S.Pratt and J.V., arXiv:0809.0089
J.V. and S.Pratt, arXiv:0810.4325
S.Pratt, arXiv:0811.3363

Universality in Early Stage Flow

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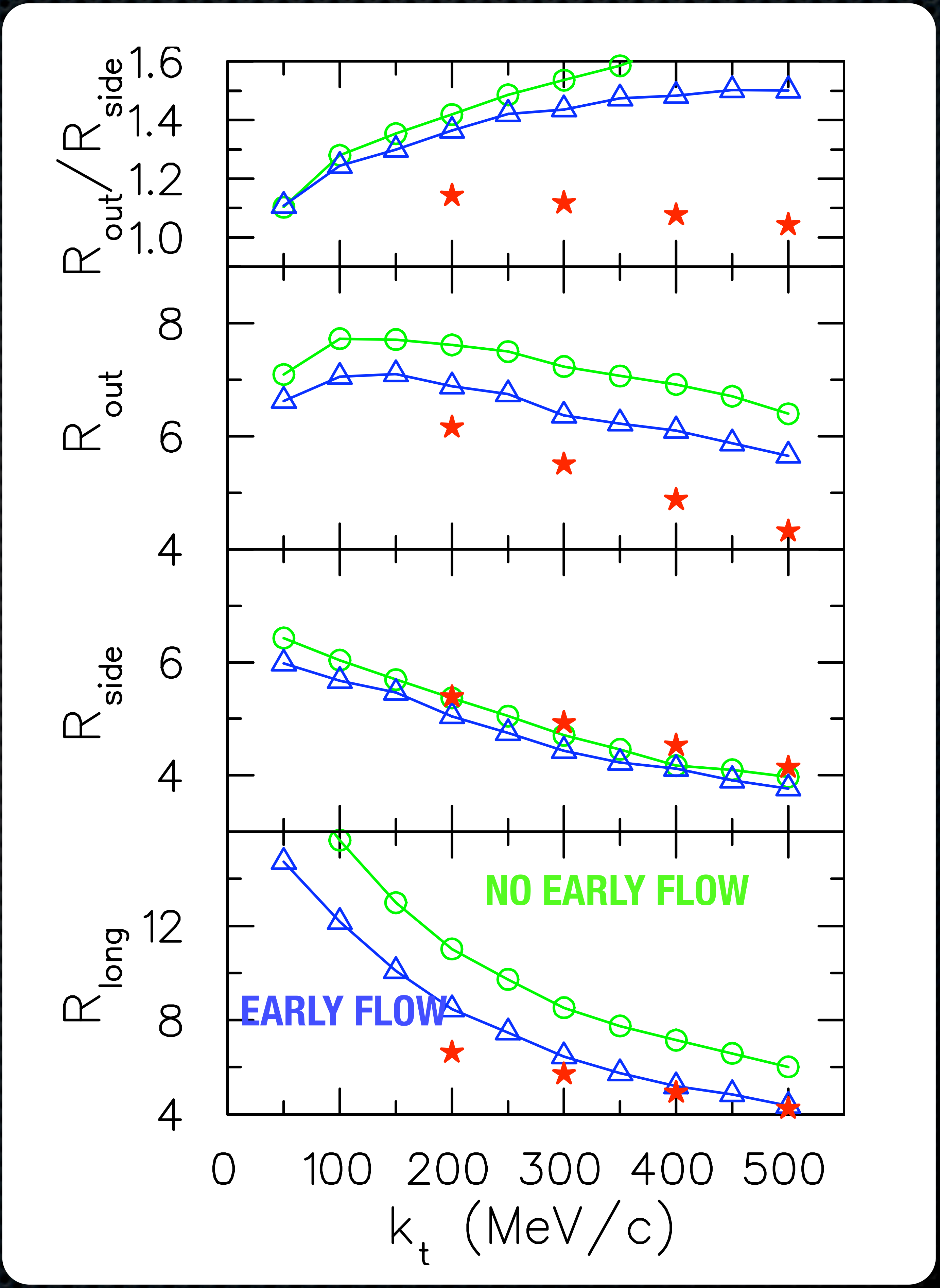
Early Acceleration

- HBT Radii and Early Acceleration
- Universality in a Class of Models
  - Why Microscopic Structure May Not Matter Much

Early Acceleration

- Helps explain HBT radii
  - With Hydro + Cascade
  - Especially R_{long}
- Early Thermalization?



Early Acceleration

- Anisotropy Parameter k: $T_{xx} = T_{yy} = kT_{00}$.
  - $k(x,t) = k(t)$
- Traceless Stress Energy Tensor
- Boost Invariance (Bjorken Flow)

Models in Class

Model	T_{xx}, T_{yy}	T_{zz}	Tr T
CGC	**≈ ε**	**≈ -ε**	0
Ideal Hydro	**ε/3**	**ε/3**	0
Free-Streaming	**ε/2**	0	0
???	0	0	0

Without Expansion...

$$T_{xx} = \kappa T_{00}$$

Transverse Pressure
(1/3, 1/2, 1)

$$\frac{d}{dt} T_{0x} = -\partial_x T_{xx}$$

$$\frac{T_{0x}}{T_{00}} \approx -\kappa \frac{\partial_x T_{00}}{T_{00}} t$$

Directly Depends on κ

With Bjorken Expansion

$$T_{00} \sim \frac{1}{\tau^{2-2\kappa}}$$

Transverse Pressure
(1/3, 1/2, 1)

$$\frac{d}{dt}T_{0x} = -\partial_x T_{xx} - \partial_z T_{xz} = -\partial_x T_{xx} - \frac{1}{\tau}T_{0x}$$

$$\frac{d}{dt}T_{00} = -T_{00}\frac{(2-2\kappa)}{\tau}$$

$$\frac{T_{0x}}{T_{00}} \approx -\frac{1}{2}\frac{\partial_x T_{00}}{T_{00}}t$$

No k Dependence!

Early Acceleration

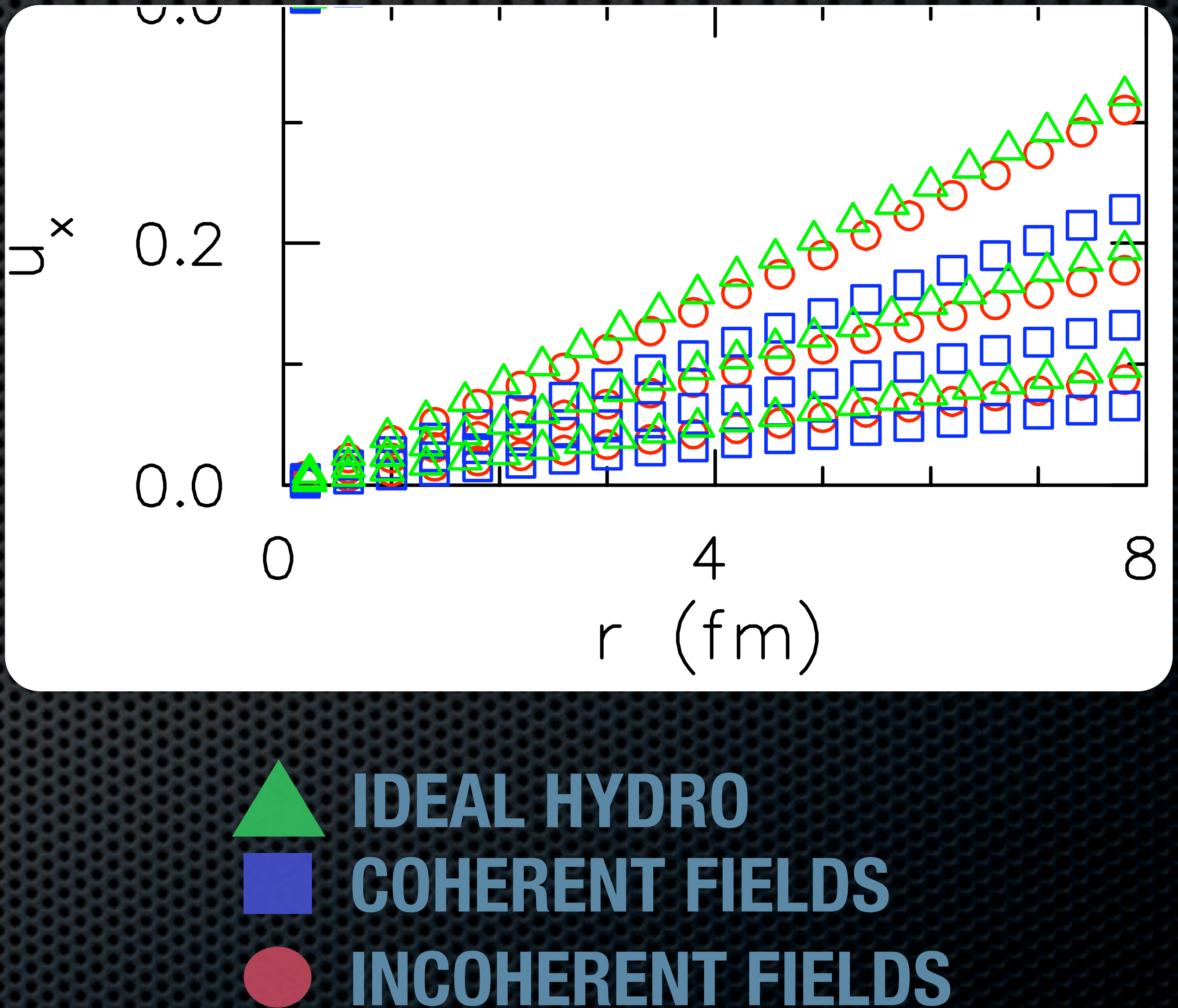
$$\mathbf{FLOW} \equiv \frac{T_{0x}}{T_{00}} = -\frac{1}{2}\frac{\partial_x T_{00}}{T_{00}} t$$

- Anisotropy Parameter k: $kT_{00} = T_{xx} = T_{yy}$.
  - $k(x,t) = k(t)$
- Traceless Stress Energy Tensor
- Boost Invariance (Bjorken Flow)

Initial flow for hydro depends only on initial profile, microscopic structure irrelevant.

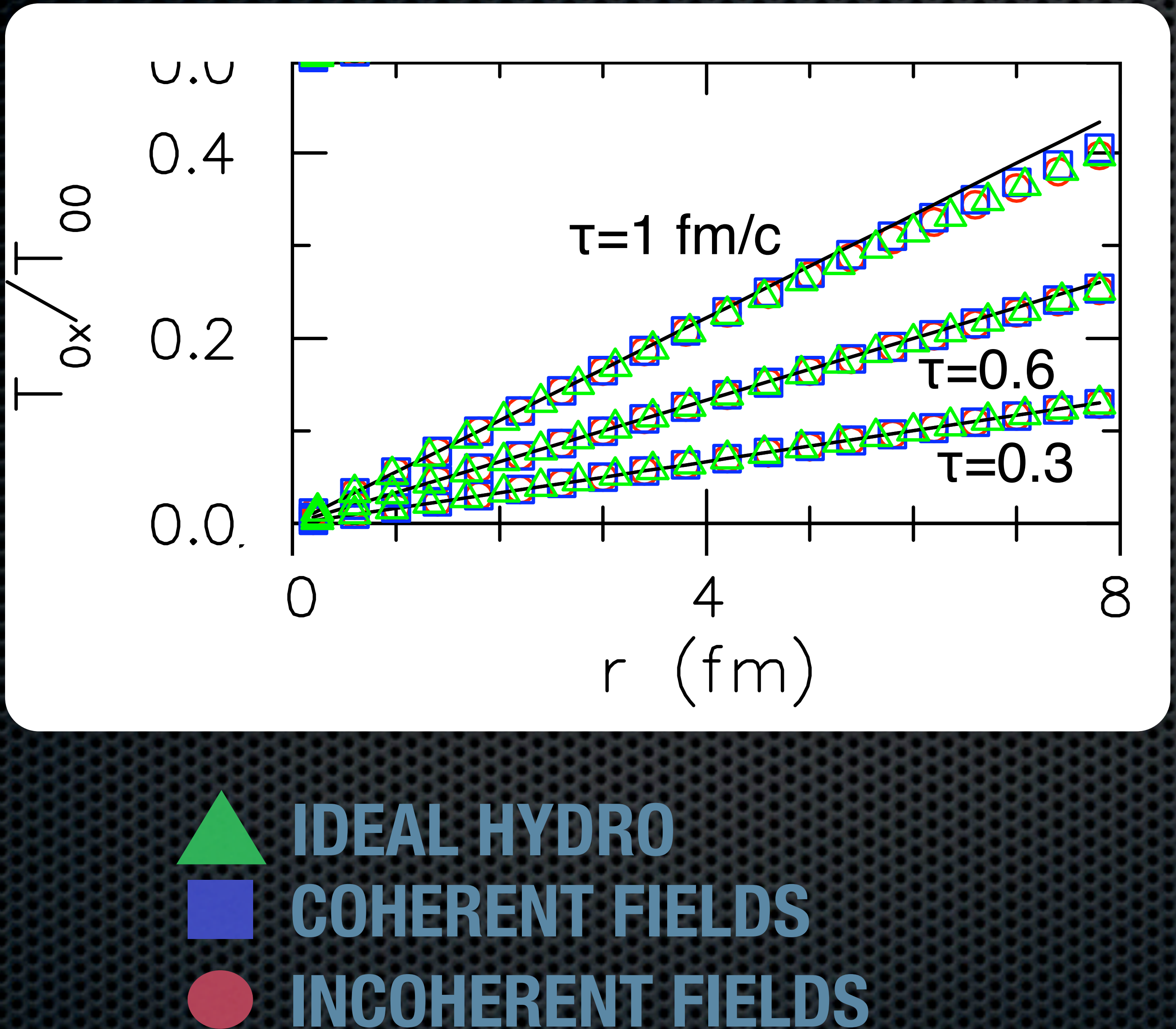
Transverse Velocity

- Between models, transverse velocities differ.
- Is this still universal flow?



arXiv:0810.4325v1

Transverse Velocity



arXiv:0810.4325v1

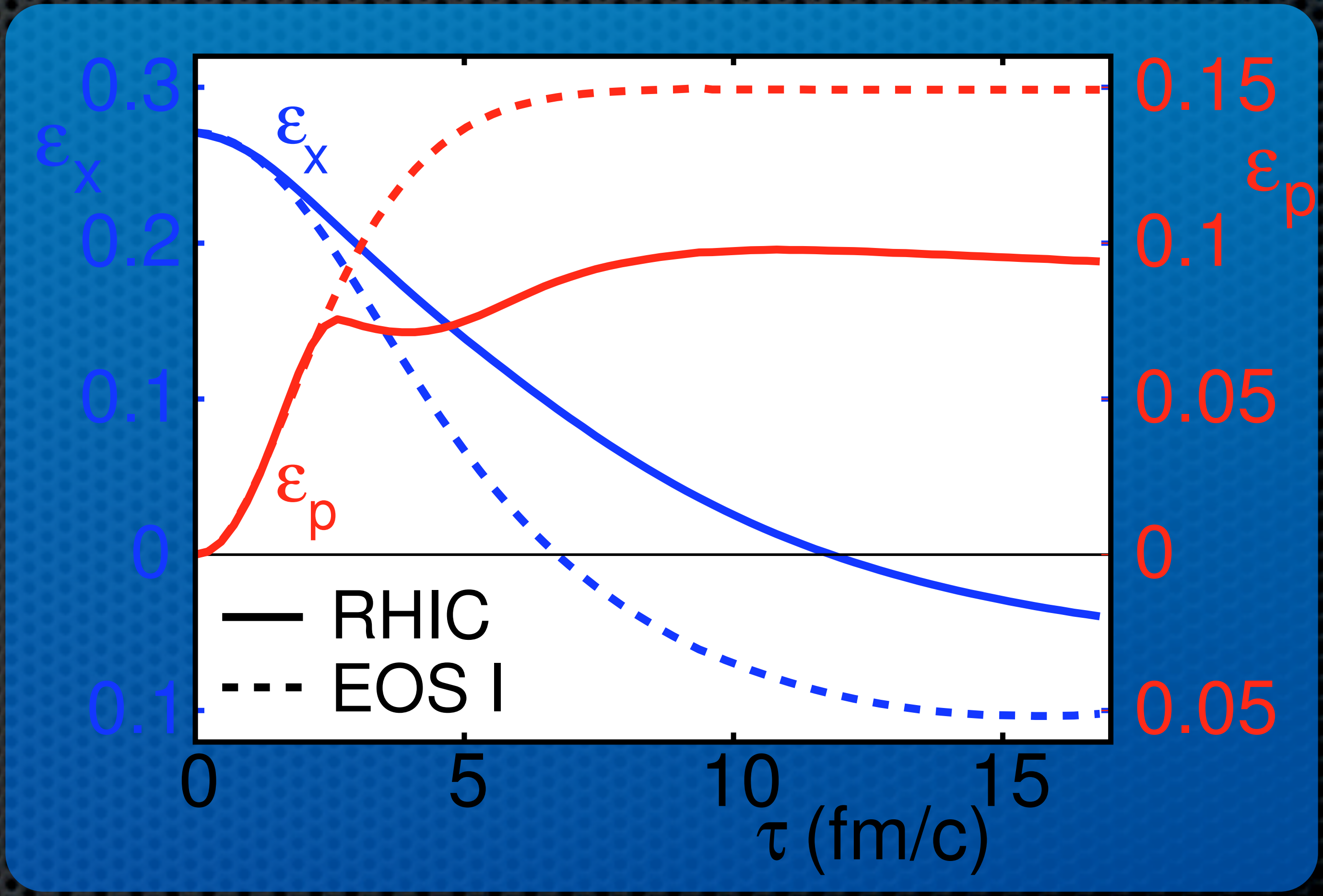
- 'Flow' develops consistently.
- This ratio is conserved in a 'sudden' transition.

Developing Flow

During thermalization,

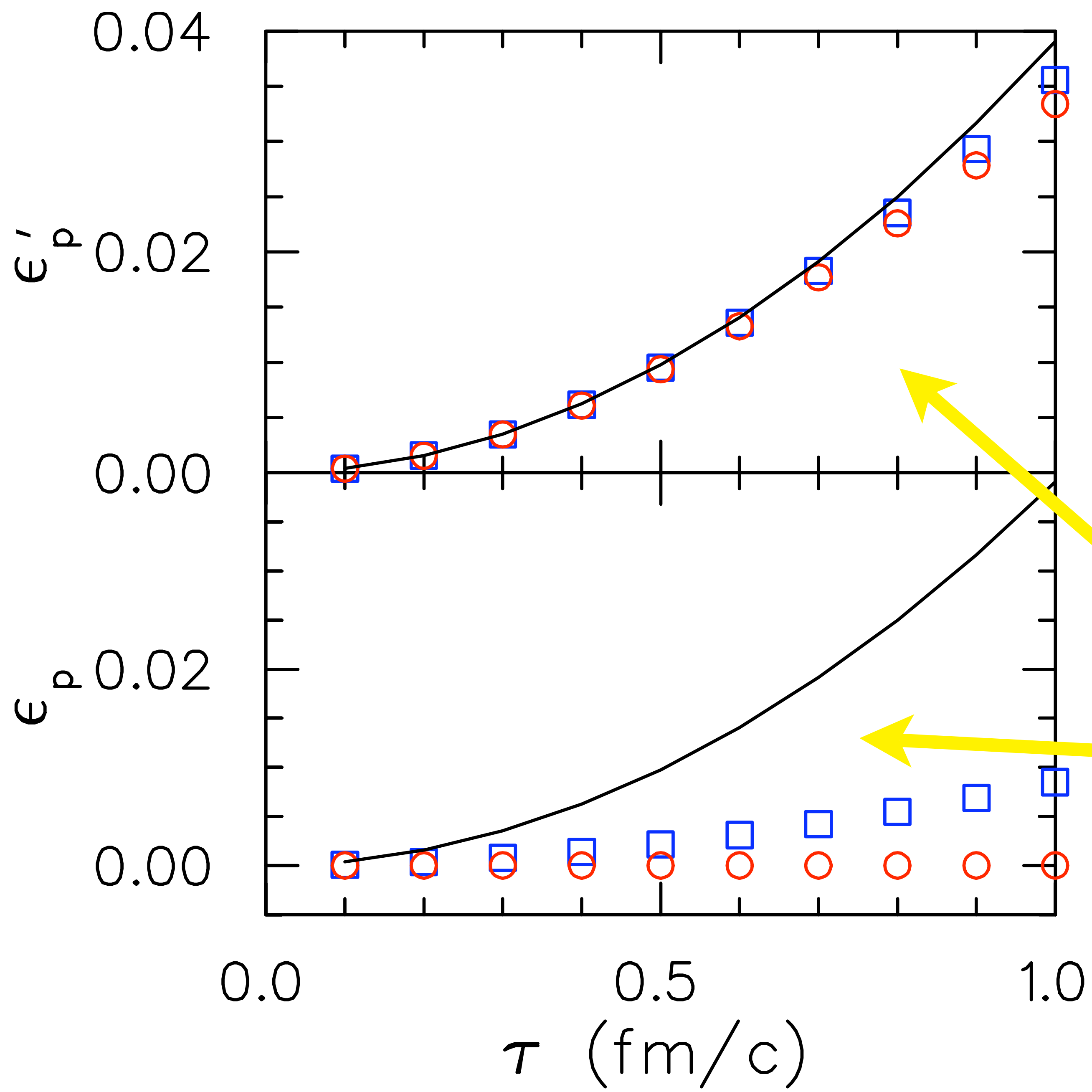
$$\epsilon_p \equiv \frac{\int dxdy\ (T_{xx} - T_{yy})}{\int dxdy\ (T_{xx} + T_{yy})}$$

could change suddenly.



Kolb, Heinz
arXiv:hep-ph/0204061v1

Developing Flow

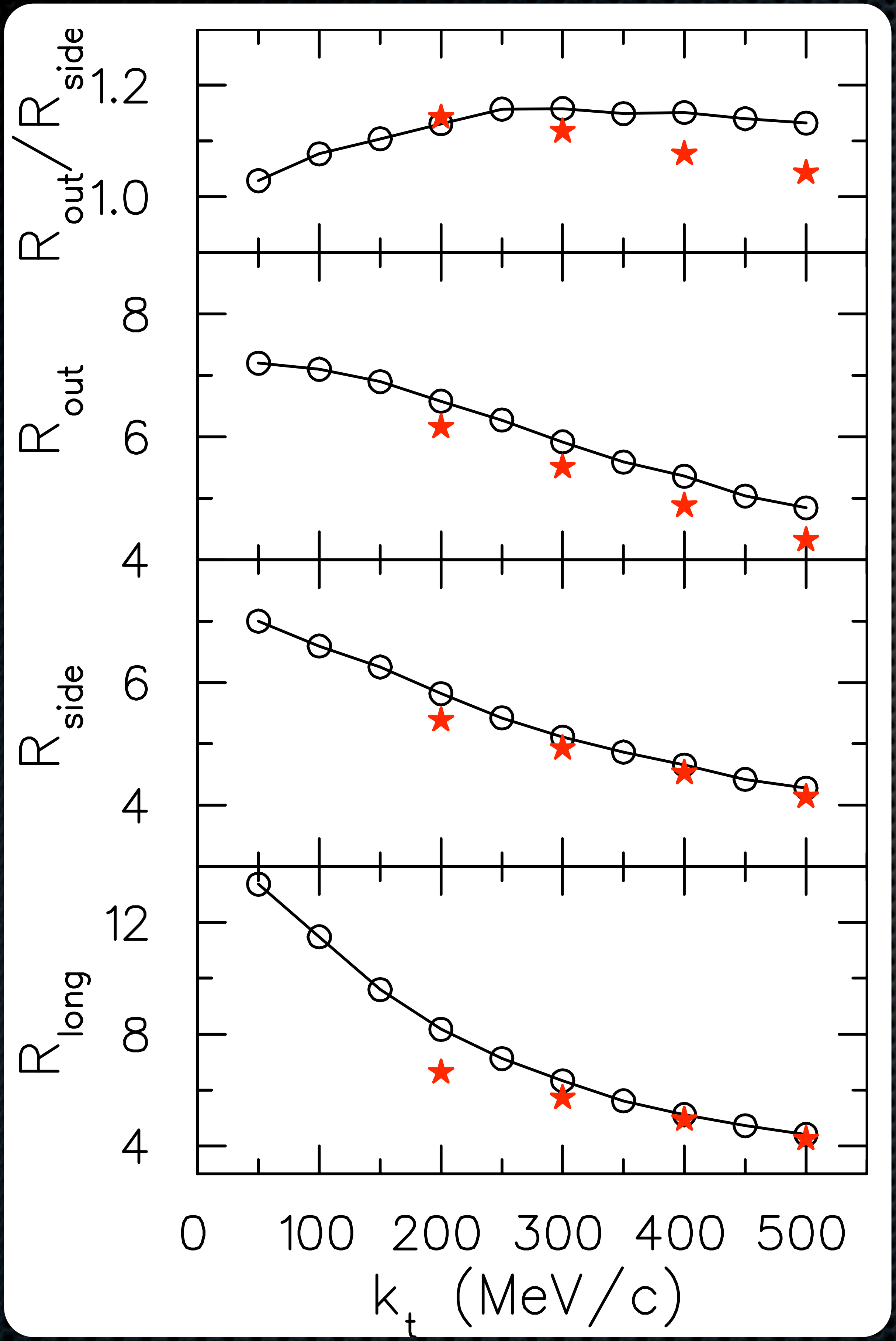


- System thermalizes.

after thermalization

before thermalization

Dying HBT?



- No definitive early model.
- But *existence* of early acceleration.
- Source size described at ~10%

S.Pratt and J.V. - arXiv:0809.0089

Remarks

- Flow develops before thermalization.
- Early Flow leads to significant improvements in HBT description, especially R_{long}.