

This is a review text file submitted electronically to MR.

Reviewer: Znojil, Miloslav

Reviewer number:

Address:

NPI ASCR,
250 68 Rez,
Czech Republic
znojil@ujf.cas.cz

Author: Cannata, Francesco; Ventura, Alberto

Short title: Non-local PT -symmetric potentials in the one-dimensional Dirac equation.

MR Number: 2515919

Primary classification: 81Q10

Secondary classification(s): 81U20 78A60 47B50 81Q05

Review text:

A specific bound- plus scattering-state problem is addressed, represented by eqs. (2) + (6) or by the title of this paper where “non-local” should read “separable of rank one, using Yamaguchi formfactors in a numerical test in penultimate section 6”. The basic assumption of the authors of this paper (as well as of its immediate “nonrelativistic” predecessor [11]) is that their problem is so interesting that it does not require any overscrupulous specification of its consistent physical meaning. Obviously, people who accept this assumption (belonging, typically, to the classical nonlinear optics community) may be recommended to study all the results. Less obviously, those with doubts should read this interesting and well organized and comprehensible text as well, just keeping in mind that the scepticism verbalized by the authors’ key introductory sentence “a satisfactory general [quantum] approach has not been formulated yet” has perceptibly weakened during the last twelve months. For proof, my own up-to-date review “Cryptohermitian picture of scattering using quasilocal metric operators” presented to int. DI microconference ”Analytic and algebraic methods in physics V” in May, 2009 (in Prague) and published in SIGMA 5 (2009), 085 (cf. doi:10.3842/SIGMA.2009.085 or arXiv:0908.4045) should be consulted for more details.

This being said one must appreciate the careful and detailed derivation and discussion of the properties of the transmission and reflection coefficients which break unitarity in a way which is quite common in nuclear physics where, in words of ref. [7], “typically the particle can be absorbed rather than merely scattered”. This means that the whole model or theory are merely “effective”

(i.e., incomplete) and the S-matrix is allowed to remain non-unitary.

Although the authors remind us, in the last two paragraphs of Conclusions, about the possibility of a return to the unitary quantum scattering scenario, their related conjecture of doing so via the most popular introduction of “a charge conjugation operator C ” has already been almost excluded, in words of H. F. Jones, Phys. Rev. D 78 (2008) 065032, not only due to the necessity “of drastically changing the physical picture” but also “not least because of the extreme difficulty in calculating $[C]$ for even the simplest potentials”. Fortunately, even the latter serious obstruction may be believed to find a remedy based on the replacement of the charge conjugation operator C by an entirely different auxiliary operator a broad family of which I sampled in Phys. Rev. D. 80 (2009) 045009.