Studying the medium behavior of the dilute system in d+Au collisions in PHENIX

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Ridge at RHIC

Ridge appears in central Au+Au collisions, and extend to $|\Delta \eta| \sim 4$

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(b) Au+Au 0-30% (PHOBOS)

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Ridge at LHC

- Ridge appears at high multiplicity pp/pPb collisions
- The ridge looks like a v2 structure
What about d+Au at RHIC?

- A relatively simple system compare to Au+Au
- A slightly more complicated system than pPb
- A much lower energy than LHC (0.2 TeV vs 5.02 TeV)

- Can we see $v2$ in dAu?
- Can we see ridge in dAu?
Lessons from previous experience

• From the experience of LHC:
  – We need to select high multiplicity events

• From measuring $v_2$ in Au+Au collisions:
  – The medium in d+Au is thin, the non-flow contribution is strong
  – Need to remove the non-flow contribution as cleanly as possible
Measuring dAu $v_2$/ridge in PHENIX

- Use two-particle correlation method
  - Both particles fall in central arm acceptance
  - $0.48<|\Delta \eta|<0.7$
- Select most central d+Au collisions (0-5%)
- Use peripheral d+Au collisions (50-88%) as a proxy for non-flow contributions
- After subtracting the non-flow contribution, extract the Fourier coefficients
Correlation functions in d+Au

- $0.48 < |\Delta \eta| < 0.7$
- Use ZYAM to subtract the underlying background
- The per trigger yield correlation in 0-5% d+Au collisions is larger than d+Au 50-88%
- After subtracting 50-88%, the remaining correlation function has a $v_2$-like shape
$c_2 \ (c_3) \ vs \ p_T$

- $c_n = v_n^A \ast v_n^B$
- Significant $c_2$, and $c_2$ increases with $p_T$
- $c_3$ is consistent with 0, basically no $c_3$ (or $v_3$) contribution in dAu!
• $v_2$ increases with $p_T$
• $v_2$ in d+Au agrees well with hydro calculations up to 2 GeV
• $v_2$ in d+Au (@200 GeV) > $v_2$ in p+Pb (@ 5.02 TeV)
\( v_2/\varepsilon_2 \) vs 1/S dN/d\( \eta \)

- \( v_2/\varepsilon_2 \) in Au+Au (@200GeV) roughly follows the Pb+Pb trend (@ 2.76 TeV) in 1/S dN/d\( \eta \)
- d+Au roughly follows the trend
Central-forward (backward) correlation

- The multiplicity distributions in d+Au collisions are asymmetric
- Measure the two-particle correlations of one particle at mid-rapidity (with central arm spectrometer, \(|\eta|<0.35\)) and another particle at forward calorimeter (with Muon Piston Calorimeter, \(3.1<|\eta|<3.9\))
Central-forward (d-going side)

- When correlated with d-going side, there is no local maximum in correlations at $\Delta \phi \sim 0$
- The correlation is dominated by $c_1$ contribution
Central-backward (Au-going side)

- When correlated with Au-going side, there is significant correlations at $\Delta \phi \sim 0$
- The nearside correlation decreases when moving to peripheral d+Au collisions
- $c_1$ and $c_2$ are comparable in central d+Au collisions
Summary

- d+Au $v_2$ is measured via two particle correlation method in PHENIX
- The $v_2$ value is consistent with hydro calculations
- $v_3$ is consistent with 0
- When particles at mid-rapidity are correlated with particles at forward rapidity on Au-going side, a near-side correlation has been observed, where no correlation is seen in d-going side