Electron Motion in Relativistically Strong Plane Waves

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The radiation-free approach [1-3] to the description of a charged particle dynamics in a strong electromagnetic field is applied to the plane-wave configuration. It is shown that by using a certain set of variables, the motion equations can be reduced to a simple system of linear ODEs. An explicit solution is presented for specific examples, such as constant crossed fields, linearly and circularly polarized monochromatic plane waves. Several implications of these solutions are discussed, such as unlimited longitudinal acceleration, a finite amount of total radiated energy, and certain electrodynamical properties of an electron-positron plasma, which allow for self-sustained QED cascade development in a plane wave environment [4]. The solution is compared to the numerical solution of the non-reduced motion equations, and the validity region of the found solution is discussed.

References

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