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Elliptic anisotropy measurement of the f0(980) hadron in proton-lead collisions and evidence for its quark-antiquark

Despite the f0(980) hadron having been discovered half a century ago, the question about its quark content has not been settled: it might be an ordinary quark-antiquark meson, a tetraquark exotic state, a kaon-antikaon molecule, or a quark-antiquark-gluon hybrid. We report strong evidence that the f0(980) state is an ordinary quark-antiquark meson, inferred from the scaling of elliptic anisotropies (v2) with the number of constituent quarks (nq), as empirically established using conventional hadrons in relativistic heavy ion collisions. The f0(980) state is reconstructed via its dominant pi-pi decay channel, in proton-lead collisions recorded by the CMS experiment at the LHC, and its v2 is measured as a function of transverse momentum (pT). It is found that the nq = 2 (quark-antiquark state) hypothesis is favored over nq = 4 (tetraquark or molecule states) by 7.7, 6.3, or 3.1 standard deviations in the pT < 10, 8, or 6 GeV/c ranges, respectively, and over nq = 3 (quark-antiquark-gluon hybrid state) by 3.5 standard deviations in the pT < 8 GeV/c range. This result represents the first determination of the quark content of the f0(980) state, made possible by using a novel approach, and paves the way for similar studies of other exotic hadron candidates.

session

G. Heavy Ion Physics

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