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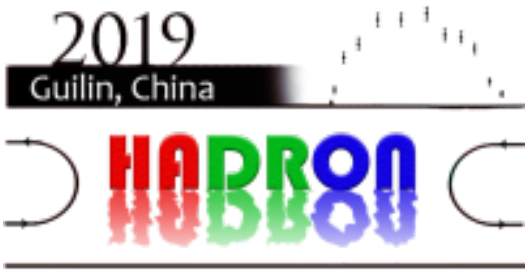

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The vector-vector approach and its recent relativistic extensions

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The vector-vector approach is revisited. In the original formalism, some approximations are made, considering the vector meson to have small momenta comparing to its mass. In the $\rho - \rho$ scattering, and for Isospin$= 0$, the potential obtained is much more attractive in $J = 2$ than for $J = 0$, and thus, two bound states are found, where the one with $J = 2$ is more bound. These are identified with the $f_0(1370)$ and $f_2(1270)$. Recently, some efforts have been made to try to extend the vector-vector formalism to a fully relativistic covariant approach. In the approach of G\"ulmez et al., the on-shell factorization of the potential is done in a region where the potential is singular and develops a large discontinuous and unphysical imaginary part, and leads to the disappearance of the pole of the $f_2(1270)$. The improved approach, where an approximated N/D method is used, gets to similar findings regarding the presence of this pole. We study this in detail and discuss the convergence of the method based on dispersion relations used. We show that the method cannot be used to extrapolate the results in the energy region where the $f_2(1270)$ appears, due to the artificial singularity stemming from the on-shell factorization of the potential. Finally, we show that if the on-shell factorization is avoided, or the decay width of the rho meson is taken into account through the proper convolution of the potential, the singularity and artificial imaginary part below threshold disappear, and then, one still gets a pole around the energy of the $f_2(1270)$.

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