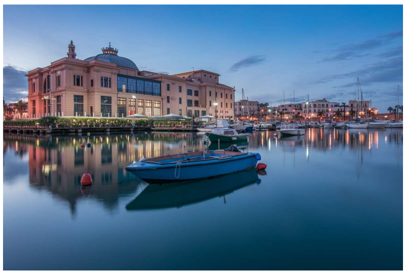

Contribution ID: **24**

Type: **not specified**

The X(3872) puzzle: insights from its radiative decays

Wednesday 12 November 2025 14:45 (13 minutes)

Exotic hadron spectroscopy plays a crucial role in deepening our understanding of the confining regime of Quantum Chromodynamics (QCD). The discovery of the $X(3872)$ in 2003 by the Belle collaboration marked a turning point in hadron physics, as it represented the first strong candidate for an exotic meson beyond the conventional quark model. To date, the internal structure of the $X(3872)$ remains elusive, and several competing theoretical interpretations are still under investigation. These include a standard charmonium state ($c\bar{c}$), a compact tetraquark configuration ($c\bar{c}q\bar{q}$), and a loosely bound $D^0\bar{D}^{*0}$ molecular state.

One of the most sensitive observables to probe the inner dynamics of this state is the ratio $\mathcal{R}$ between the branching fractions of its radiative decays: $X(3872) \to J/\psi\,\gamma$ and $X(3872) \to \psi'\,\gamma$. Several theoretical works have shown that the value of $\mathcal{R}$ is highly dependent on the underlying structure and wavefunction of the $X(3872)$. Recently, the LHCb collaboration has provided the most precise measurement of this ratio to date, offering a stringent test for competing models.

In this talk, I will present a theoretical framework for computing the mass spectrum of compact tetraquarks using the Born-Oppenheimer approximation. This method allows for the separation of the dynamics of heavy quarks ($c\bar{c}$) from those of the light quark pair ($q\bar{q}$), adapting a technique well-known in QED to the non-perturbative regime of QCD. We will discuss how this approximation can be applied to a confining theory like QCD, and compare our predictions with known exotic candidates listed in the PDG.

Moreover, this approach enables the construction of internal quark wavefunctions within the hadron, which proves essential for calculating $\mathcal{R}$. I will show how these theoretical predictions compare with experimental data from LHCb and with expectations from alternative theoretical models.

Author: GERMANI, Davide (Sapienza Università di Roma & Istituto Nazionale di Fisica Nucleare)

Presenter: GERMANI, Davide (Sapienza Università di Roma & Istituto Nazionale di Fisica Nucleare)

Session Classification: Young Scientific Forum