)

Noreta Andreasyan-Thomas (Thomas Research Institute, USA)

Sophia Beradze (NPLE Ilia State University – Physics, Georgia)

Richard De Grijs (Kavli Inst. Astron. Astrophys., Peking Univ. (KIAA-PKU), China)

Serguei Dodonov (Special Astrophysical Observatory (SAO) of RAS, Russia)

Suleyman Fisek (Istanbul Univ., Astron. and Space Sciences Department, Turkey)

Valeri Hambaryan (Astrophys. Inst. Univ. Obs. Friedrich-Schiller-Univ. Jena, Germany)
Alisher Hojaev (NUU Dept. of Physics, Ulugh Beg Astron. Inst. (UBAI), Uzbekistan)
Sergo Kapanadze (Abastumany Astrophysical Observatory (AAO), Georgia)
Arefeh Khoshbakht Marvi (Inst. Res. Fundamental Sciences (IPM), School of Astron., Iran)
Nino Kochiashvili (Abastumani Astrophysical Observatory (AAO), Georgia)
Sergey Kotov (Special Astrophysical Observatory (SAO) of RAS, Russia)
Hamidreza Mahani (Institute for Advanced Studies in Basic Sciences (IASBS), Iran)
Vardan Martikyan (Yerevan State University (YSU), Armenia)
Tatevik Mkrтчyan (Yerevan State University (YSU), Armenia)
Artem Mokhnatkin (Central Astron. Obs. of the Russian Academy of Sciences, Russia)
Hanna Parul (Saint Petersburg State University (SPbSU), Russia)
Vajihеh Sabzali (Res. Inst. of Astron. Astrophys. of Maragheh (RIAAM), Iran)
Anush Sargsyan (Yerevan State University (YSU), Armenia)
Elena Shablovinskaya (Saint Petersburg State University (SPbSU), Russia)
Olena Shubina (Main Astron. Obs. Natl. Academy of Sciences of Ukraine, Ukraine)
Mohammad Hossein Talezade (Res. Inst. of Astron. Astrophys. of Maragheh (RIAAM), Iran)
Martin Topinka (Dublin Institute for Advanced Studies (DIAS), Ireland)
Olena Torbaniuk (Main Astron. Obs. National Acad. of Sci. of Ukraine, Ukraine)
Vasili Zhuzhunadze (Samtskhe-Javakheti State Univ., Abastumani Astr. Obs., Georgia)

19-23.09.2016, participation in the **International Conference *Non-Stable Universe: Energetic Resources, Activity Phenomena and Evolutionary Processes (BAO-70)***:

Martin Abrahamyan (Yerevan State University (YSU), Armenia)
Vardan Adibekyan (Institute of Astrophysics and Space Sciences (IA), Portugal)
Victor Afanasiev (Special Astrophysical Observatory (SAO) of RAS, Russia)
Georges Alecian (LUTH, CNRS – Observatoire de Paris, PSL, France)
Noreta Andreasyan-Thomas (Thomas Research Institute, USA)
Ivan Andronov (Odessa National Maritime Univ., Dept. Math., Phys. Astron., Ukraine)
Ara Avetisyan (Yerevan State University (YSU), Armenia)
Sophia Beradze (NPLE Iliа State University – Physics, Georgia)
Jerome Bouvier (Inst. de Planetologie et d'Astrophys. de Grenoble (IPAG), France)
Pantea Davoudifar (Res. Inst. Astron. and Astrophys. of Maragheh (RIAAM), Iran)
Richard De Grijs (Kavli Inst. Astron. Astrophys., Peking Univ. (KIAA-PKU), China)
Massimo Della Valle (Astronomical Observatory of Capodimonte in Naples, Italy)
Zhanna Dlugach (Main Astron. Obs. National Academy of Sciences, Ukraine)
Serguei Dodonov (Special Astrophysical Observatory (SAO) of RAS, Russia)
Suleyman Fisek (Istanbul Univ., Astron. and Space Sciences Department, Turkey)
Konstantin Grankin (Crimean Astrophysical Observatory (CrAO), Ukraine)
Vladimir Grinin (Saint Petersburg State University (SPbSU), Russia)
Valeri Hambaryan (Astrophys. Inst. Univ. Obs. Friedrich-Schiller-Univ. Jena, Germany)
Alisher Hojaev (NUU Dept. of Physics, Ulugh Beg Astron. Inst. (UBAI), Uzbekistan)
Sergo Kapanadze (Abastumany Astrophysical Observatory (AAO), Georgia)
Arefeh Khoshbakht Marvi (Inst. Res. Fundamental Sciences (IPM), School of Astron., Iran)
Habib Khosroshahi (Inst. Res. Fundamental Sciences (IPM), School of Astron., Iran)
Nino Kochiashvili (Abastumani Astrophysical Observatory (AAO), Georgia)
Sergey Kotov (Special Astrophysical Observatory (SAO) of RAS, Russia)
Alex Lazarian (University of Wisconsin-Madison (UWM), USA)
Hamidreza Mahani (Institute for Advanced Studies in Basic Sciences (IASBS), Iran)
Oleg Malkov (Institute of Astronomy of the RAS (INASAN), Moscow, Russia)
Artem Mokhnatkin (Central Astron. Obs. of the Russian Academy of Sciences, Russia)
Rezo Natsvlishvili (Abastumani Astrophysical Observatory (AAO), Georgia)
Hanna Parul (Saint Petersburg State University (SPbSU), Russia)

Nikolai Rogovtsov (Belarus National Technical Univ. (BNTU), Energy Dept, Belarus)
Vajih Sabzali (Res. Inst. of Astron. Astrophys. of Maragheh (RIAAM), Iran)
Elena Shablovinskaya (Saint Petersburg State University (SPbSU), Russia)
Olena Shubina (Main Astron. Obs. Natl. Academy of Sciences of Ukraine, Ukraine)
Boris Shustov (Institute of Astronomy of the RAS (INASAN), Moscow, Russia)
Mohammad Hossein Talezade (Res. Inst. of Astron. Astrophys. of Maragheh (RIAAM), Iran)
Maya Todua (Abastumani Astrophysical Observatory (AAO), Georgia)
Martin Topinka (Dublin Institute for Advanced Studies (DIAS), Ireland)
Olena Torbaniuk (Main Astron. Obs. National Acad. of Sci. of Ukraine, Ukraine)
Massimo Turatto (Osservatorio Astronomico di Padova – INAF, Italy)
Tõnu Viik (Tartu Observatory, Estonia)
Valeri Vlasyuk (Special Astrophysical Observatory (SAO) of RAS, Russia)
Vasili Zhuzhunadze (Samtskhe-Javakheti State Univ., Abastumani Astr. Obs., Georgia)

17.10.2016, collaboration visit and informal **seminar at BAO**:

Agop Terzan (Lyon, France)

Nov 2016, collaboration and **seminar at BAO**:

Sergei Dodonov (Special Astrophysical Observatory (SAO), Russia)

08.12.2016, research and **seminar at BAO**:

Mohammad Bagheri (History of Science Institute, University of Tehran, Iran)

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

Participation in Meetings and Schools

During 2016, Byurakan astronomers have participated in **28 meetings, schools and other events**, including a number of important international ones, such as IAU Symposia #321 in Toledo (Spain) and #325 in Sorrento (Italy), EWASS-2016 meeting in Athens (Greece), as well as other meetings in Austria, Belgium, Czech Republic, Georgia, Germany, Iran, Italy, Macedonia, Russia, South Africa, Spain, USA (2), astronomical schools in Germany, Vatican, Greece and Kazakhstan, International Astronomical Olympiads in Bulgaria and India, as well as 6 meetings and seminars in Armenia: *Non-Stable Universe: Energetic Resources, Activity Phenomena and Evolutionary Processes* (BAO-70), Young Scientists Conference *Astronomical Heritage of the Armenian Highland*, 5BISS, 3BSC, Summary of Astronomical Year 2016 and Armenian Republican Astronomical Olympiad. The list contains 3 meetings, 1 summer school, 1 science camp and 1 Olympiad in Armenia, and 16 meetings, 4 schools, and 2 Olympiads abroad.

IAU OAD/ROADs Workshop, 02-04.03.2016, SAAO, Cape Town, South Africa

Areg Mickaelian, Sona Farmanyan

IAU Symposium #321: Formation and evolution of galaxy outskirts,

14-18.03.2016, Toledo, Spain

Susanna Hakopian

Armenian Astronomical School Olympiad final phase, 29.03.2016, Yerevan, Armenia

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

UN COPUOS meeting, 04-08.04.2016, Vienna, Austria

Haik Harutyunian

COST BigSkyEarth training school, 04-09.04.2016, DLR, Oberpfaffenhofen, Germany

Gor Mikayelyan

COST BigSkyEarth MC meeting and Workshop, 13-16.04.2016, Brno University of Technology, Brno, Czech Republic

Areg Mickaelian

Vatican Observatory 15th Summer School in Astrophysics (VOSS 2016): *Water in the Solar System and Beyond*, 29.05-24.06.2016, Vatican City, Vatican

Ani Vardanyan

Young Scientists Conference *Cultural Astronomy in Armenian Highland*,

20-23.06.2016, Yerevan, Armenia

Organizers and speakers: Areg Mickaelian, Sona Farmanyan, Hayk Abrahamyan, Gor Mikayelyan, Gurgen Paronyan, Haik Harutyunian, Gayane Kostandyan, Elma Parsamian, Anahit Yeghiazarian

Global Entrepreneurship Summit 2016 (GES 2016), 23-24.06.2016, Silicon Valley, CA, USA

Levon Aramyan

Starmus III Festival *Beyond the Horizon – Tribute to Stephen Hawking*,

27.06-02.07.2016, Tenerife, Canary Islands, Spain

Areg Mickaelian, Sona Farmanyan

International scientific-practical seminar *Spectrophotometry of astronomical objects: theory and practice*, 02-14.07.2016, Alakol, Kazakhstan

Gurgen Paronyan

European Astronomical Society Annual Meeting (EWASS-2016), 04-08.07.2016, Athens, Greece; S4:

Future Prospects for the Far-Infrared Space Astrophysics; S16: *Frontiers of massive-star evolution and core-collapse supernovae*; SS5: *A multi-messenger view of mergers and multiple supermassive black holes*

Areg Mickaelian, Artur Hakobyan, Hayk Abrahamyan; also Gagik Tovmassian (Mexico)

Conference *Star Clusters: from Infancy to Teenagehood*,

08-12.08.2016, ARI, Heidelberg, Germany

Naira Azatyan

8th Advanced Astrophysics Workshop of Maragheh, 14-18.08.2016, RIAAM, Maragha, Iran

Areg Mickaelian, Sona Farmanyan

3rd Byurakan Science Camp (3BSC), 22-27.08.2016, Byurakan, Armenia

Organizers and lecturers: Areg Mickaelian, Sona Farmanyan, Hayk Abrahamyan, Marietta Gyulzadyan, Haik Harutyunian, Gor Mikayelyan, Gabriel Ohanyan, Gurgen Paronyan, Elma Parsamian

WDS Forum and SciDataCon 2016: *Advancing the Frontiers of Data in Research*,

11-13.09.2016, Denver, Colorado, USA

Areg Mickaelian

5th Byurakan International Summer School (BBISS), 12-23.09.2016, Byurakan, Armenia

Organizers and lecturers: Areg Mickaelian, Hayk Abrahamyan, Anahit Samsonyan, Naira Azatyan, Hasmik Andreasyan, Sona Farmanyan, Susanna Hakopian, Haik Harutyunian, Knarik Khachatryan, Gayane Kostandyan, Tigran Magakian, Gor Mikayelyan, Tigran Movsessian, Arthur Nikoghossian, Elena Nikoghosyan, Gurgun Paronyan, Ararat Yeghikian

International Conference *Non-Stable Universe: Energetic Resources, Activity Phenomena and Evolutionary Processes*, 19-23.09.2016, Yerevan and Byurakan, Armenia

Organizers, speakers and other participants: Haik Harutyunian, Areg Mickaelian, Elena Nikoghosyan, Edward Khachikian, Tigran Magakian, Arthur Nikoghossian, Elma Parsamian, Hayk Abrahamyan, Hasmik Andreasyan, Naira Azatyan, Sona Farmanyan, Knarik Khachatryan, Gayane Kostandyan, Gor Mikayelyan, Gurgun Paronyan, Anahit Samsonyan, Ashot Akopian, Ruben Andreasyan, Levon Aramyan, Norayr Asatrian, Lilit Barkhudaryan, Grigor Broutian, Mkrtich Gevorgyan, Satenik Ghazaryan, Armen Gyulbudaghian, Marietta Gyulzadyan, Artur Hakobyan, Arpine Karapetyan, Abraham Mahtessian, Tigran Movsessian, Gabriel Ohanian, Hovhannes Pikichyan, Anahit Yeghiazaryan, Ararat Yeghikian

OPTICON Awareness Conference and SREAC meeting, 26-27.09.2016, Ohrid, Macedonia

Areg Mickaelian

Conference *Physics of Stars: from Collapse to Collapse*, 03-07.10.2016, SAO, Russia

Tigran Magakian, Tigran Movsessian

The ISM-SPP Olympian School of Astrophysics,

03-07.10.2016, Paralia Katerini, Mount Olympus, Greece

Hasmik Andreasyan

Eastern Partnership E-Infrastructure Conference (EaPEC), 06-07.10.2016, Tbilisi, Georgia

Areg Mickaelian

21th International Astronomical Olympiad (IAO), 05-13.10.2016, Plovdiv, Bulgaria

Armenian Team Leader: Marietta Gyulzadian

IAU Symposium #325: *Astroinformatics (AstroInfo16)*, 20-24.10.2016, Sorrento, Italy

Areg Mickaelian

COST BigSkyEarth MC meeting and Workshop, 24-25.10.2016, Sorrento, Italy

Areg Mickaelian

H2020 Space NCP-day, 09.11.2016, European Commission, Brussels, Belgium

Areg Mickaelian

10th International Olympiad on Astronomy and Astrophysics (IOAA), 09-19.12.2016, Bhubaneswar, India

Armenian Team Leader: Marietta Gyulzadian

Summary of Astronomical Events 2016, 21.12.2016, Yerevan, Armenia

Organizers, speakers and awardees: Areg Mickaelian, Haik Harutyunian, Sona Farmanyan, Anahit Samsonyan, Levon Aramyan, other BAO staff members

Talks, posters and lectures presented at meetings and schools

During 2016, Byurakan astronomers presented invited, oral and poster contributions at 14 meetings held in 11 countries (Czech Republic, Georgia, Germany, Greece, Iran, Italy, Macedonia, Russia, South Africa, Spain, and Armenia) and gave lectures at 3BSC and 5BISS. Altogether, there were **19 invited talks, 23 contributed oral talks, 13 posters, and 18 lectures**.

IAU OAD/ROADs Workshop, 02-04.03.2016, SAAO, Cape Town, South Africa; 2 contributed talks

Sona Farmanyan – *The role of Archaeoastronomy and Astronomy in Culture in the implementation of IAU Strategic Plan "Astronomy for Development"* (contributed talk)

Areg Mickaelian – *IAU South West Asian ROAD activities* (contributed talk)

IAU Symposium #321: Formation and evolution of galaxy outskirts,

14-18.03.2016, Toledo, Spain; 1 poster

Susanna Hakopian – *The Details from the 3D-spectroscopy of Starforming Galaxies* (poster)

COST BigSkyEarth MC meeting and Workshop, 13-16.04.2016, Brno University of Technology, Brno, Czech Republic; 1 contributed talk

Areg Mickaelian – *The Digitized Markarian Survey and the Armenian Virtual Observatory* (contributed talk)

Young Scientists Conference Cultural Astronomy in Armenian Highland,

20-23.06.2016, Yerevan, Armenia; 2 invited and 4 contributed talks

Farmanyan, S. V. – *Cultural Astronomy in Armenia and in the World* (contributed talk)

Farmanyan, S. V. – *Astronomical Knowledge in Armenian Medieval Riddles* (contributed talk)

Mickaelian, A. M. – *Astronomy as the Leader of Interdisciplinary and Multidisciplinary Sciences* (invited talk)

Mickaelian, A. M. – *Armenian Names of Sky Constellations* (invited talk)

Mickaelian, A. M. – *Byurakan Astrophysical Observatory as Cultural Centre* (contributed talk)

Yeghiazaryan, A. A. – *Astrology: Science, Art or Prophecy* (contributed talk)

European Astronomical Society Annual Meeting (EWASS-2016), 04-08.07.2016, Athens, Greece; 2 contributed talks and 1 poster

S4: *Future Prospects for the Far-Infrared Space Astrophysics*

Areg Mickaelian – *Large FIR galaxy sample for study of galaxy formation and evolution* (contributed talk)

S16: *Frontiers of massive-star evolution and core-collapse supernovae*

Artur Hakobyan – *The impact of bars on the radial distribution of supernovae in disc galaxies* (poster)

SS5: *A multi-messenger view of mergers and multiple supermassive black holes*

Areg Mickaelian – *Interacting/merging pairs and multiples from the BIG and IRAS PSC/FSC samples* (contributed talk)

Conference Star Clusters: from Infancy to Teenagehood,

08-12.08.2016, ARI, Heidelberg, Germany; 1 poster

Naira Azatyan – (poster)

8th Advanced Astrophysics Workshop of Maragheh, 14-18.08.2016, RIAAM, Maragha, Iran;

4 invited talks

Sona Farmanyan – *Archaeoastronomy and Cultural Astronomy in South West and Central Asia* (invited talk)

Sona Farmanyan – *Ancient Mythology and Cosmology* (invited talk)

Areg Mickaelian – *Astronomical Surveys, Catalogs, Databases, Archives, and Virtual Observatories* (invited talk)

Areg Mickaelian – *Multi-Wavelength Studies of Active Galaxies* (invited talk)

3rd Byurakan Science Camp (3BSC), 22-27.08.2016, Byurakan, Armenia; 9 lectures

- Abrahamyan, H. V. – *Solar System* (lecture)
 Abrahamyan, H. V. – *In the world of galaxies* (lecture)
 Farmanyan, S. V. – *Cultural Astronomy* (lecture)
 Gyulzadyan, M. V. – *International Astronomical Olympiads* (lecture)
 Harutyunian, H. A. – *Viktor Ambartsumian and the Byurakan Astrophysical Observatory* (lecture)
 Mickaelian, A. M. – *The role of the science in human society* (lecture)
 Mickaelian, A. M. – *Our understanding of the Universe* (lecture)
 Mickaelian, A. M. – *Astronomy and Computer Science* (lecture)
 Parsamian, E. S. – *Ancient Astronomy in Armenia* (lecture)

5th Byurakan International Summer School (5BISS), 12-23.09.2016, Byurakan, Armenia; 9 lectures

- Haik Harutyunian – *Viktor Ambartsumian and Byurakan Astrophysical Observatory* (lecture)
 Tigran Magakian – *Astrophysics with Space Telescopes* (lecture)
 Areg Mickaelian – *Telescopes and Modern Observational Techniques* (lecture)
 Areg Mickaelian – *Astronomical Surveys, Catalogues, Databases, Archives, and Virtual Observatories* (lecture)
 Tigran Movsessian – *Telescopes and Observations* (lecture)
 Elena Nikoghosyan – *The main methods for determining the basic parameters of PMS stellar objects* (lecture)
 Elena Nikoghosyan – *Aperture Photometry* (lecture)
 Artur Nikogossian – *Theoretical Astrophysics Methods and Solutions* (lecture)
 Ararat Yeghikyan – *The irreplaceable role of ubiquitous cosmic rays in the space chemistry: from the origin of complex species in interstellar molecular clouds to the ozone depletion in the atmospheres of Earth-like planets* (lecture)

International Conference Non-Stable Universe: Energetic Resources, Activity Phenomena and Evolutionary Processes, 19-23.09.2016, Yerevan and Byurakan, Armenia; 9 invited talks, 9 contributed talks and 10 posters

- Grigor Broutian – *The origin of the Protohaykian calendar* (invited talk)
 Haik Harutyunian – *70 years of Byurakan Astrophysical Observatory* (invited talk)
 Haik Harutyunian – *Byurakan cosmogony concept in the light of modern observational data: Why we need to recall it?* (invited talk)
 Edward Khachikyan – *Physical features of central regions of active galaxies* (invited talk)
 Areg Mickaelian – *Search and Studies of Active Galaxies using Multiwavelength Data* (invited talk)
 Tigran Movsessian – *Some results of scanning Fabry-Perot observations of the jets from YSO's* (invited talk)
 Arthur Nikogossian – *The field of the line radiation in turbulent atmospheres* (invited talk)
 Hovhannes Pikichyan – *Some new results in astrophysical problems of nonlinear theory of radiative transfer* (invited talk)
 Ararat Yeghikyan – *On dust irradiation in planetary nebulae* (invited talk)
 Ruben Andreasyan – *On the formation and amplification of magnetic fields in the central part of active galaxies* (contributed talk)
 Levon Aramyan – *The distribution of supernovae relative to spiral arms in host disc galaxies* (contributed talk)
 Norayr Asatrian – *Hour-timescale profile variations in the broad Balmer lines of the Markarian 6 AGN: Implications for the kinematics of the BLR* (contributed talk)
 Satenik Ghazaryan – *Statistical analysis of HgMn stars* (contributed talk)
 Armen Gyulbudaghian – *The Results of Surveys of ESO/SRC Plates of Southern Hemisphere* (contributed talk)
 Artur Hakobyan – *Supernovae distribution and host galaxy properties* (contributed talk)
 Tigran Magakian – *A new powerful outburst of V1318 Cyg S (LkHa 225): extreme EXor?* (contributed talk)
 Gabriel Ohanian – *The Origin and Evolution of Galaxies. Two different approaches* (contributed talk)
 Anahit Samsonyan – *Neon and [CII] 158 micron Emission Line Profiles in Dusty Starbursts and Active Galactic Nuclei* (contributed talk)
 Naira Azatyan – *The search and study of the dense stellar clusters in vicinity of intermediate and high mass YSOs* (poster)
 Lilit Barkhudaryan – *The impact of bars and spiral density waves on the relative frequencies of supernovae* (poster)
 Lidia Erastova – *Remote BCDGs* (poster)
 Mkrtich Gevorgyan – *Detailed investigation of the emission structures in the vicinity of LkHa 198* (poster)
 Marietta Gyulzadyan – *Spectroscopic Investigation of Mrk Galaxies from SDSS* (poster)
 Arpine Karapetyan – *The impact of bulges on the radial distribution of supernovae in disc galaxies* (poster)
 Knarik Khachatryan – *The Statistical Analysis of stars with Ha emission in IC 348 Cluster* (poster)
 Gayane Kostandyan – *Infra-Red Characteristics of Faint Galactic Carbon Stars from the First Byurakan Spectral Sky Survey* (poster)
 Abraham Mahtessian – *Luminosity functions of Arakelian galaxies and their environmental dependences* (poster)
 Anahit Yeghiazaryan – *On physical systems of galaxies with UV excess from Kazarian lists* (poster)

OPTICON Awareness Conference and SREAC meeting, 26-27.09.2016, Ohrid, Macedonia;

2 contributed talks

Areg Mickaelian – *Observational possibilities in Byurakan* (contributed talk)Areg Mickaelian – *Recent Activities in the Armenian Astronomy* (contributed talk)**Conference *Physics of Stars: from Collapse to Collapse*, 03-07.10.2016, SAO, Russia;**

1 invited talk, 1 contributed talk

Tigran Magakian – *New powerful outburst of the unusual young star V1318 Cyg S (LkHa 225 S)* (contributed talk)Tigran Movsessian – *Collimation and propagation of jets from young stellar objects* (invited talk)**Eastern Partnership E-Infrastructure Conference (EaPEC), 06-07.10.2016, Tbilisi, Georgia;**

1 invited talk

Areg Mickaelian – *Astronomical Surveys, Catalogs, Databases, Archives and Virtual Observatories: Managing Big Data in Astronomy* (invited talk)**IAU Symposium #325: *Astroinformatics (AstroInfo16)*, 20-24.10.2016, Sorrento, Italy;**

1 contributed talk

Areg Mickaelian – *Multi-wavelength studies of the statistical properties of active galaxies using Big Data* (contributed talk)**COST BigSkyEarth MC meeting and Workshop, 24-25.10.2016, Sorrento, Italy; 1 contributed talk**Areg Mickaelian – *Big Data Era in Astronomical Educational Activities in Armenia* (contributed talk)**Summary of Astronomical Events 2016, 21.12.2016, Yerevan, Armenia; 2 invited talks**Haik Harutyunian – *The most important BAO activities in 2016* (invited talk)Areg Mickaelian – *Summary of the most important events at the international level and an overview on astronomical educational and public outreach events in 2016* (invited talk)***Scientists with 2 and more presentations during 2016:***

Scientists	Invited talk	Oral talk	Poster	Lecture	Total
Abrahamyan, H. V.				2	2
Azatyanyan, N. M.			2		2
Farmanyan, S. V.	2	3		1	6
Gyulzadyan, M V.			1	1	2
Hakobyan, A. A.		1	1		2
Harutyunian, H. A.	3			2	5
Magakian, T. Yu.		2		1	3
Mickaelian, A. M.	7	9		5	21
Movsessian, T. A.	2			1	3
Nikogossian, A. G.	1			1	2
Nikoghosyan, E. H.				2	2
Yeghiazarian, A .A.		1	1		2
Yeghikian, A. G.	1			1	2
Others	3	7	8	1	19
All	19	23	13	18	73

Seminars

In total, 8 BAO seminars were held, including 3 by BAO scientists and 5 by visitors (from USA, France, Russia (2), and Iran). In addition, 11 foreign invited seminars were given in Georgia, Italy, Kazakhstan and Tajikistan and 1 invited seminar was given at YSU, Armenia. This is the largest number of invited seminars by BAO scientists during a year.

Date	Speaker	Institution, country	Topic
21.03	Kamo Gigoyan	BAO, Armenia	<i>Study of carbon stars</i>
27.06	Vladimir Airapetian	GSFC, NASA, USA	<i>Solar-terrestrial connections</i>
05.09	Sofia Mitronova	SAO, Russia	<i>Study of collective motions in the Local Universe by means of the samples of flat galaxies</i>
17.10	Agop Terzan	Lyon, France	<i>Agop Terzan's way in astronomy</i>
24.10	Ararat Yeghikian	BAO, Armenia	<i>Radiation-chemical transformation of molecules in interstellar clouds</i>
07.11	Serguei Dodonov	SAO, Russia	<i>Presentation of the accomplished works on BAO 1m telescope and its current state</i>
07.11	Edward Khachikian	BAO, Armenia	<i>The features of the nuclei of active galaxies</i>
19.12	Mohammad Bagheri	History of Science Institute, University of Tehran, Iran	<i>History of Sundials in Iran</i>

Foreign seminars and seminars of BAO researchers in other Armenian institutions:

- 28.03.2016, Ilia State University, Tbilisi, Georgia: Invited seminar by Areg Mickaelian “*IAU South West Asian ROAD activities*”
- 28.03.2016, Ilia State University, Tbilisi, Georgia: Invited seminar by Susanna Hakopian “*Panoramic spectroscopy of some FBS and SBS galaxies in investigations of starforming activity*”
- 29.03.2016, Ilia State University, Tbilisi, Georgia: Invited seminar by Sona Farmanyan “”
- 31.03.2016, Abastumani Astrophysical Observatory, Georgia: Invited seminar by Areg Mickaelian “”
- 31.03.2016, Abastumani Astrophysical Observatory, Georgia: Invited seminar by Sona Farmanyan “”
- 01.04.2016, Abastumani Astrophysical Observatory, Georgia: Invited seminar by Susanna Hakopian “*Selected samples of SBS galaxies as a base for further studies*”
- 11.04.2016, Department of Physics, University of Naples Federico II, Naples, Italy: Invited seminar by Areg Mickaelian “*AGN research using Multi-Wavelength Big Data*”
- 18.05.2016, Fesenkov Astrophysical Institute, Almaty, Kazakhstan: Invited seminar by Elena Nikoghosyan “*Recent studies on young stars and star-formation regions*”
- 18.05.2016, Fesenkov Astrophysical Institute, Almaty, Kazakhstan: Invited seminar by Areg Mickaelian “*Active galaxies among X-ray, IR and radio sources*”
- 20.05.2016, Tajik Academy of Science, Dushanbe, Tajikistan: Invited seminar by Elena Nikoghosyan “*Recent studies on young stars and star-formation regions*”
- 20.05.2016, Tajik Academy of Science, Dushanbe, Tajikistan: Invited seminar by Areg Mickaelian “*Active galaxies among X-ray, IR and radio sources*”
- 03.06.2016, YSU Department of Biology, Yerevan, Armenia: Invited seminar by Areg Mickaelian “*Astrobiology and Extrasolar Planets*”

Publications

During 2016, Byurakan astronomers had **113 publications: 38 papers in 16 refereed journals** (including 10 in *Astrofizika/Astrophysics*, 10 in the 4 highest ranked astronomical and astrophysical journals (1 – *ApJ*, 1 – *ApJS*, 3 – *A&A*, 5 – *MNRAS*), 1 *Ap&SS*, 3 in also highly ranked *JQSRT*, 2 review papers in *Baltic Astronomy* and *Astronomy Reports*, 4 in *AApTr*, 1 in *Journal of Astrophysics and Astronomy*, 1 in *Frontiers in Astronomy and Space Sciences*, 1 in *Advances in Astrophysics*, 1 in *Astron. & Astrophys. (Caucasus)*, 2 in *Publ. Astron. Obs. Belgrade* and 2 in *Mediterranean Archaeology and Archaeometry*), **61 in Proceedings of 8 meetings** (including 28 in *Proc. Astronomical Surveys and Big Data*, 24 in *Proc. Armenian-Iranian Astronomical Workshop*, and 9 papers in the Proceedings of 6 other meetings, including IAU Symp. #319), **5 electronic catalogues**, **4 books** (Proceedings of 2 meetings held in 2015, Proceedings of the Young Scientists Conference held in 2016, as well as *Byurakan Astrophysical Observatory* booklet), as well as **4 preprints** that will be published as papers and **1 abstract** of a paper presented at EWASS-2016. Numerous information materials and popular articles were published as well. Compared to 2015 and all other previous years, the number of refereed papers is among the highest ones (the 2nd highest after 2004), and the total number is the highest during the last 17 years (2000-2016), when statistics was made. The total number of publications in 2016 is of course high due to the Proceedings of 2 meetings held in Byurakan in 2015: *Astronomical Surveys and Big Data* and *Armenian-Iranian Astronomical Workshop*. Anyway, it is worth mentioning that the number of papers in highly ranked international journals is rather high as well.

Refereed Journals (38)

- Ter-Kazarian, G.** – On the physical nature of the source of ultraluminous X-ray pulsations // *Astrophysics and Space Science, Volume 361, article id.11, 20 pp., 01/2016.*
- Arshakian, T. G.;** Ossenkopf, V. – Wavelet-based cross-correlation analysis of structure scaling in turbulent clouds // *Astronomy & Astrophysics, Volume 585, id.A98, 24 pp., 01/2016.*
- Nikoghossian, A. G.;** Kapanadze, N. G. – Addition Laws for Intensities of Radiation Emerging from Scattering Atmospheres Containing Energy Sources // *Astrophysics, Volume 59, Issue 1, pp. 11-19, 03/2016.*
- Andreasyan, H. A.;** **Andreasyan, R. R.;** **Paronyan, G. M.** – Distribution of Pulsars in the Galaxy // *Astrophysics, Volume 59, Issue 1, pp. 57-67, 03/2016.*
- Pikichyan, H. V.** – Internal Radiation Field in the Nonlinear Transfer Problem for a One-Dimensional Anisotropic Medium. I // *Astrophysics, Volume 59, Issue 1, pp. 114-125, 03/2016.*
- Rossi, C.; Dell'Agli, F.; Di Paola, A.; **Gigoyan, K. S.;** Nesci, R. – The variable V381 Lac and its possible connection with the R CrB phenomenon // *Monthly Notices of the Royal Astronomical Society, Volume 456, Issue 3, p. 2550-2557, 03/2016.*
- Hakobyan, A. A.;** **Karapetyan, A. G.;** **Barkhudaryan, L. V.;** Mamon, G. A.; Kunth, D.; Petrosian, A. R.; Adibekyan, V.; **Aramyan, L. S.;** Turatto, M. – Supernovae and their host galaxies – III. The impact of bars and bulges on the radial distribution of supernovae in disc galaxies // *Monthly Notices of the Royal Astronomical Society, Volume 456, Issue 3, p. 2848-2860, 03/2016.*
- Yeghiazaryan, A. A.;** **Nazaryan, T. A.;** **Hakobyan, A. A.** – H α Velocity Fields and Galaxy Interaction in the Quartet of Galaxies NGC 7769, 7770, 7771 and 7771A // *Journal of Astrophysics and Astronomy, Volume 37, article id.1, 10 pp., 03/2016.*
- Mickaelian, A. M.** – Astronomical surveys and big data // *Baltic Astronomy, Vol. 25, Issue 1, p. 75-88, 05/2016.*
- Gyulbudaghian, A. L.** – Two Interesting Southern Objects // *Astrophysics, Volume 59, Issue 2, pp. 256-264, 06/2016.*
- Pikichyan, H. V.** – Internal Radiation Field in the Nonlinear Transfer Problem for a One-Dimensional Anisotropic Medium. II // *Astrophysics, Volume 59, Issue 2, pp. 272-284, 06/2016.*

- Andreasyan, H. R.; Andreasyan, R. R.; Paronyan, G. M.** – Erratum: Erratum to: Distribution of Pulsars in the Galaxy // *Astrophysics*, Volume 59, Issue 2, pp. 292-292, 06/2016.
- Adibekyan, V.; Delgado-Mena, E.; Figueira, P.; Sousa, S. G.; Santos, N. C.; Faria, J. P.; González Hernández, J. I.; Israelian, G.; Harutyunyan, G.; Suárez-Andrés, L.; **Hakobyan, A. A.** – ζ^2 Reticuli, its debris disk, and its lonely stellar companion ζ^1 Ret. Different T_c trends for different spectra // *Astronomy & Astrophysics*, Volume 591, id.A34, 11 pp., 06/2016.
- Patiño Álvarez, V.; Torrealba, J.; Chavushyan, V.; Cruz González, I.; **Arshakian, T.**; León Tavares, J.; Popovic, L. – Baldwin Effect and Additional BLR Component in AGN with Superluminal Jets // *Frontiers in Astronomy and Space Sciences*, Volume 3, id.19, 06/2016.
- Magakian, T. Yu.; Movsessian, T. A.**; Bally, J. – A new star-forming region in Canis Major // *Monthly Notices of the Royal Astronomical Society*, Volume 460, Issue 1, p. 489-496, 07/2016.
- Aramyan, L. S.; Hakobyan, A. A.**; Petrosian, A. R.; de Lapparent, V.; Bertin, E.; Mamon, G. A.; Kunth, D.; **Nazaryan, T. A.**; Adibekyan, V.; Turatto, M. – Supernovae and their host galaxies – IV. The distribution of supernovae relative to spiral arms // *Monthly Notices of the Royal Astronomical Society*, Volume 459, Issue 3, p. 3130-3143, 07/2016.
- Adibekyan, V.; Delgado-Mena, E.; Figueira, P.; Sousa, S. G.; Santos, N. C.; González Hernández, J. I.; Minchev, I.; Faria, J. P.; Israelian, G.; Harutyunyan, G.; Suárez-Andrés, L.; **Hakobyan, A. A.** – Abundance trend with condensation temperature for stars with different Galactic birth places // *Astronomy & Astrophysics*, Volume 592, id.A87, 12 pp., 08/2016.
- Ghazaryan, S.**; Alecian, G. – Statistical analysis from recent abundance determinations in HgMn stars // *Monthly Notices of the Royal Astronomical Society*, Volume 460, Issue 2, p. 1912-1922, 08/2016.
- Azatyán, N. M.; Nikoghosyan, E. H.; Khachatryan, K. G.** – Search for Compact Stellar Groups in the Vicinity of IRAS Sources // *Astrophysics*, Volume 59, Issue 3, pp. 339-353, 09/2016.
- Gevorgyan, M. H.; Movsessian, T. A.; Andreasyan, H. R.; Magakian, T. Yu.** – Detailed Study of Emission Structures in the Vicinity of LkH α 198 // *Astrophysics*, Volume 59, Issue 3, pp. 354-359, 09/2016.
- Gyulbudaghian, A. L.** – The Object CLN 138 - a Double Star-Formation Region // *Astrophysics*, Volume 59, Issue 3, pp. 360-368, 09/2016.
- Mickaelian, A. M.** – Multiwavelength astronomy and big data // *Astronomy Reports*, Volume 60, Issue 9, pp. 857-877, 09/2016.
- Weedman, D.; **Sargsyan, L.** – Dusty Quasars at High Redshifts // *The Astrophysical Journal*, Volume 828, Issue 1, article id. 43, 17 pp., 09/2016.
- Samsonyan, A.**; Weedman, D.; Lebouteiller, V.; Barry, D.; **Sargsyan, L.** – Neon and [C II] 158 μ m Emission Line Profiles in Dusty Starbursts and Active Galactic Nuclei // *The Astrophysical Journal Supplement Series*, Volume 226, Issue 1, article id. 11, 18 pp., 09/2016.
- Mickaelian, A. M.; Paronyan, G. M.**; Harutyunyan, G. S.; **Abrahamyan, H. V.; Gyulzadyan, M. V.** – Multiwavelength studies of X-ray selected extragalactic sample // *Astronomical and Astrophysical Transactions*, Volume 29, Issue 3, pp. 333-345, 11/2016.
- Harutyunian, H.**; Alecian, G.; **Khachatryan, K.; Vardanyan, A.** – Bilinear Expansion for Redistribution Functions // *Journal of Quantitative Spectroscopy and Radiative Transfer*, Volume 183, p. 64-69, 11/2016.
- Nikoghossian, A. G.** – Groups in the radiative transfer theory // *Journal of Quantitative Spectroscopy and Radiative Transfer*, Volume 183, p. 90-99, 11/2016.
- Pikichyan, H. V.** – On the linear properties of the nonlinear radiative transfer problem // *Journal of Quantitative Spectroscopy and Radiative Transfer*, Volume 183, p. 113-127, 11/2016.
- Ter-Kazarian, G.** – Rotating black holes in microscopic theory: the implications for periodic source M82X-2 // *Advances in Astrophysics*, Volume 1, Issue 3, pp. 201-223, 11/2016.
- Nikoghossian, A. G.** – Some New Directions of Development of the Radiative Transfer Theory // *Astron. & Astrophys. (Caucasus)*, Volume 1, pp. 68-, 2016.

- Melikian, N. D.; Karapetian, A. A.;** Gomez, J. – New Emission Stars in B Cyg OB7 // *Astrophysics, Volume 59, Issue 4, pp. 484-491, 12/2016.*
- Mickaelian, A. M.; Paronyan, G. M.; Abrahamyan, H. V.; Gigoyan, K. S.; Gyulzadyan, M. V.; Kostandyan, G. R.** – The nature of X-ray selected star candidates // *Astronomical and Astrophysical Transactions, Volume 29, Issue 4, pp. , 12/2016.*
- Magakian, T. Yu.; Movsessian, T. A.;** Bally J. – A new star-forming region in CMa // *Astronomical & Astrophysical Transactions, Volume 29, Issue 4, pp. 317-, 12/2016.*
- Movsessian, T. A.; Magakian, T. Yu.** – Inner structure of the jets from YSO's // *Astronomical & Astrophysical Transactions, Volume 29, Issue 4, pp. , 12/2016.*
- Mickaelian, A. M.** – Regional Activities related to IAU Strategic Plan and Integration of Armenia in the European Astronomy // *Publ. AOB No. 94 DAS No.1 DepAstro No. 21, pp. 291-296, 12/2016.*
- Farmanyan, S. V.; Mickaelian, A. M.** – Cultures across the sky and the roots of Armenian astronomy // *Publ. AOB No. 94 DAS No.1 DepAstro No. 21, pp. 438-443, 12/2016.*
- Mickaelian, A. M.; Farmanyan, S. V.** – Armenian Archaeoastronomy and Astronomy in Culture // *Mediterranean Archaeology and Archaeometry (MAA), Vol. 16, No 4, pp. 385-392, 12/2016.*
- Farmanyan, S. V.; Mickaelian, A. M.** – Ancient and Medieval Cosmology in Armenian Highland // *Mediterranean Archaeology and Archaeometry, Vol. 16, No 4, pp. 393-399, 12/2016.*

Proceedings of Meetings (61)

28 papers in **Astronomical Surveys and Big Data:** Proceedings of an International Symposium dedicated to the 50th anniversary of the Markarian Survey and the 10th anniversary of the Armenian Virtual Observatory held at Byurakan Astrophysical Observatory, Byurakan, Armenia on 5-8 October 2015. Eds. A. M. Mickaelian, A. Lawrence, T. Yu. Magakian. ASP Conference Series, Vol. 505, 290 pp., 06/2016.

- Mickaelian, A. M.** – Fifty Years of the Markarian Survey // *pp. 3-15.*
- Mickaelian, A. M.;** Atsatryan, H. V.; Knyazyan, A. V.; **Magakian, T. Yu.;** **Mikayelyan, G. A.;** **Erastova, L. K.;** Hovhannisyan, L. R.; **Sargsyan, L. A.;** Sinamyan, P. K. – Ten Years of the Armenian Virtual Observatory // *pp. 16-23.*
- Sarkissian, A.; Gopala Krishna, B.; Crichton, D. J.; Beebe, R.; Yamamoto, Y.; Arviset, C.; Di Capria, M. T.; **Mickaelian, A. M.;** IPDA – The International Planetary Data Alliance (IPDA): Overview of the Activities // *pp. 29-34.*
- Magakian, T. Yu.;** **Movsessian, T. A.;** **Nikoghosyan, E. H.** – Searches of Herbig-Haro Objects: History, Current Situation, and Perspectives // *pp. 50-58.*
- Gigoyan, K. S.** – Cool Carbon Stars in the Galactic Halo // *pp. 59-65.*
- Nikoghosyan, E. H.;** **Vardanyan, A. V.;** **Khachatryan, K. G.** – The Search and Study of PMS Stars with H α Emission // *pp. 66-72.*
- Gyulbudaghian, A. L.;** Mendez, R. A. – Two Types of Radial Systems of Dark Globules // *pp. 73-77.*
- Rossi, C.; **Mickaelian, A. M.;** **Gigoyan, K. S.;** Gaudenzi, S.; Nesci, R. – Spectroscopic and Photometric Properties of Late-type BIS Catalogue Sources // *pp. 78-84.*
- Gigoyan, K. S.;** **Kostandyan, G. R.;** **Paronyan, G. M.** – Investigation of Variability of Faint Galactic Early-Type Carbon Stars from the First Byurakan Spectral Sky Survey // *pp. 92-94.*
- Erastova, L. K.** – Binary Stars in SBS Survey // *pp. 95-96.*
- Andreasyan, H. R.;** **Andreasyan, R. R.;** **Paronyan, G. M.** – The Distribution of Normal Radio Pulsars in Our Galaxy // *pp. 97-100.*
- Mickaelian, A. M.** – Multiwavelength Search and Studies of Active Galaxies // *pp. 117-132.*
- Yeghikyan, A. G.** – On Survivability of Ices in Active Galaxies // *pp. 144-151.*
- Harutyunian, H. A.** – A Brief Survey of Activity Phenomena in Cosmic Objects // *pp. 152-161.*

- Gyulzadyan, M. V.; Mickaelian, A. M.; Abrahamyan, H. V.; Paronyan, G. M.** – Spectral Investigation and Physical Properties of Markarian Galaxies from SDSS // *pp. 162-168.*
- Hakopian, S. A.** – Exploring the Subsample of SBS Galaxies: Current Results // *pp. 169-175.*
- Ohanian, G. A.** – The Existence of Ultra Massive Black Holes (UMBHs) in the Center of Radiogalaxies // *pp. 176-179.*
- Erastova, L. K.** – The Tadpole Galaxies in SBS // *pp. 180-182.*
- Hakopian, S. A.; Balayan, S. K.** – Revealing of HII-regions in Galaxies with Panoramic Spectroscopy // *pp. 183-185.*
- Paronyan, G. M.; Mickaelian, A. M.; Abrahamyan, H. V.** – Multiwavelength Studies of X-ray Selected AGN // *pp. 189-192.*
- Abrahamyan, H. V.; Mickaelian, A. M.** – Properties of IRAS PSC/FSC Galaxies // *pp. 193-195.*
- Yeghiazaryan, A. A.; Hakobyan, A. A.; Nazaryan, T. A.** – On the Interaction in a Quartet of Galaxies // *pp. 196-198.*
- Mickaelian, A. M.** – Astronomical Surveys, Catalogs, Databases, and Archives // *pp. 203-217.*
- Atsatryan, H. V.; Knyazyan, A. V.; Mickaelian, A. M.** – Computational Astrophysics Towards Exascale Computing and Big Data // *pp. 220-225.*
- Samsonyan, A. L.** – Using the Cornell Atlas of Spitzer/IRS Sources // *pp. 233-235.*
- Knyazyan, A. V.; Atsatryan, H. V.; Mickaelian, A. M.** – Armenian Virtual Observatory: Services and Data Sharing // *pp. 236-241.*
- Erastova, L. K.; Mickaelian, A. M.** – Revised and Updated Catalogue of the Second Byurakan Sky Survey // *pp. 242-244.*
- Mickaelian, A. M.; Abrahamyan, H. V.; Andreasyan, H. R.; Azatyan, N. M.; Farmanyan, S. V.; Gigoyan, K. S.; Gyulzadyan, M. V.; Khachatryan, K. G.; Knyazyan, A. V.; Kostandyan, G. R.; Mikayelyan, G. A.; Nikoghosyan, E. H.; Paronyan, G. M.; Vardanyan, A. V.** – BAO Plate Archive Project: Digitization, Electronic Database and Research Programmes // *pp. 262-273.*
- 24 papers in Proceedings of the Armenian-Iranian Astronomical Workshop (AIAW), held on 13-16 October 2015 in Byurakan Astrophysical Observatory, Armenia. Eds.: A. M. Mickaelian, H. G. Khosroshahi, H. A. Harutyunian. Yerevan, “Gitutyun” Publishing House of the National Academy of Sciences of the Republic of Armenia (NAS RA), 09/2016.*
- Harutyunian, H. A.** – Byurakan Astrophysical Observatory: Active Researches of the Activity Phenomena // *pp. 12-21.*
- Mickaelian, A. M.** – Armenian Astronomical Society (ArAS) activities // *pp. 37-45.*
- Nikoghossian, A. G.** – Some Directions of Development of Theoretical Astrophysics in Byurakan Astrophysical Observatory // *pp. 46-55.*
- Movsessian, T. A.** – Observational Possibilities in BAO // *pp. 56-61.*
- Mickaelian, A. M.; Atsatryan, H. V.; Magakian, T. Yu.; Sargsyan, L. A.; Gigoyan, K. S.; Erastova, L. K.; Gyulzadyan, M. V.; Sinamyanyan, P. K.; Paronyan, G. M.; Knyazyan, A. V.; Mikayelyan, G. A.; Farmanyan, S. V.; Hovhannisyanyan, L. R.; Nikoghosyan, E. H.; Abrahamyan, H. V.; Andreasyan, H. R.; Azatyan, N. M.; Khachatryan, K. G.; Kostandyan, G. R.; Vardanyan, A. V.** – BAO Plate Archive and Armenian Virtual Observatory (ArVO) // *pp. 62-76.*
- Melikian, N. D.** – The Study of Flare Stars in Byurakan Observatory // *pp. 84-92.*
- Nikoghosyan, E. H.; Harutyunyan, H. A.; Azatyan, N. M.** – The Multiple Systems in the Young Stellar Cluster IRAS 05137+3919 // *pp. 94-100.*
- Kostandyan, G. R.; Gigoyan, K. S.** – Investigation of Faint Galactic Carbon Stars from the First Byurakan Spectral Sky Survey // *pp. 101-104.*

- Gevorgyan, M.; Movsessian, T. A.; Magakian, T. Yu.; Andreasyan, H. R.** – Integral field spectroscopy of HH161 // *pp. 105-108.*
- Nikoghosyan, E. H.; Vardanyan, A. V.; Khachatryan, K. G.** – The Statistical Analysis of stars with H α emission in IC 348 Cluster // *pp. 109-114.*
- Azatyanyan, N. M.; Nikoghosyan, E. H.** – The search of the stellar clusters in vicinity of YSOs with high and middle masses // *pp. 115-120.*
- Andreasyan, H. R.; Andreasyan, R. R.; Paronyan, G. M.** – The Galactic distribution of Normal pulsars // *pp. 121-126.*
- Yeghikyan, A. G.** – Irradiation of ices inside molecular clouds in cosmic ray dominated regions of galaxies // *pp. 162-169.*
- Mickaelian, A. M.; Paronyan, G. M.; Abrahamyan, H. V.; Gyulzadyan, M. V.; Mikayelyan, G. A.** – AGN content of X-ray, IR and radio sources // *pp. 170-177.*
- Harutyunian, H. A.** – Quasi-gravitational Effect in the Accelerating Universe // *pp. 184-188.*
- Samsonyan, A. L.** – Mid-Infrared [NeII] and [NeIII] Emission Line Profiles in Starbursts and AGN // *pp. 200-204.*
- Abrahamyan, H. V.; Mickaelian, A. M.** – Blazars properties // *pp. 208-212.*
- Talezade Lari, M. H.; Davoudifar, P.; **Mickaelian, A. M.** – IR properties of AGN and SB // *pp. 213-217.*
- Asatrian, N. S.** – Simultaneous hour-timescale variations in the profiles of the broad Balmer lines of the Seyfert galaxy Markarian 6 // *pp. 218-222.*
- Gyulzadyan, M. V.; Mickaelian, A. M.; Abrahamyan, H. V.; Paronyan, G. M.** – The Investigation of SBS Galaxies from SDSS DR7 // *pp. 227-229.*
- Yeghiazaryan, A. A.** – On Galaxies with UV Excess from Kazarian Lists // *pp. 230-232.*
- Sabzali, V.; Davoudifar, P.; **Mickaelian, A. M.** – The Study of Relativistic AGN Jets and Experimental Survey of AGN Properties // *pp. 233-238.*
- Broutian, G. H.** – The relation of 300-day and 360-day years in the oldest Armenian calendars // *pp. 242-247.*
- Farmanyan, S. V.; Mickaelian, A. M.** – The Concept of Cosmic Tree in Armenian and Iranian Cosmologies // *pp. 248-252.*

9 papers in *Proceedings of other meetings:*

- Vinković, D.; Gritsevich, M.; Srećković, V.; Pečnik, B.; Szabó, G.; Debattista, V.; Škoda, P.; Mahabal, A.; Peltoniemi, J.; Mönkölä, S.; **Mickaelian, A.**; Turunen, E.; Kákona, J.; Koskinen, J.; Grokhovsky, V. – Big data era in meteor science // *Proceedings of the International Meteor Conference, Egmond, the Netherlands, 2-5 June 2016, Eds.: Roggemans, A.; Roggemans, P., pp. 319-329, 07/2016.*
- Mickaelian, A.; Abrahamyan, H.; Paronyan, G.** – High-redshift quasars and blazars and their relation to high-redshift galaxies // *Galaxies at High Redshift and Their Evolution Over Cosmic Time, IAU Symposium Vol. 319, pp. 34-34, 08/2016.*
- Mickaelian, A. M.; Abrahamyan, H. V.; Andreasyan, H. R.; Azatyanyan, N. M.; Farmanyan, S. V.; Gigoyan, K. S.; Gyulzadyan, M. V.; Khachatryan, K. G.; Knyazyan, A. V.; Kostandyan, G. R.; Mikayelyan, G. A.; Nikoghosyan, E. H.; Paronyan, G. M.; Vardanyan, A. V.** – BAO Plate Archive digitization, creation of electronic database and its scientific usage // *Astronomy in Focus, as presented at the IAU XXIX General Assembly, 2015. Proceedings of the IAU, Volume 29A, 2016, pp. 130-133, 10/2016.*
- Farmanyan, S. V.; Devrikyan, V. G.; Mickaelian, A. M.** – Astronomical Knowledge from Holy Books // *Astronomy in Focus, as presented at the IAU XXIX General Assembly, 2015. Proceedings of the IAU, Volume 29A, 2016, pp. 148-149, 10/2016.*
- Mickaelian, A.; Azatyanyan, N.; Farmanyan, S.; Mikayelyan, G.** – IAU South West Asian ROAD // *Astronomy in Focus, as presented at the IAU XXIX General Assembly, 2015. Proceedings of the IAU, Volume 29A, 2016, pp. 422-423, 10/2016.*

Mickaelian, A.; Paronyan, G.; Abrahamyan, H. – Large homogeneous sample of X-ray selected AGN and its study // *Astronomy in Focus, as presented at the IAU XXIX General Assembly, 2015. Proceedings of the IAU, Volume 29B, 2016, pp. 91-91, 10/2016.*

Adibekyan, V.; Delgado-Mena, E.; Figueira, P.; Sousa, S.; Santos, N.; Faria, J.; González Hernández, J.; Israelian, G.; Harutyunyan, G.; Suárez-Andrés, L.; **Hakobyan, A.** – Tc Trends and Terrestrial Planet Formation: The Case of ζ Reticuli // *The 19th Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun (CS19), Uppsala, Sweden, 06-10 June 2016, id.41, 11/2016.*

Mickaelian, A. M.; Farmanyan, S. V.; Mikayelyan, A. A. – Armenian Names of Sky Constellations // *Cultural Astronomy in the Armenian Highland. Proc. Young Scientists Conf., held on 20-23 June 2016 in Yerevan, Armenia. Eds.: Farmanyan, S. V.; Suvaryan, Yu. M.; Mickaelian, A. M., Yerevan, NAS RA "Gityutyun" Publ. House, p. 61-71, 12/2016.*

Mickaelian, A. M.; Farmanyan, S. V. – Byurakan Astrophysical Observatory as Cultural Centre // *Cultural Astronomy in the Armenian Highland. Proc. Young Scientists Conf., held on 20-23 June 2016 in Yerevan, Armenia. Eds.: Farmanyan, S. V.; Suvaryan, Yu. M.; Mickaelian, A. M., Yerevan, NAS RA "Gityutyun" Publ. House, p. 236-246, 12/2016.*

Electronic Catalogs (5)

Hakobyan, A. A.; Karapetyan, A. G.; Barkhudaryan, L. V.; Mamon, G. A.; Kunth, D.; Petrosian, A. R.; Adibekyan, V.; **Aramyan, L. S.;** Turatto, M. – Properties of 500 SNe and their 419 hosts (Hakobyan+, 2016) // *VizieR On-line Data Catalog: J/MNRAS/456/2848. Originally published in: 2016MNRAS.456.2848H, 02/2016.*

Adibekyan, V.; Delgado-Mena, E.; Figueira, P.; Sousa, S. G.; Santos, N. C.; Faria, J. P.; Gonzalez Hernandez, J. I.; Israelian, G.; Harutyunyan, G.; Suarez-Andres, L.; **Hakobyan, A. A.** – Chemical abundances of zeta Reticuli (Adibekyan+, 2016) // *VizieR On-line Data Catalog: J/A+A/591/A34. Originally published in: 2016A&A...591A..34A, 05/2016.*

Adibekyan, V.; Delgado-Mena, E.; Figueira, P.; Sousa, S. G.; Santos, N. C.; Gonzalez Hernandez, J. I.; Minchev, I.; Faria, J. P.; Israelian, G.; Harutyunyan, G.; Suarez-Andres, L.; **Hakobyan, A. A.** – Chemical abundances of solar analogues (Adibekyan+, 2016) // *VizieR On-line Data Catalog: J/A+A/592/A87. Originally published in: 2016A&A...592A..87A, 06/2016.*

Aramyan, L. S.; Hakobyan, A. A.; Petrosian, A. R.; de Lapparent, V.; Bertin, E.; Mamon, G. A.; Kunth, D.; **Nazaryan, T. A.;** Adibekyan, V.; Turatto, M. – Lists of arm and interarm supernovae (Aramyan+, 2016) // *VizieR On-line Data Catalog: J/MNRAS/459/3130. Originally published in: 2016MNRAS.459.3130A, 08/2016.*

Samsonyan, A.; Weedman, D.; Leboutellier, V.; Barry, D.; **Sargsyan, L.** – IR spectroscopy of AGN & starbursts (Samsonyan+, 2016) // *VizieR On-line Data Catalog: J/ApJS/226/11. Originally published in: 2016ApJS..226...11S, 10/2016.*

Books and Booklets (4)

Mickaelian, A.; Lawrence, A.; **Magakian, T.** (Eds.) – Astronomical Surveys and Big Data. Proceedings of an International Symposium dedicated to the 50th anniversary of the Markarian Survey and the 10th anniversary of the Armenian Virtual Observatory held at Byurakan Astrophysical Observatory, Byurakan, Armenia on 5-8 October 2015 // *ASP Conference Series, Vol. 505, 280 pp., 06/2016.*

Astronomical surveys are the main source for discovery of astronomical objects and accumulation of observational data for further analysis, interpretation, and achieving scientific results. Vast amount of observations with many ground-based and space telescopes using large fields and modern receivers led to the collection of Big Data in astronomy. Large amounts of data require new approaches to data reduction, management and analysis. Powerful computer technologies are required, including clusters and grids. The International Symposium *Astronomical Surveys*

and *Big Data* was aimed at combining astronomers and computer scientists with heavy involvement of astronomical surveys, catalogs, archives, databases and VOs. It was dedicated to the 50th anniversary of the Markarian Survey and the 10th anniversary of the Armenian Virtual Observatory (ArVO). The meeting contributed to reviewing and discussions large astronomical surveys, catalogues, databases and archives to summarize observational data obtained in astronomy, learning about major upcoming surveys, introducing tools and techniques for working with large data sets, discussing the future of astronomical research by joint efforts of astronomers and computer scientists. The Volume consists of 4 sections; Dedication Articles (*Markarian Survey* and *Armenian Virtual Observatory*), Section 1: *Planets, Stars, and Nebulae*, Section 2: *Galaxies and Cosmology* and Section 3: *Databases, Virtual Observatories, and Computational Astrophysics*. They cover historical surveys, surveys for exoplanets, stars and nebulae, extragalactic and cosmological surveys, cross-identifications between surveys, future large-area surveys, digitization of astronomical data, astronomical catalogues, archives and databases. The book is especially useful in sense of reviewing results of several sub-fields of multi-wavelength astronomy: gamma-ray, X-ray, UV, optical, IR, sub-mm/mm, and radio. It will be useful for researchers and students engaged in the field of astronomical surveys, Astrostatistics, Astroinformatics, computational astrophysics, Virtual Observatories, and Laboratory Astrophysics, for their future studies and research.

Mickaelian, A. M. – Byurakan Astrophysical Observatory // *Yerevan, NAS RA "Gitutyun" Publishing House, 64 pp., ISBN: 978-5-8080-1240-0, 09/2016.*

This booklet is devoted to NAS RA V. Ambartsumian Byurakan Astrophysical Observatory and is aimed at people interested in astronomy and BAO, pupils and students, BAO visitors and others. The booklet is made as a visiting card and presents concise and full information about BAO. A brief history of BAO, the biography of the great scientist Viktor Ambartsumian, brief biographies of 13 other deserved scientists formerly working at BAO (B.E. Markarian, G.A. Gurzadyan, L.V. Mirzoyan, M.A. Arakelian, et al.), information on BAO telescopes (2.6m, 1m Schmidt, etc.) and other scientific instruments, scientific library and photographic plate archive, Byurakan surveys (including the famous Markarian Survey included in the UNESCO Memory of the World International Register), all scientific meetings held in Byurakan, international scientific collaboration, data on full research staff of the Observatory, as well as former BAO researchers, who have moved to foreign institutions are given in the booklet. At the end, the list of the most important books published by Armenian astronomers and about them is given.

Mickaelian, A. M.; Khosroshahi, H. G.; Harutyunian, H. A. (Eds.) – *Proceedings of the Armenian-Iranian Astronomical Workshop, held on 13-16 October 2015 in Byurakan, Armenia // Yerevan, "Gitutyun" Publishing House of the National Academy of Sciences of the Republic of Armenia (NAS RA), 256 pp., 09/2016.*

An Armenian-Iranian Astronomical Workshop (AIAW) was organized on 13-16 October 2015 in Byurakan, Armenia aimed at strengthening scientific relations between Armenian and Iranian astronomers and establishing new collaborations. The scientific program consisted of 18 invited and 22 contributed talks and 4 posters. Invited talks by senior scientists were given on each topic followed by a number of contributed ones, as well as posters were presented and discussed. The Volume consists of 4 sections: 1) Astronomy in South West Asia (Armenia, Iran and Georgia); 2) Sun, Stars and Nebulae; 3) Galaxies and Cosmology and 4) Archaeoastronomy and Astronomy in Culture. A number of excellent review talks were given on various related topics and many new outstanding results were presented during the Workshop, and many papers are useful for a number of astrophysical fields. A Preface, Organizers and Sponsors, the List of Participants, and Author Index are also given.

Farmanyan, S. V.; Suvaryan, Yu. M.; Mickaelian, A. M. (Eds.) – *Cultural Astronomy in the Armenian Highland. Proceedings of the Young Scientists Conference, held on 20-23 June 2016 in Yerevan, Armenia // Yerevan, "Gitutyun" Publishing House of the National Academy of Sciences of the Republic of Armenia (NAS RA), 250 pp., 12/2016.*

The book contains 29 articles of the Proceedings of the Young Scientists Conference "Cultural Astronomy in the Armenian Highland" held at the Armenian National Academy of Sciences on 20-23 June 2016. It consists of 4 main sections: "Introductory", "Cultural Astronomy", "Archaeoastronomy", "Scientific Tourism and Journalism, Astronomical Education and Amateur Astronomy". The book may be interesting to astronomers, culturologists, philologists, linguists, historians, archaeologists, art historians, ethnographers and to other specialists, as well as to students.

Preprints (4)

Kitze, M.; **Akopian, A. A.**; Hambaryan, V.; Torres, G.; Neuhäuser, R. – KIC011764567: An evolved object showing substantial flare-activity // *eprint arXiv:1607.08412, 07/2016 (to be published in Astronomische Nachrichten).*

Hakobyan, A. A.; **Karapetyan, A. G.**; **Barkhudaryan, L. V.**; Mamon, G. A.; Kunth, D.; Petrosian, A. R.; Adibekyan, V.; **Aramyan, L. S.**; Turatto, M. – The Impact of Bulges on the Radial Distribution of Supernovae in Disc Galaxies // *eprint arXiv:1609.08319, 09/2016.*

Hakobyan, A. A.; **Karapetyan, A. G.**; **Barkhudaryan, L. V.**; Mamon, G. A.; Kunth, D.; Petrosian, A. R.; Adibekyan, V.; **Aramyan, L. S.**; Turatto, M. – Supernovae Distribution and Host Galaxy Properties // *eprint arXiv:1612.07524, 12/2016.*

Nikoghosyan, E. H.; **Azatyany, N. M.**; **Khachatryan, K. G.** – New eruptive variable in the massive star-forming region associated with IRAS 18507+0121 source // *eprint arXiv:1612.09190, 12/2016.*

Abstracts (1)

Hakobyan, A. A.; **Karapetyan, A. G.**; **Barkhudaryan, L. V.**; Mamon, G. A.; Kunth, D.; Petrosian, A. R.; Adibekyan, V.; **Aramyan, L. S.**; Turatto, M. – The impact of bars on the radial distribution of supernovae in disc galaxies // *EWASS-2016 Symposium 16 "Frontiers of massive-star evolution and core-collapse supernovae" held in Athens, Greece, 4-8 July 2016. Online at <http://eas.unige.ch/EWASS2016>, id.296, 07/2016.*

Most productive authors have been (at least 3 refereed papers or at least 8 publications in total):

Scientists	Refereed journals	Proc. meetings	Electronic catalogs	Books, Theses	Preprints	Abstracts	All
Abrahamyan, H. V.	2	11					13
Abdreasyan, H. R.	2	6					8
Azatyany, N. M.	1	6			1		8
Farmanyan, S. V.	3	8		1			12
Gigoyan, K. S.	2	7					9
Gyulzadyan, M V.	2	6					8
Hakobyan, A. A.	5	2	4		2	1	14
Khachatryan, K. G.	2	5			1		8
Magakian, T. Yu.	4	4		1			9
Mickaelian, A. M.	8	29		4			41
Movsessian, T. A.	4	3					7
Nikoghossian, A. G.	3	1					4
Nikoghosyan, E. H.	1	8			1		10
Paronyan, G. M.	3	12					15
Pikichyan, H. V.	3						3

Publications by research groups:

Head of group (number of members)	Refereed journals	Proc. meetings	Electronic catalogs	Books, Theses	Preprints	Abstracts	All
Hakobyan, A. A. (5)	5	2	4		2	1	14
Harutyunian H.A. (3)	1	6		1			8
Magakian T. Yu. (4)	5	10		1			16
Mickaelian A. M. (9)	10	36		4			50
Nikoghosyan E.H. (3)	2	10			1		13
Parsamian E. S. (4)	2	3			1		6

Teaching, supervision of students

The 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. Yu. Magakian, 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. 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: G. R. Kostandyan, M. G. Gevorgyan, A. L. Samsonyan, N. M. Azatyan, K. G. Khachatryan.

Armenian Astronomical School Olympiad was held on 29 March 2016 in Yerevan Phys.-Math. School (Chair of Jury: A. A. Akopian). The winners were selected for participation in international Olympiads. The **21th International Astronomical Olympiad (IAO)** was held on 05-13 Oct 2016 in Plovdiv, Bulgaria, where Armenian pupils won 1 Bronze medal (team leaders: Marietta Gyulzadian and Avetik Grigoryan). The **10th International Olympiad on Astronomy and Astrophysics (IOAA)** was held on 09-19 Dec 2016 in Bhubaneswar, India, where Armenian pupils won 1 Bronze medal (team leaders: Marietta Gyulzadian and Vardges Mambreyan).

Third Byurakan Science Camp (3BSC). On 22-27 Aug 2016, for the third time, BAO and ArAS organized a Science Camp for school pupils. 25 pupils participated. A. M. Mickaelian, H. A. Harutyunian, E. S. Parsamian, M. V. Gyulzadyan, S. V. Farmanyan, H. V. Abrahamyan delivered lectures at the Camp.

Membership

International Astronomical Union (IAU, 20 members from BAO): A. A. Akopian, R. R. Andriasyan, K. S. Gigoyan, A. L. Gyulbudaghian, M. V. Gyulzadyan, A. A. Hakobyan, S. A. Hakopian, H. A. Harutyunian, E. Ye. Khachikian, T. Yu. Magakian, A. P. Mahtessian, N. D. Melikian, A. M. Mickaelian, T. A. Movsessian, A. G. Nikoghossian, E. H. Nikoghossian, E. S. Parsamian, H. V. Pikichian, G. T. Ter-Kazarian, A. G. Yeghikyan.

European Astronomical Society (EAS, 12 members from BAO): Hayk Abrahamyan, Lilit Barkhudaryan, Sona Farmanyan, Marietta Gyulzadian, Artur Hakobyan, Haik Harutyunian, Arpine Karapetyan, Tigran Magakian, Norair Melikian, Areg Mickaelian, Yelena Nikogosian, Gurgen Paronyan.

Euro-Asian Astronomical Society (EAAS, 7 members from BAO): 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 from BAO): A.M. Mickaelian.

Armenian Astronomical Society (ArAS): 28 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. Four 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 and Secretary-in-Chief*), **H. A. Harutyunian**, **E. Ye. Khachikian** and **E. S. Parsamian**. Four issues of Vol. 59 were published in Mar, June, Sep and Dec 2016 with 47 papers (among them 3 reviews), including **10 (21.3%) from BAO**, which is slightly higher than in the previous years. Anyway, the number of papers from BAO is not very high. Other papers were from the YSU, other Armenian institutions, Russia, Ukraine, Georgia, China, India and other countries.

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. Farmanyanyan**, Webmaster: **G. A. Mikayelyan**. ArAS has **100 members from 21 countries**, including 55 from Armenia. During 2016, **ArAS webpage** was updated, 12 issues (Nos. 89-100) of **ArAS Newsletter (ArASNews)** were released, **ArAS XV meeting** was held on December 21 combined with the Summary of Astronomical Year 2016, **ArAS Annual prize for Young Astronomers** was awarded for the 13th time (2016 winner: Anahit Samsonyan), **ArAS School Lectures** programme was organized in 30 schools of Yerevan and in all Armenian provinces. ArAS was the organizer or co-organizer of almost all events held in Byurakan. During 2016, in frame of the **scientific journalism**, ArAS prepared and circulated some 100 press-releases to Armenian mass media with information on sky events, international and local astronomical news that resulted in more than 500 publications. In 2016, ArAS accomplished **Scientific Tourism** project in Armenia and **Astro Tourism** project in South West Asia (including Armenia, Georgia and Iran).

Areg Mickaelian