

# QFT II

homework II (Oct. 03)

- **At the head of your report, please write your name, student ID number and a list of problems that you worked on in a report (like “II-1, II-3, IV-2”).**

## 1. Feynman rule of external lines [B]

- (a) In the classroom, we did not take enough time to explain what the Feynman rule is supposed to be for external states. What are they supposed to be in the momentum space version? and why? It will be a good exercise to think about that in the case of relativistic Weyl fermion, Dirac fermion (both particle and its anti-particle), and its non-relativistic limit, if you have plenty of time.

## 2. Time ordered perturbation theory [C]

- (a) When we learn quantum mechanics for the first time, we learn that for a state with energy  $E_*$ , states with energy level  $E_n$  contribute to the perturbative correction to  $E_*$  by  $\Delta E_* = \sum_n |V_{n*}|^2 / (E_* - E_n)$ . This is just one example of general phenomenon that quantum processes give rise to corrections inverse proportional to the virtuality  $(E_* - E_n)$ . How can computations using Feynman diagram in quantum field theory be consistent with the general principle of quantum mechanics? Discuss in any way you like.
  - i. It is OK to read related sections of some QFT textbooks, follow computations and fill gaps between the lines; you can take a photo-copy of your computation notes of that process and submit it as a report. For example, an explanation is found in pp.71–72 of a lecture note by G. Sterman, available in the following URL.  
<http://arxiv.org/abs/hep-ph/9606312>