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TWO-COMPONENT FERMIONS WITH ZERO-RANGE INTERACTIONS: SOME ASPECTS OF CORRECT FORMULATION AND MATHEMATICAL PROBLEMS

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A quantum-mechanical problem of two identical fermionic particles of mass m interacting with a distinguishable particle of mass m_1 via the zero-range potential is discussed. The mass ratio m/m_1 is a single parameter, which is essentially important for the correct formulation of the problem and, consequently, for the description of this system. More precisely, it is necessary to define the problem separately in two intervals, $\mu_r < m/m_1 \leq \mu_e$ and $\mu_e < m/m_1 \leq \mu_c$, where three critical values $\mu_r < \mu_e < \mu_c$ are universal constants unambiguously determined for each sector of the total angular momentum L and parity P. (For $L^P = 1^-$, $\mu_r = 8.61858$, $\mu_e = 12.31310$, and $\mu_c = 13.60697$). Notice that for $m/m_1 > \mu_c$, the problem is similar to the three-bosonic one, in particular, there exists an infinite number of the Efimov bound states. In each mass-ratio interval, the correct definition is obtained by introducing the boundary condition depending on an additional parameter in the vicinity of the triple-collision point. A key role in the analysis plays the correspondence between the generalized Coulomb problem and the three-body problem under consideration. For this reason, the detailed discussion of the former problem is given.

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