Dimer-dimer zero crossing in a one-dimensional mixture

Alexandre Pricoupenko*[1,2] and Dmitry Petrov[3]

[1]Laboratoire de Physique Théorique et Modèles Statistiques – Université Paris-Sud - Paris 11, Centre National de la Recherche Scientifique : UMR8626 – France

[2]Ecole Normale Supérieure - Lyon – École Normale Supérieure - Lyon – France

[3]Laboratoire de Physique Théorique et Modèles Statistiques (LPTMS) – CNRS : UMR8626, Université Paris XI - Paris Sud – Bâtiment 100 Université Paris-Sud Centre Scientifique d'Orsay 15 rue Georges Clémenceau 91405 Orsay cedex, France

Abstract

We consider the system of dimers formed in a one-dimensional two-component mass-balanced Bose-Bose mixture with attractive inter- and repulsive intraspecies contact interactions. In the plane parameterized by the ratios of the coupling constants g↑↑/—g↑↓— and g↓↓/—g↑↓— we trace out the curve where the dimer-dimer interaction switches from attractive to repulsive. We find this curve to be significantly (by more than a factor of two) shifted towards larger $g_{\sigma\sigma}$ (or smaller—g↑↓—) compared to the mean-field stability boundary g↑↑*g↓↓ = g↑↓^2. For a weak dimer-dimer attraction we predict a dilute dimerized liquid phase stabilized against collapse by a repulsive three-dimer force.

If I have time I will speak a little bit about an other article which is in the continuity of the previous subject, (and which involves collaborators in Barcelona), namely :

We solve the three-boson problem with contact two- and three-body interactions in one dimension and analytically calculate the ground and excited trimer-state energies. Then, by using the diffusion Monte Carlo technique we calculate the binding energy of three dimers formed in a one-dimensional Bose-Bose or Fermi-Bose mixture with attractive inter- and repulsive intraspecies interactions. Combining these results with our three-body analytics we extract the three-dimer scattering length close to the dimer-dimer zero crossing. In both considered cases the three-dimer interaction turns out to be repulsive. Our results constitute a concrete proposal for obtaining a one-dimensional gas with a pure three-body repulsion.

*Speaker