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Editorial

Topical issue on cluster structure and dynamics of nuclei: a tribute to Mahir Hussein

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Mahir Saleh Hussein, a renowned Brazilian/Iraqi physicist, passed away on 16 May 2019 in Sao Paulo, Brazil. He left behind an indelible legacy for the Brazilian nuclear physics community that extends beyond the scientific community. Mahir had a long and distinguished career, working on several topics in theoretical physics, such as nuclear reactions, exotic nuclei, accelerator physics, quantum chaos mesoscopic systems, and Bose-Einstein condensation.

Mahir was born on 21 November 1944 in Baghdad, Iraq. He kept his Iraqi citizenship throughout his life because of his beautiful memories of a childhood and adolescence. In Iraq, he attended public schools in several districts of Baghdad. In 1964–1965, he enrolled in the College of Science in the University of Baghdad, becoming the first graduate student of the University of Baghdad in 1965. His dream was to hold a Ph.D. title, and hence he left in 1967 to the Massachusetts Institute of Technology (MIT). He was considered a very skillful student, strongly motivated by his mentor Arthur Kerman. He was granted a Ph.D. in Physics in 1971 and immediately after his graduation he accepted a faculty position at the University of Sao Paulo (USP), in October 1971. There, he quickly emerged among the most energetic Brazilian scientists, for the next 47 years. He became an associate professor in 1977 and a full professor in 1987. At the end of his career he had published over 300 papers in refereed journals.

Mahir's research interest encompassed many interdisciplinary fields, with a close eye to the new developments in physics and astronomy. He was always optimistic in his theoretical predictions, providing useful input to new experimental proposals. This allowed him to collaborate with the finest physicist around the world. In 1979–1980 he became a distinguished Tinker Visiting Professor at the University of Wisconsin at Madison, followed by a Smithsonian visiting professor fellowship at the MIT in 1994–1995 and at the Institute of Theoretical Atomic and Molecular Physics at Harvard University. In 1995, he served as the Scientific Secretary of the DOE - NSF Nuclear Science Long Range Plan. At the time, his close friend E. J. Moniz (MIT), was the Chair of NSAC. Mahir did not shy away from administrative tasks, e.g., serving as the head of the Nuclear Physics Department of the Instituto de Física of the University of São Paulo from 1995 from 1999.

Mahir had a strong vision of the needs of experimental physics programs and was the key leading person in a project to install a superconducting solenoid system for the production of radioactive ion beams at the University of Sao Paulo. He coordinated an effort to purchase solenoids and ancillary systems, leading to what is now known as the Radioactive Ion Beams in Brazil (RIBRAS) system. Up to the last few months prior to his passing, Mahir never stopped helping his experimental colleagues with theoretical analysis of results

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obtained with RIBRAS. The study of the reactions induced by radioactive nuclei in this laboratory shed light on several important issues in nuclear physics and astrophysics.

Over the last 25 years, Mahir had been involved rather heavily in four major research efforts: 1. Laser Driven Accelerators, 2. Theoretical Nuclear Physics, 3. Quantum Chaos Theory and Applications and 4. Theory of Bose-Einstein Condensation. Of the four, the second, Theoretical Nuclear Physics, was his main research interest. He contributed heavily to the development of reaction theory for exotic (neutron- or proton-rich) nuclei. To only mention a few topics, he produced a successful theory for the excitation and decay of multiple giant resonances, studied in details fundamental symmetry violations, and collaborating with experimental colleagues in Brazil, USA, Germany and France, he assessed the degree of isospin violation in light nuclei. After his retirement in 2007 and till his passing, Mahir chaired the Non-Conventional Astrophysics group at the Advanced Studies Institute (IEA) of the USP where he organized workshops every year, on topics ranging from Bose-Einstein condensation, quantum chaos, and cosmology. He also maintained his activities at the Institute of Physics of the University of Sao Paulo.

Because they were so many, it is also difficult to summarize the awards and honors received by Mahir during his long and distinguished career. In 1987-1988, he was a J.S. Guggenheim Fellow at the University of Wisconsin, Madison, a Smithsonian Foundation Fellow in 1995 at the MIT working with Herman Feshbach, Arthur Kerman, Ernest Moniz and with Franco Iachello (Yale) on the foundations of nuclear theory. In 2007-2008, Mahir was a Martin Gutzwiller Fellow at the Max-Planck Institute for Physics of Complex Systems in Dresden, working on quantum chaos and Bose-Einstein condensation. Mahir was a member of the Brazilian Academy of Sciences, of the World Academy of Sciences and was a Fellow of the American Physical Society.

Mahir sincerely mentioned very often that he tried to help Iraqi scientists to get involved in international exchange programs. One way to accomplish this was through his association with the Board of Directors of the Iraqi Society for Higher Education Abroad.

As a tribute to Mahir, the European Physics Journal A invited a small number of Mahir's collaborators to contribute to a special volume dedicated to his memory. This volume is a collection of independent and original works. All articles have been peer-reviewed.

We are grateful to all our colleagues acting either as authors or reviewers for this special issue. Our posthumous gratitude goes to Mahir Hussein for his inspirational ideas as a source of motivation for us all.

This topic issue is devoted to works related to cluster and dynamics of nuclei. These are quite hot topics since the early works on nuclear physics. Clustering is a general phenomenon of many-body systems which has been observed in several light nuclei emerging from the saturating two-nucleon force and the Pauli exclusion principle. Although cluster dynamics in nuclei has been reported and various phenomena have been discussed in several review papers, in this special topic issue, novel roles of clustering in nuclei and the synergy between the reaction and structure of nuclei is further addressed. While far from covering all relevant points, some of the contributions are devoted to the discussion of the role of clustering in nuclear reactions such as in two-nucleon transfer, breakup, fusion and elastic scattering, while reactions such as quasi-free scattering is used to investigate their cluster structure. The importance of nuclear clusters is also discussed as a cornerstone for the chemical evolution of the universe. Clusters also play an important role in indirect techniques abundantly used in nuclear physics for nuclear astrophysics and for nuclear spectroscopic in general. Examples are the surrogate method and the Trojan horse method, with contributions in this special volume.

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Guest editors

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