High-pT correlations from parton transport

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- **Implications of an opaque parton soup**

DM & Gyulassy NPA697 ('02); DM & Huovinen PRL94 ('05); DM nucl-th/041041

- **Quark number scaling of v_2 and quark coalescence**

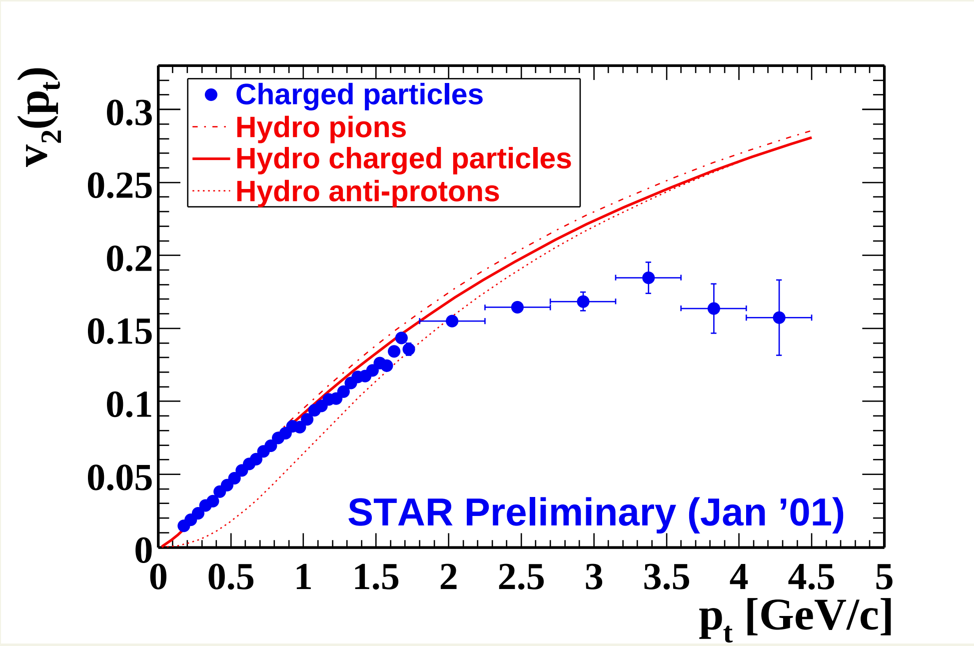
DM & Voloshin PRL91 ('03) 092301; DM nucl-th/0406066, nucl-th/0408044

- **Where v_2 comes from at moderately high p_T**

DM in progress

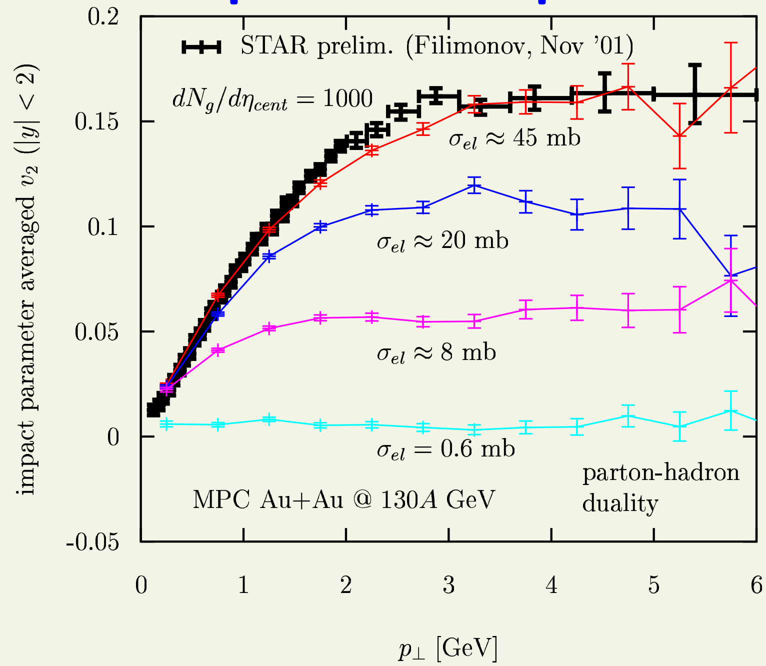
Kolb, Heinz et al

ideal hydro $v_2(6GeV)/v_2(3GeV) > 1.5$



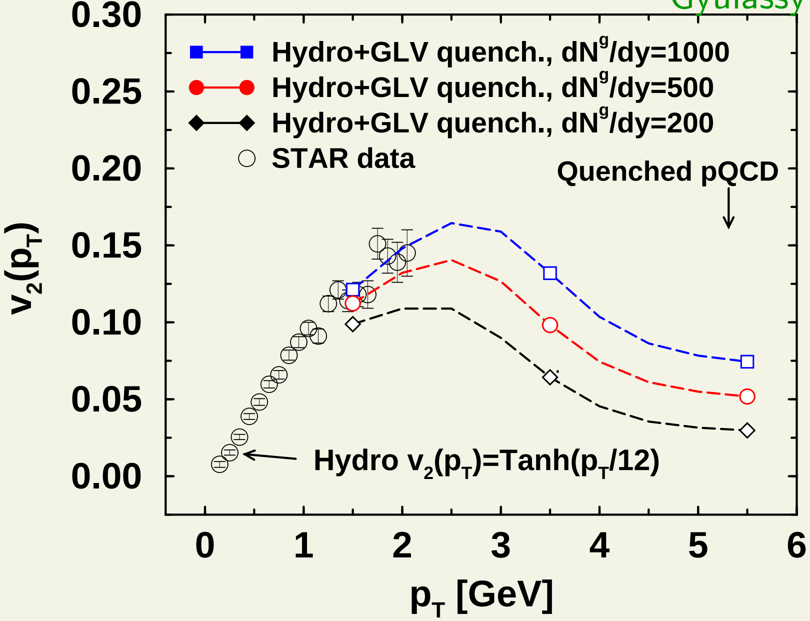
DM & Gyulassy

covariant parton transport ~ 1



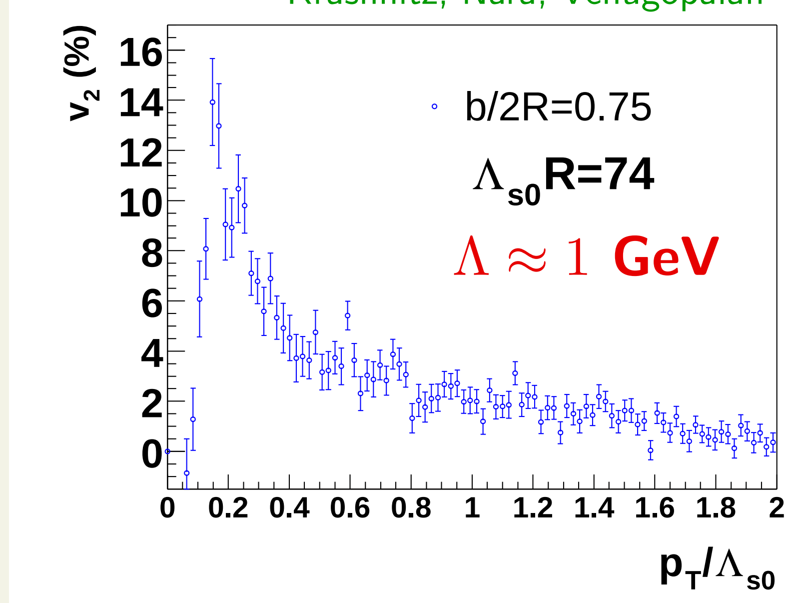
parton energy loss $\sim 0.4 - 0.5$

Gyulassy & Vitev



classical Yang-Mills ...

Krashnitz, Nara, Venugopalan



from coalescence formula

$$\frac{dN_M(\vec{p})}{d^3p} = g_M \int (\prod_{i=1,2} d^3x_i d^3p_i) W_M(x_1 - x_2, \vec{p}_1 - \vec{p}_2) f_\alpha(\vec{p}_1, x_1) f_\beta(\vec{p}_2, x_2) \delta^3(\vec{p} - \vec{p}_1 - \vec{p}_2)$$

$$\frac{dN_B(\vec{p})}{d^3p} = g_B \int (\prod_{i=1,2,3} d^3x_i d^3p_i) W_B(x_{12}, x_{13}, \vec{p}_{12}, \vec{p}_{13}) f_\alpha(\vec{p}_1, x_1) f_\beta(\vec{p}_2, x_2) f_\gamma(\vec{p}_3, x_3) \delta^3(\vec{p} - \sum \vec{p}_i)$$

hadron yield space-time hadron wave-fn. quark distributions

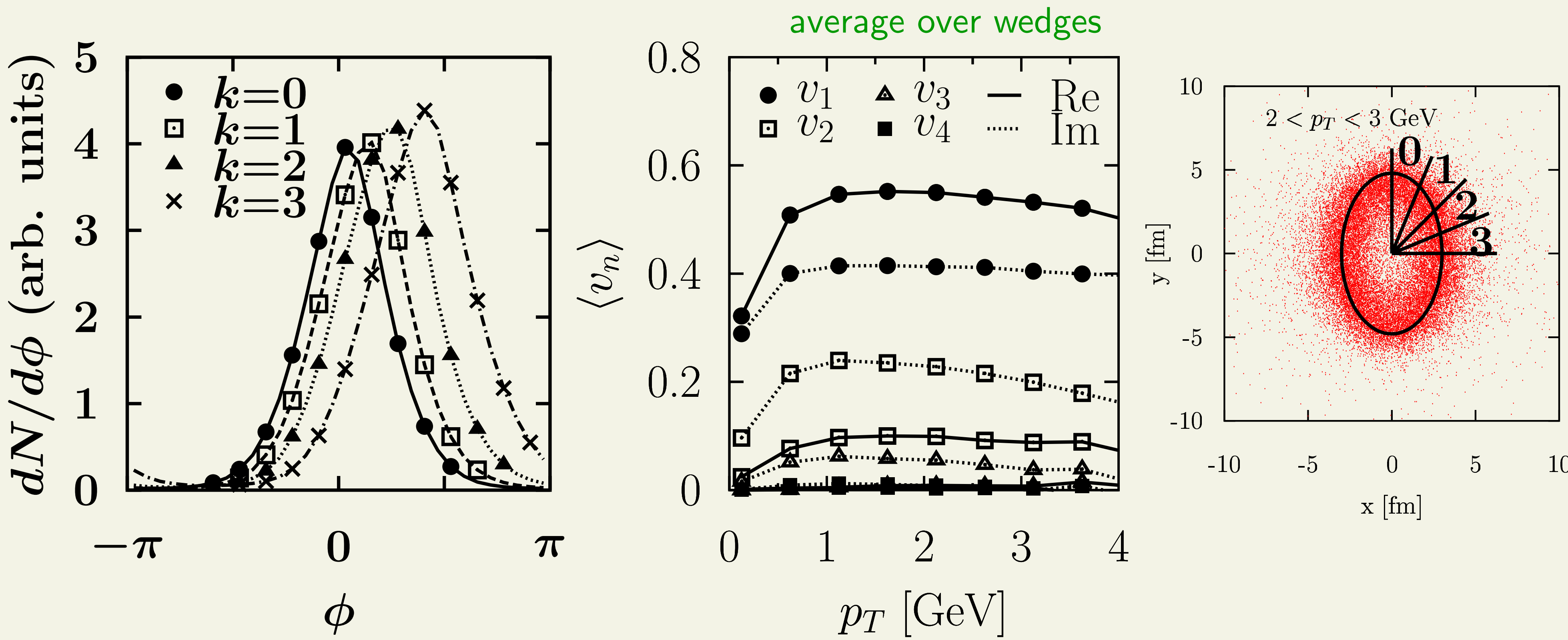
v_2 **scaling arises trivially <u>if</u>:**

1. **no other hadronization channels play a role**
2. **only small harmonic modulations** $|v_2| \ll 1$, $|v_n| \ll 1$
3. **spatial dependence can be ignored (e.g., factorizes out)**
4. **narrow wave functions** $W \sim \delta^3(\Delta x)\delta^3(\Delta p)$

Are these conditions satisfied?

3. Surface emission $\rightarrow |v_n| \sim \mathcal{O}(1)$

local $\cos(n\phi)$ **and** $\sin(n\phi)$ **anisotropies** $\rightarrow$ **use** $v_n \equiv \langle \cos(n\phi) + i \sin(n\phi) \rangle$



large $|v_n| \sim 1$, almost Gaussian peaks - $dN/d\phi \sim \exp[-(\phi - \phi_0)^2/(2\sigma^2)]$

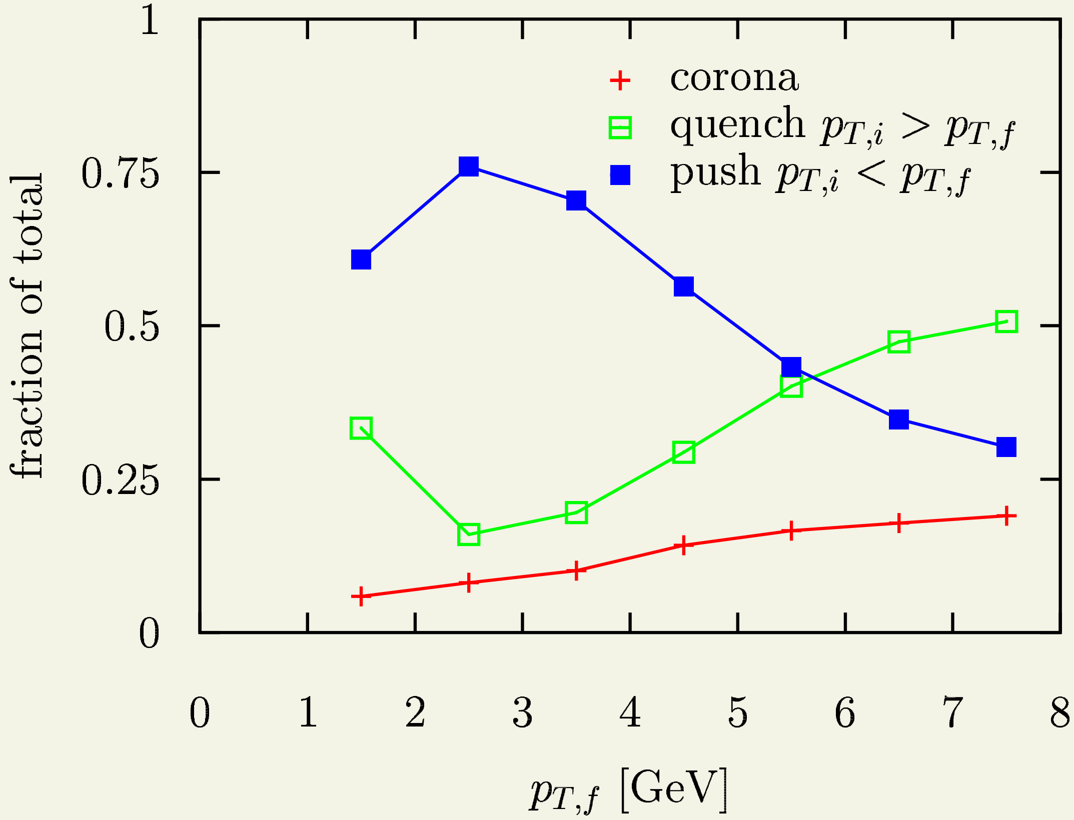
$\langle \cos(2\phi) \rangle = \cos(2\phi_0) \cdot |v_2| \rightarrow$ **varies with transverse coordinate**

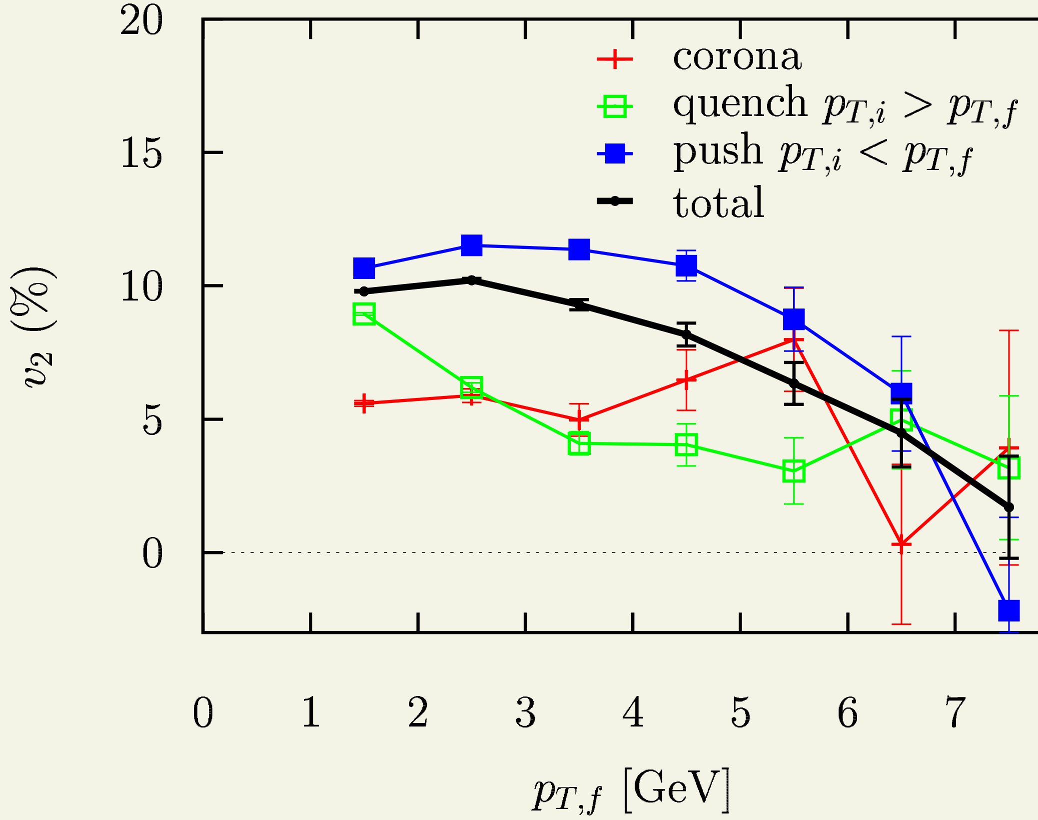
DM, nucl-th/0408044

$\Rightarrow$ **new scaling:** $|v_{n,B}(3p_T)| \simeq |v_{n,q}(p_T)|^{1/3}, \quad |v_{n,M}(2p_T)| \simeq |v_{n,q}(p_T)|^{1/2}$

corona/quench/push fractions **elliptic flow contributions vs pT**

DM '05:





rapid v_2 drop from quench at high p_T is compensated by large v_2 of "pushed-up" partons

combined $v_2(p_T)$ still decreases at high p_T, but more slowly

Summary

- **A significant fraction of initially soft partons can end up at high p_T and moderate drop of v_2**
  - **cannot ignore cross-talk between soft and hard even at $p_T \sim 6-7$ GeV, for $6\times$ perturbative opacities**
  - **expect even stronger effect for the strongly-coupled RHIC plasma ($15\times$ perturbative opacities)**
  - **precision data should settle whether we "need" such a component to supplement quenching results**

- **The observed quark number scaling of v_2 is truly remarkable. From parton transport theory**
  - **significant fragmentation contributions**
  - **strong space-momentum correlations (spatial anisotropies)**
  - **and surface emission**

  each spoil the scaling. The scaling may hold accidentally, however, there seems to be no guarantee that the scaled v_2 gives the v_2 of quarks at hadronization. Does even the ϕ meson scale??