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η and η' mesons from $N_f = 2 + 1$ lattice QCD at the physical point using topological charge operators

We present the first lattice QCD determination of both the eta and eta' masses as well as the mixing angle theta_1 by using topological charge operators. The calculation employs two state-of-the-art gauge ensembles both with physical quark masses. We obtain m_{\eta} = 0.546(43)(5) GeV, $m_{\eta'}$=0.941(54)(50) GeV, and $\theta_1 = -11.7(2.5)(1.6)°$. Compared with conventional studies using quark bilinear operators, our mixing angle defined by the topological charge operators has remarkably high precision. These results provide critical inputs for understanding the flavor symmetry breaking and the $U_A(1)$ anomaly. It also demonstrates that the topological charge operators are well suited to study the η and η' mesons.

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