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Lifetime-analysis of three-body resonance states

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We theoretically study the lifetimes of three-body resonance (quasi-bound) states. In particular, we are interested in how these lifetimes vary between one-dimensional and three-dimensional geometries. As an example, we consider a two-component three-body system with short-range pair-interactions that support several two-body bound states. Three-body resonance states are discrete eigenstates of the three-body Hamiltonian whose energies lie above one (or more) two-body bound state energies, i.e., they live within a continuum created from one of the lower-lying two-body thresholds. This can open a decay channel into a deeply bound dimer and a free particle, which manifests itself in an imaginary part of the energy eigenvalue. Recently, we have analyzed [1] this situation in a one-dimensional geometry, considering solely real energies and we have found a behaviour which converged smoothly and accurately to the one of three-body bound states. This has raised the question whether in the one-dimensional case the quasi-bound states are in fact bound states with real energy who are embedded in the continuum. With our current research we aim to shed more light onto this question by performing ab-initio calculations considering complex energies, which allows us to make statements about the lifetimes of these states.

[1]: Lucas Happ et al, J. Phys. B: At. Mol. Opt. Phys. 55 015301 (2022)

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