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Universality in low-dimensional three-body systems

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We study a heavy–heavy–light three-body system confined to one or two space dimensions. Both the binding energies and corresponding wave functions are obtained for (i) no heavy-heavy interaction and (ii) a finite-range heavy-light interaction potential. We demonstrate that when the two-body ground-state energy approaches zero, the three-body bound states display a universal behavior, independent of the shape of the interaction potential [1, 2, 3]. Moreover, in this limit the three-body binding energies and wave functions are shown to converge to the respective ones found in the case of the zero-range interaction.

In addition, we explore the regime where the heavy–light subsystems have a weakly bound excited state [4]. The associated two-body system is characterized by (i) the structure of the weakly-bound excited heavy–light state and (ii) the presence of deeply-bound heavy–light states. The consequences of these aspects for the behavior of the three-body system are analyzed. We find a strong indication for universal behavior of both three-body binding energies and wave functions for different weakly-bound excited states in the heavy–light subsystems.

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