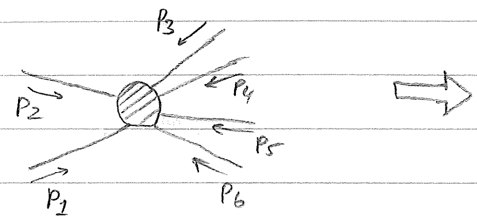
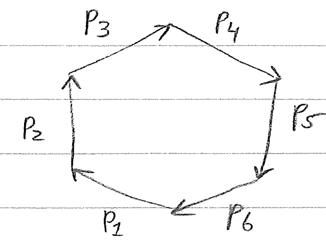
Dual diagrams and overlapping channels

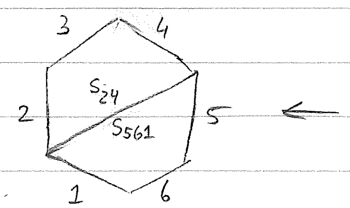
Scattering process:



Dual diagram:



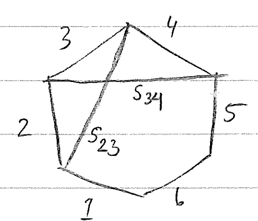
a polygon displaying the conservation of linear momentum.



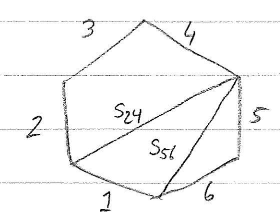
Channel energy: Represented by a diagonal of the polygon.

$$s_{24} = (p_2+p_3+p_4)^2 \equiv (p_5+p_6+p_1)^2 = s_{561}$$

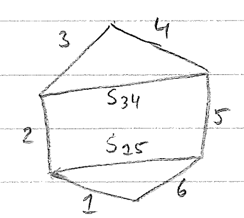
Overlapping channel: Channels whose diagonals cross in the dual diagram. Also called dual channels – they represent the angular variable in one-another's channel.



s_{23} & s_{34} are overlapping



s_{24} & s_{56} are not overlapping



s_{15} & s_{34} are not overlapping (s_{34} is subenergy of s_{15})

Because dual channel energies (like t) represent the <u>angular variable</u> of a direct channel (like s-channel),

No physical amplitude can contain a simultaneous (double, or higher order-) pole in overlapping channel energies. (like s & t).

<u>Reason:</u>

Suppose an amplitude had a pole at $s = m^2$. By factorization,

$$A(s,t,\ldots) \sim \frac{-g^2 P_J(t)}{s - m^2} + \ldots$$

The residue function $P_J(t)$ provides information about the <u>spin</u>: it is a polynomial in t of order J.

If $P_J(t)$, itself had a pole within the physical region,

$$P_J(t) \approx \frac{1}{(t - t_0)},$$

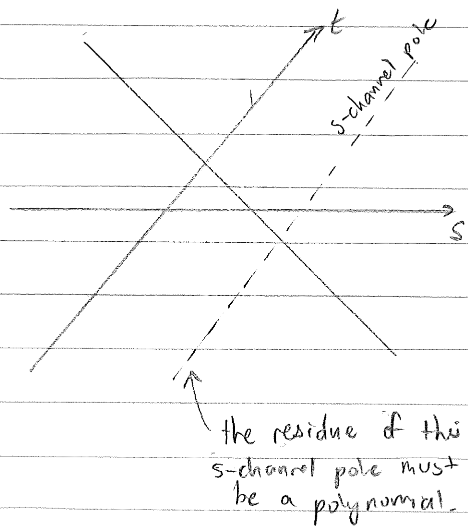
it would no longer be a polynomial in t

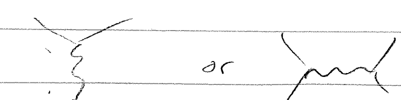
$\Rightarrow$ infinite number of particles of all possible spins.

$A(s,t) \sim \frac{1}{s} + \frac{1}{t}$ <u>ok!</u>

$A(s,t) \sim \frac{1}{st}$ <u>NOT OK</u>.

Feynman diagrams automatically forbid "overlapping poles".





impossible to draw a graph with overlapping poles.