## Spectrum of particles in the $2\to 2$ Veneziano model.

Consider pole expansion of planar amplitude:

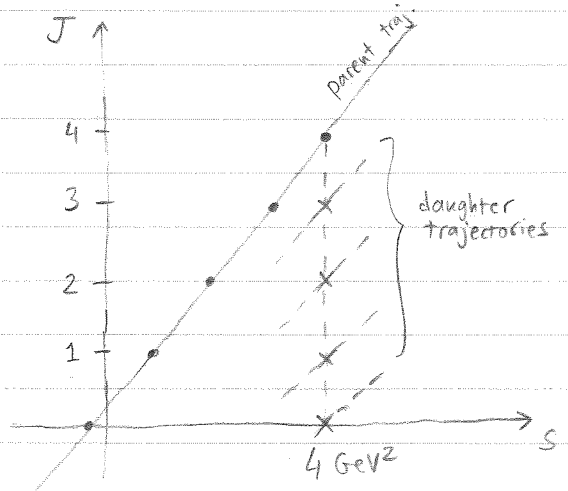
$$B_4(s,t) = \sum_{n=0}^{\infty} \frac{R_n(-\alpha(t))}{n-\alpha(s)} \qquad \alpha(s) = \alpha_0 + \alpha' s \qquad \text{(linear \underline{parent} trajectory)}$$

not the angular momentum.

Note $R_n$ is negative the residue at each pole – best to define it this way.

$R_n(\alpha(t)) \equiv$ polynomial in $\alpha$, and hence in $t$ (and $\cos\theta$).

order of polynomial $= n$ $\leftarrow$ contains spins $J = n, n-1, \ldots 0$.




Suppose at $s \sim 4\,\text{GeV}^2$, $\alpha(s) = 4$.

$\Rightarrow$ then there is a pole in the amplitude at $s \sim 4\,\text{GeV}^2$

$\Rightarrow$ existence of particle of mass $= 2$ GeV,

and spin determined by residue of pole.

$J = 4, 3, 2, 1, 0.$

$$\underline{\deg_J(s) \sim \alpha' \times s}$$

However, if we consider the full amplitude,

$$V = g\left[B_4(s,t) + B_4(s,u) + B_4(t,u)\right]$$

$$= g\sum_{n=0}^{\infty} \frac{R_n(-\alpha(t)) + R_n(-\alpha(u))}{n-\alpha(s)} + \left(\begin{matrix}\text{Regular in}\\ \text{physical } s\end{matrix}\right)$$

Since $z \sim \dfrac{t-u}{s-4m^2}$ [equal mass kinematics]

and $4m^2 \sim s + (t+u)$ [physical cond. constraint]

can write $t \sim \frac{1}{2}(\Sigma + z)$ $\quad u \sim \frac{1}{2}(\Sigma - z)$

Then, the total residue function is even under $z \to -z$ $\Rightarrow$ Residue function of $z^2$ only. <u>Only even spins present</u> (Regge trajectories are <u>even</u> signatured)