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Obituary for Shahriar Bayegan

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On May 5, 2021, the Iranian physics society and the international few-body physics community lost one of their respected members, [Shahriar Bayegan](#). Bayegan was born in Tehran on Oct. 19, 1951, and passed away at the age of 69 in Tehran after a short battle with Covid-19. He received his undergraduate degree at Pars College (Iran) in 1974, and immediately started his graduate education at [Queen Mary University of London](#), and earned a Master's degree in 1977. He then pursued a Ph.D. in theoretical nuclear physics at the [University of Edinburgh](#) (Scotland) and met his wife and the love of his life, [Zohreh Abdi Daneshpour](#). Bayegan received a Ph.D. in 1983 after completing a doctoral dissertation titled “[A study of pre-equilibrium phenomena in photo-nuclear reactions](#)” under the supervision of [Prof. Alan C. Shotter](#). Bayegan and Daneshpour moved to Tehran in 1983, right in the middle of the [Iran-Iraq war](#), where shortly after their move, their son, Siavash, was born in 1984. Bayegan joined the [University of Tehran](#) (UT) in 1983 as an assistant professor of physics and spent his entire professional life in higher education as a faculty member at the [Department of Physics](#) of UT for about four decades.

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The UT has been identified with the training and education of the first generation of Iranian physicists since 1935, when a Bachelor of Science in Physics program was established there. This program was later extended to a Master's program at the beginning of 1970. When Bayegan joined the UT in 1983, he was appointed as the graduate program director for seven years to maintain and develop the Master's program in physics. The program's key goal was to train graduate students for academia and industry in different sectors of physics, from atomic, molecular, and optical physics to nuclear and particle physics. Many graduate students find this Master's program a bridge between undergraduate studies and the Ph.D. program later established at the UT. In 1988, Bayegan was invited to establish the Department of Natural Sciences at the Shahid Sattari University of Aeronautical Engineering and served as the first department head for five years. Subsequently, Bayegan established his research group at the UT and focused more on research-based training. In 1998, Bayegan and his colleagues, [Majid Modarres](#), Ali Pazirandeh, and [Hamidreza Moshfegh](#) developed a Ph.D. program in theoretical nuclear physics focusing on the quantum mechanics of few- and many-body systems. A few years later, [Masoud Mahjour-Shafiei](#), joined the nuclear physics faculty and was actively involved in mentoring the graduate students and expanding on the activities in the area of experimental nuclear physics. During his tenure as the department chair from 2003 to 2005, Bayegan made an extraordinary effort to expand and reorganize the department that became the school of physics in 2005. He became and served as the founding head of the school for three years to 2008. From then on, he was the head of the theoretical nuclear physics group (2009-2021).

Throughout his service at the UT faculty, Bayegan taught a wide range of undergraduate and graduate physics courses. He also developed many courses in mathematical physics, differential equations, thermodynamics, introductory and advanced nuclear physics, classical and quantum mechanics, nuclear structure, and quantum chromodynamics. Bayegan served on the [Journal of Theoretical and Applied Physics](#) editorial board for about one decade and reviewed many journal articles, conference papers, and research proposals. During his impressive career, Bayegan successfully supervised 43 Master's theses and 11 Ph.D. dissertations and published 33 peer-reviewed journal articles with 19 coauthors in the most prestigious physics journals.

At the beginning of the 21st century, Bayegan's research activities were mainly divided into two lines of research going on in parallel to the end of his carrier. The first one was concentrated on applying a three-dimensional (3D) approach for the few-body bound and scattering states, without using a partial wave decomposition. In the second one, Bayegan was interested in applying the effective field theory (EFT) approach for investigating the low-energy few-body reactions.

The 3D approach was first introduced and implemented in the calculations of two- and three-body bound and scattering states by Walter Glöckle, Charlotte Elster, and collaborators starting in 1997. Then, Bayegan conducted the first extension of the 3D scheme to a four-body bound state, [with](#) and [without](#) three-body forces in 2007 (with [Hadizadeh](#)). Furthermore, Bayegan included the spin and isospin degrees of freedom in 3D formalism for the first time in triton calculations with [nucleon-nucleon](#) and [three-nucleon](#) forces (with [Hadizadeh](#), [Radin](#), and [Tomio](#)). The developed Yakubovsky formalism and computer codes were later employed by [Hadizadeh](#) and Brazil few-body group to explore [the universality and Efimov physics in weakly four-body bound states](#). In parallel to Bayegan's attempts for a [3D representation of nucleon-nucleon chiral potentials](#) (with [Shalchi](#) and [Hadizadeh](#)), he [derived](#) and [solved](#) the Yakubovsky equations with realistic two- and three-nucleon interactions (with [Hadizadeh](#), [Walter Glöckle](#), and [Lauro Tomio](#)). Bayegan further implemented the 3D scheme in [three-nucleon scattering](#) and [triton photodisintegration](#) (with [Radin](#) and [Shalchi](#)), and also in the calculation of low-momentum effective interactions V_{low-k} using [spin-independent](#) and [modern](#) nucleon-nucleon potentials that were later used in [two-](#), [three-](#), and [four-body](#) bound state calculations (with [Radin](#), [Shalchi](#), and [Hadizadeh](#)).

Bayegan's EFT research was initially focused on the electromagnetic radiative capture of the $3N$ systems by applying the pionless EFT formalism to the neutron capture by deuteron at [thermal](#) and [low energies](#) (with [Sadeghi](#) and [H. W. Grißhammer](#)). The reaction was later comprehensively studied in [2014](#) and then extended to [pd radiative capture](#) by considering the Coulomb effects (with [Moeini Arani](#), [Nematollahi](#), and [Mahboubi](#)). Since 2009, Bayegan started developing the EFT approach to determine the parity-violation low-energy coupling constants by calculating the [photon circular polarization](#) and [asymmetry](#) in $n + d \rightarrow {}^3\text{H} + \gamma$ reaction, which was later advanced to [pd scattering](#) and $p + d \rightarrow {}^3\text{He} + \gamma$ reaction (with [Moeini Arani](#), [Nematollahi](#), and [Mahboubi](#)). Bayegan expanded the EFT approach to halo nuclei by studying [two-neutron radiative capture by alpha](#), and calculating the ${}^6\text{He}$ charge form factor (with [Moeini Arani](#), [Radin](#), and [Jesri](#)). In his last EFT projects, Bayegan calculated [the proton-proton fusion S-factor with a new power counting \(PC\)](#) pursued as a testing ground (with [Moeini Arani](#) and [Behzadmoghaddam](#)) and proposed [a new regularization scheme in the lattice EFT calculations of two-nucleon systems](#) (with [Ahmadi](#), [Hadizadeh](#), and [Radin](#)). Bayegan

had several in-progress projects that are not yet published, including the investigation of the new PC in pionfull EFT up to NLO for pp fusion, the evaluation of the $E1$ strength function for two-proton radiative capture by ^{15}O , and also the study of four-body force effect on the universality and scaling limit of weakly bound tetramers.

With deep knowledge and experience in few-body physics, Bayegan crucially led the Tehran few-body group for over two decades and trained numerous young researchers in this physics area, some of whom now have leading positions in academia and are active in preparing the next generation of theoretical few-body physicists. In addition to the few-body community in particular and the physics community as a whole, Bayegan left behind his beloved family, including his wife and their son. In the hearts of his colleagues and students, he will be forever remembered as an inspirational and cherished colleague and friend, and we will never forget his honesty, charismatic personality, discipline, passion, and dedication to duty. We will miss Bayegan immensely, his positive attitude, his bright smile, and his kind heart.

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