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Relativistic quantum mechanics of a spin-1/2 charge in a Penning trap

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Abstract

The Dirac equation describing a spin-1/2 charged particle in a processing chamber of an ideal Penning trap is considered. The first order perturbation theory as expansion in powers of c^{-2} is applied. Having used the Birkhoff transformation we present relativistic perturbations as functions of action-angle variables. Standard quantization by means of creation and annihilation operators gives accurate corrections to energy levels of the charge in an ideal Penning trap. Resonances which produce degenerate states are considered. The relativistic corrections to their energy spectra are found with the help of the Birkhoff transformation.

Keywords: quantum Penning trap, relativistic effects, anharmonic perturbations, Birkhoff transformation, resonances
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