Contribution ID: **226** Type: **Contributed talk**

Can femtoscopic correlation function shed light on the nature of the lightest, charm, axial mesons?

Monday, 8 July 2024 17:55 (20 minutes)

There seem to exist two lightest axial mesons with charm whose masses are very similar but the associated widths and other properties are different. These mesons are denominated as D1(2430)D1(2430) and D1(2420)D1(2420). Although two mesons with similar masses are expected to exist, with such quantum numbers, within the traditional quark model, as we discuss the description of their decay widths and other properties requires contributions from meson-meson coupled channel scattering. We present the amplitudes obtained by solving the Bethe-Salpeter equations which unavoidably lead to the generation of two axial resonances when mesons are considered as the degrees of freedom in the model. One of them is narrow and has properties in good agreement with those of D1(2420)D1(2420). The other pole is wider, but not wide enough to be related to D1(2430)D1(2430). Its position (mass) also does not match well with that of D1(2430)D1(2430). The situation improves when a bare quark-model state is included. Further, we calculate the scattering lengths for different channels and compare them with the available data from lattice QCD. Using arguments of heavy quark symmetry, we discuss possible differences between the scattering lengths coming from the lattice QCD calculations for the $D\pi D\pi$ and $D^*\pi D^*\pi$ systems and the preliminary experimental data from the ALICE Collaboration on the $D\pi D\pi$ system. We present two models, which can produce compatible properties for the two lightest D1D1 states but result in different scattering lengths: one in agreement with the findings of lattice QCD and the other in agreement with the estimation obtained using the $D\pi D\pi$ results from the ALICE Collaboration. We present the correlation functions for both cases and discuss how femtoscopic physics can shed light on this issue.
(e-Print: 2312.11811 [hep-ph])

session

G. Heavy Ion Physics

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Session Classification: G. Heavy Ion Physics