

Localization of s-Wave and Quantum Effective Potential of a Quasi-free Particle with Position-Dependent Mass

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Abstract: The properties of the s-wave for a quasi-free particle with position-dependent mass (PDM) have been discussed in details. Differed from the system with constant mass in which the localization of the s-wave for the free quantum particle around the origin only occurs in two dimensions, the quasi-free particle with PDM can experience attractive forces in D dimensions except D=1 when its mass function satisfies some conditions. The effective mass of a particle varying with its position can induce effective interaction, which may be attractive in some cases. The analytical expressions of the eigenfunctions and the corresponding probability densities for the s-waves of the two- and three-dimensional systems with a special PDM are given, and the existences of localization around the origin for these systems are shown.

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Key words: position-dependent mass, s-wave, Schrödinger equation, dimensionality of the space, localization, eigenfunction, probability density

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