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Heavy hadron systems in a magnetic field

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Quantum chromodynamics (QCD) in a strong magnetic field is one of the most exciting topics in hadron physics. In relativistic heavy-ion collision experiments performed in RHIC and LHC, it is predicted to be produced a strong magnetic field by non-central collision of charged nuclei. In particular, hadron properties under such external field can be drastically modified by perturbative and non-perturbative effects.

In this study, we investigate theoretically the properties of heavy hadrons (especially, D mesons) including a charm quark in a magnetic field by using some theoretical approaches such as the QCD sum rules and effective models.
From our approaches, we can predict the D meson mass shifts by magnetic effects such as the Landau level for a charged particle, the mixing effect between different hadron states and magnetic field dependence of condensates. Technically, in the QCD sum rules, the OPE up to the order of the square of magnetic field is calculated and the magnetic field dependences of condensates are taken from the recent results of lattice QCD or effective field theory. For the phenomenological side, we introduce a new structures induced by a magnetic field to go beyond the analysis by (conventional) "pole + continuum" assumption.

As a result, we discuss some magnetic properties of the hadrons induced by a magnetic field, such as Landau level of the charged meson, mixing effect with other hadron states and magnetic field dependence of QCD condensates. Furthermore, we discuss comparison with recent indications from the lattice QCD and experimental possibilities.

On behalf of collaboration:

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