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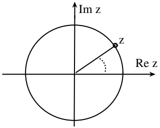
JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

BOCHVM · RVHR-VNIVERSITAT

Branch point

- let $z = |z|e^{i\phi}$
- two numbers $|z|$ and ϕ define points on the complex energy plane



- $z = |z|e^{i\phi} = |z|e^{i(\phi+2\pi)}$
- two solutions $(\xi_1)^2 = z$, $(\xi_2)^2 = z$
- first branch $\xi_1 = \sqrt{|z|}e^{\frac{i}{2}\phi}$:
  domain of definition of function ξ_1: $\phi = 0 ... 2\pi$
- second branch $\xi_2 = \sqrt{|z|}e^{\frac{i}{2}\phi}$:
  domain of definition of function ξ_2: $\phi = 2\pi ... 4\pi$

$\pi^+ p \to \pi^+ p$ below $2\pi N$ threshold

Scattering amplitude with Δ

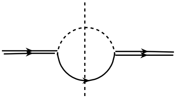
$$T = -\frac{\Gamma_{\pi NN^*}\,\Gamma_{\pi NN^*}}{E^2 - m^2 + i\Sigma(g_{\pi NN^*}, E)}$$

Optical theorem(unitarity)

$$Im T_{\pi^+ p \to \pi^+ p} \sim \sigma_{\rm tot}^{\pi^+ p \to \pi^+ p}(\sqrt{s})$$

$$\Sigma(g_{\pi NN^*}, E) > 0$$

$$\Sigma(g_{\pi NN^*}, E) \sim g^2_{\pi NN^*}\frac{k(E)}{E}$$



$$k(E) = \frac{\sqrt{(E^2 - (m_\pi + m_N)^2)(E^2 - (m_\pi - m_N)^2)}}{2E}$$

pole on the second Riemann sheet $E_{\rm pole} = m - i\Gamma/2$