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**Task 24.**

Show that

$$\Lambda_+(\mathbf{p}) = \frac{1}{2m}\sum_s u(\mathbf{p},s)\bar{u}(\mathbf{p},s),$$
$$\Lambda_-(\mathbf{p}) = -\frac{1}{2m}\sum_s v(\mathbf{p},s)\bar{v}(\mathbf{p},s)$$

are projectors to positive and negative energy solutions respectively, i.e. that

$$\Lambda_\pm(p) = \frac{m \pm \not{p}}{2m}. \tag{1}$$

**Task 25.**

Consider electron-proton ($ep$) and positron-proton ($\bar{e}p$) scattering..

**(a)** Draw all Feynman diagrams that contribute to the scattering cross section in second order $e$ (electron charge). Give the reduced scattering matrix elements for each diagram.

**(b)** Calculate the difference

$$\sum_{\text{spins}} |\mathcal{M}|^2_{ep} - \sum_{\text{spins}} |\mathcal{M}|^2_{\bar{e}p}\,, \tag{2}$$

which determines the difference in the differential scattering cross sections.

**(c)** Discuss the result of (b) in terms of the experimental precision required to distinguish the $ep$ from the $\bar{e}p$ scattering.