Subharmonic resonance and critical eccentricity for the classical hydrogen atomic system

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Previous research investigated the subharmonic resonant behavior for the classical hydrogen atom, with classical radiation damping and circularly polarized light acting on the classical electron. The predicted behavior is believed to be physically accurate when the electron lies far from the nucleus, so that quantum mechanical effects are minimized, thereby applying to Rydberg atomic situations and highly excited hydrogen states. This work examines several new physical effects. First, the semimajor axis is shown to remain relatively constant when in subharmonic resonance; second, the eccentricity steadily increases until a maximum value is reached, at which point orbital decay again sets in. If the initial orbit is circular, the maximum value of the eccentricity, ε, before decay sets in, is shown to always be the same value for each subharmonic condition. Specifically, with f_1 being the applied frequency of light and with n=2,3,4,... , denoting the subharmonic orbital frequency corresponding to $(1/n)\times f_1$, then a unique and critical value of ε occurs for each n before decay sets in, where $\varepsilon_2<\varepsilon_3<\varepsilon_4<\ldots$, regardless of the initial radius of the circular orbit. A mixture of simulation results are shown, combined with an analytic derivation for these critical values of eccentricity.

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