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Mass Ratio Dependence of Three-Body Resonance Lifetimes

Tuesday, 24 September 2024 17:30 (30 minutes)

We present a theoretical study of resonance lifetimes in a two-component three-body system, specifically examining the decay of three-body resonances into a deep dimer and an unbound particle. Utilising the Gaussian expansion method together with the complex scaling method, we obtain the widths of these resonances from first principles. We focus on mass ratios in the typical range for mixtures of ultracold atoms and reveal an intriguing dependence of the resonance widths: as the mass ratio increases, the widths show oscillations on top of an overall decaying behavior. In particular, for some mass ratios the resonance width vanishes, meaning that the resonance becomes in fact stable. Notably, near the mass ratio for Caesium-Lithium mixtures, we obtain nearly vanishing widths of the resonances which validates to treat them in the bound state approximation. In addition, we perform our analysis on the resonance widths in both one and three dimensions and find a qualitatively similar dependence on the mass ratio.

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