A detailed study of open heavy flavor production, enhancement, and suppression at RHIC.

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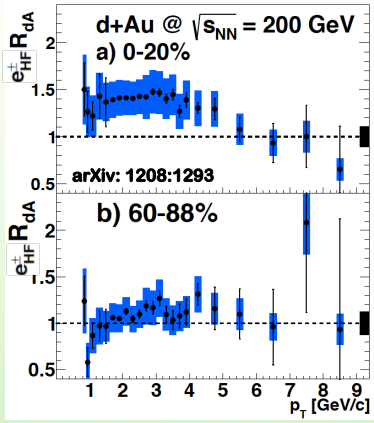
The flexibility of the beam species available at the Relativistic Heavy Ion Collider has enabled the PHENIX Collaboration to examine open heavy flavor production across a wide range of temperature, energy density, and system size. Charm and bottom production in *p+p* collisions, which is dominated by gluon fusion, is largely consistent with FONLL pQCD calculations. New analysis techniques have extended the momentum coverage and provide constraints on the bottom cross section. Measurements in *d*+Au collisions exhibit a strong cold nuclear matter Cronin enhancement of electrons from *D* mesons, which is roughly consistent with the mass-dependence observed for the lighter π, *K*, and *p* families. This also shows that the nuclear baseline for interpreting Au+Au data is significantly modified from the *p+p* shape. Collisions of Cu nuclei provide a crucial intermediary testing ground between the small *d*+Au collision system and the large Au+Au system, and show how the cold nuclear matter enhancement is overtaken by competing hot nuclear matter suppression as the system size increases towards the most central Au+Au collisions.

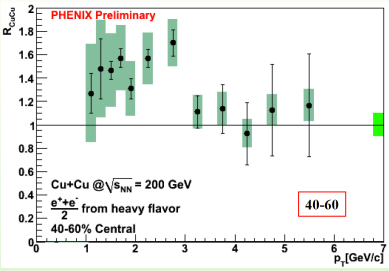
Open Heavy Flavor Enhancement: d+Au, Cu+Cu



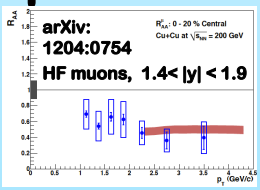
Significant Cronin enhancement in d+Au collisions at RHIC is observed for electrons from the decays of hadrons containing a single charm or bottom quarks.

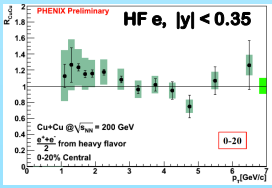
Enhancement is most apparent in the charm-dominated region of the electron spectrum, while no effects are apparent in bottom dominated region.
-Possibly implies a different magnitude of CNM effects on D and B mesons

Similar enhancement effects are seen in peripheral Cu+Cu collisions



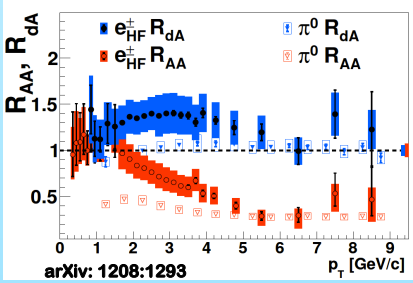
Open Heavy Flavor Suppression: Cu+Cu, Au+Au





Heavy flavor electrons in central Cu+Cu collisions, while not suppressed relative to p+p, are suppressed compared to peripheral Cu+Cu collisions.
-Indicates that competing hot nuclear matter effects become significant at large N_{coll}.

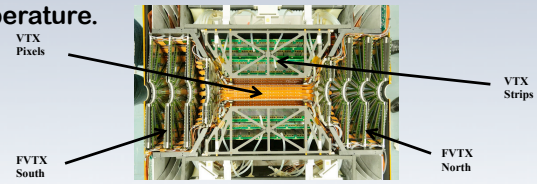
At forward rapidity, muons from heavy flavor decays are suppressed in central Cu+Cu collisions.
-Different cold nuclear matter effects (possibly due to the modified nPDF) dominate at forward rapidity.



Significant differences in R_{dA} between light mesons and heavy flavor meson decay electrons could indicate that the initial state of light and heavy flavors in A+A collisions are quite different. This modified initial state possibly contributes to the observed differences in light and heavy flavor R_{AA}.

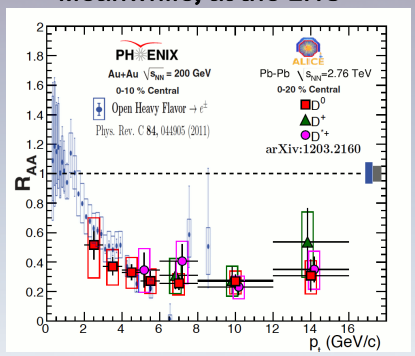
Outlook

Heavy Flavor is even more interesting (and complicated) than we ever thought:
- Strong initial state effects visible in d+Au.
- Initial state Au+Au spectra is highly modified from p+p.
- Strong suppressing effects are due to hot medium.
- Interesting interplay between enhancement and suppression as a function of rapidity, system size, and temperature.



With upcoming VTX/FVTX/HFT measurements, we enter a new precision era of heavy flavor at RHIC

Meanwhile, at the LHC



- Similar suppression for reconstructed D mesons at ALICE and HF electrons at PHENIX.
- Similar CNM effects? Addressed by p+Pb.