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Efimov effect and the quest for a theory of Nuclear Forces

PAULO BEDAQUE, University of Maryland

The force between two nucleons or two atoms is well understood at large distances (pion exchange or Van der Waals force) but, at short distances, they are much complex. These are examples of a common problem in physics: how can we understand long distance properties of a system when they seem to depend on short distance details that are unknown? Effective field theories and the renormalization group techniques have been developed primarily to deal with this situation. The application of these ideas to the nuclear force problem or to atoms close to a Feshbach resonance shows the full power of these techniques and allow the derivation of a host of results equally applicable in nuclear and atomic physics. In particular, the study of three-particle systems provides a startling example of a limit cycle in the renormalization flow – a theoretical possibility not previously realized in Nature.