Duke Physics

Single inclusive suppression and intra-jet correlations @ LHC

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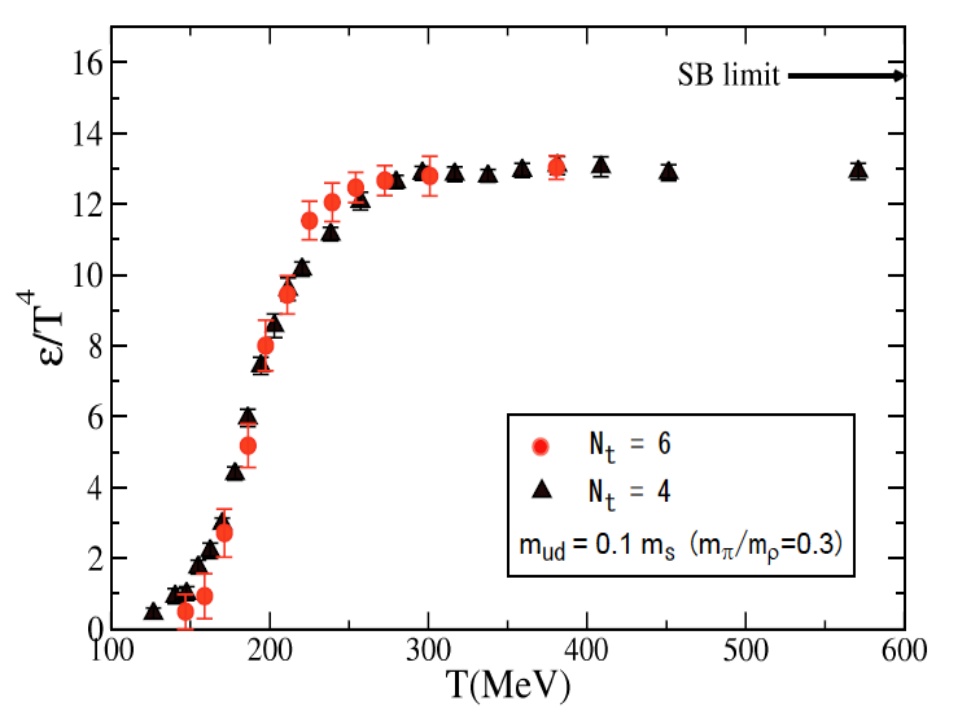
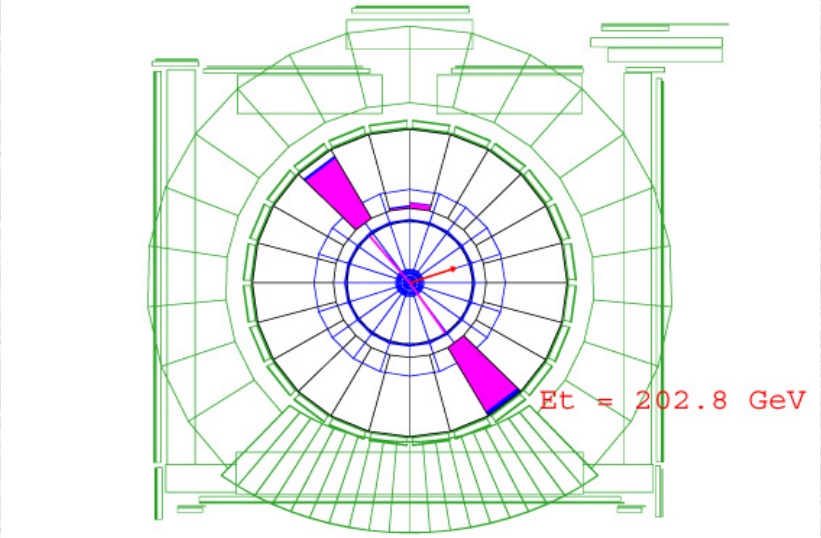
Extrapolating from RHIC to LHC

- *The matter is denser*
- *T_{init} @LHC ~ 2 T_{init} @RHIC*
- *More flow !*
- *Will ideal Hydro work ?*

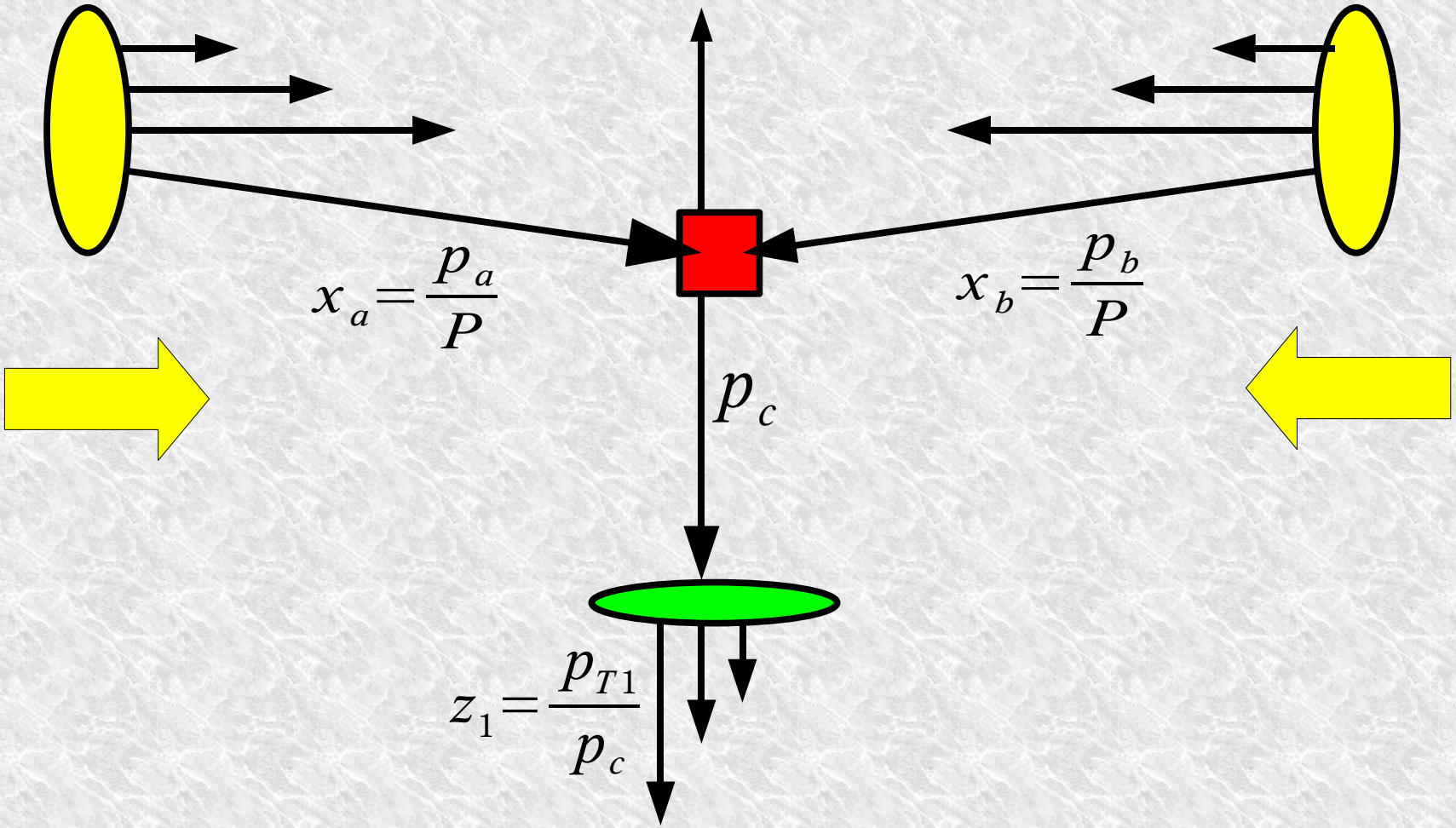


- *Lots of jets for sure!*
- *Very high energy jets*
- *Multi-particle analysis*



Baseline

A factorized approach for hard jets

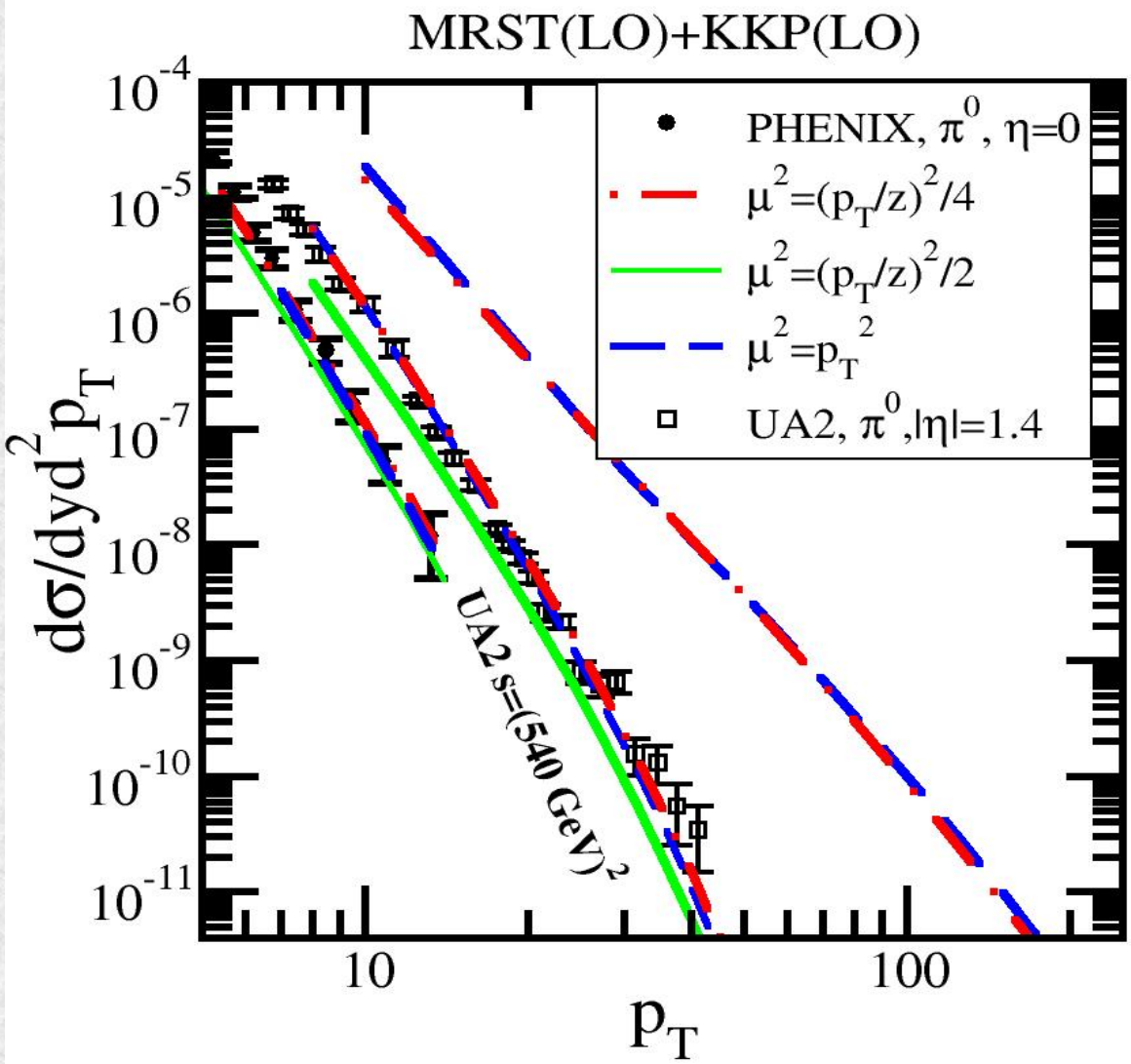


$$\frac{d\sigma^{h_1}}{dy\,dp_{T_1}} \sim \int dx_a\,dx_b\; G(x_a)\; G(x_b)\; \frac{d\hat{\sigma}}{d\hat{t}}\; D_q^{h_1}(z_1)$$

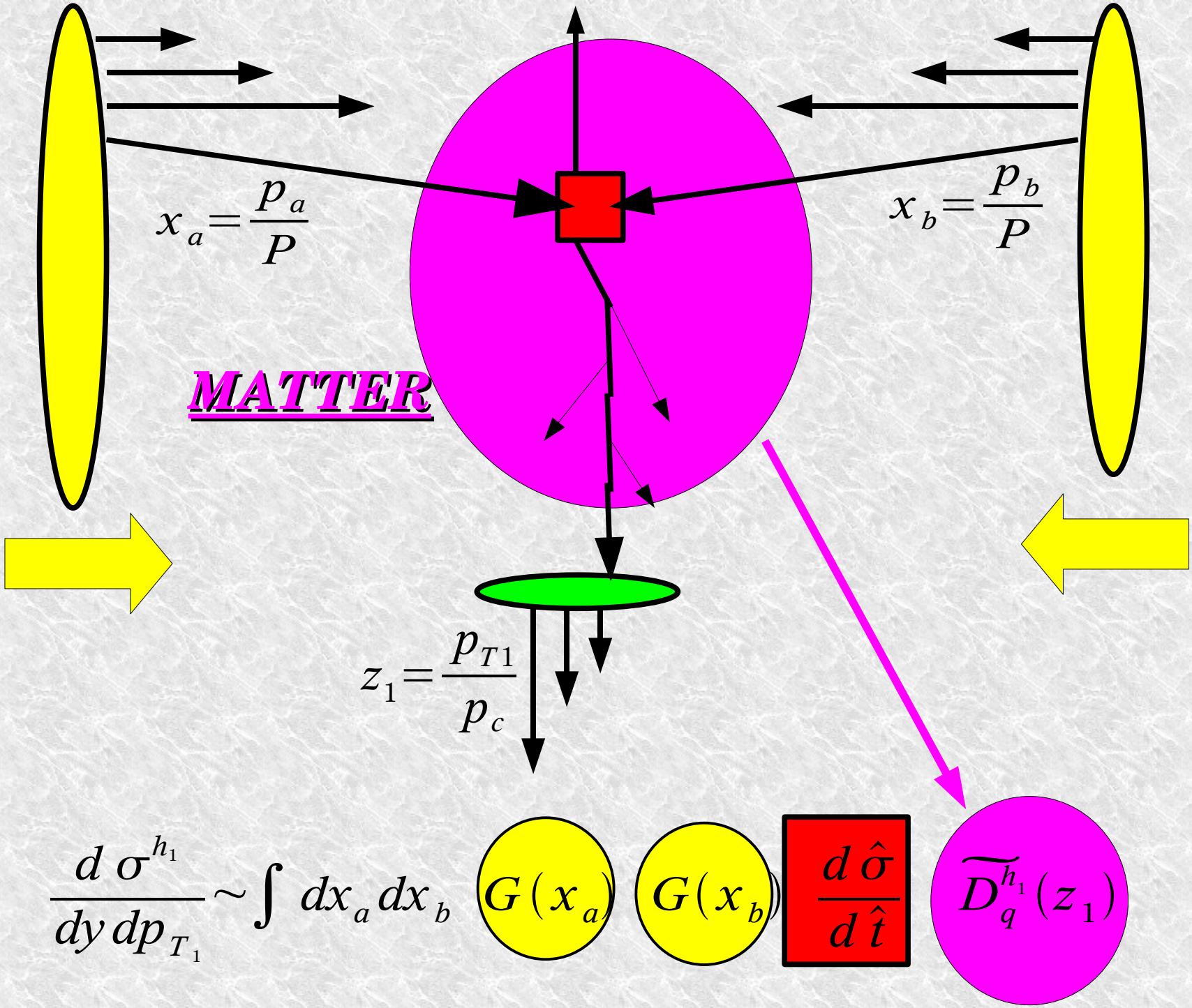
The p-p baseline @ LO

Exploring RHIC and UA2 with a K=2, LO calculation,

Good control over predictions

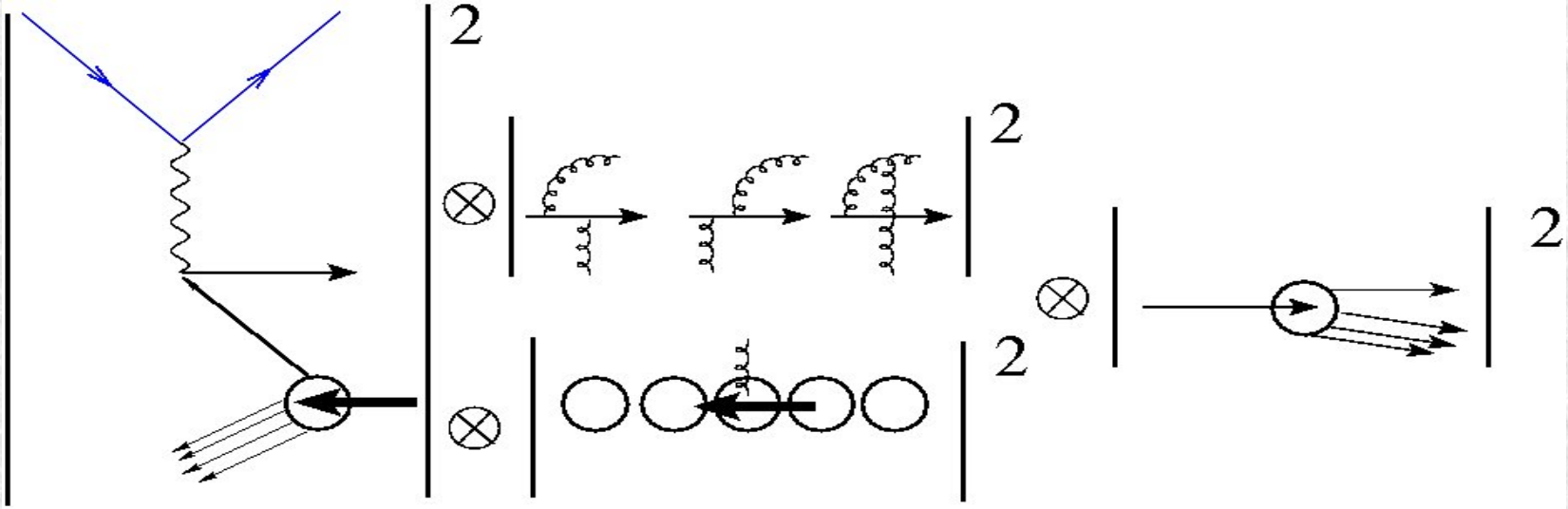


Factorized approach for hard jet modification



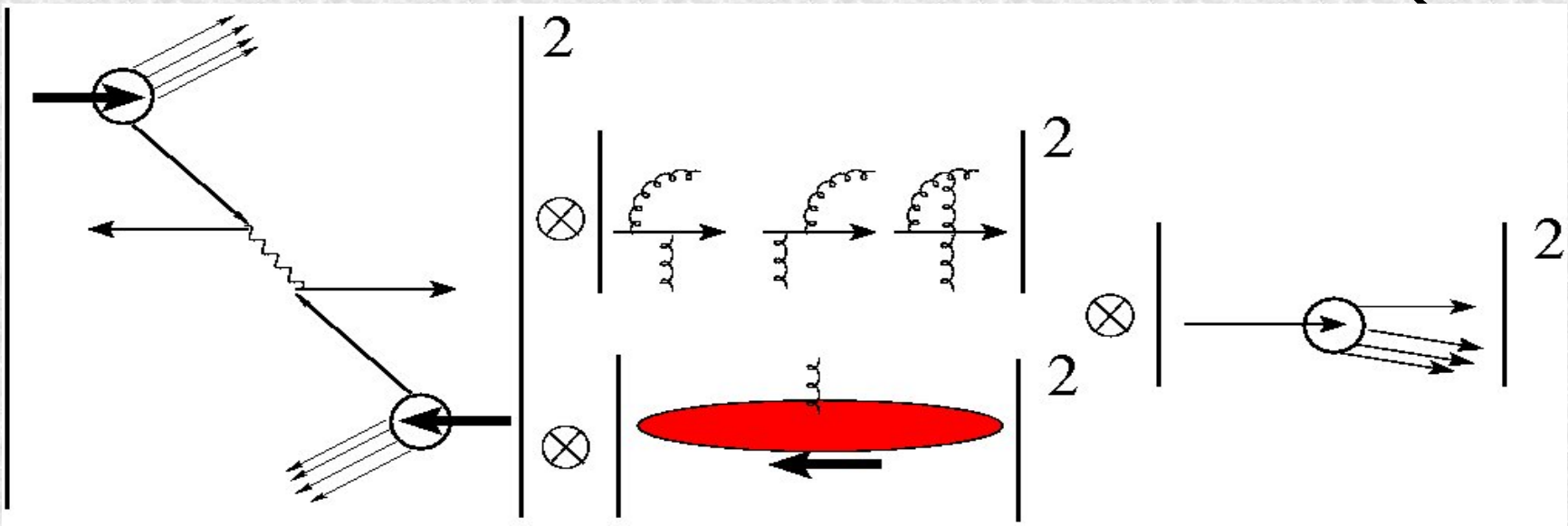
Generalized factorization

A-DIS



$$A F(p/p_h) d\sigma_{e^- + q \to q + e^-} \qquad L \int dt \left\langle F^{\mu\alpha}(t) v_\alpha F^{\beta}_{\mu}(0) v_\beta \right\rangle \qquad \sigma_T \propto \frac{A^{1/3} \mu_H^2}{Q^2}$$

Au-Au



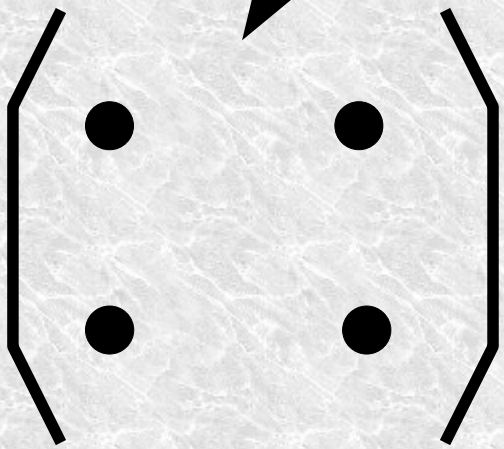
Guo, Wang, NPA 696:78, 2001. Majumder, EPJC 43, 259, 2005.

$\hat{q}$ is a multidimensional object

$$\hat{q} = \frac{p_\perp^2}{\zeta} = \frac{2\pi^2 \alpha_s C_R}{N_c^2 - 1} \int dt \left\langle F^{\mu\alpha}(t) v_\alpha F^\beta_\mu(0) v_\beta \right\rangle$$

$$\hat{q}^{\mu\nu} = \hat{q}_0 f^{\mu\nu}(\underbrace{x, y, z, t, \gamma_{flow}}_{\text{Medium parameters}}; \mu^2, p_{jet})$$

Jet parameters



Need to make up models for the space time dependence

How does the jet see the medium

How does $\hat{q}$ *depend on the bulk properties of medium*

$$\hat{q} \sim \epsilon^{3/4}$$

BDMPS,ASW, Renk,

$$\hat{q} \sim T^3$$

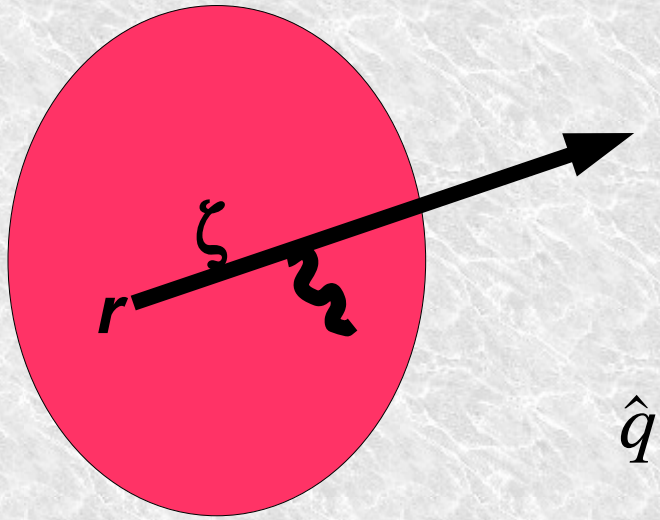
A.M., B. Mueller and X.N.Wang, hep-ph/0703082

$$\hat{q} \sim \frac{dN}{dy}, s$$

GLV, DGLV, WHDGLV

$\hat{q}$ *In deconfined phase* ***vs.*** $\hat{q}$ *In hadronic phase*

Need a dynamical model of the medium to get the evolution of bulk properties



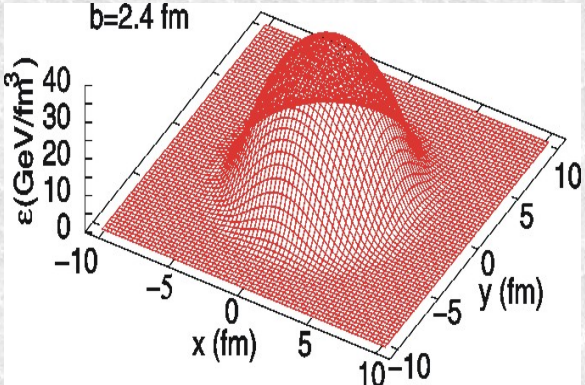
Model for qhat!

$$\hat{q}=\frac{p_\perp^2}{\zeta}=\frac{2\pi^2\alpha_s C_R}{N_c^2-1}\int dt\left\langle F^{\mu\alpha}(t)v_\alpha F^{\beta}_{\mu}(0)v_\beta\right\rangle$$

1) A functional form: $\hat{q}(\vec{\zeta})=\hat{q}_0\frac{\zeta_0}{\zeta}\rho(\vec{r}+\vec{\zeta})$

$\rho(\vec{r})$ *From a Wounded nucleon model for* N_{part}

2) Use a Hydro space-time output



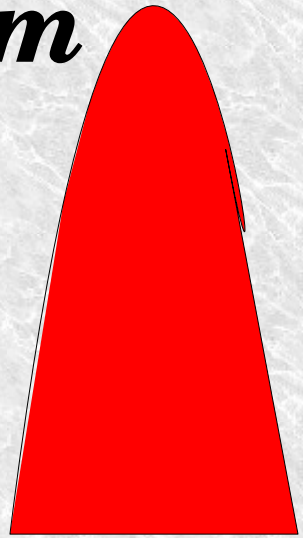
$$\hat{q}(\zeta)=\hat{q}_0\frac{\gamma_\perp(\vec{r}+\vec{\zeta},t=\zeta)T^3(\vec{r}+\vec{\zeta},t=\zeta)}{T_0^3}$$

R_{AA} *with a functional form*

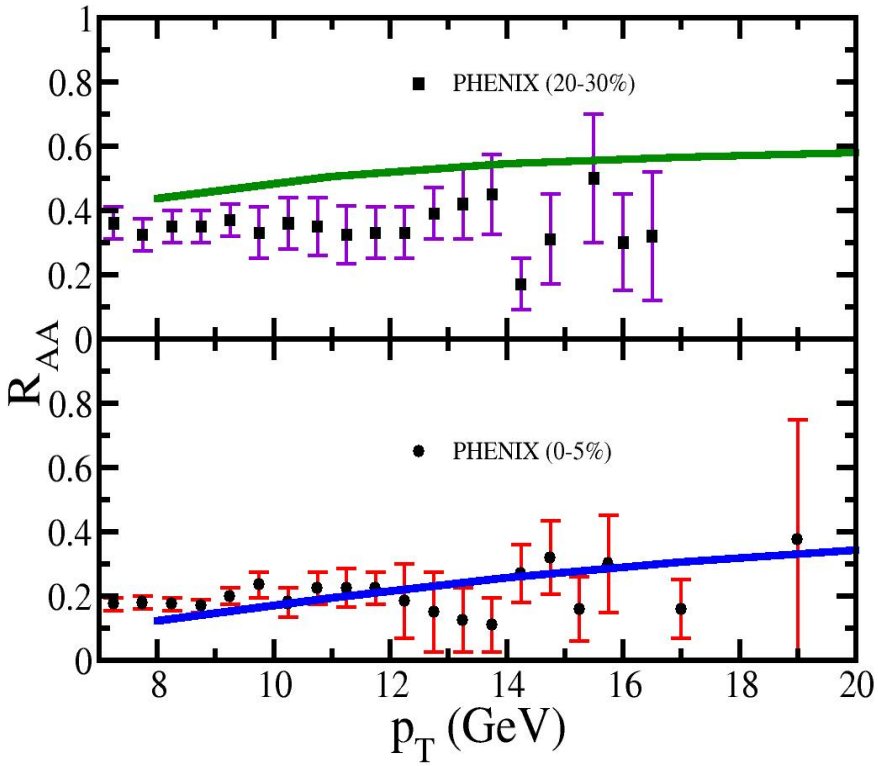
Keep the same space-time profile for medium, increase qhat by a factor of 6

@ RHIC

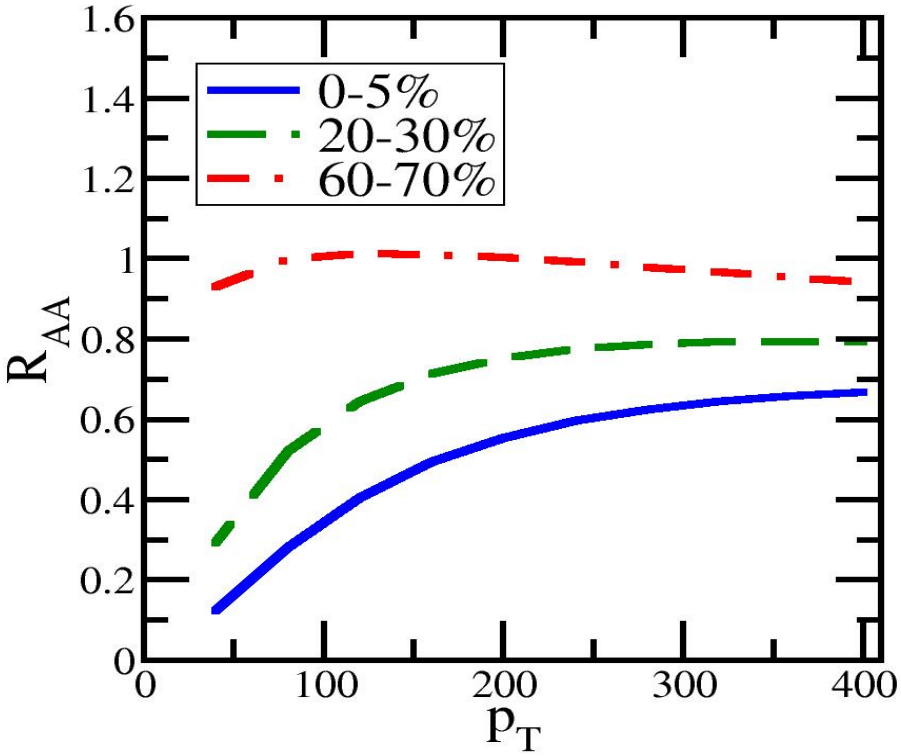
@ LHC



$\hat{q}_0(quarks) = 0.57\, GeV^2/fm$



$\hat{q}_0(quarks) = 3.5\, GeV^2/fm$



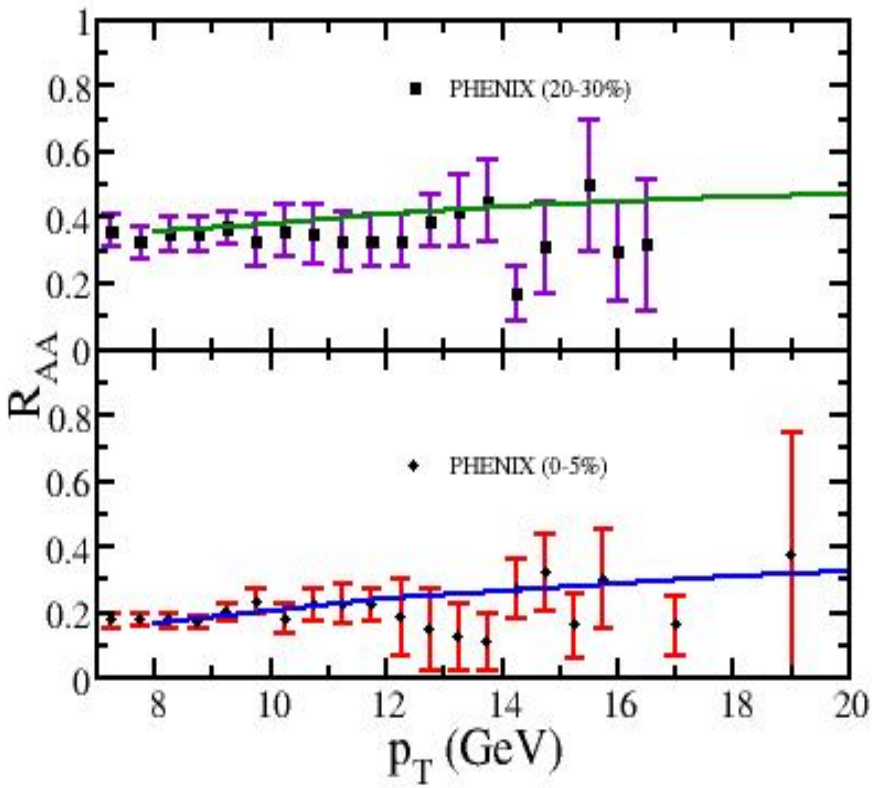
R_{AA} with 3-D hydrodynamics

$$\hat{q}(\zeta)=\hat{q}_0\frac{T^3(\vec{r}+\vec{\zeta},t=\zeta)}{T_0^3}$$

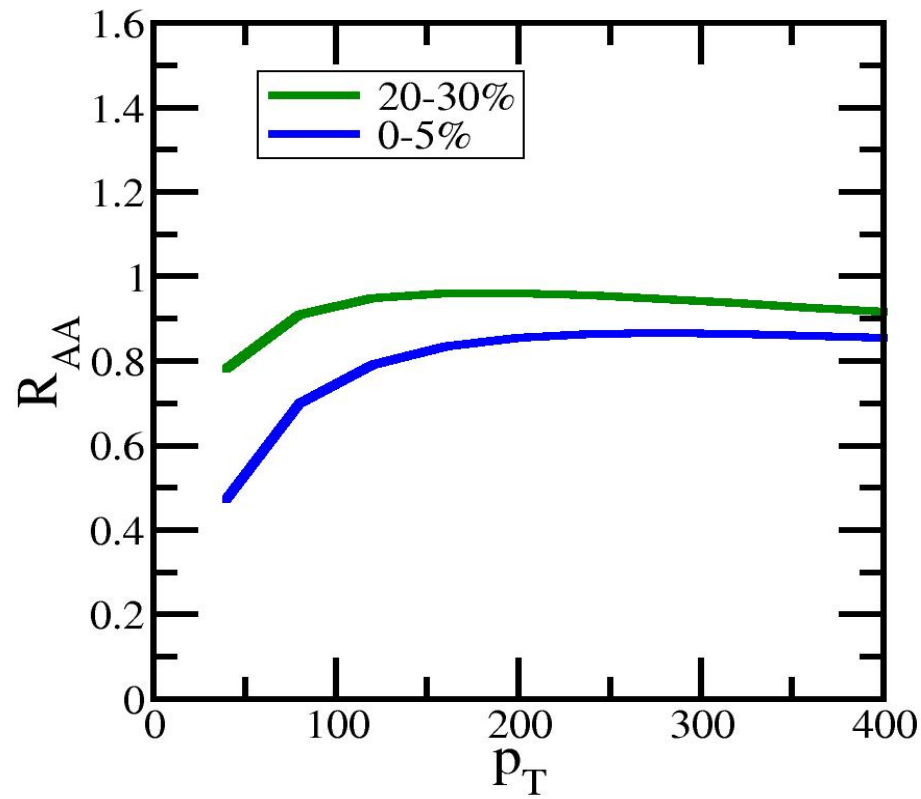
hold the two constants at their RHIC values

@ RHIC

$$\hat{q}_0(quarks)=0.6\,GeV^2/fm$$

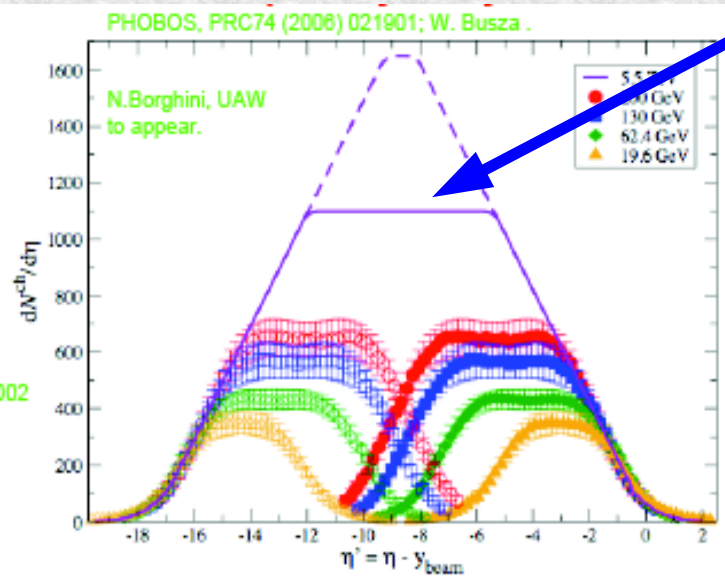


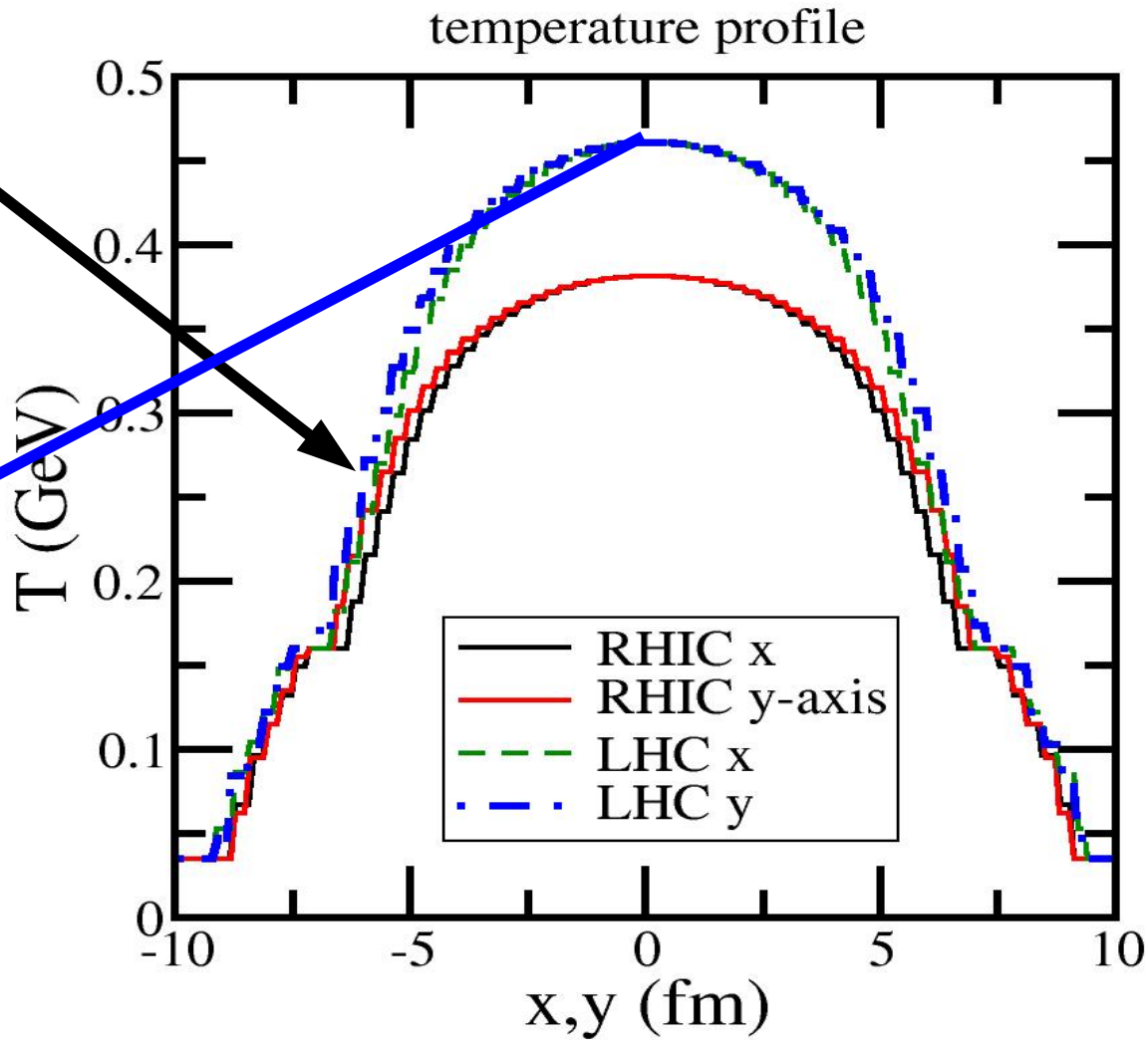
@ LHC



Little difference between hydro profiles at the same time 0.7 fm/c

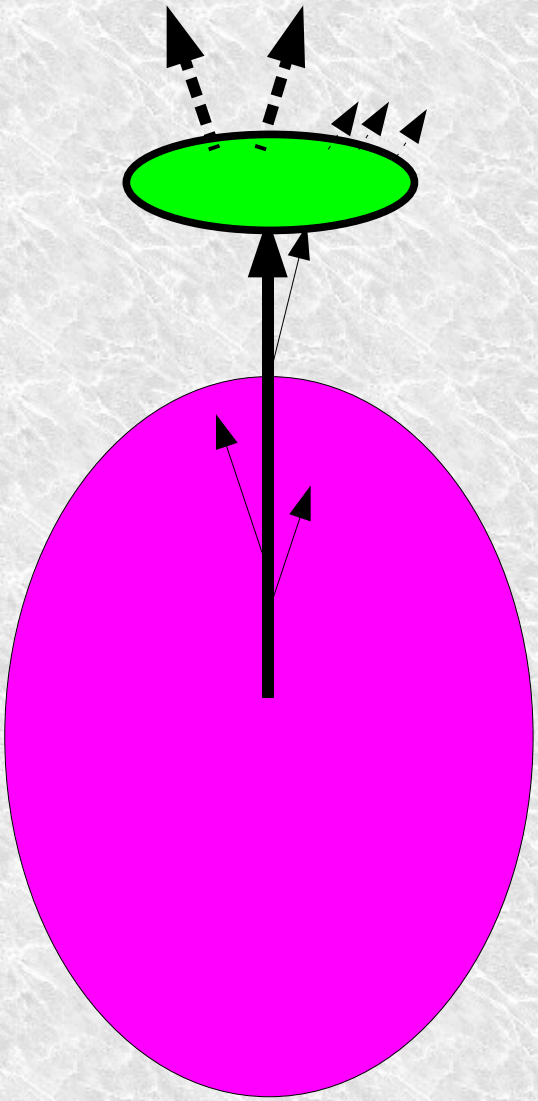
Partially Quenched jets feel this region





Extrapolations to LHC deviate from

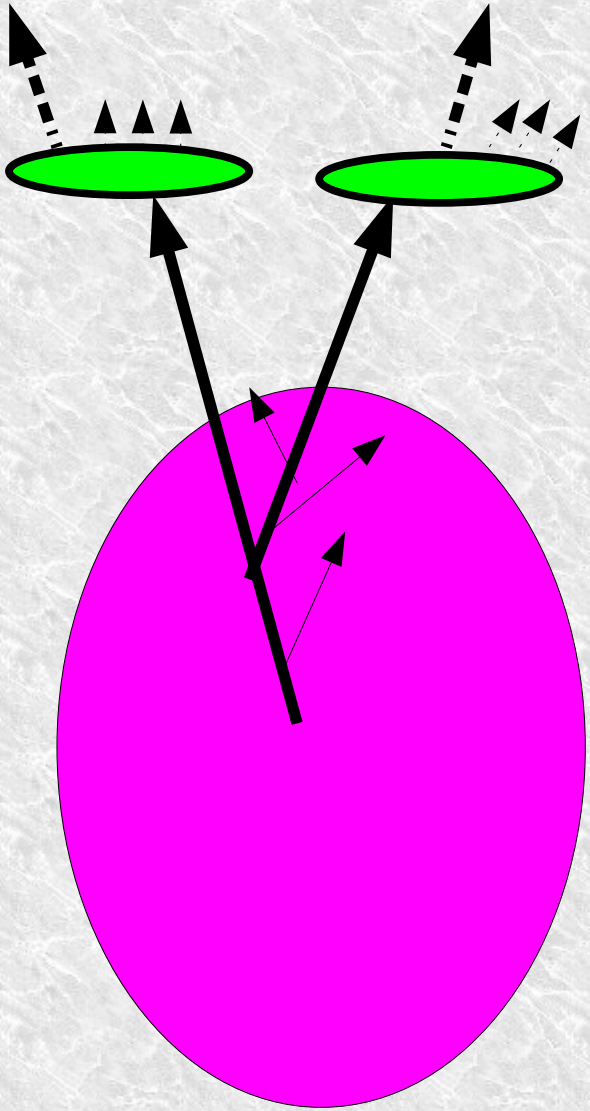
Near side associated yield



Total yield includes 2 components

Consistency check for the formalism

A. Majumder, X. N. Wang, PRD70:014007,2004; PRD 72:034007,2005.

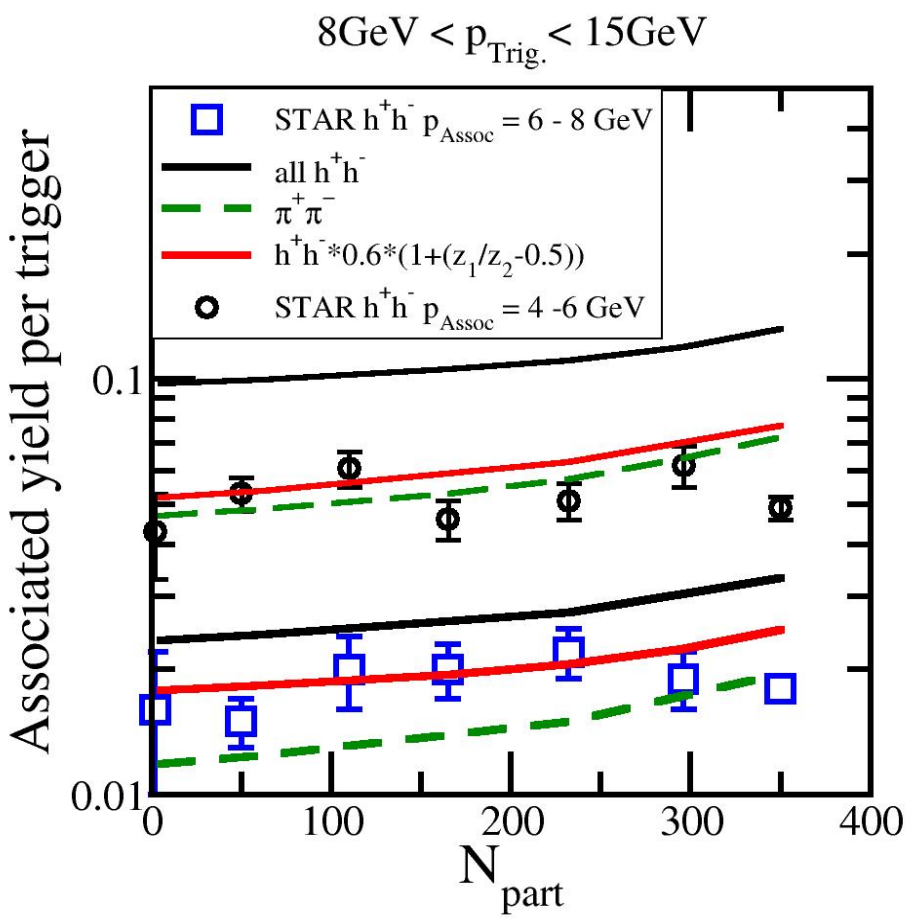


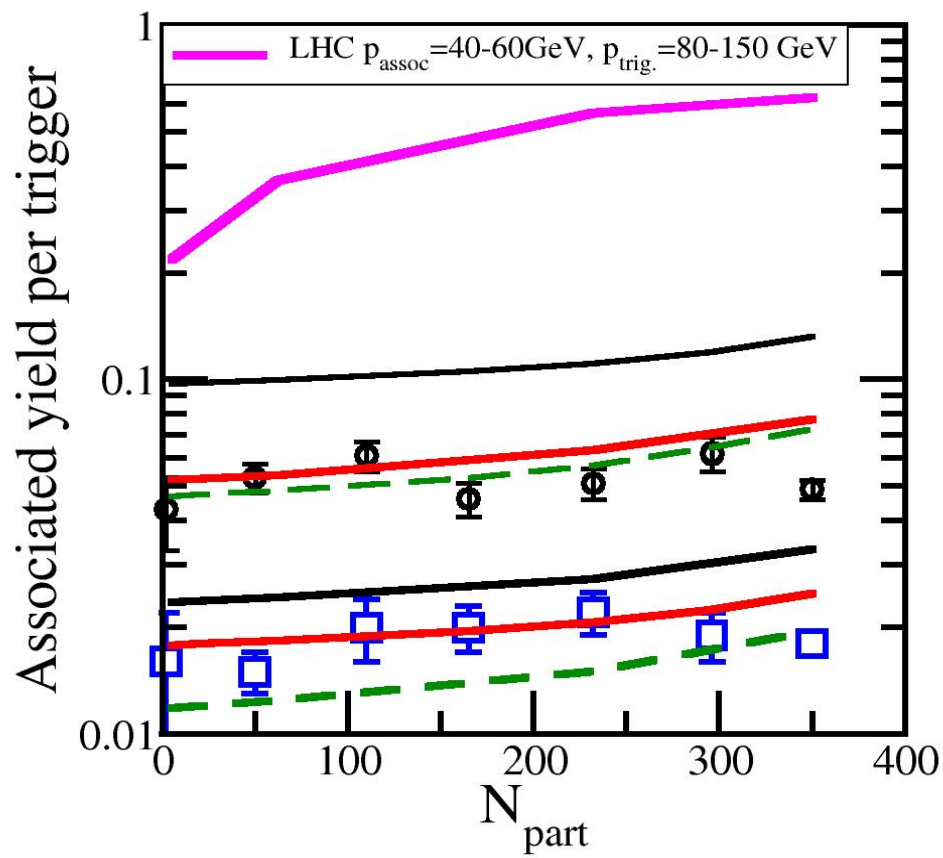
Small momentum difference Need Dihadron fragmentation function

Large momentum difference perturbative calculation, single fragmentation function

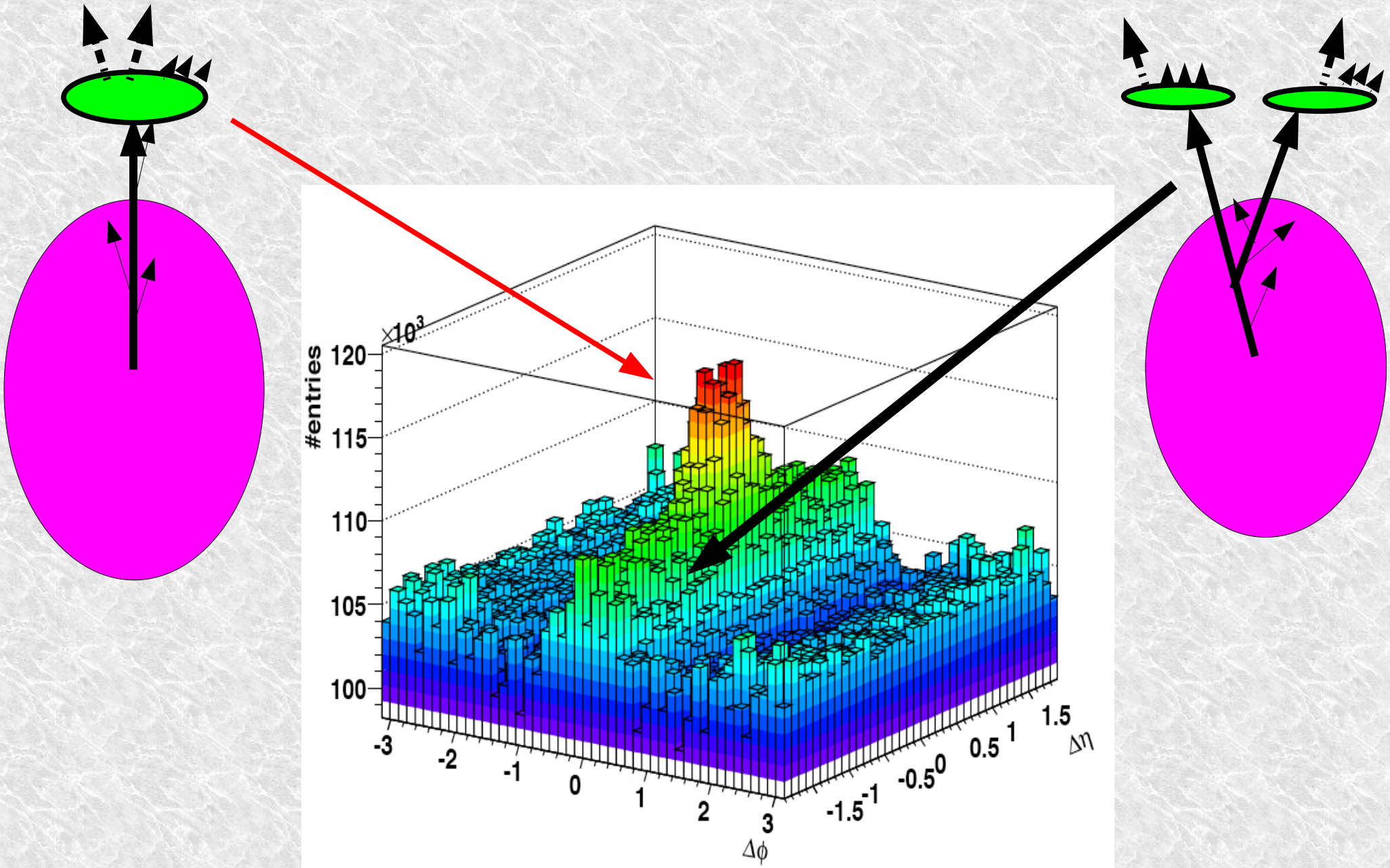
Integrated associated yield

Results using a functional form and 6 times RHIC qhat

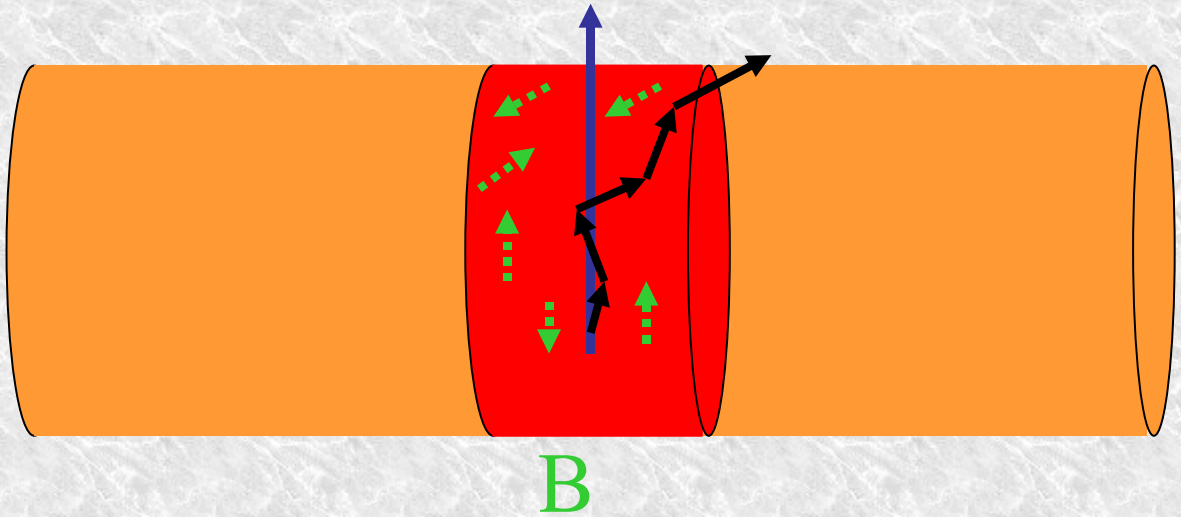


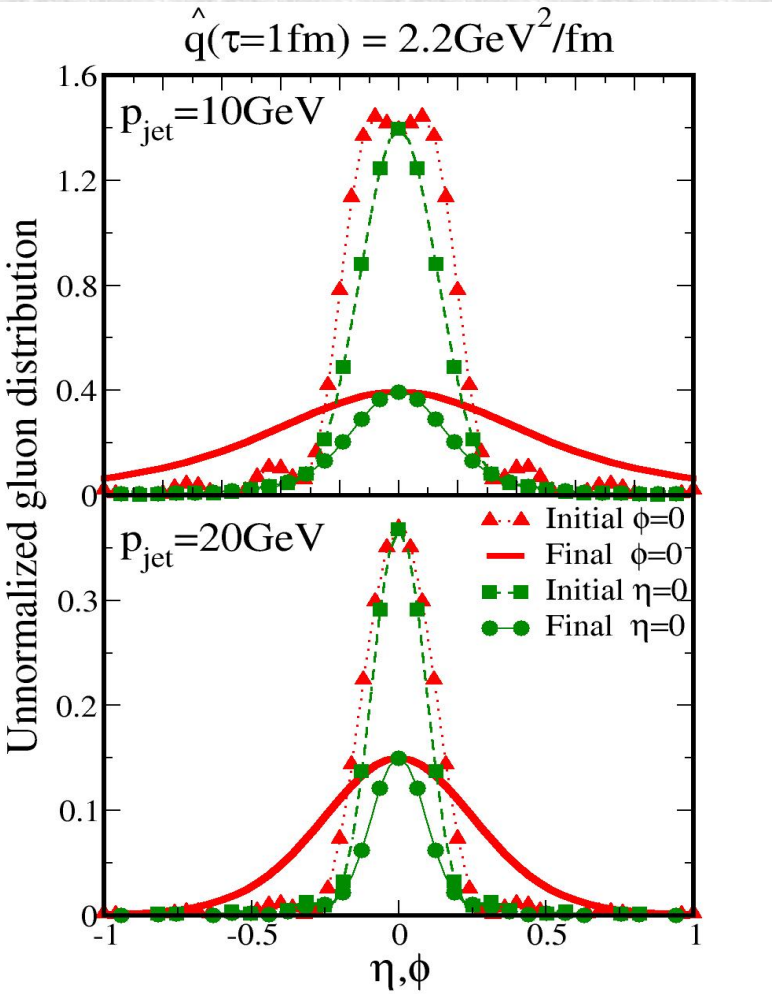


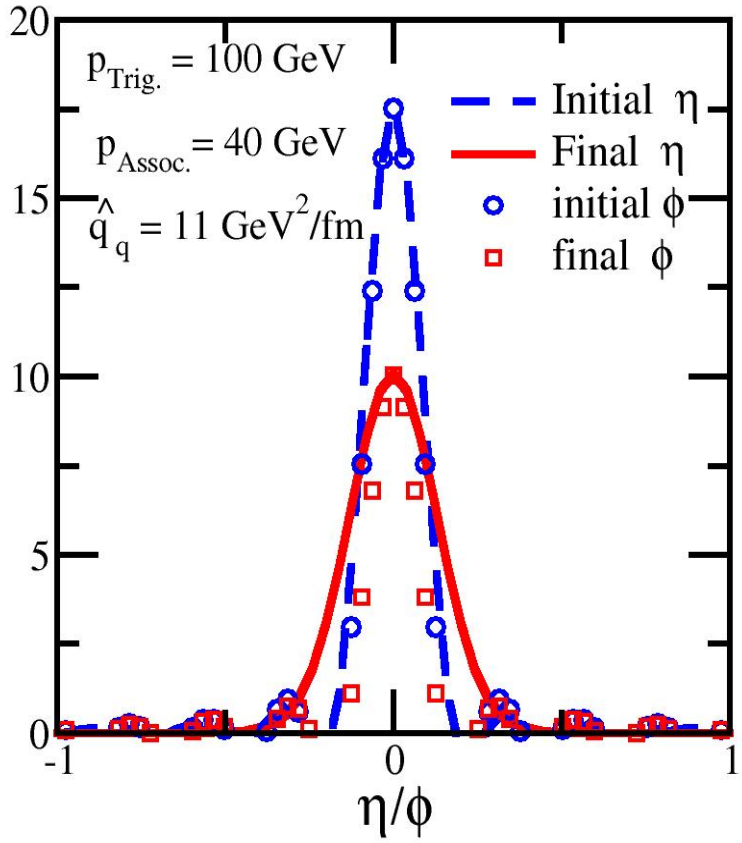
The structure of the near side Ridge



See M. Strickland, QM2006







Conclusions(incomplete)

- Medium at LHC probably similar to that at RHIC
- Very high energy jets will pass through medium
- Less surface bias, more near side energy loss
- Enhancement in near side yield increased
- Most of the yield sits in the jet cone at high energy