

EDITORIAL

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Special Issue on Weakly Bound Exotic Nuclei

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Nuclear physics went through a new phase of questions, challenges, discoveries, and interdisciplinary connections during the last 30 years. The seminal work of Tanihata and collaborators put the search and study of nuclei far from the line of stability on the spotlight. One of the exotic properties of these recently discovered nuclei is the clustering phenomenon, with compact cores and nucleons forming systems with very low binding energies. Cluster states, halo nuclei in particular, have been objects of intense study in the few-body community due to universal aspects that emerge independently of the details of the short-distance interaction. Universality in weakly-bound systems has its origin on the infinite limit of the two-body scattering length, revealing a continuous scale invariance that is broken down to the discrete scale invariance of the Efimov spectrum in the corresponding three-body system. Approaches based on universal properties grasp the relevant physics of loosely-bound systems using well-established few-body tools, serving as guide to more microscopic ab-initio approaches. Regarding the latter, several progresses have been achieved with better computational resources followed by more efficient algorithms. The ambitious path of understanding the formation of exotic nuclear structures from the underlying theory of strong interactions is being paved with the state-of-the-art internucleon interactions, notably the two- and three-nucleon forces from chiral effective field theory (EFT) ultimately connected to quantum chromodynamics via chiral symmetry, merged to a certain level of accuracy into modern many-body calculations. Evidently, all the progress achieved and envisioned for the future in this area would not be possible with the inspiration and cross-feeding knowledge from dedicated facilities across the world.

Concepts such as universality, Efimov effect, chiral interactions, and nuclear effective field methods already permeated and is common parlance in the nuclear structure community. However the community of nuclear reactions, which has representative experimental groups and a dedicated facility (RIBRAS) in Brazil, are not yet well aware of the potential opportunities and mutual benefits from these approaches. The idea of bringing these two communities closer to each other was the main purpose of Carlos Bertulani (Texas A&M U-Commerce), Paulo Gomes (Fluminense Federal University), Alinka Lépine-Szily (University of São Paulo), Ubirajara van Kolck (IPN-Orsay), and myself, in organizing the workshop Weakly Bound Exotic Nuclei held in Natal, Brazil, from May 24 to 30, 2015 (<http://www.iip.ufrn.br/eventsdetail?inf===wTEFUP>). Participation was limited to 40 participants. Distinguished scientists from United States (7), Europe (14), Asia/Australia (4) and Brazil/Uruguai (11) presented their latest scientific outcomes at high level, with intense and stimulating participation of the audience. Two extra discussion sessions have to be arranged in the last minute (Tuesday and Thursday, after the last talk) to accommodate the amount of discussions spontaneously generated during the program. We are thankful to Profs. Nasser Kalantar-Nayestanaki (KVI-CART) and Nicolas Alamanos (CEA-Saclay) for taking the lead on the respective discussion sessions. The enthusiasm of the participants and the scientific outcome of the workshop lead us to understand the need of this special issue as a way to register and boost the effervescent ideas between these two closely-related nuclear physics communities.

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