Elementary Particle Physics: Assignment # 6

Due Tuesday March 21st

1 The lagrangian for electromagnetic interactions of an electron ψ (charge -1 and mass m) and a scalar ϕ of charge e_i and mass m_s with an electric field (photon) A is

$$\mathcal{L} = \bar{\psi}\left(i\partial_\mu\gamma^\mu - e\gamma^\mu A_\mu - m\right)\psi + [(\partial_\mu + iee_i A_\mu)\phi][(\partial^\mu + iee_i A^\mu)\phi]^\dagger - m_s^2|\phi|^2$$

- With this Lagrangian the amplitude for $e^-(k,r) + s(p) \to e^-(k',r') + s(p')$ is

$$M = \frac{e^2 e_i}{q^2}\bar{u}^{r'}(k')(\not{p} + \not{p}')u^r(k)$$

- Obtain the unpolarized squared amplitude and the corresponding differential cross section $\frac{d\sigma}{dE'd\Omega}$ in the LAB system (where $p = (m_s, 0)$). Neglect the electron mass. As usual E' and Ω are the corresponding energy and solid angle of the outgoing electron.
- With the results above obtain the differential cross section $\frac{d\sigma}{dE'd\Omega}$ for the DIS $e^-p \to e^-X$ in a parton model with partons being scalars.
- Predict the expected scaling and relations between the form factors F_1^{ep} and F_2^{ep} in this scalar-parton model