Contribution ID: **68** Type: **Contributed talk**

Elastic nucleon-pion scattering at $m_\pi = 200\ \mathrm{MeV}$ from lattice QCD

Thursday, 18 January 2024 09:50 (30 minutes)

Elastic nucleon-pion scattering amplitudes are computed using lattice QCD on a single ensemble of gauge field configurations with $N_\mathrm{f} = 2 + 1$ dynamical quark flavors and $m_\pi = 200$ MeV. The s-wave scattering lengths with both total isospins $I = 1/2$ and $I = 3/2$ are inferred from the finite-volume spectrum below the inelastic threshold together with the $I = 3/2$ p-wave containing the $\Delta(1232)$ resonance. The amplitudes are well-described by the effective range expansion with parameters constrained by fits to the finite-volume energy levels, enabling a determination of the $I = 3/2$ scattering length with statistical errors below 5\%, while the $I = 1/2$ scattering length is somewhat less precisely evaluated. Systematic errors due to excited states and the influence of higher partial waves are controlled, providing a step toward future computations down to physical light quark masses with multiple lattice spacings and volumes.

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