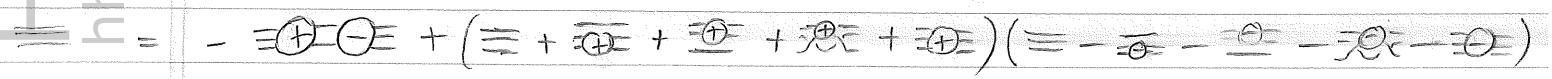
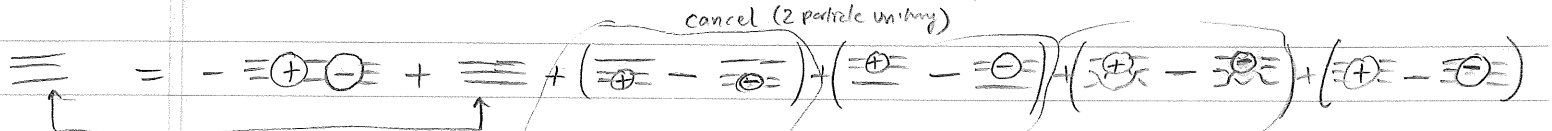
$3 \to 3$ unitarity equation (derivation)

Write:

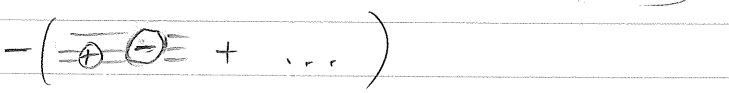
So: unitary eqn is



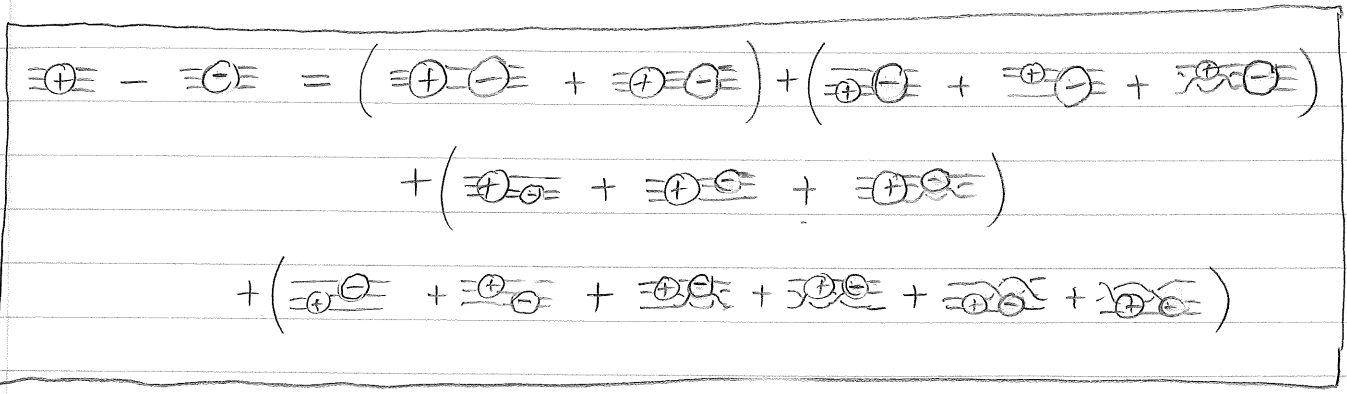
cancel (2 particle unitary)



cancel

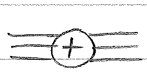


Solve for  :



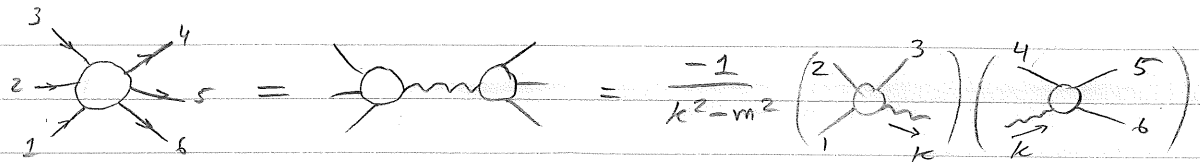
Factorization property of scattering amplitudes

So, what we have is



$$= iA_{123\to 456} = iA_{12\to 3k}\frac{i}{k^2-m^2+i\epsilon}iA_{k4\to 56} + (\text{regular})$$

$$\Rightarrow \quad A_{123\to 456} = \frac{-1}{k^2-m^2}A_{12\to 3k}A_{k4\to 56} + (\text{regular})$$



$$= \frac{-1}{k^2-m^2}$$

The amplitude "falls apart" into a product of two amplitudes at the pole.
i.e. the residue of the pole factorizes into $A_{12\to 3k}$ & $A_{k4\to 56}$.