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Comparison between two-quark, tetra-quark and molecular states of the sigma meson from lattice QCD

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Our purpose is to obtain insights of structure of the sigma meson from lattice QCD. At present we do not reach a conclusive understanding of nature of the sigma meson. Currently it is considered as a usual two-quark state, four-quark states such as a tetra-quark and mesonic molecules or superposition of them. At present we do not reach a conclusive understanding of nature of the sigma meson. Besides, the mixing with glueballs is one of important and interesting ingredients for structure of the sigma meson. Furthermore, a disconnected diagram of the sigma meson plays an important role in the structure of the sigma meson. However, to evaluate the disconnected part of the propagator is not an easy task in lattice QCD calculation. To compute the disconnected part of the propagator, we use the Z2 noise method with the truncated eigenmode acceleration and the time dilution for estimating the all-to-all quark propagators. Here, we compare between two-quark, tetra-quark and molecular states in the sigma meson. An advantage state in the sigma meson will be discussed.

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