

Session of Monday 8 September at 16-18 in aud A315.

1. * What accelerator facilities do you know where hadron physics is done? Name, location, beam(s)?
 - ** Give some specific result(s) in hadron physics from one or several of these facilities.
 - *** Explain how this (these) result(s) have furthered our understanding of QCD.

2. At the DESY HERA facility 920 GeV protons collide head-on with 27.5 GeV electrons.
 - * Calculate $\sqrt{s} = E_{CM}$. What would the E_{CM} be if the protons and electrons were moving in the *same* (rather than opposite) direction around the HERA ring?
 - ** How high should the electron energy be to reach the E_{CM} of HERA if the electrons collided with protons at rest? Conversely, how high should the proton energy be for an electron target at rest?
 - *** Have stationary electron targets been used in actual high energy scattering experiments and if so, for what purpose(s)? Have co-moving electron and proton beams (having the same direction and velocity) been used?

3. * Sketch the behavior of the cross sections $\sigma(e^+e^- \rightarrow \text{hadrons})$, $\sigma(e^+e^- \rightarrow \text{anything})$ and of $\sigma(p\bar{p} \rightarrow \text{anything})$ as a function of $s = E_{CM}^2$.
 - ** Characterize the most common final states in each process as a function of s .
 - *** Explain (qualitatively) the s -dependence of each process, based on QED and QCD.

Note: You are welcome to consult textbooks and data compilations (and refer to them). The number of stars indicates difficulty/advance knowledge required. A full answer to each partial question gives 2 points, with 4 points considered a complete answer to each question (leaving up to 2 extra bonus points per question!)