RESONANT TRAPPING OF CHARGED PARTICLES IN OSCILLATING ELECTRIC AND MAGNETIC FIELDS

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The classical motion of a charged particle in oscillating magnetic and electric fields is investigated. Introducing a rotating coordinate system greatly simplifies the equations of motion and allows a formal analogy to the problem of three coupled oscillators with *anisotropic* damping. The solutions are calculated analytically, as a linear combination of the normal modes of oscillation. There are two resonance frequencies, one at $\omega_c = qB_0/m$, the cyclotron frequency, and the other at $\omega_L = qB_0/2m$, the Larmor frequency. It is shown that when the resonance condition $\omega = \omega_c$ is achieved, that is, the frequency of the oscillating field equals the cyclotron frequency of the particle , the particle is *confined* to a region of space of volume given approximately by $8v_o^3/3\omega_c\omega_1^2$. Here v_o is the modulus of the initial velocity of the particle and $\omega_1 = qB_1/m$ is the frequency of the particle about B_1, the magnitude of the oscillating field. The orbit of the particle is shown to be a *closed* curve in the rotating system, or a closed surface in the laboratory system. On the other hand, when $\omega = \omega_L$, the particle drifts away, exponentially. The results suggest a resonant method for charged particle confinement and resonant isotope separation. We simulate the motion for the isotopes $^{235,238}U$, triply ionized, and show that they can be resonantly separated. The charge-to-mass ratios in this case differ by less than 1%. [1] V.L.B. de Jesus, A.P. Guimarães and I.S. Oliveira, J.Phys.B, to be published. See also "Further Remarks on the Quantum Dynamics of a Charged Particle in an Oscillating Magnetic Field" from the same authors, in this conference.
