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Two-body double pole and three-body bound states: physical and unphysical quark masses

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We solve the Faddeev bound-state equations for three particles with simple two-body nonlocal, separable potentials that yield a scattering length twice as large as a positive effective range, as indicated by some lattice QCD simulations. Neglecting shape parameters, the two-body bound state is a double pole. For bosons we obtain a cor- relation between three- and two-body energies. For nucleons, this correlation depends additionally on the ratio of effective ranges in the two two-body S-wave channels. When this ratio takes the value suggested by lattice QCD, our three-body energy agrees well with a direct lattice determination. When this ratio takes the experimental value, we find a three-body bound state with energy close to that of the physical triton.

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