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Disconnected contributions to hadronic processes

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The evaluation of so-called disconnected diagrams in Lattice Quantum Chromodynamics (QCD) calculations of hadronic processes has been computationally challenging and expensive. These disconnected diagrams, which are fermionic Wick contraction diagrams involving quark propagators beginning and ending at the same time coordinates, are noisy and the extraction of lattice information from them is difficult. We show how effective field theory (EFT) can be used to understand the quantitative influence and relevance of these disconnected contributions in important lattice calculations of hadronic processes. We use Partially Quenched Chiral Perturbation Theory (PQChPT) to separate the connected and disconnected contributions for, firstly, pion-pion scattering, and then combine it with Lüscher's formalism to relate the theoretical predictions to lattice data. We then show how this technique can be applied towards a better understanding of the pion-nucleon sigma term, which is a crucial element in numerous new physics searches and experiments.

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