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EDITORIAL

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Special Issue on Efimov Physics

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Efimov Physics is a cross disciplinary subfield of physics connected by common concepts and techniques. The basic concept originated from an observation by V. Efimov that three identical bosons in quantum mechanics have infinitely many bound states provided each pair has a bound state at zero energy. If the strength of the pair attraction is increased or decreased the number of trimer states decreases in both cases. This anomaly for three-body systems in three dimensions has now been realized and measured in a number of laboratories. The effect is real, and in its basic form allowed in a relatively small window of potential strengths.

During many years after Efimov published his theoretical deduction, the searches were confined to systems where nature by chance could have made a two-body potential with a bound state close to zero energy. The window is rather small and all the searches were negative in the end. The invention of the method using magnetic Feshbach resonances opened an avenue of possibilities. This new technique allows changes of the effective two-body potential by coupling and tuning of two excited states of the particles by use of magnetic fields. It is then possible to control the binding energy of the pairs. With this tool the Efimov effect was finally observed in cold atoms as variations of decay properties at specific predictable relative energies.

The initial Efimov effect leads to bound three-body states of a special structure. They now are naturally called Efimov states. The keyword in the description is "universality" or "model independence", which loosely speaking means independence of detailed model properties. In the decade prior to the observation of the Efimov effect, similar model-independent structures were used in descriptions of the weakly bound nuclear halo states. They were also related to few-body bound states close to zero energy. Recognition of universal behavior or model independence directly suggests that it would be beneficial to transfer experience from one subfield of physics to another. The cross disciplinary character becomes evident, and researchers working with related problems are found in chemistry, condensed matter, atomic and molecular, nuclear, and mathematical physics.

It is not surprising that the large enthusiastic efforts and the broad activities have opened the field and the concepts have been generalized to non-identical particles, more than three particles, and other than three spatial dimensions. This broader cross-disciplinary subfield is naturally denoted as Efimov Physics, which is the subject of the present topical issue. The present state-of-the-art contributions are timely, and I expect this issue will prove itself useful. I want to thank the contributing authors, I appreciate their efforts. I believe this special issue contains very interesting discussions, presentations, and summaries of results.

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