Contribution ID: **30** Type: **not specified**

Scattering amplitude and effective range expansion with complex potential

Thursday, April 3, 2025 12:30 PM (20 minutes)

Since most hadrons are unstable, we study nature of hadrons using complex potentials. In general, an eigenmomentum of the system is expressed as a pole of the scattering amplitude that is analyticaly continued to the complex momentum plane. Bound states are described by real potentials and their pole appears on the positive imaginary axis. By using complex potentials, we can describe unstable quasibound states with a decay width.
In this study, to investigate the effect of the decay width on the transition from bound state to resonance, we calculate the trajectory of the pole of the scattering amplitude varying the real part of the potential. In addition, we compare the position of the pole obtained exactly with that estimated by the effective range expansion and discuss the validity of the effective range expansion. We discuss these results also from the viewpoint of coupled channel potential models with the explicit decay channel.

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Session Classification: Parallel Session (A)