



Contribution ID: 49

Type: **not specified**

Exotic tetraquarks with some heavy quarks in lattice QCD

Saturday 29 October 2022 09:30 (30 minutes)

We review all the different direct and indirect approaches that lattice QCD has been employing to study multi-quarks, focusing in the tetraquarks with heavy quarks. We also briefly review the experimental progress in observing tetraquarks, and the most representative models of tetraquarks, comparing them with the results of lattice QCD.

Since the discovery of quarks and the development of the QCD theory, there has been a large interest in exotic hadrons, initiated by the tetraquark models developed by Jaffe in 1974. In the new millennium, this interest exploded with several experimental discoveries of tetraquark resonances with heavy quarks, starting with the Z_c and Z_b .

Moreover there is a second class of tetraquarks such as the T_{bb} , boundstates in the sense of having no strong decays. Very recently, the narrow T_{cc} tetraquark first predicted with quark models in 1982 by Richard et al, was observed experimentally.

Lattice QCD, being a first principle approach to solve non-perturbative QCD, has been crucial not only to compute precise results, but also to motivate and inspire research in hadronic physics, with particular interest in exotic hadrons. So far, lattice QCD has not yet been able to comprehend the Z class of tetraquarks, while it predicted the T class of tetraquarks. New methods are being developed to determine the masses, decay widths and decay processes of tetraquarks.

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