Physics 195b
Problem set number 18
Due 2 PM, Thursday, March 6, 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 "Electromagnetic Interactions" course note.

PROBLEMS:

84. Extended boson principle and decays to two pions: Do Exercise 2 of the Identical Particles course note.

85. Gauge transformation in electromagnetism: Do Exercise 1 of the Electromagnetic Interactions course note.

86. We discussed the method of stationary phase in class. Recall that the problem it addresses is to evaluate integrals of the form:

$$I(\epsilon) = \int_{-\infty}^{\infty} f(x) e^{i\theta(x)/\epsilon} dx, \tag{150}$$

where f and θ are real, and $\epsilon > 0$. We showed that, in the situation where ϵ is very small, and θ has a stationary point at $x = x_0$, this integral is approximately:

$$I(\epsilon) = \sqrt{\epsilon} f(x_0) e^{i\theta(x_0)/\epsilon} e^{i\frac{\pi}{4} sign(\theta''(x_0)} \sqrt{\frac{2\pi}{|\theta''(x_0)|}} \left[1 + O(\epsilon)\right]. \qquad (151)$$

If there is more than one stationary point, then the contributions are to be summed.

To get a little practice applying this method, evaluate the following integral for large t:

$$J(t) = \int_0^1 \cos\left[t(x^3 - x)\right] dx. \qquad (152)$$

87. In problem 82 you considered the scattering of particles in a multiplet. You determined the total elastic (sometimes called "scattering") cross section and the total inelastic ("reaction") cross sections in terms of the $A^{(\ell)}_{\alpha\beta}$ matrix in the partial wave expansion. Consider now the graph in Fig. 2.

    This graph purports to show the allowed and forbidden regions for the total elastic and inelastic cross sections in a given partial wave ℓ. Derive the formula for the allowed region of this graph. Make sure to check the extreme points.

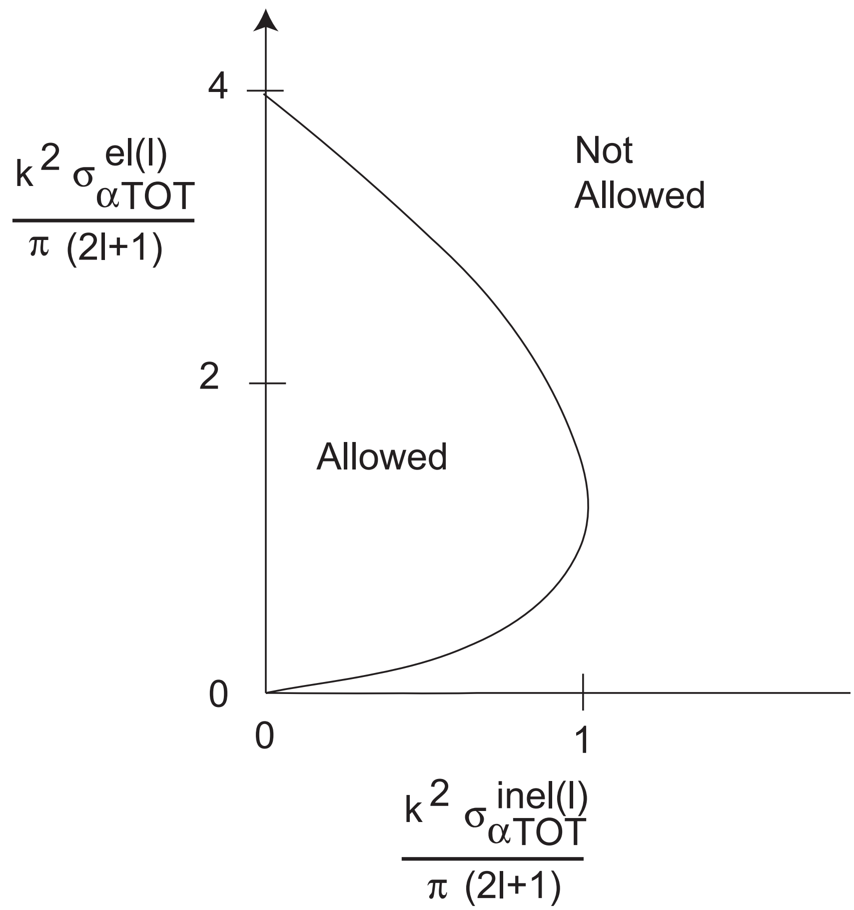

Figure 2: Made-up graph of phase shifts δ_0 and δ_1 for elastic π^+p scattering (neglecting spin).