Contribution ID: **267** Type: **Parallel Talk**

Search for isoscalar axialvector $bc\bar{u}\bar{d}$ tetraquark bound states

Monday, 31 July 2023 14:30 (20 minutes)

The study of doubly heavy tetraquarks has gained substantial topical interest, primarily boosted by the recent discovery of doubly charmed tetraquark T_{cc} and by its phenomenological prospects. While T_{cc}^{+} is observed to be $\sim$0.4 MeV below the DD^* threshold, multiple lattice calculations point to a deep binding ($\mathcal{O}(100MeV)$) in T_{bb}. However, the predictions for the binding in T_{bc} are scattered. We report a lattice study of DB^*-BD^* scattering in the isoscalar axial-vector channel with the explicitly exotic flavor $bc\bar{u}\bar{d}$. The simulation is performed on four $N_f = 2+1+1$ MILC gauge ensembles with different lattice spacings and volumes. The DB^* scattering amplitudes are extracted from the low-lying finite-volume spectra following the amplitude analysis {\it \'a la} L\"uscher. The light quark mass ($m_{u/d}$) dependence of the continuum extrapolated amplitudes is analyzed to determine the fate of the $bc\bar{u}\bar{d}$ at the physical $m_{u/d}$. We find strong evidence for a bound $bc\bar{u}\bar{d}$ tetraquark at physical $m_{u/d}$ in this channel. We also determine the critical $m_{u/d}$ at which such a state becomes unbound.

Topical area

Hadronic and Nuclear Spectrum and Interactions

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Session Classification: Hadronic and Nuclear Spectrum and Interactions