Pragmatic self-adjoint extension procedure in the Schrodinger equation for the bound and scattering states of the inverse square attractive potential

Teimuraz Nadareishvili [a,b] *(sylfaen, 11 pt, italic) coauthor's Anzor Khelashvili*[b]

e-mail: teimuraz.nadareisvili@tsu.ge (sylfaen, 10 pt)

[a] Faculty of Exact and Natural Sciences, Iv. Javakhishvili Tbilisi State University, Chavchavadze Ave 3, 0179, Tbilisi, Georgia.

[b] Inst. of High Energy Physics, Iv. Javakhishvili Tbilisi State University, University Str. 9, 0109, Tbilisi, Georgia

The self-adjoint extension procedure is considered in the Schrodinger equation for potentials behaving as an attractive inverse square at the origin of coordinates. For extension, we choose a so-called pragmatic approach, which guarantees self-adjointness of the radial Hamiltonian in three dimensions when singular solutions are also included. Earlier, the bound state problem was considered[1-2] and a single bound state was found, depending on the self-adjoint extension parameter. The same parameter also arises for the scattering case when the extension is made by the orthogonality requirement. The closed form is derived for the modified scattering amplitude, which consists of an extra factor that is dependent on the self-adjoint extension parameter. This guarantees the appearance of the same bound state in the form of the scattering amplitude pole. Therefore, the generalization of the pragmatic method is demonstrated for a continuous spectrum in 3 dimensions. The findings of our investigation below often repeat results already derived in two dimensions or sometimes differ from them, but the difference is caused mainly by misunderstandings related to areas of parameters under consideration.

References

[1] A. Khelashvili, T. Nadareishvili, ''What is the boundary condition for the radial wave function of the Schrödinger equation?'' Am.J.Phys, **79**, 668(2011).

[2] A.Khelashvili,T.Nadareishvili,''Singular behavior of the Laplace operator in polar spherical coordinates and some of its consequences for the radial wave function at the origin of coordinates'', Physics of Particles and Nuclei Letters **12**, 11 (2015).