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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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