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Analyzing the $D^*D^*D^*$ system: Hexaquark states and the Efimov effect

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When two particles form a nearly resonant bound state due to short-range attractive forces, an effective long-range three-body emerges giving rise to an infinite number of three-body bound states with a discrete scale invariance. This phenomena, called *Efimov effect*, was first described in the 1970's by V. Efimov [1]. The Efimov effect has been mostly studied in atomic physics, due to its experimental observation in Cesium atoms in 2006 [2]. However, its relevance has also been explored in nuclear physics, e.g., in the ^{12}C three-α structure, the triton formation or the nuclear halo of ^{14}Be, ^{22}C and ^{20}C nuclei.

The existence of three-body bound states and its low-energy universality in the charm and bottom sectors has been explored in the recent literature, specially since the discovery of the $X(3872)$ state, a loosely-bound $D^{*\,0}\bar{D}^0$+*h.c.* molecule with quantum numbers $J^{PC}=1^{++}$. The properties of the $X(3872)$, unfortunately, rule out the existence of the Efimov effect [3]. However, the recent discovery in 2021 of the T_{cc}^+ [4] can renew this interest.

In this talk I will analyze the $D^*D^*D^*$ system in the $J^P=0^-$ sector with $I=\frac{1}{2}$, assuming that the isoscalar heavy partner of the T_{cc}^+, dubbed T_{cc}^*, exists close and below the D^*D^* threshold. I find that $(I)J^P=(\frac{1}{2})0^-$ three-body bound states can be formed, with properties that suggest that the Efimov effect can be realised for reasonable values of the molecular probability and binding energy of the T_{cc}^* [5].

[1] V. Efimov, Phys. Lett. B **33** (1970), 563-564.

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[3] E. Braaten and M. Kusunoki, Phys. Rev. D **69** (2004), 074005.

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[5] P.G. Ortega, arXiv:2403.10244 [hep-ph].

session

B. Hadron Spectroscopy

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