Abstract Submitted
for the DAMOP07 Meeting of
The American Physical Society

Relativistic Dynamics of highly charged hydrogen-like systems exposed to intense high-frequency electromagnetic fields EVA LINDROTH, SØLVE SELSTØ, JAKOB BENGTSSON, Stockholm University — We solve the time dependent Dirac equation in a basis consisting of the eigenstates of the field free Hamiltonian $H_0 = c\boldsymbol{\alpha} \cdot \mathbf{p} + V(r) + mc^2\beta$. The dynamics induced by the time dependent perturbation, $H'_v = c\boldsymbol{\alpha} \cdot \mathbf{A}(\mathbf{r}, t)$ in the velocity gauge, or equivalently $H'_l = \mathbf{r} \cdot \mathbf{E}(\mathbf{r}, t)(1 - \boldsymbol{\alpha} \cdot \hat{\mathbf{k}})$ in the length gauge, is resolved by solving the first order differential equation arising from the expansion. The number of continuum states needed in order to get converged results is reduced by complex scaling of the coordinates, $r \rightarrow re^{i\theta}$. We investigate the importance of relativistic effects for various field strengths, E_0, and nuclear charges by comparing the solutions of the Dirac equation with those of the Schrödinger equation. The dynamics is described both within and beyond the dipole approximation ($\mathbf{A}(\mathbf{r}, t) \approx \mathbf{A}(t)$). For high E_0 and high photon energy, $\hbar\omega$, it is clear that this approximation breaks down. However, for increasing Z, the electron is increasingly tightly bound, which to some extent reduces the importance of non-dipole effects.

Eva Lindroth
Stockholm University

Date submitted: 02 Feb 2007 Electronic form version 1.4