

SEMINAR ANNOUNCEMENT

Dipole in a Magnetic Field, Work, and Quantum Spin

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Abstract: Place an atom in a nonuniform static external magnetic field and, because of the interaction between the atom's magnetic moment and the magnetic field gradient, the atom will accelerate. This, of course, is what occurs in the classic Stern-Gerlach experiment. An important and fundamental question, which has been neglected in the literature, is whether or not the magnetic field is doing work on the atom. It is shown that, while the magnetic field does no work on the electron orbital contribution to the magnetic moment (the source of translational kinetic energy being the atom's internal energy), whether or not it does work on the electron-spin contribution to the magnetic moment depends on whether the electron has an intrinsic rotational kinetic energy associated with its spin. If the electron does have a rotational kinetic energy, which is shown to be consistent with the Dirac equation, the acceleration of a silver atom in a Stern-Gerlach experiment or the emission of a photon from an electron spin-flip can be explained without requiring the magnetic field to do work.

Two classical systems, for which animations are shown, are also studied: a rotating charged ring and a spinning charged ball. For a constant magnetic field gradient along the z axis, it is found that the classical objects oscillate in simple harmonic motion along the z axis, the total kinetic energy -- translational plus rotational -- being a constant of the motion. For the charged ball, the change in rotational kinetic energy is associated only with a change in the precession frequency, the rotation rate about the figure axis remaining constant. For details please refer to R.J. Deissler, Phys. Rev. E. 77, 036609 (2008). A link to this paper, as well as other information, may be found at:

<http://webmail.aplus.net/hwebmail/services/go.php?url=http%3A%2F%2Fdeissler.us%2F>.

Tuesday, February 23rd, 2010

12:00 – 1:00 pm

Room SI 117

Pizza and refreshments will be served before the seminar.