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The role of dimensionality on effective two- and three-body interactions of trapped ultracold bosons[1] P.R. JOHNSON, American University, D. BLUME, Washington State University, E. TIESINGA, JQI, NIST and University of Maryland — We analyze the perturbative ground-state energies of N ultracold bosons in 1D, 2D isotropic, and 3D cylindrically symmetric harmonic potentials using renormalized perturbation theory. We assume pair-wise, zero-range (delta-function) interactions with boson-boson coupling parameter g, and in all three cases we obtain analytic expressions for the effective 2- and 3-body interaction energies to second order in g. As a function of the ratio of the transverse and longitudinal trapping frequencies, we show that the quasi-1D and quasi-2D limits of the 3D expressions agree with the "true" zero-range interaction 1D and 2D results. We also compare to numerical simulations using a finite-range interaction potential in a 3D trap. We anticipate that our results can be useful for experiments with anisotropically trapped ultracold atoms, when effective 3-body interactions play a significant role.

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