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Heavy Quarkonia in magnetized matter –effects of (inverse) magnetic catalysis

The partial decay widths of charmonium (bottomonium) states to DDbar (B Bbar) mesons in magnetized (nuclear) matter using a field theoretical model of composite hadrons with quark (and antiquark) constituents. These are computed from the mass modifications of the decaying and produced mesons within a chiral effective model, including the nucleon Dirac sea effects. The Dirac sea contributions are observed to lead to a rise (drop) in the light quark condensates (given in terms of the scalar fields in the chiral effective model) as the magnetic field is increased, an effect called the (inverse) magnetic catalysis. These effects are observed to be significant and the anomalous magnetic moments (AMMs) of the nucleons are observed to play an important role. For ρB=0, there is observed to be magnetic catalysis (MC) without and with AMMs, whereas, for ρB = ρ0, the inverse magnetic catalysis (IMC) is observed when the AMMs are taken into account, contrary to MC, when the AMMs are ignored. In the presence of a magnetic field, there are also mixings of pseudoscalar (P) and vector (V) meson (PV mixing) which modify the masses of these mesons. The heavy Quarkonia mass shifts in the magnetized matter modify the radiative decay widths (Γ(V ⟶ P γ)), in addition to modifying the decay widths of heavy Quarkonia to open heavy flavor mesons. The magnetic field effects on the heavy quarkonium decay widths should have observable consequences on the production the heavy flavor mesons, which are created in the early stage of ultra-relativistic peripheral heavy ion collisions, at RHIC and LHC, when the produced magnetic fields can still be extremely large.

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