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Hadron scatterings in small chemical potential

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We discuss hadron scatterings in zero temperature and small chemical potential (μ). First, we derive the dispersion relation of a single hadron from the Euclidean-time dependence of the 2-point correlation function. It is found that the energy has linear behavior with respect to μ. We then formulate the HAL QCD method in small μ, where we extract scattering amplitudes via the interaction potentials. It indicates that the amplitude is independent of μ for any scattering unless the spontaneous breaking occurs. Furthermore, we demonstrate this conclusion by analyzing S-wave scatterings of two pions with isospin $I = 2$ and two scalar diquarks in two-color QCD using lattice simulation. The results of the scattering amplitudes in different chemical potentials agree with each other, which is consistent with our conclusion.

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