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Nonlocally induced (quasirelativistic) bound states: harmonic confinement and the finite well. (English) Zbl 1371.35046

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Summary: We address the Schrödinger-type eigenvalue problems for $H = T + V$, where a kinetic term $T = T_m$ is a manifestly nonlocal quasirelativistic energy operator $T_m = \sqrt{-\hbar^2 c^2 \Delta + m^2 c^4} - mc^2$, where the whole mass $m \in (0, \infty)$ range is admitted. We are primarily interested in a simple confining enclosure where $V(x)$ refers to a finite well of an arbitrary depth. As a useful test model, preceding the finite well analysis, we consider the case of the harmonic attraction. We analyze spectral solutions, e.g. infer detailed eigenvalue and eigenfunction (shapes) data of the pertinent nonlocal quantum systems. We focus on their m-dependence and specifically on their low mass regime, which can be directly compared with existing $m = 0$ spectral solutions for the Cauchy oscillator and the infinite Cauchy well. To this end, an efficient spectrum generating algorithm is implemented. All computations are carried out directly in the configuration space which entails a proper assessment and control of the spatial nonlocality impact on simulation outcomes, e.g. explicit nonlocally induced eigenvalues and eigenfunctions.

MSC:

35J10 Schrödinger operator, Schrödinger equation
35P05 General topics in linear spectral theory for PDEs

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