Physics 6213
Homework 2

1 Problem

The following problem will be due Wed Feb. 10, 1999. Write the solution out and somebody should be prepared to discuss in class.

1. Start with the Dirac equation:

$$(\gamma^\mu p_\mu - m)u^{(r)} = 0$$

Then make the minimal substitution $p^\mu \to p^\mu + eA^\mu$. Finally, show that in the non-relativistic limit, for the particle states, the Dirac equation reduces to:

$$\frac{1}{2m}(\vec{p} + e\vec{A})^2 + \frac{e}{2m}\vec{\sigma}\cdot\vec{B} - eA^0)u_A^{(r)} = (E-m)u_A^{(r)}$$

where:

$$u^{(r)} = \begin{pmatrix} u_A \\ u_B \end{pmatrix}$$