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Universal interactions in atomic and low-energy few-nucleon systems[1]

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Atomic systems with large two-body scattering lengths present remarkable similarities with nuclear systems at low energies. In both cases, the system properties are universal, depending mainly on the scattering length, which is much larger than the interparticle separation, and not on the details of the interaction. Therefore, the few-body methods developed to test one system, can be readily applicable to the other system. The study of the atomic systems characterized by large scattering lengths provide an excellent testing ground for few- and many-body methods that can be further applied, with little or no changes, to the description of nuclear systems at low energies. In this talk, I will present an effective-field theory approach to constructing two-body effective interactions in no-core shell model (a method developed for describing nuclear systems) finite spaces, with direct applications to the description of cold atom gases in harmonic traps. In particular, results up to next-to-next-to-leading order for the spectrum of the three-fermion system at unitarity will be presented and shown to agree with know results. Next, I will present the extension to finite values of the scattering length, as well as finite albeit small finite range, of interest for nuclear physics. Finally, I will discuss further application of such an approach to the description of atomic nuclei.

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