Problems in Quantum Field Theory 3: Interacting quantum fields

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NOTE: Priority to exercises marked by a "$\star$" will be given during the tutorials.

1. Derive the formula for the cross section $d\sigma$ from the S-matrix.

2. $\star$ Prove that the sum over polarization gives

$$\sum_s u^s(p)\bar{u}^s(p) = \gamma.p + m, \qquad \sum_s v^s(p)\bar{v}^s(p) = \gamma.p - m.$$

3. $\star$ Check that $\gamma_0^+ = \gamma_0$ and that $\gamma_0\gamma_\mu\gamma_0 = \gamma_\mu^+$.

4. $\star$ Compute $Tr(\gamma^\mu\gamma^\nu\gamma^\alpha\gamma^\beta)$ and $\gamma_\mu\gamma^\alpha\gamma^\beta\gamma^\mu$.

5. $\star$ What are the Feynman rules for the Lagrangians of exercise 2.6?