Effective and intrinsic three-body interactions in ultracold harmonically-trapped few-atom systems X.Y. YIN, D. BLUME, Washington State University, P.R. JOHNSON, American University, E. TIESINGA, National Institute of Standards and Technology and University of Maryland — We derive the ground state energy for a small number of ultracold atoms in an isotropic harmonic trap using quantum field theory. Atoms are assumed to interact through pairwise energy-independent and energy-dependent delta-function potentials with strengths proportional to the scattering length \(a_s\) and effective-range volume \(V_{\text{eff}}\), respectively. Additionally, an intrinsic three-body potential with strength proportional to \(g_3^{(0)}\) is accounted for. The calculations are performed systematically up to order \((a_{\text{ho}})^{-4}\), where \(a_{\text{ho}}\) denotes the harmonic oscillator length. Effective-range volume dependent energy contributions are calculated up to order \((a_{\text{ho}})^{-5}\). We explain how our effective field theoretical results can be, if combined with independent energy calculations or measurements, used to obtain the renormalization scheme independent three-body contribution. The need for three-body counter-term interactions is discussed in the context of the effective-range volume dependent effective interactions.

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