

Physics 195b
Problem set number 17
Due 2 PM, Thursday, February 27, 2003

Notes about course:

- Homework should be turned in to the TA's mail slot on the first floor of East Bridge.
- Collaboration policy: OK to work together in small groups, and to help with each other's understanding. Best to first give problems a good try by yourself. Don't just copy someone else's work – whatever you turn in should be what you think you understand.
- There is a web page for this course, which should be referred to for the most up-to-date information. The URL:
<http://www.hep.caltech.edu/~fcp/ph195/>
- TA: Anura Abeyesinghe, anura@caltech.edu
- If you think a problem is completely trivial (and hence a waste of your time), you don't have to do it. Just write “trivial” where your solution would go, and you will get credit for it. Of course, this means you are volunteering to help the rest of the class understand it, if they don't find it so simple. . .

READING: Read the “Identical Particles” course note.

PROBLEMS:

80. High energy limit: Do Exercise 7 of the Scattering course note.
81. Consider the graph in Fig. 1.

Assume that the other phase shifts are negligible (*e.g.*, “low energy” is reasonably accurate). The pion mass and energy here are sufficiently small that we can at least entertain the approximation of an infinitely heavy proton at rest – we'll assume this to be the case, in any event. Note that T_π is the relativistic kinetic energy of the π^+ : $T_\pi = \sqrt{P_\pi^2 + m_\pi^2} - m_\pi$.

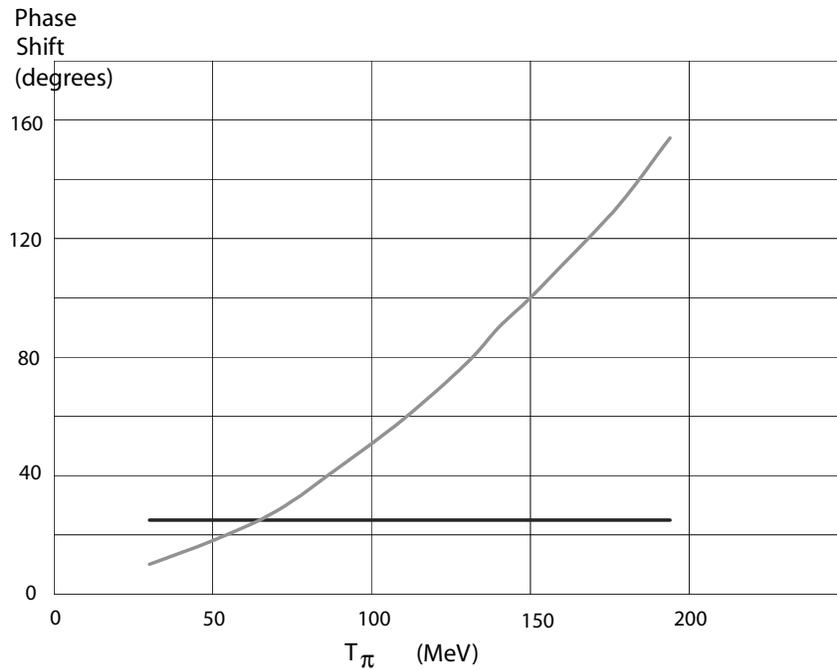


Figure 1: Made-up graph of phase shifts δ_0 and δ_1 for elastic π^+p scattering (neglecting spin).

- Is the π^+p force principally attractive or repulsive (as shown in this figure)?
- Plot the total cross section in mb (millibarns) as a function of energy, from $T_\pi=40$ to 200 MeV.
- Plot the angular distribution of the scattered π^+ at energies of 120, 140 and 160 MeV.
- What is the mean free path of 140 MeV pions in a liquid hydrogen target, with these “protons”?

82. Inelastic scattering: Do Exercise 8 of the Scattering course note.

83. Exclusion principle and atomic states: Do Exercise 1 of the Identical Particles course note.