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SIMPLE APPROACH TO THE DETERMINATION OF REGGE-POLES

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In a recent work[1] we have established the following properties of the Regge-pole, determining the high-energy diffraction scattering:

/1/ G.Domokos. ОИЯИ Preprint, D-900 (1962).

1. $L(t)$ analytic in the cut t -plane, the cut running from $t=4$ to infinity.

2. $dL/dt > 0$. 3. $L(0) = 1$.

We add to these the following properties.

4. $Im\,L = O\left((t-4)^{Re\,L(4)+3/2} \right)$ for $t \to 4+0$.[2]

(This follows at once from unitarity and from properties 1. – 3.).

5. The branch point at $t=4$ connects just two sheets of a Riemann surface (because it corresponds to a two-particle-singularity).

6. $L(t) \leq 2$ if $0<t<4$ because experimentally no $I=0$, $J=2$ bound state is observed[2].

/2/ This remark is due to I.Ja.Pomeranchuk (Private communication).

7. There are no bound states with imaginary mass (''Ghost'')

a) It follows from the properties 2. – 6. that

$$Re\,L(4) = 2 .$$

In order to satisfy 1. we represent L as a power series (approximately, as a polynomial) in the variable[3]

$$\eta = -t\,[2+\sqrt{4-t}\,]^{-2} \qquad (1)$$

/3/ C.Lovelace. Diffraction Scattering and Mandelstam Representation, preprint , 1961.

b) For $t=4+0$, the coefficients of $i(t-4)^{1/2}$ ... $i(t-4)^{5/2}$ must vanish. (Cf. property 4) and condition a)).

c) $L(t)>0$ at least in the interval, where the ''elastic'' approximation is to be valid* i.e. $|t| \lesssim 16$ (Cf. property)

This can be achieved by prescribing the value of L at infinity. In our opinion it is natural to choose $L(\infty) = L(-\infty) = 0$. (L must be continuous at infinity).

The requirements a) to c) give six conditions for the coefficients of η^n in the power series of L. Therefore we put

$$L(t) = 1 + \sum_{n=1}^{5} C_n \eta^n \qquad (2)$$

and find a system of five linear equations for the coefficients C_n .

The solution obtained satisfies- of course- the requirements imposed, for $|t| < 16$. L actually passed through zero at about $t \approx -32$, but this point is already outside of the domain of validity of our approximation.

*It is, of course, possible that the residue vanishes where $L(t) = 0$; at present, however, we have no indication for such a behaviour.

Calculating the angular distribution of πN diffraction scattering with the help of formula (2) and eq. (5) of ref.[1] one obtaines a satisfactory agreement with experimental data at 5 and 7 GeV pion energy in the lab. sys.[4] .

4/ E.Fenyves, private communication.

Let us remark that requirement c) seems to play an essential role. If one drops it and approximates L by a polynomial of the fourth degree, then the solution gives $L(\infty) = L(-\infty) = -6$ and a 'ghost' already at $t \approx -9$. Obviously $0 \leq L(\infty) < 1$ and one can hope that by varying its value the ghost can be eliminated at all, and a good agreement with experimental data will be obtained.

There is serious hope that the procedure sketched above can be extended to a general method of obtaining Regge-trajectories.

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