

Laboratory/research team

Laboratoire Leprince-Ringuet, École polytechnique / LHCb Heavy ions

Title

Quark gluon plasma: study of color screening as a signature of the phase transition, with the LHCb experiment.

Overview of the research:

At the end of 2015, the LHCb collaboration has recorded the first collisions induced by the LHC proton and lead beams on fixed target (gaseous targets). Such data will allow a thorough test, for the first time, of the color screening mechanism predicted by lattice QCD (when producing a Quark Gluon Plasma in heavy ion collisions).

The LHCb detector is optimized for heavy flavor measurements. In particular, it allows extremely accurate measurements of bound states such as D mesons, J/ψ , ψ' and χ_c considered as very sensitive probes for quark gluon plasma studies.

Thanks to the LHCb SMOG system (System for Measuring Overlap with Gas), initially intended for luminosity measurement, noble gases such as He, Ne, Ar, can be injected inside the vertex detector VELO (Vertex Locator). Acting as "fixed targets" for the LHC beams, they give access to proton-nucleus and nucleus-nucleus collisions at optimum energy to study the phase transition from normal nuclear matter to a Quark Gluon Plasma. LHCb has recorded p-Ar data at $\sqrt{s} \sim 110$ GeV in 2015 (<http://cds.cern.ch/record/2255650>), p-He data at $\sqrt{s} \sim 87$ GeV in 2016 and will record a p-Ne run at $\sqrt{s} \sim 87$ GeV in december 2017. This type of data has never been recorded before and is the first of this kind within LHCb.

Thesis project

The proposed thesis will be the first performed on such data. It can include:

- A participation in the analysis of the data which will be recorded during the 2017 runs (p-Ne collisions). We will first study J/ψ and ψ' production (via their dimuon decay channel) and D^0 and \overline{D}^0 mesons (via their πK decay channel).
- A leading role in the analysis of χ_c production which will require more effort due to the larger background (χ_c measurement via the $J/\psi + \gamma$ channel).
- A participation in the 2018 Pb-nucleus run data-taking and analysis.

The interpretation of these data in the context of phenomenological work in close relationships with theorists may, depending on the tastes of the student, be an important part of the thesis project.

Finally, the PhD student will participate in the dissemination of these results in publications and international conferences.

Master and doctoral school

- Master 2 in particle physics
- PHENIICS doctoral school – Université Paris-Saclay

Local team

Experimentalists :

Heavy ions: Frédéric Fleuret (LLR), Emilie Maurice (LLR), Patrick Robbe (LAL), Michael Winn (LAL), Yanxi Zhanj (LAL)

Luminosity: Vlasdislav Balagura (LLR)

Theorist : François Arleo (LLR)

Contact

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