The wave equation with energy-dependent potentials. The linear case.

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Abstract:

The properties of the wave equation are studied in the case of energy-dependent potentials for discreet states. The non-linearity induced by the energy-dependence requires modifications of the standard rules of quantum mechanics. They are briefly recalled. We consider various radial shapes in the D = 3 dimensional space, assuming spherical symmetry and a linear energy dependence. This last is chosen because it produces a coherent theory.
We present the effects of the energy dependence on the spectra of one-body and many-body systems. The most spectacular result is the saturation of the spectrum in the case of confining potentials : as the quantum number increase, the eigenvalues reach an upper limit. We deal with the question of the equivalent local potential. We discuss the role of the energy-dependence in critical situations, and show, for instance, that is regularized the $-1/r^2$ potential.