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Diquark properties from lattice QCD

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The idea of diquarks as effective degrees of freedom in QCD has been a successful concept in explaining certain low lying QCD states. Recently they have also played an important role in studying doubly heavy tetraquarks in phenomenology and on the lattice. The first member of this family of hadrons is the T_{CC} , newly discovered at LHCb. However, diquarks are colored objects and this has hampered ab initio, lattice calculations in the past. Here we present a study that resolves this issue and report on the properties of diquarks in a gauge-invariant formalism with quark masses down to almost physical pion masses in full QCD. We broadly confirm the diquark-diquark as well as diquark-quark mass splittings estimated phenomenologically. Going further we find attractive quark-quark spatial correlations only in the “good” scalar channel with $\bar{3}_F, \bar{3}_C, J^P = 0^+$ quantum numbers and we observe that the good diquark shape is spherical. From the spatial correlations in the good diquark channel we extract a diquark size of ~ 0.6 fm. Our results provide quantitative support for modelling certain QCD states using good light diquark effective degrees of freedom.

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