

Special Issue
Dedicated to the Memory of
Academician Alpik Mkrtchyan

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This special issue of the “Armenian Journal of Physics” is dedicated in memory of academician Alpik Mkrtchyan. He was the founder and director of the Institute of Applied Problems of Physics NAS RA. As a researcher, Alpik Mkrtchyan made pioneering and lasting contributions in the fields of acoustics, radiation transfer theory, Mössbauer spectroscopy, plasma physics, inverse scattering problems, materials science, interaction of electromagnetic radiation and elementary particles with solids in the presence of external influences. Many interesting physical effects have been discovered by him with coauthors. A.R. Mkrtchyan was the author of more than four hundred scientific papers in high ranked journals. His mentorship made significant and lasting contributions to all he interacted with, including many current researchers in the abovementioned fields of investigations. Academician Alpik Mkrtchyan will live through his outstanding academic contributions and the many people he touched with his scientific expertise, wisdom, kindness, and positive attitude. The papers presented in this special issue cover the main part of the research fields by Alpik Mkrtchyan. The Editors are indebted to the authors of the papers, who took time from busy schedules to put together a set of interesting contributions.

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In Memory of Academician Alpik Rafael Mkrtchyan

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On October 22, 2019, at the 82nd year of his life, the Academician of the National Academy of Sciences of the Republic of Armenia (NAS RA), a foreign member of the Engineering Academy of Sciences named after A.S. Prokhorov, Honored Scientist of the Republic of Armenia, Honored Inventor, Doctor of Physical and Mathematical Sciences, Professor Alpik Rafael Mkrtchyan passed away.

The scientific community of Armenia has lost an outstanding scientist, organizer of science and a great patriot. Alpik Mkrtchyan was the organizer and permanent director of the Institute of Applied Problems of Physics (IAPP) of NAS RA from 1980 to 2006 and its scientific superior started from 2006. He was awarded the Gold medals of the Ministry of Higher Education and Science of Armenia, of the Yerevan State University, of the Yerevan Polytechnic University, Gold medals named after Yu.A. Gagarin, N.N. Semenov, Berg Alexander Ivanov, George the Pobedonosets (Victorious), the Gold medal of the Engineering Academy of Sciences named after A.S. Prokhorov, St. Ghazanchetsots Amenaprkich (Savior) Medal, the Prize named after I.V. Kurchatov, the Jubilee medal of the Supreme Patriarch and Catholicos of All Armenians Vazgen I for services to the Armenian people, Medals "Anania Shirakatsi" and "For Services to the Fatherland" of the first degree, the Silver medal named after Davit Anhakht, the Diploma of the National Assembly of the Nagorno-Karabakh Republic, the Gold and Silver medals of the Exhibition of Achievements of the National Economy of the USSR, diplomas of international exhibitions, Badge of honor, Diplomas of the Central Committee of the Komsomol of the USSR and Armenia, of the Government of the USSR, of the Central Committee for Communist Party and the Government of Armenia, A.S. Prokhorov Prize.

A.R. Mkrtchyan was a member of the editorial board of the journal «Izvestiya NAS of Armenia. Physics», the chairman of the Specialized Council at the IAPP NAS RA for the defense of candidate and doctoral dissertations in the fields of “Condensed Matter Physics”, “Plasma Physics” and

“Acoustics”. For many years he was a member of the Presidium of NAS RA and for about 15 years headed the Specialized Expert Council under the Ministry of Education and Science of the RA, which conducted and examined the scientific and research programs in the specialty “Physics and Astrophysics” financed from the RA budget. Being a member of the Coordinating Council of the International Science and Technology Center (ISTC), A.R. Mkrtchyan directed the reorientation of Armenian scientists from military to peaceful topics.

Alpik Mkrtchyan was born on February 16, 1937 in the village Tsakhkunk of the Gegharkunik region of Armenia, in the family of the honored teacher of the Armenian SSR Mkrtchyan Rafael Karapet, a representative of the first generation of teachers in Sevan. After graduating from high school with a gold medal, he enters the Physics Department of the Yerevan State University and in 1961 - the graduate school at the Institute of Chemical Physics of the USSR Academy of Sciences named after Academician N. Semyonov. He worked in the Laboratory of Nuclear Magnetic Resonance (NMR), headed by the Nobel Prize Laureate in Chemistry for 1956. The main scientific publications of that period were devoted to the creation of the NMR techniques for solid states and its application to solve some problems of physics of crystal and nuclear physics. He demonstrated the enormous potentials of the NMR method for solving complex structural problems of natural compounds, which contain nuclei (atoms) that possess magnetic or quadrupole momenta in stationary states.

Since the late 1960s, A.R. Mkrtchyan permanently lived in Armenia. During this period, he defended his doctoral dissertation (1983), received the title of professor (1988), has been elected as a corresponding member (1986), and then - as a full member of the NAS RA (1996). He began his career in Ashtarak as a senior researcher at the Institute for Physical Research of the Academy of Sciences of the Armenian SSR. In 1972-1975 A.R. Mkrtchyan was the head of the Physics and Technology Center of the Academy of Sciences of the Arm. SSR in Goris, and in 1975-1979 – the head of the department of the problem laboratory of Radiation Physics at YSU. He participated in the creation of the Research Institute of Condensed Matter Physics at YSU and was the deputy director of the institute in 1979-1980. His scientific interests during that period shifted to the field of the gamma resonance (Mössbauer) and X-ray spectroscopy with external acoustic fields.

In 1978 A.R. Mkrtchyan organized a department in the Problem Laboratory of Radiation Physics of YSU, which gathered his colleagues on interest in the gamma resonance spectroscopy. He achieved to establish excellent relations between Armenian and Russian physicists, and primarily with scientists from the Institute of Chemical Physics of the Academy of Sciences of the USSR, the Institute of Atomic Physics named after I.V. Kurchatov at the State Committee for Atomic Energy, Institute of Crystallography of the Academy of Sciences of the USSR. Such relations with leading Russian scientists in the field of gamma resonance spectroscopy allowed A.R. Mkrtchyan quickly assemble a modern fleet of gamma-resonance spectrometers and create an appropriate team of young specialists who began their research in the late seventies of the last century.

From the very beginning of the research, a characteristic feature of A.R. Mkrtchyan was discovered – to be not limited to the scope of the scientific task posed in a given period of time. He looked for all the possibilities for using this highly sensitive method in various fields of scientific research: from the

acoustics of solids and liquids to the studies of some classes of biologically active compounds containing Mössbauer atoms. The very first results obtained in the field of gamma-resonance spectroscopy led him to the expediency of examining the discovered properties and phenomena also by other research methods - optical, radiographic, etc. - for a more detailed understanding of the results and possible prospects for their use in both in applied and scientific tasks.

In the early 1980s, an event of supreme importance for the development of physics in Armenia took place: By the efforts of A.R. Mkrtchyan the Department of Applied Problems of Physics at the Academy of Sciences of Arm. SSR was created, which in December 1984 was renamed the Institute of Applied Problems of Physics (IAPP). Starting from that period, all the activities of A.R. Mkrtchyan were inextricably linked with the IAPP, run by him until 2006. Since 2006 until the end of his life, he was the adviser to the director, at the same time the scientific superior and the head of department in the same institute. A.R. Mkrtchyan actively advocated for the support of science in the regions of Armenia. He was the initiator of the organization of IAPP branches in the cities of Meghri and Kapan. With his efforts several joint Armenian-Russian and Armenian-Italian laboratories were created.

Based on the results of basic research carried out by academician A.R. Mkrtchyan and the IAPP scientific staff, a new scientific field of Acoustophysics was formed with its three sections: Modulation Mössbauer spectroscopy, Modulation spectroscopy of Angstrom wavelengths and the control of cold plasma parameters by acoustic waves with numerous applications. The scientific level of those studies were highly appreciated by Nobel laureates, the creator of the method of gamma resonance spectroscopy R.L. Mössbauer and Yu.M. Prokhorov, as well as by Academicians V.A. Hambartsumyan, A.P. Alexandrov, V.I. Goldanskij, Yu.M. Kagan, G.M. Garibyan.

The main areas of basic research of academician A.P. Mkrtchyan included acoustics, radiation transmission theory, inverse scattering problems, materials science, the interaction of electromagnetic radiation and elementary particles with solids in the presence of external influences (acoustic waves, temperature gradient, electromagnetic fields), the impact of external influences on the parameters of cold plasma and phase transitions. He and his colleagues conducted observations and discoveries of such physical phenomena as double gamma-radio-frequency resonance of nuclei in the first excited state (the works were awarded the prize named after Academician I.V. Kurchatov), oscillations and the vanishing of the intensities of gamma-resonance lines by acoustic fields, the complete transfer of X-rays from the propagation direction to the diffraction direction under the influence of acoustic vibrations or temperature gradient with the preservation of the spectral distribution, the expansion and splitting of gamma-resonance lines, focusing and defocusing of diffracted X-rays under the external influences, multiple amplification of the integrated radiation intensity of channeled electrons in piezoelectric crystals, amplification of the intensity for parametric X-ray radiation using acoustic fields, the control of transition radiation parameters, cross sections of coherent bremsstrahlung and the production of electron-positron pairs using acoustic fields, the vanishing of the linear absorption coefficient of electromagnetic radiation of Angstrom wavelengths under the influence of acoustic fields, the control of the parameters of cold plasma by acoustic waves, the excitation and amplification of low-frequency acoustic fields and phase transitions in cold plasma.

Under the direction of A.R. Mkrtchyan at the IAPP NAS RA the technologies for the synthesis of porous materials with different degrees of ordering and non-metallic resistive materials, as well as the technology for producing semiconductor porous materials for hydrogen storage were developed. An important achievement is the development of an X-ray acoustic monochromator and, based on it, a high-speed ultra-sensitive diffractometer. Based on the results of basic scientific research led by A.R. Mkrtchyan, in the IAPP NAS RA various high-tech devices were developed and created, which are used in various fields of science, technology and the national economy - in solid state physics, nuclear physics, acoustics, hydro acoustics, seismology, thermophysics, medicine, etc. These devices were awarded with diplomas, gold and silver medals of the Exhibition of Achievements of the National Economy of the USSR and of a number of international exhibitions.

Academician A.R. Mkrtchyan is the author of more than 400 scientific articles in highly respected domestic and foreign scientific journals, as well as more than 20 certificates for inventions and patents of an open and closed nature. He conducted joint research with scientists from Russia, Germany, France and Italy. He participated in more than 50 international scientific conferences. A.R. Mkrtchyan paid great attention to preparation of young specialists. Under his leadership, more than 50 IAPP employees defended their candidate and 18 doctoral dissertations. A.R. Mkrtchyan organized and actively participated in various national and international conferences both in Armenia and abroad. He was the initiator and permanent chairman of the organizing committee of the international conferences “Electron, positron, neutron and X-ray scattering in the presence of external influences”, conducted since 1977 in Yerevan and Meghri.

In the memory of colleagues and close friends, Alpik Rafael Mkrtchyan will forever remain an example of high citizenship and selfless devotion to science and the homeland.



Fig. 1. A.R. Mkrtchyan with the President of NAS Arm. SSR, Academician of the Academy of Sciences of the USSR V.A. Hambardzumyan at the IAPP NAS RA.



Fig. 2. R.L. Mössbauer, Nobel Prize laureate in physics for the study of resonance absorption of gamma radiation, and A.R. Mkrtchyan at the IAPP NAS RA.



Fig. 3. A.P. Aleksandrov , the President of the USSR Academy of Sciences, V.A. Hambartsumyan, the President of the Academy of Sciences of Arm. SSR and A.R. Mkrtchyan, the Director of the IAPP NAS RA.