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Observation of a family of all-charm tetraquarks with spin-2 and positive parity

We present a detailed spin-parity analysis of near-threshold structures in the fully-charm tetraquark sector, using a matrix-element-based approach applied to the J/\psi J/\psi \rightarrow 4\mu final state. Based on the full Run-2 dataset from the CMS experiment, multiple JˆP hypotheses are tested using kinematic distributions of the four-muon system. A set of spin-parity combinations, JˆP = 0ˆ+, 0ˆ-, 1ˆ+, 1ˆ-, 2ˆ+, 2ˆ-, is considered. The primary analysis uses decay-only observables, while production angular distributions are also examined to test consistency with a polarized initial state. The result establishes the quantum numbers C = +1, P = +1, and J = 2 as the most likely configuration, offering strong constraints on the nature of fully-charm tetraquark states. Besides, complementary studies with both Run 2 and Run 3 data based on the J/\psi J/\psi and J/\psi \psi(2S) \rightarrow 4\mu final states were also conducted, revealing consistent spectral structures associated with the observed resonances.

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