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Quarkonium physics in heavy ion collisions and its open quantum system description

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The theory of elementary particles (Standard Model) predicts the existence of a new state of matter at extreme temperatures ($\sim 10^{12}$ K): the Quark-Gluon Plasma (QGP). The QGP is mainly composed of "free" quarks and gluons, the elementary components of baryonic matter usually confined into nucleons. It may have filled the Universe up to few milliseconds after the Big Bang and can be, in theory, re-produced in high energy heavy ion colliders. The expected life-time ($\sim 10^{-21}$ s) and size ($\sim 10^{-15}$ m) of the QGP "drops" created in these experiments are really small, making its study a great challenge. First evidences of QGP production were reported by the CERN SPS in 2000 and is, since then, under deep investigation. It was f.i. shown to be a nearly perfect fluid and its hadronisation almost statistical. One of the main QGP signature and probe beyond this hadronisation is the suppression of the quarkonia (heavy quark/antiquark bound states), i.e. a decrease of their detected production in comparison to proton-proton collisions in which no QGP is possible or significant. This suppression was predicted as a consequence of deconfinement enabling a temperature dependent "Debye" screening of the tightly bound quarkonia. The present communication gives an overview of quarkonium physics in heavy ion collisions with a special focus on the open quantum system treatment of their dynamics, an interdisciplinary framework recently applied by various authors of this field.

Choix de session parallèle

1.3 Physique nucléaire: physique hadronique et QCD

Primary author: KATZ, Roland (subatech)

Co-authors: GOSSIAUX, Pol Bernard (subatech); GOUSSET, Thierry (Subatech); DELORME, Stéphane (subatech)

Presenter: KATZ, Roland (subatech)

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