

**QUANTUM FIELD THEORY**  
**PHY 655/461**

**ASSIGNMENT IV**

- (1) Derive the Schwinger-Dyson equations.
- (2) Derive an expression for  $U(t, t_0)$  and get the Dyson series.
- (3) How is the interacting vacuum  $|\Omega\rangle$  related to the vacuum in free theory  $|0\rangle$  ?
- (4) Prove that for Mandelstam variables,  $s + t + u = \sum_i m_i^2$ .
- (5) Consider an interaction term with three different spin-0 fields  $\phi_1, \phi_2$  and  $\phi_3$

$$\mathcal{L}_{\text{int.}} \supset \frac{g}{3!} \phi_1 \phi_2 \phi_3$$

- (a) Draw all Feynman diagrams for the decay of particle  $\phi_1 \rightarrow \phi_2 + \phi_3$  (assume  $m_1 \gg m_2, m_3$ ). Write an expression for this decay rate and attempt to compute it.
- (b) Apart from the decay  $\phi_1 \rightarrow \phi_2 + \phi_3$ , what other decay channels are possible for  $\phi_1$  ?
- (c) Compute the cross section for the process  $\phi_1 + \phi_1 \rightarrow \phi_2 + \phi_2$ .