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Efimov spectrum for N bosons

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When the two-body scattering length a of two identical bosons diverges the three-boson spectrum shows the Efimov effect. In this limit, the unitary limit, an infinite set of bound states, E_3^n, appears approaching zero in a geometrical progression. In other words, the $L = 0$ sector of three identical bosons presents a discrete scaling invariance (DSI). As the absolute value of a takes finite values, the highest bound states disappear into the atom-dimer continuum ($a > 0$) or in the three-atom continuum ($a < 0$). In recent years the spectrum of the three-boson system has been extensively studied in the $(1/a, \kappa)$ plane, with $\kappa^2 = mE/\hbar^2$ [1]. When one boson is added to the system, the four-body system at the unitary limit presents two bound states, one deep (E_4^0) and one shallow (E_4^1) with the following ratios, $E_4^0/E_3^0 \approx 4.6$ and $E_4^1/E_3^0 \approx 1.001$, having an universal character [2]. This particular form of the spectrum has been recently studied up to six bosons [3].

In the present work I will show the spectrum of A bosons for increasing number of particles using a Leading Order description in terms of a two-body gaussian potential plus a three-body potential devised to describe the dimer and trimer binding energies. The capability of this model to describe the saturation properties, as N goes to infinite, is analysed making a direct link between the low energy scale and the short-range correlations. We will show that the energy per particle, E_N/N, can be obtained with reasonable accuracy at leading order extending the universal behaviour observed in few-boson systems close to the unitary limit to the many-body system [4].

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