Relativistic extension of shape-invariant potentials

2002 J. Phys. A: Math. Gen. 35 6207

(http://iopscience.iop.org/0305-4470/35/29/501)

J. Phys. A: Math. Gen. **35** (2002) 6207 www.iop.org/Journals/ja PII: S0305-4470(02)36618-6

Corrigendum

Relativistic extension of shape-invariant potentials

A D Alhaidari 2001 *J. Phys. A: Math. Gen.* **34** 9827–9833

The Hamiltonian that resulted in the radial equation (1) of our paper [1] is not the minimum coupling Hamiltonian H shown on page 9828 but the one obtained from it by replacing the two off-diagonal terms $\alpha\vec{\sigma}\cdot\vec{A}$ with $\pm i\alpha\vec{\sigma}\cdot\vec{A}$, respectively. Consequently, our interpretation of $(V, \hat{r}W)$ as the electromagnetic potential and the statement that '$W(r)$ is a gauge field' are not correct. Likewise, refering to equation (3) in the paper, or any other derived from it, as the 'gauge fixing condition' is not accurate. This has to be replaced throughout by the term 'constraint'. Therefore, the gauge considerations in our approach are not valid. Nonetheless, except for an error which is corrected below, all developments based on, and findings subsequent to equation (1) still stand independent of those considerations.

Below equation (11) on page 9831, the assignment of the inadmissible value $\kappa = 0$ for the case where $V(r) = 0$ is an error which was hastily made to eliminate the centrifugal barrier $\kappa(\kappa+1)/r^2$ and the term $2\kappa W/r$ simultaneously from equation (11) so that we end up with the 'super-potential' $W^2 - W'$. This mistake, which will now be corrected, affects only the Dirac–Rosen–Mörse II, Dirac–Scarf, and Dirac–Pöschl–Teller problems. Eliminating these two terms can be achieved properly by replacing the potential function $W(r)$ given in the paper for each of the three problems by $W(r) - \kappa/r$ with an arbitrary value for κ. That is, in equations (10) and (11) and in the table we substitute the following potential function for the corresponding problem:

Dirac–Rosen–Mörse II: $W(r) = F\coth(\lambda r) - G\mathrm{csch}(\lambda r) - \kappa/r$
Dirac–Scarf: $W(r) = F\tanh(\lambda r) + G\mathrm{sech}(\lambda r) - \kappa/r$
Dirac–Pöschl–Teller: $W(r) = F\tanh(\lambda r) - G\coth(\lambda r) - \kappa/r$

where F, G, and λ are the potential parameters defined in the paper. Doing so will result in the same differential equations for the spinor components and will reproduce the same solutions (energy spectrum and wavefunctions) as those given in the paper for each of the three problems.

References

[1] Alhaidari A D 2001 *J. Phys. A: Math. Gen.* **34** 9827