

FLAVOUR PHYSICS ASSESSMENT

To be returned to Tim Gershon (T.J.Gershon@warwick.ac.uk) by April 18th 2008

Answer the following, each in 100 words or less. (10 marks each)

1. What is the experimental evidence for the existence of exactly three pairs of quarks?
2. How does the existence of three generations of quarks allow CP violation within the Standard Model?
3. What are the Sakharov conditions and why are they necessary for the existence of a matter dominated Universe?
4. The lightest bound state of a b quark and its antiquark is predicted to be the pseudoscalar η_b meson. Why has this particle not been observed while its (heavier) counterpart, the Y was discovered in 1977?
5. Why was the symmetric electron-positron collider experiment CLEO unable to observe CP violation in the B system?

Give brief answers to the following (5 marks each). Use diagrams and calculations as appropriate.

6. What property of the Unitarity Triangle can be measured from the rate of the rare kaon decay $K_L \rightarrow \pi^0 \nu \bar{\nu}$?
7. Estimate the maximum size of direct CP violation in $D^0 \rightarrow K^+ K^-$ within the Standard Model.
8. The mass differences in the B_d and B_s systems are measured to be $\Delta m_d = (0.511 \pm 0.005 \pm 0.006) \text{ ps}^{-1}$ and $\Delta m_s = (17.77 \pm 0.10 \pm 0.07) \text{ ps}^{-1}$ respectively. Estimate the ratio of CKM matrix elements $|V_{td}/V_{ts}|$.
9. The rare decay $B_s \rightarrow \mu \mu$ is highly sensitive to new physics effects and will be searched for by LHCb. Estimate its branching fraction within the Standard Model.
10. Estimate the rate of the decay $\mu \rightarrow e \gamma$ due to neutrino oscillations.

Finally, in as many words as you like (25 marks)

11. What reasons are there for believing that physics beyond the Standard Model might reveal itself in flavour observables?