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On Resonant Tunneling Across $\alpha\delta(x) + \beta\delta'(x)$ Pseudopotentials

Turning back to the well-known problem how to interpret the Schrödinger operator with the pseudopotential $\alpha\delta(x) + \beta\delta'(x)$ we show that the problem encloses hidden parameters. The scattering properties of regularizing finite-range potentials $\alpha\varepsilon^{-1}\Phi(\varepsilon^{-1}x) + \beta\varepsilon^{-2}\Psi(\varepsilon^{-1}x)$ are studied in the zero-range limit. We introduce the concepts of resonance set Σ_Ψ, coupling function $\theta_\Psi\colon \Sigma_\Psi \to R$ and interaction function $\zeta_\Psi^\Phi\colon \Sigma_\Psi \to R$ as the spectral characteristics of the shape Ψ of the short-range potential that approximates the first derivative of the Dirac function. The selfadjoint operators used in our solvable models strongly depend on these characteristics. All point interactions that correspond to such operators are shown to be divided into two types: non-transparent interactions for $\beta \notin \Sigma_\Psi$ and partially transparent interactions for $\beta \in \Sigma_\Psi$.

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