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Renormalization of fermion-mass and charge using the relativistic, time-dependent Dirac equation. TIMOTHY KUTNINK, DAVID ATRISCHULLER, ZACHARY FISHER, CHRISTIAN MCMURRAY, SARAH HOCKETT, AMELIA SANTRACH, SCOTT BARCUS, ATHANASIOS PETRIDIS, Drake University — The time-dependent electromagnetically self-coupled Dirac equation is solved numerically by means of the staggered-leap-frog algorithm with a stability region established. The expectation values of several dynamic operators are evaluated as functions of time. These include the fermion and electromagnetic energies, the fermion dynamic mass, and contributions of positive and negative energy states to the norm. There is a characteristic time-dependence leading to asymptotic constants of these expectation values. In the case of the fermion mass and charge this amounts to renormalization. The dependence of the expectation values on the spatial-grid size is evaluated and yields finite results due to the finiteness and continuity of the spinor. A statistical method, employing a canonical ensemble whose temperature is the inverse of the spatial-grid size, is used to remove the momentum-dependence. A result for each spatial-grid size value is obtained. The continuum limit is taken to calculate both the fermion mass and charge. The renormalization mass correction is 10% and the charge correction is about 5%.

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