High-p_T π^0 production with respect to the reaction plane in $\sqrt{s_{NN}}$= 200 GeV Au+Au collisions at PHENIX

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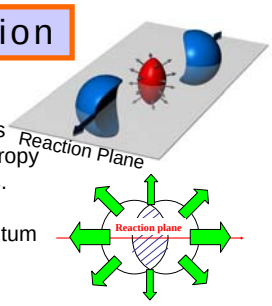
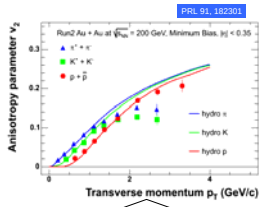
Introduction

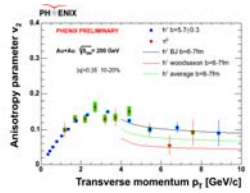
- Non-central collisions lead to spatial anisotropy of produced particles.
- This gives rise to anisotropy in momentum space…





At low p_T, hydro models have successfully described the anisotropy parameter v_2, but….

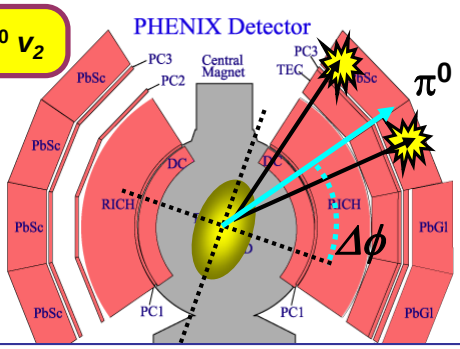
…understanding source of significant non-zero v_2 (esp in terms of energy loss of jets) is an area of active study



Studies of in-medium energy loss:
- Gyulassy, Vitev, Wang (Phys.Rev.Lett.86:2537,2001)
- Shuryak (Phys.Rev.C66:027902,2002)
- Drees, Feng, Jia (Phys.Rev.C71:034909,2005)
- These are just a few examples…

Method

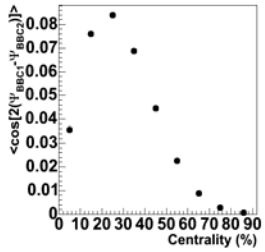
π^0 v_2



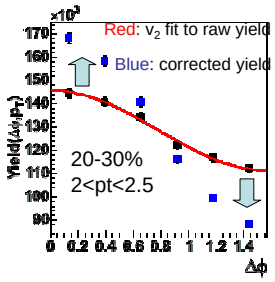
- Find reaction plane with PHENIX Beam-Beam counter
- Measure π^0 yield vs angle relative to reaction plane, $\Delta\phi$
- Correct for measured reaction plane resolution.

6 bins (from 0 to $\pi/2$) in $\Delta\phi = \phi - \Psi$
Fit with 2nd term in Fourier expansion of anisotropy

$$\frac{dN}{d\phi} \propto 1 + 2v_2 \cos 2(\phi - \Psi_R)$$



Resolution estimated from two independent Beam-Beam Counter measurements of Ψ



Corrected yields and v_2

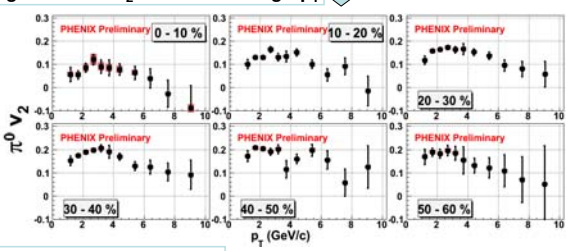
π^0 Suppression vs. $\Delta\phi$

Using inclusive R_{AA} measurements, we can extract R_{AA} as a function of $\Delta\phi$.

$$R_{AA}(p_T,\Delta\phi) = \frac{\text{Yield}(p_T,\Delta\phi)}{\text{Yield}(p_T)} \times R_{AA}(p_T)$$

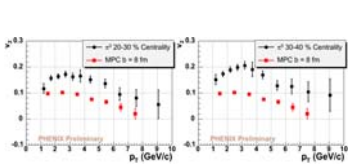
Results & Discussion

Significant π^0 v_2 observed at high p_T

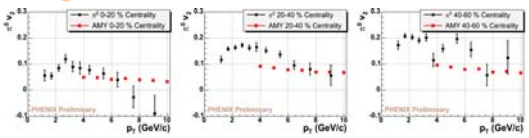


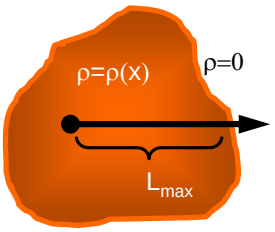
Comparison with models

MPC(nucl-th/0503051)
- Corona effects, E-loss via interactions, p_T boost



AMY (JHEP 0305:51 2003)
- E-loss at high p_T





As a parton propagates a distance L_{max} through the medium of density ρ, how much energy is lost?

Energy loss in GLV formalism:

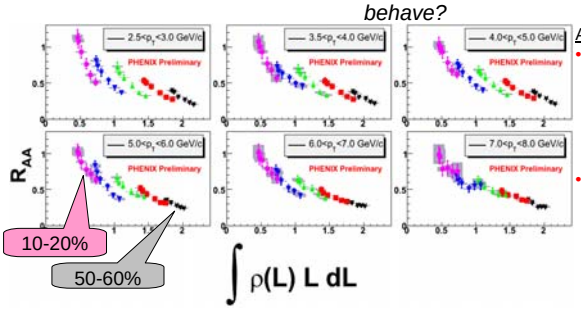
$$\Delta E_{QCD} \propto \int_0^{L_{max}} \rho(L) L dL \quad \left\{ = \rho_0 L^2 \text{ for constant density } \rho_0 \right\}$$

Using Bjorken 1D expansion where:

$$\rho(x,\tau) = \rho(x,\tau_0)\tau_0/\tau$$

$$\Delta E_{QCD} \propto \int_0^{L_{max}} \frac{\rho(x,\tau_0)\tau_0 L}{\tau_0 + L} dL$$

Question: *How does the dependence of R_{AA} on this quantity behave?*



Answer:
- **Low p_T** single geometric description not sufficient to describe suppression
- **High p_T**: R_{AA} collapses to universal dependence

Summary:
- We observe non-trivial π^0 v_2 at p_T up to 10 GeV/c
- (High-)p_T dependence of v_2 consistent with energy loss models
- Suppression (R_{AA}) universal dependence on "ρLdL" geometric picture at high p_T strongly suggests energy loss as dominant mechanism
- Is E-loss collisional? Radiative? What is the role of flow & recombination (at high p_T)? These measurements can provide valuable input to such study.

Further Reading/Presentations:
- M. Shimomura (Poster Session)
- K. Miki (Poster Session)
- V. S. Pantuev (Parallel 2.2)
- Eur.Phys.J.C43:271-280,2005
- nucl-ex/0609019

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