Contribution ID: **92** Type: **Talk**

Subtractive renormalization and scaling in low-energy few-body physics

Thursday, July 2, 2015 4:35 PM (15 minutes)

Renormalized fixed-point Hamiltonians are formulated for systems described by interactions that originally contain point-like singularities (as the Dirac-delta and/or its derivatives). They express the renormalization group invariance of quantum mechanics. The approach has been applied in the study low-energy scattering observables, such as the nucleon-nucleon interaction with one pion exchange potentials, as well as bound-state systems. In case of low-energy bound-state systems, this subtractive procedure was found convenient to introduce the scales in formalisms with zero-range interactions, when renormalizing the theory. Of particular interest in recent years has been the studies of neutron-rich light nuclei, with two-neutron halos and a core, dominated by s-wave short-range two-body interactions. In this case, the observables are expressed by universal scaling laws obtained in the limit of a renormalized zero-range force, expected to be model independent for large halos. The corresponding scaling functions are determined by the neutron-neutron and neutron-core low-energy information, such as scattering lengths and short-range parameters. By using recent experimental data, which constrain the two-neutron separation energy, we study the core momentum distribution for large halo nuclei, like Lithium-11, Carbon-20 and Carbon-22.

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Session Classification: Parallel Session 6 - Few-Body Physics WG

Track Classification: Few-Body Physics Working Group