Universality of three-body systems in 2D: parameterization of the bound states energies

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We consider three-body systems in two dimensions with zero-range interactions for general masses and interaction strengths. The problem is formulated in momentum space and the numerical solution of the Schrdinger equation is used to study universal properties of such systems in respect to the bound-state energies.

The number of universal bound states in two dimensional three-body systems is strongly mass dependent and increases as one particle becomes much lighter than the other ones. We have found an accurate analytical approximation to the Born-Oppenheimer potential for one light particle in the field of two heavy particles. The number of bound states are computed as function of the mass, and found to agree with full calculations [1]. We found that the maximum number of bound states for any three-body system in 2D takes place when all two-body subsystems have the same binding energy [1,2].

The ground and first state energies have different behaviours as function of the two-body energy [3]. Whereas always a bound ground state for any three-body system in 2D exists (assuming at least two pairs are bound), the first excited state only occurs for special choices of masses and two-body binding energies. Nevertheless, we are able to parameterize the ground and first state energies as super-circles (powers different from 2), where the scaled two-body energies are the "coordinates" and the radius and the power present a weak mass-dependence [2].

We show as an example the ^{6}Li^{40}K^{87}Rb system which has, at most, three universal bound states.

[1] F. F. Bellotti *et al.*, J. Phys. B: At. Mol. Opt. Phys. **46**, 055301 (2013).

[2] F. F. Bellotti *et al.*, Phys. Rev A **85**, 025601 (2012).

[3] F. F. Bellotti *et al.*, J. Phys. B: At. Mol. Opt. Phys. **44**, 205302 (2011).

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