



Mathematics > Numerical Analysis

A time-splitting spectral scheme for the Maxwell-Dirac system

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We present a time-splitting spectral scheme for the Maxwell-Dirac system and similar time-splitting methods for the corresponding asymptotic problems in the semi-classical and the non-relativistic regimes. The scheme for the Maxwell-Dirac system conserves the Lorentz gauge condition, is unconditionally stable and highly efficient as our numerical examples show. In particular we focus in our examples on the creation of positronic modes in the semi-classical regime and on the electron-positron interaction in the non-relativistic regime. Furthermore, in the non-relativistic regime, our numerical method exhibits uniform convergence in the small parameter ϵ , which is the ratio of the characteristic speed and the speed of light.

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