Joined Physics Analysis Center

Summer Workshop on the Reaction Theory
Exercise sheet 9

Alessandro Pilloni, Andrew Jackura, Misha Mikhasenko, Vincent Mathieu

Contact: http://www.indiana.edu/~ssrt/index.html

June 12 – June 22 To be discussed on Thursday of Week-II.

Quick Quiz

(a) In the full amplitude, can you have singularities on the first sheet? If so, which and where?

(b) Show an example of isospin breaking reaction, involving no photons.

(c) Is the phase of the scattering amplitude unambiguosly determined? Why?

(d) Resonances are poles of the amplitude. However, causality says you cannot have poles. How is this resolved?

(e) Consider the coupled channel system $\pi\pi \to \pi\pi$, $\pi\pi \to KK$, and $KK \to KK$. How many Riemann sheets are there? On what sheets could resonance poles lie?

(f) Consider a simple t-channel exchange $A(s,t) = g^2/(t - M^2)$. Does this amplitude produce cuts? Consider the s-channel partial waves of this amplitude. Does it produce cuts? Which way?

(g) Dalitz plot of the decay $M \to m_1 + m_2 + m_3$, $m_1 > m_2 > m_3$ drawn at the Mandelstam plane (s,t,u). What is the closest point inside the decay kinematic region to the sides of the triangle s=0, t=0, u=0?

(h) Dalitz plot in the Cartesian coordinates m_{12}^2 along x and m_{23}^2 along y. What does a horizontal band indicate?

(i) Consider equation

$$f(x) = 3 + \frac{x^2}{\pi}\int_1^7 \frac{\mathrm{Im} f(x')}{x'^2(x'-x)}\mathrm{d}x'$$

Can it be satisfied? How many subtractions are made in the dispersive relation? Draw the analytic structure of the f(x) in the complex x plane.

(j) How does the cross section changes with energy in the black disc model?

(k) Why there is no left-hand-cut in the case of a form factor $N \to \gamma^* N$?

(l) Consider Regge trajectory $\alpha(t) = \alpha_0 + \alpha' t$? Are there any restrictions on the intercept α_0?

What is the phenomenological intercept of the Pomeron trajectory?

(m) What are the possible $I^G J^{PC}$ quantum numbers of the $\pi^- \eta$ system?