QUARK MATTER 2015
Sep. 27 – Oct. 3, 2015 Kobe, Japan

Contribution ID: **144** Type: **Poster**

Heavy-flavor dynamics in relativistic proton-nucleus and nucleus-nucleus collisions

Tuesday 29 September 2015 16:30 (2 hours)

Heavy-flavor hadrons serve as valuable probes for the quark-gluon plasma (QGP): low transverse momentum (p_T) heavy quarks provide important information about thermal properties of the system, while high p_T heavy quarks provide a reference to quantify the in-medium modification. We establish a comprehensive framework to describe the full heavy flavor evolution in heavy-ion collisions: the QGP medium is described in a (3+1)-dimensional viscous hydrodynamics model, the dynamics of heavy quarks are studied in an improved Langevin framework incorporating both radiative and collisional energy loss, and the hadronization of heavy quarks is described with a hybrid model of fragmentation and recombination.\\

In this talk, we present first calculations of heavy flavor energy loss and collective behavior in p+Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV. The Nuclear modification factor shows a centrality dependence: in the untra-central collisions, in-medium energy loss leads to suppression of heavy quarks; while cold-nuclear-matter effects are dominant in mid-central to peripheral collisions. The comparison between the elliptic flow of mesons and light charged hadrons indicates an incomplete coupling of heavy quarks with the medium due to the reduced temperature and medium size. We propose to use centrality dependence of the observables in p+Pb collisions in order to disentangle hot-nuclear-matter effects from cold-nuclear-matter effects. In addition, we go beyond the typically studied systems in heavy-ion collisions and focus on small systems (Cu+Cu collisions at $\sqrt{s_{NN}}$ = 200 GeV) and on a lower collisional energy (Au+Au collisions at $\sqrt{s_{NN}}$ = 62.4 GeV). Looking at the nuclear modification factor and collective flow of D and B mesons, we are able to quantify the QGP modifications to heavy quark over the entire p_T range: suppression at high p_T, and collective behavior as well as signs for partial thermalization at low p_T.

On behalf of collaboration:

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Session Classification: Poster Session

Track Classification: Open Heavy Flavors and Strangeness