May 20, 2000

Circumstances in which Radiation is not absorbed, Forbidding Photoionization: Four Classes of Matrix Element Zeros

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ABSTRACT

We compare a new class of photoionization matrix element zeros, which we will call relativistic high energy zeros (RHEZ), occurring at energies on the order mc^2, to three well studied classes of zeros, which include Cooper minima, point Coulomb relativistic zeros (PCRZ) and higher energy nonrelativistic Coulomb zeros (HENRCZ). RHEZ differ from the other three types of zeros in several ways. For example the position of the zero with respect to photon energy in dipole RHEZ matrix elements is completely independent of n, Z, the central potential V, and retardation; has a simple dependence on the bound state l quantum number. Despite the fact that RHEZ occur at such high energies the dipole RHEZ do have some physical consequences.