Measurements of Open-charm Hadrons in Heavy-ion Collisions by the STAR experiment

Jan Vanek for the STAR collaboration

NUCLEAR PHYSICS INSTITUTE,
CZECH ACADEMY OF SCIENCES

57. International Winter Meeting on Nuclear Physics, Bormio, Italy

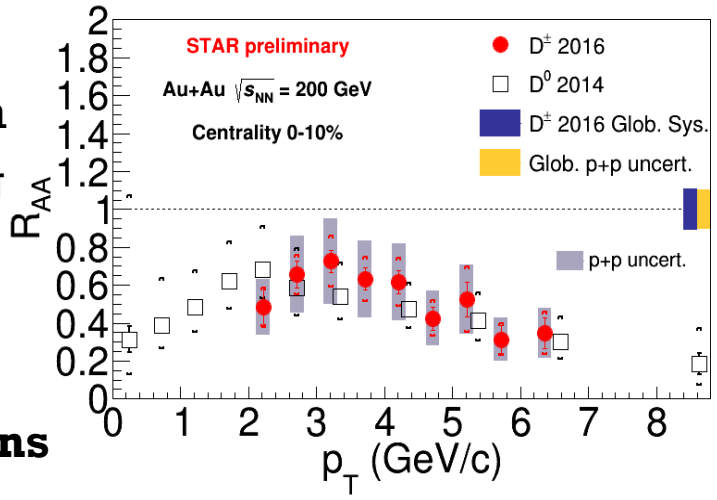
21. 01. 2019

ENERGY LOSS OF CHARM QUARKS IN THE QGP

- At RHIC energies, charm quarks are produced predominantly through partonic hard scatterings
- They experience the whole evolution of the system
- Energy loss in the medium can be quantified using the nuclear modification factor:

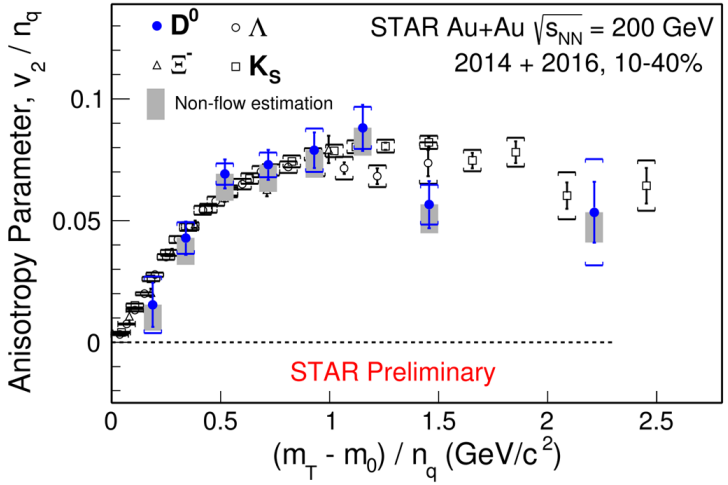
$$R_{AA}(p_T) = \frac{dN_D^{AA}/dp_T}{\langle N_{coll}\rangle\, dN_D^{pp}/dp_T}$$

- **D^0 and $D^{\pm}$ suppressed in central Au+Au collisions**



CHARM QUARK DIFFUSION COEFFICIENT

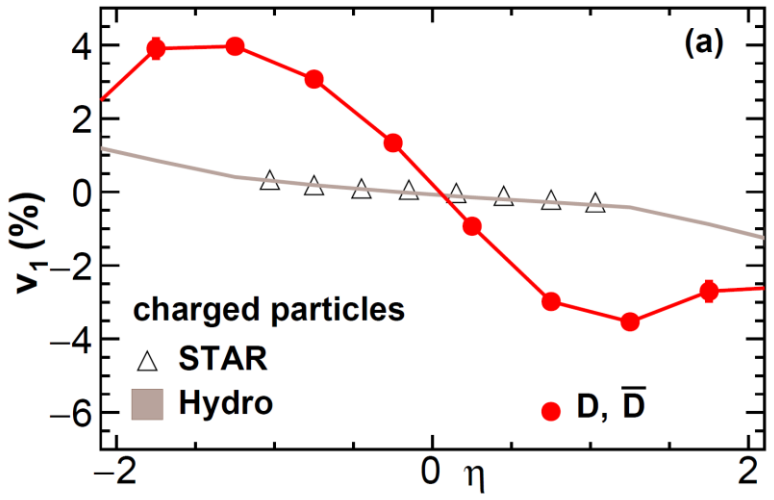
- More information about charm quark interaction with the QGP can be accessed by measurement of elliptic flow (v_2) of open-charm mesons
  - Interactions of charm quark with the QGP (transport coefficient)
  - Level of thermalization of charm quarks in the QGP
- **Suggests strong interactions of the charm quarks with the QGP and that charm quarks acquire similar flow as light flavor quarks**

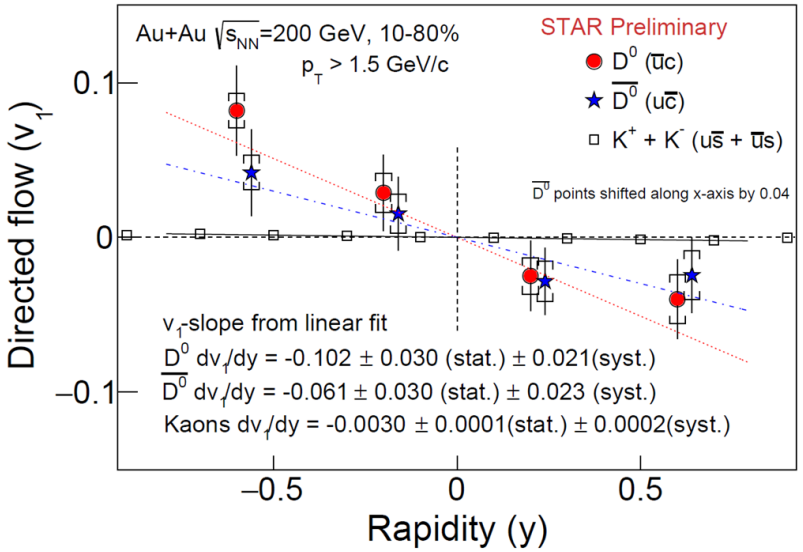


INITIAL TILT OF THE BULK AND INITIAL EM FIELD

- Directed flow (v_1) of open charm mesons probes:
  - The mismatch between the initial longitudinal density profiles of the bulk and heavy flavor quark production
    - Larger v_1 slope with respect to rapidity predicted for open-charm hadrons than for light flavor hadrons
  - EM field induced by the passing spectators
    - Opposite slopes for c and $\bar{c}$ containing hadrons
- Insufficient precision to conclude about the EM induced splitting
- **Approximately 20 times larger v_1 for D^0 than for kaons.**

Phys. Rev. Lett. 120, 192301

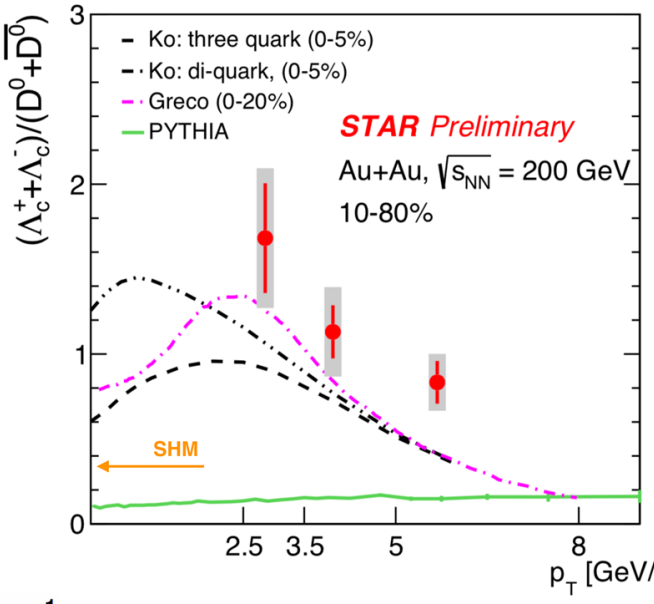


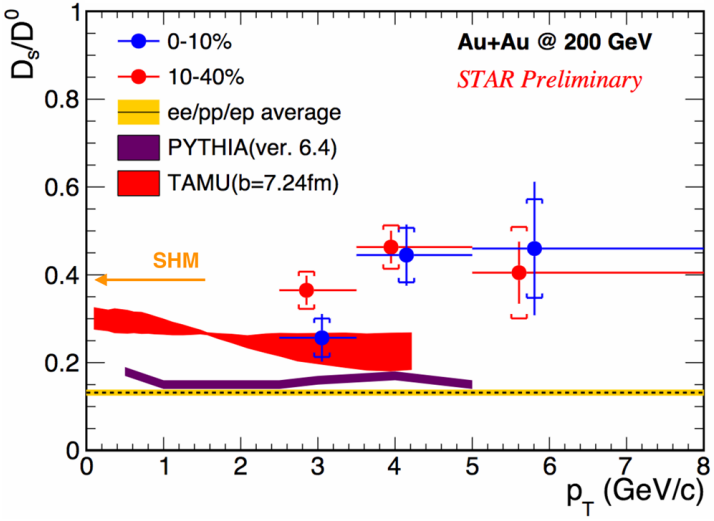


Kaons (STAR): PRL 120, 062301 (2018).

CHARM QUARK HADRONIZATION

- Measurement of various open-charm hadron species can help with understanding the hadronization process
- Production of Λ_c
  - Baryon/meson ratio for heavy quarks
  - Coalescence vs. fragmentation hadronization
- Production of D_s
  - Strangeness enhancement
  - Coalescence vs. fragmentation hadronization
- **Λ_c/D^0 ratio shows significant enhancement in Au+Au collisions with respect to PYTHIA**
- **D_s/D^0 is enhanced in Au+Au collisions possibly due to strangeness enhancement with respect to PYTHIA and elementary collisions, and due to coalescence hadronization**





Ko: Phys.Rev.C 79 (2009) 044905
Greco: Eur.Phys.J.C (2018) 78:348
SHM: Phys.Rev.C 79 (2009) 044905
ep/pp/ep avg: EPJ C 76, 397 (2016)
TAMU: PRL 110, 112301 (2013)

THANK YOU FOR ATTENTION, MORE ON DETAILS ON MY POSTER