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From alpha clustering to homogeneous nucleonic matter

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Over the last few decades the study of nuclei and neutron-rich matter from first principles has entered a new era. This has partly been driven by the development of novel interactions between two or three nucleons. In an attempt to produce a systematic expansion, several groups have produced Effective Field Theory (EFT) interactions, whether of finite range (chiral EFT) or zero range (pionless EFT). Pionless EFT has been quite successful in studies of cold-atomic Fermi gases. In this talk, I will present recent Quantum Monte Carlo calculations of 8-particle systems and discuss their impact on 8Be and the physics of alpha clustering. I will also discuss recent work on trying to connect ab initio theory with simpler qualitative pictures. Specifically, I will address the first ever systematic non-perturbative calculations of the single-particle excitation spectrum in strongly interacting neutron matter. In addition to impacting light and neutron-rich nuclei, this work and this talk also touch upon the physics of ultracold gases and of neutron stars.

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