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Periodic orbits in muonic hydrogen atoms exposed to both circularly-polarized laser light and a uniform magnetic field

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Abstract

The underlying motivation for this work has been a search for a viable stripping mechanism to ameliorate the critical sticking problem in muon-catalyzed fusion schemes, i.e., the problem of muon capture by the fusion alpha particle. The present paper considers a classical muonic hydrogen atom and the motion of the muon in the combined fields of the atomic nucleus, a strong circularly-polarized laser, and a coaxial magnetic field. Quantum mechanical treatments of atomic hydrogen in strong circularly-polarized laser fields [1] provide clear evidence that the resulting quantum waveforms are due to localization of the electron onto nonlinear *classical* structures. Accordingly, our model is classical.

Two exact circular orbits, phase-locked to the laser polarization, exist in this combination of fields. Underlying these orbits is a rotating potential energy function, analogous to the rotating saddle-shaped potential responsible for the stability of ion motion in a Paul trap [2]. The uniform magnetic field introduces a new dimension in parameter space and interesting resonance effects. An analysis of the stability properties of the orbits will be presented. The optimum conditions for muon *instability* and escape will also be discussed.

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[2] W. Paul, Rev. Mod. Phys. **62**, 3 (1990).

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