Project Dirac Equation
Physics 481 / Spring 2000
Professor Klaus Schulten

Problem 1: Born Approximation for Dirac Particles

Express the scattering amplitude connecting states $|\Psi(\vec{p},\lambda,\sigma)\rangle$ in the Born approximation for a spin-independent potential. Show

$$\langle \vec{p}_i,\lambda,\sigma_i|V|\vec{p}_f,\lambda,\sigma_j\rangle \;=\; M(\vec{p}_i,\vec{p}_f)\;\times\left\{\begin{array}{ll}\cos\frac{\vartheta}{2} & \sigma_f \;=\; \sigma_i\\ \sin\frac{\vartheta}{2} & \sigma_f \;=\; -\sigma_i\end{array}\right. \qquad (1)$$

where ϑ denotes the scattering angle.

Problem 2: MIT Bag Model of Quark Confinement

Find the radial solution of the first excited state for the MIT bag model of quark confinement. Plot the result and compare with the ground state wave function.

Problem 3: Relativistic Hydrogen-type Atom

Evaluate and plot the radial wave functions for the $2p_{\frac{1}{2}}$ and $2p_{\frac{3}{2}}$ states of hydrogen-type atoms using the expressions derived in the class notes.

This project needs to be handed in by Friday, May 12, 2000 into the mail box of Gheorghe-Sorin Paraoan in Loomis.