Threshold decay mode detection

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Dyson resummation gives

$$\Delta(p^2) = \frac{i}{p^2 - M_0^2 + \Pi(p^2)},$$

where the self-energy $\Pi(p^2)$ contains the sum of 1PI loop integrals. Following the "real on-shell" renormalisation convention, the propagator is

$$\Delta(p^2) = \frac{i}{p^2 - M^2 + \Pi(p^2)} = \frac{iZ}{p^2 - M^2 + iZ\,\mathrm{Im}\,\Pi(p^2) + O((p^2 - M^2)^2)},$$

where the real on-shell mass M and the field-strength renormalisation Z satisfy

$$\begin{aligned} M^2 &= M_0^2 - \mathrm{Re}\,\Pi(M^2), \\ Z^{-1} &= 1 + \mathrm{Re}\left[\frac{d\Pi(p^2)}{d(p^2)}\right]_{p^2=M^2}. \end{aligned}$$

(Particles near threshold ref. here) The imaginary part of the denominator of the propagator is related to the particle's total decay width Γ, where

$$M\Gamma = Z\,\mathrm{Im}\,\Pi(M^2).$$

Because of unitarity, this definition of decay width coincides with the definition given by the scattering amplitude with one initial state.

One of the alternative definition... Pole mass $= M_p - \frac{i}{2}\Gamma$... But more than one pole or zero pole (depend on the choice convention), so we don't use this definition. Maybe some pole trajectory plot here?