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The σ resonance as a bound, virtual bound and resonant estate.

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We determine, from Lattice QCD, the elastic $\pi\pi$ scattering amplitude in the isoscalar $I = 0$ channel, and the σ resonance. We extract its lineshape for two different quark masses corresponding with $m_\pi \sim 283$ and 330 MeV; where it is predicted that this state transitions from bound to virtual bound. In order to provide an accurate picture we use a high statistics volume for the heavier pion mass, and two for the lighter. The comparison between the two masses showcases very different lineshapes for the phase shifts. This is related to the different behavior of the σ resonance for these values of its quark mass dependence.

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