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QCD sum rules for D and B mesons in a strongly interacting medium

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Collaboration

Abstract content

Mesons with open charm or bottom, such as D or B mesons, represent the "hydrogen problem" of QCD. QCD sum rules provide a tool to get access to the $\bar{Q}q$ and $\bar{q}Q$ bound states, where $q = u, d$ and $Q = c, b$. Medium modifications of such states are of particular interest since they offer an opportunity to study the change of the complex QCD ground state. Within QCD sum rules, there is a direct impact of QCD condensates on the spectral properties of mesons. Most notable are changes of the chiral condensate and the gluon condensate which are related to chiral symmetry breaking and scale invariance breaking, respectively. The operator product expansion of qQ mesons in a medium up to mass dimension 5 is extended here to four-quark condensate contributions of mass dimension 6. A complete catalogue of four-quark condensates in the qQ sector is presented. Four-quark condensates on the one hand proofed to be of utmost numerical importance in other meson sum rules, in particular for the ρ meson, and on the other hand they contain chirally odd contributions providing insight into the breaking patterns of chiral symmetry, which we are going to investigated by means of Weinberg-type sum rules. The calculation of associated Wilson coefficients from tree-level diagrams is performed for interpolating currents of chiral partner mesons, i.e. scalar, pseudo-scalar and vector, axial-vector mesons. Numerical results showing the impact of four-quark condensate contributions are presented. Medium modifications of qQ meson properties are of relevance for RHIC and LHC heavy-ion collisions as well as for the envisaged experiments at FAIR.

Primary author(s) : BUCHHEIM, Thomas (Helmholtz-Zentrum Dresden-Rossendorf)

Co-author(s) : HILGER, Thomas (University of Graz); KÄMPFER, Burkhard (Helmholtz-Zentrum Dresden-Rossendorf and TU Dresden)

Presenter(s) : BUCHHEIM, Thomas (Helmholtz-Zentrum Dresden-Rossendorf)

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