QCD Phase Structure III workshop

Anomalous transport from Chiral Viscous Hydrodynamics

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BEST COLLABORATION

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Outline

- Motivation
- Our framework
- Numerical results

✓ *Viscous parameters*

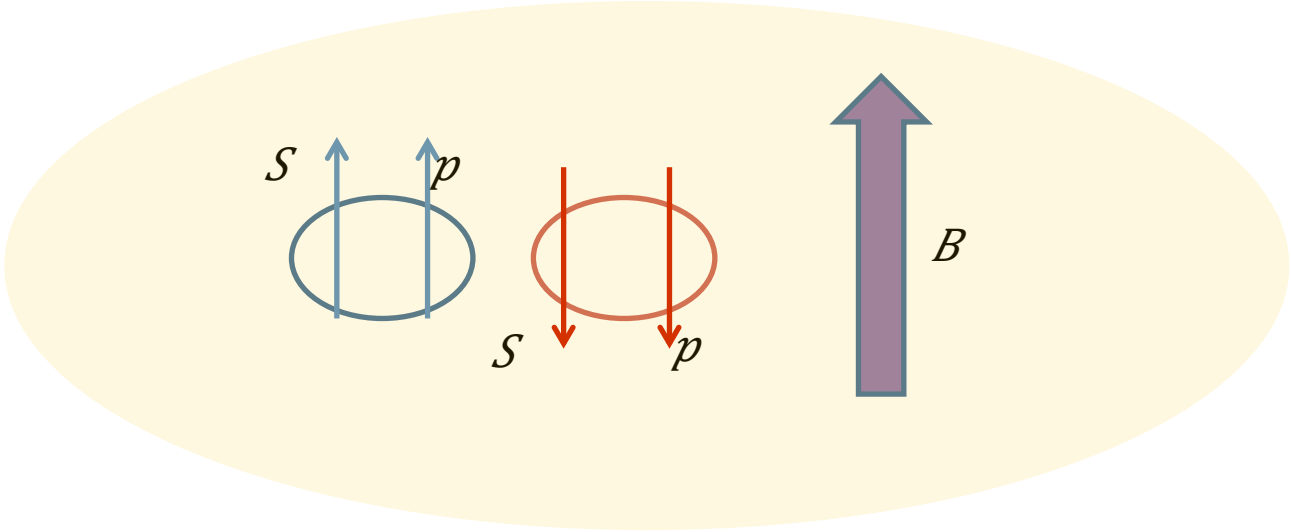
✓ *Initial conditions*

✓ *B field lifetime*

- *Summary and outlook*

Motivation

- Chiral magnetic effect $J = C_A \mu_A B$

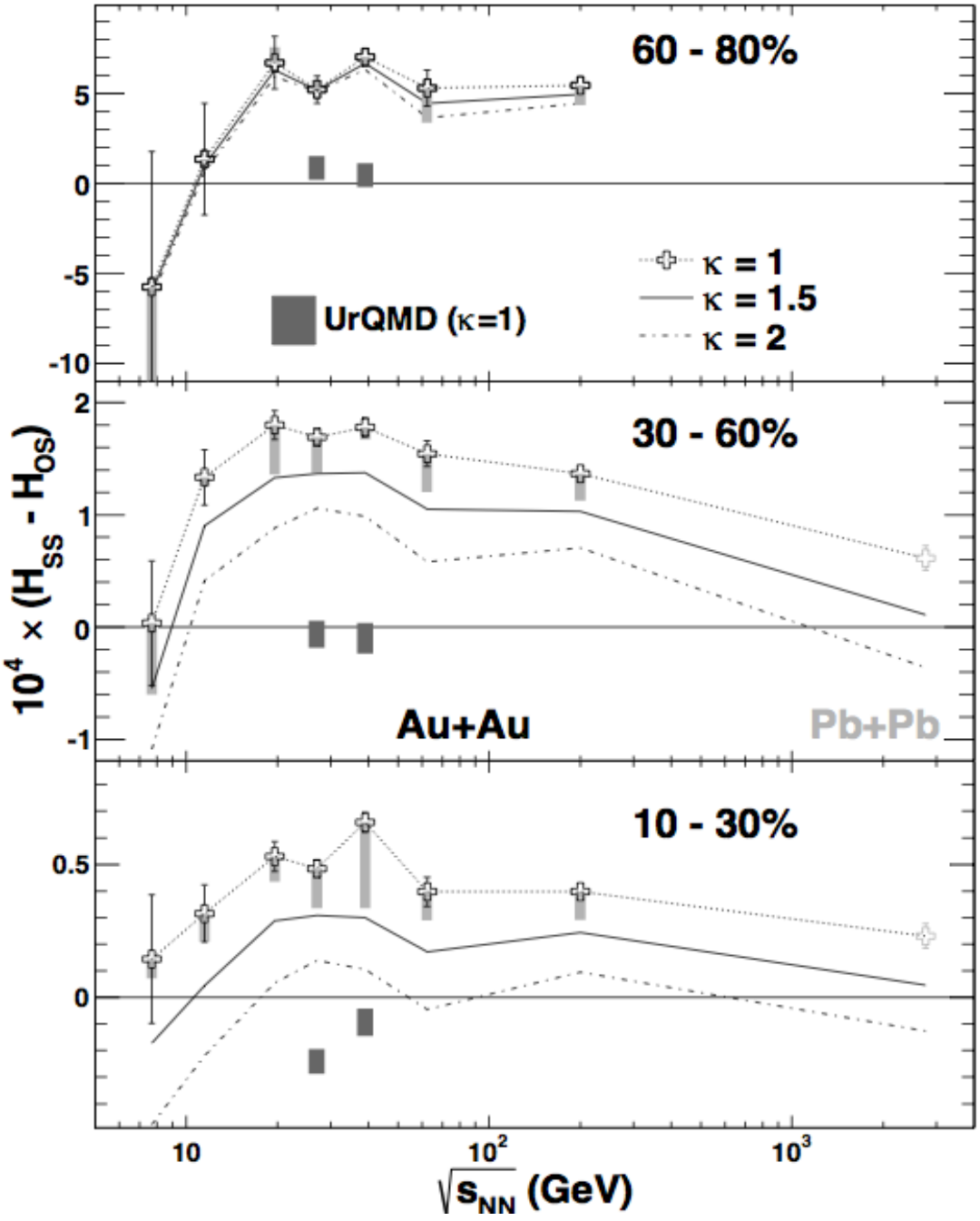


- Charge separation

$dN/d\phi \propto 1 \pm a_1 \sin(\phi - \psi_{RP}) + \ldots$

$$H\downarrow SS - H\downarrow OS = 2a\downarrow 1\uparrow 2$$

STAR, PRL, 2014



Chiral viscous hydro

- $J\downarrow V\uparrow\mu = n\downarrow V\, u\uparrow\mu + \nu\downarrow V\uparrow\mu + \sigma E\uparrow\mu + N\downarrow c\,/2\pi\uparrow 2\;\; q\mu\downarrow A\, B\uparrow\mu$
- $J\downarrow A\uparrow\mu = n\downarrow A\, u\uparrow\mu + \nu\downarrow A\uparrow\mu + N\downarrow c\,/2\pi\uparrow 2\;\; q\mu\downarrow V\, B\uparrow\mu$

✓ $D\downarrow\mu\, J\downarrow V\uparrow\mu = 0,\qquad D\downarrow\mu\, J\downarrow A\uparrow\mu = N\downarrow c\,/2\pi\uparrow 2\;\; q\uparrow 2\; E\cdot B$

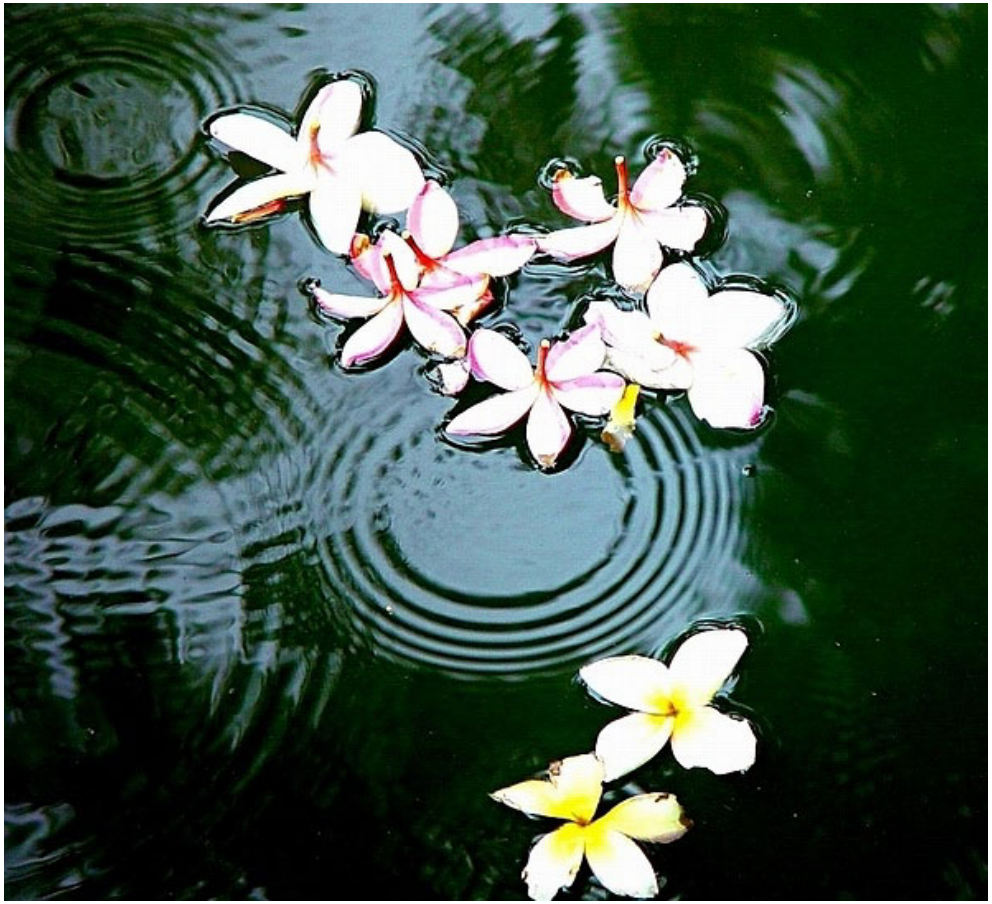
✓ $dv\downarrow V,\;\; A\uparrow\mu = (v\downarrow NS\uparrow\mu - v\downarrow V,\;\; A\uparrow\mu)/\tau\downarrow rlx$

➢ Background: 2+1 D VISHNew----OSU Group

$$D\downarrow\mu\, T\uparrow\mu\nu = 0 \text{ with } n = 0$$

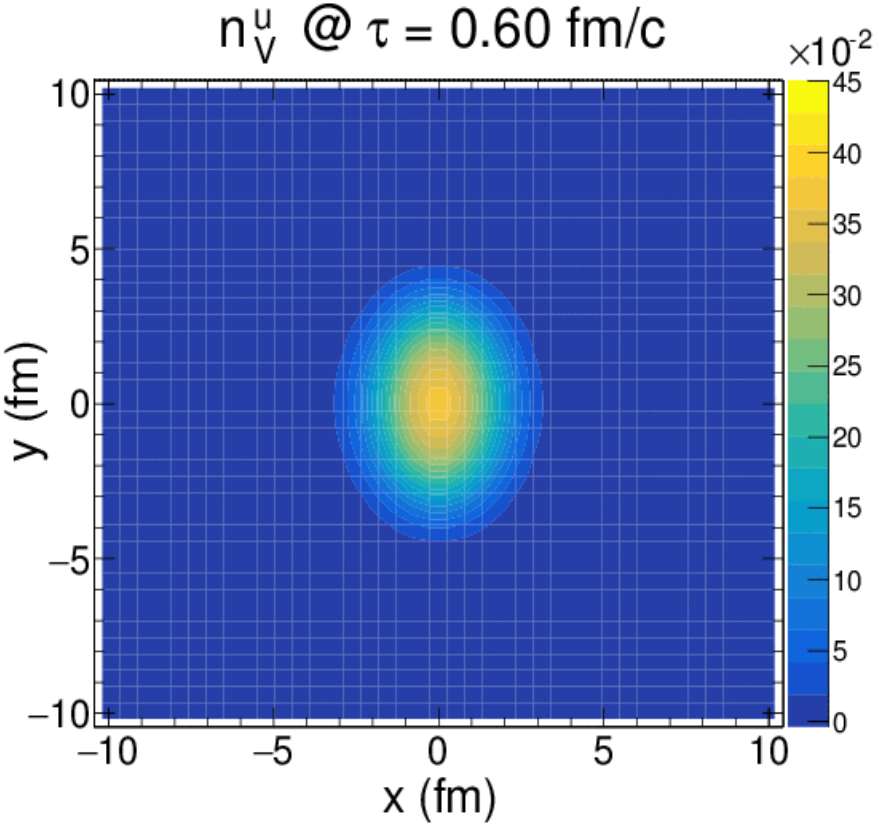
Chiral viscous hydro

- *Linearized version of the full hydro*

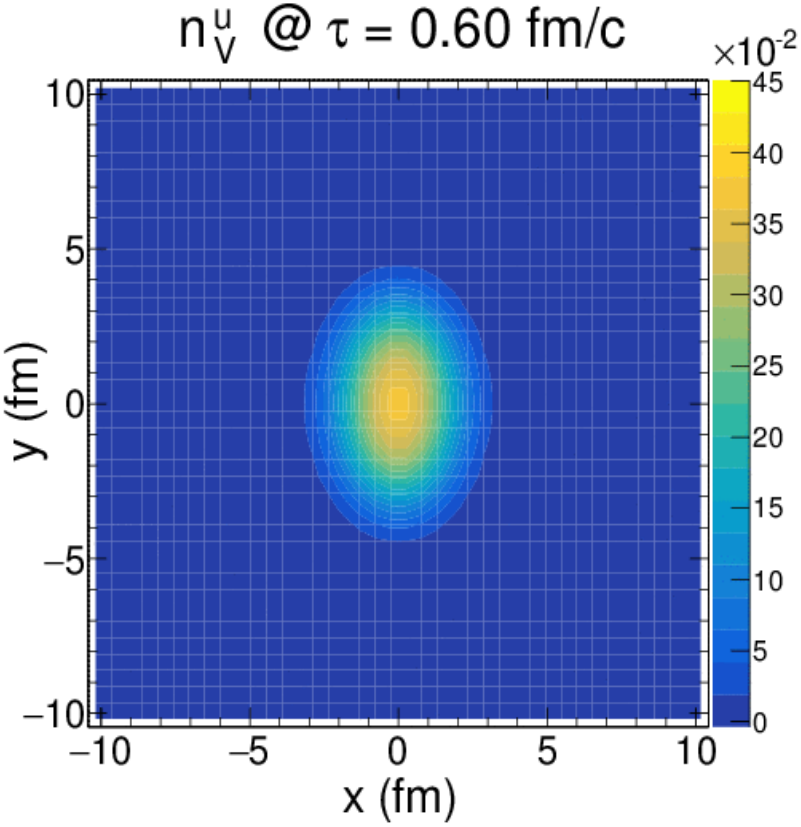


Density evolution

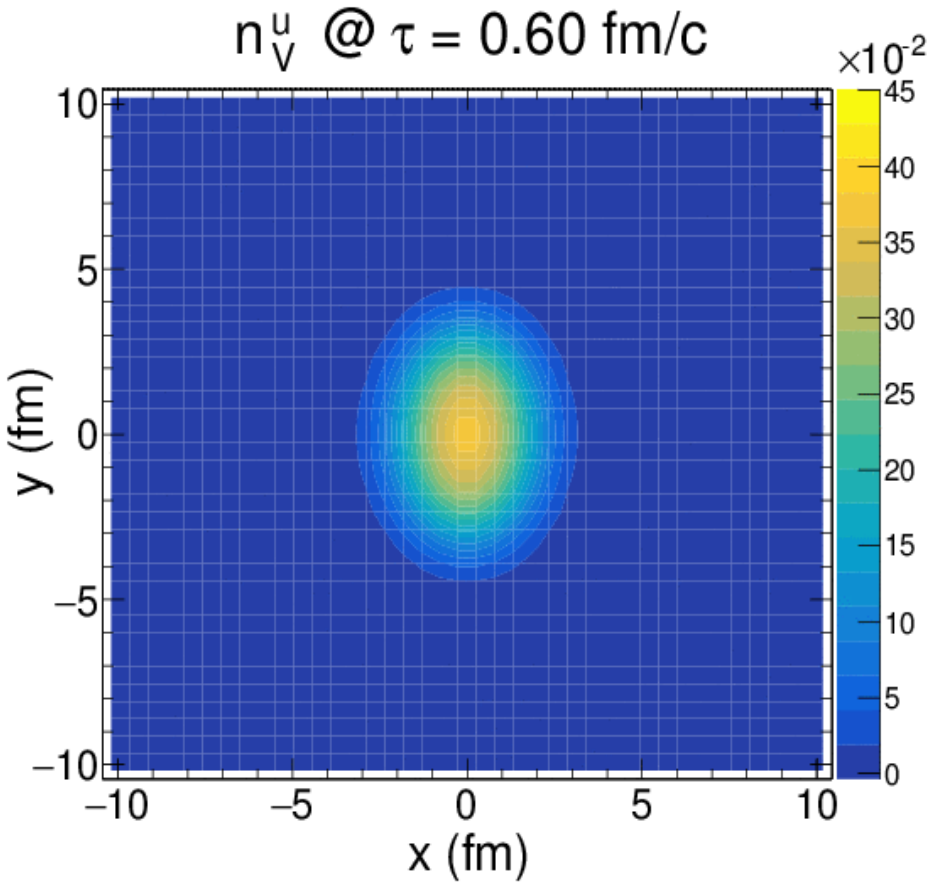
$B=0$

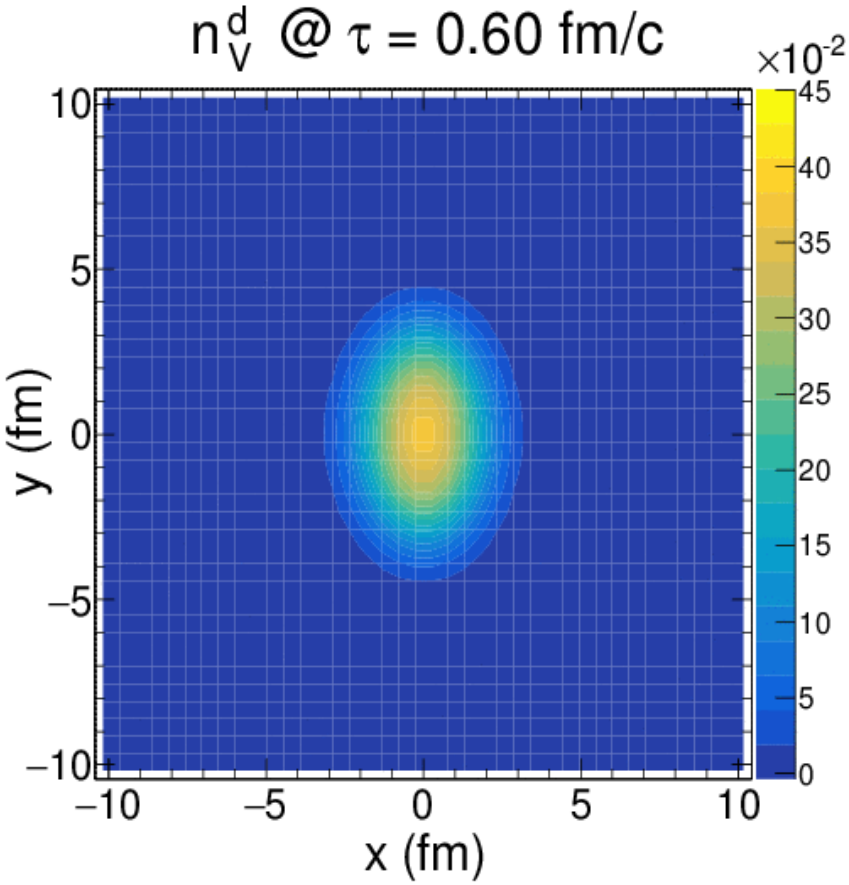


$B\neq0$



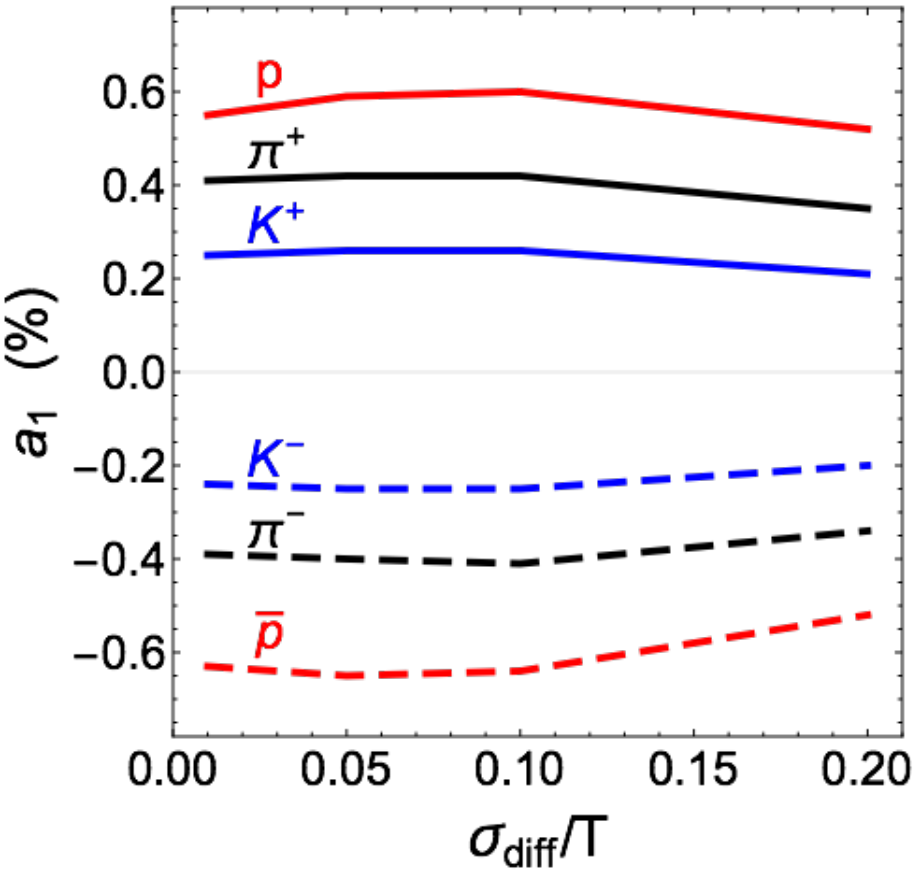
Density evolution

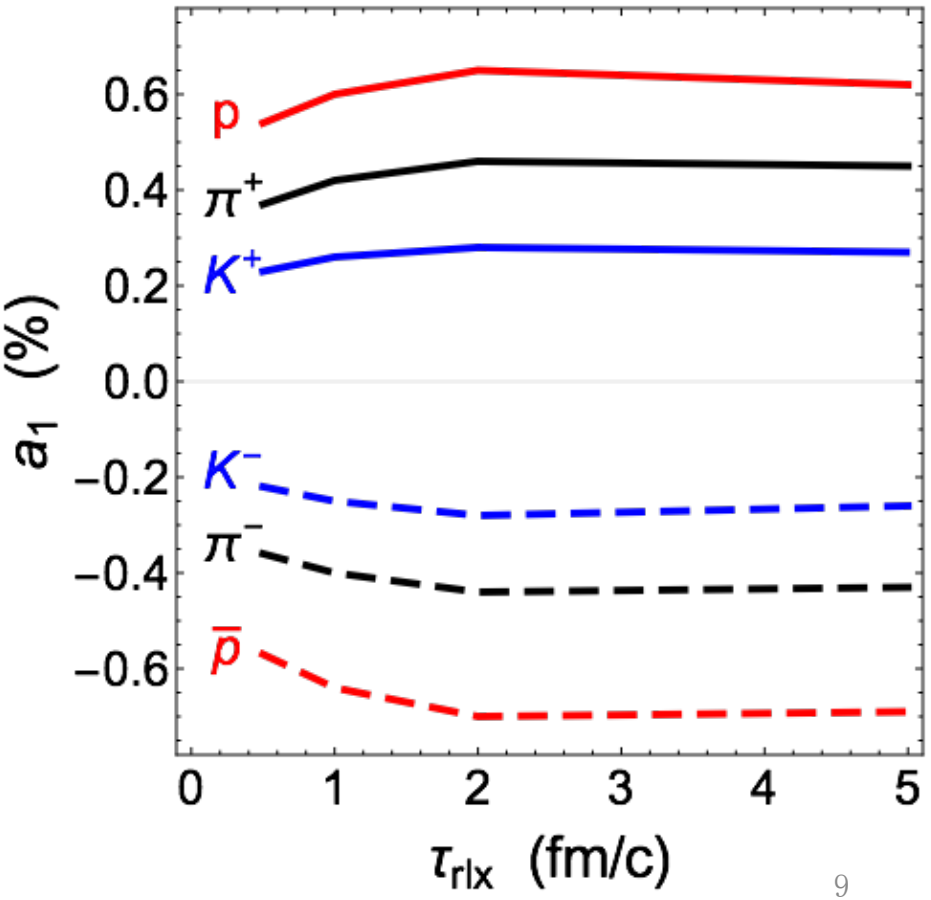




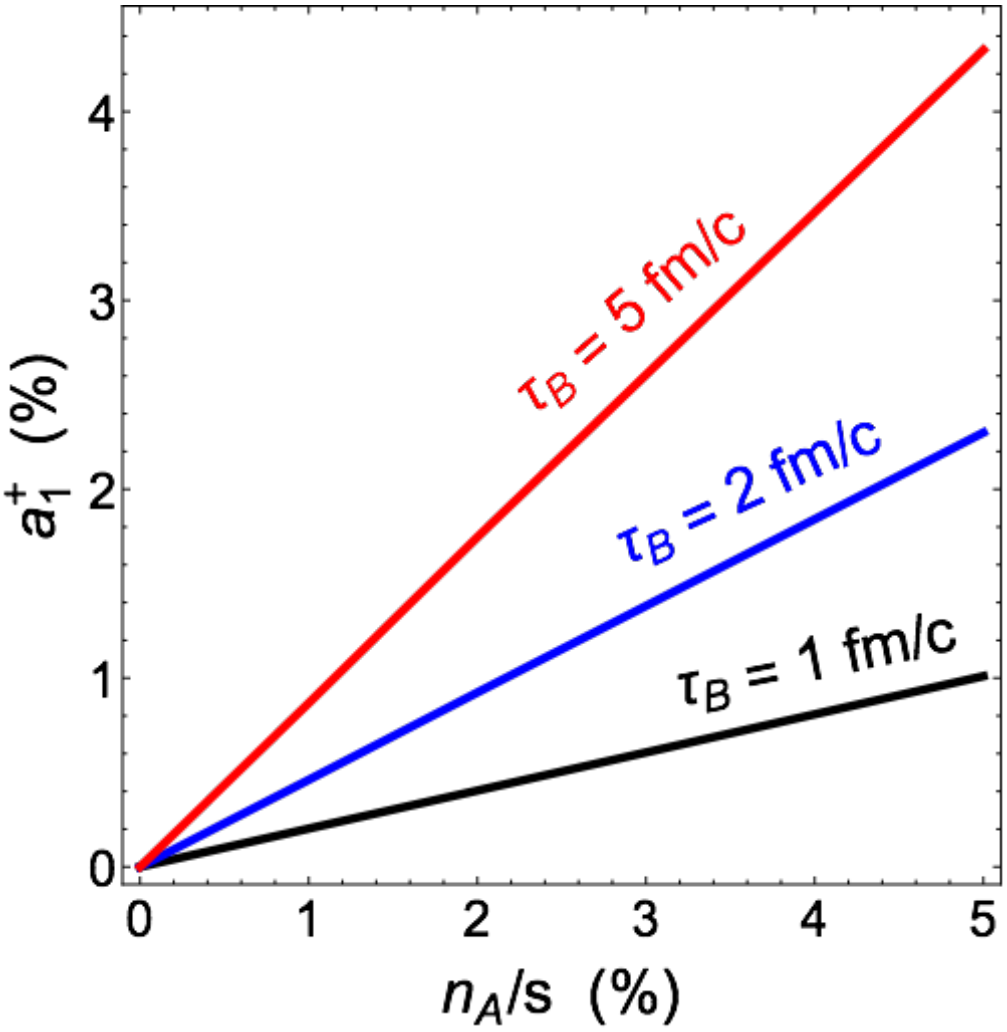
Diffusion term

- Not so sensitive to relaxation time and diffusion





Initial axial density



Axial density

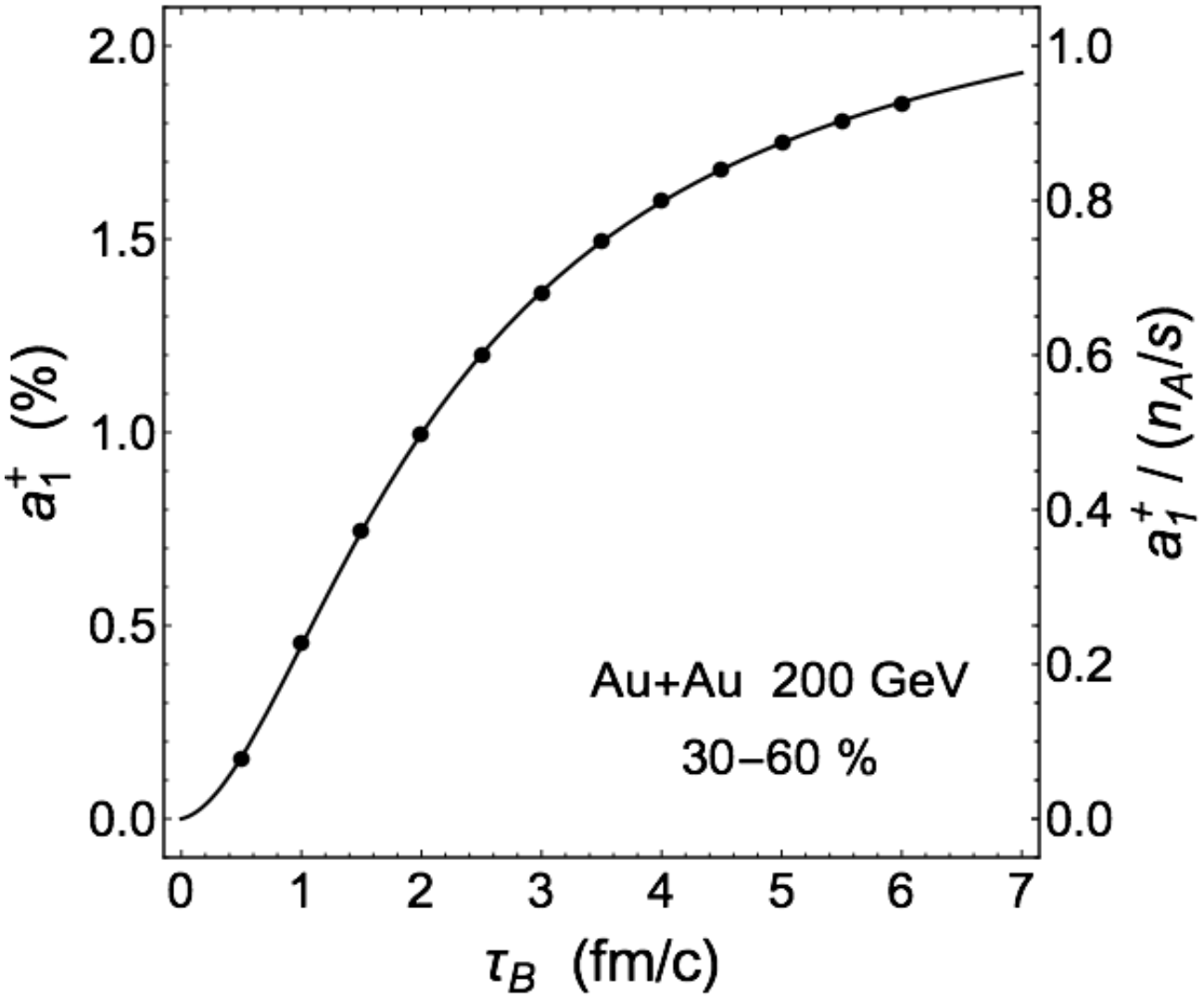
Linear

Vector density

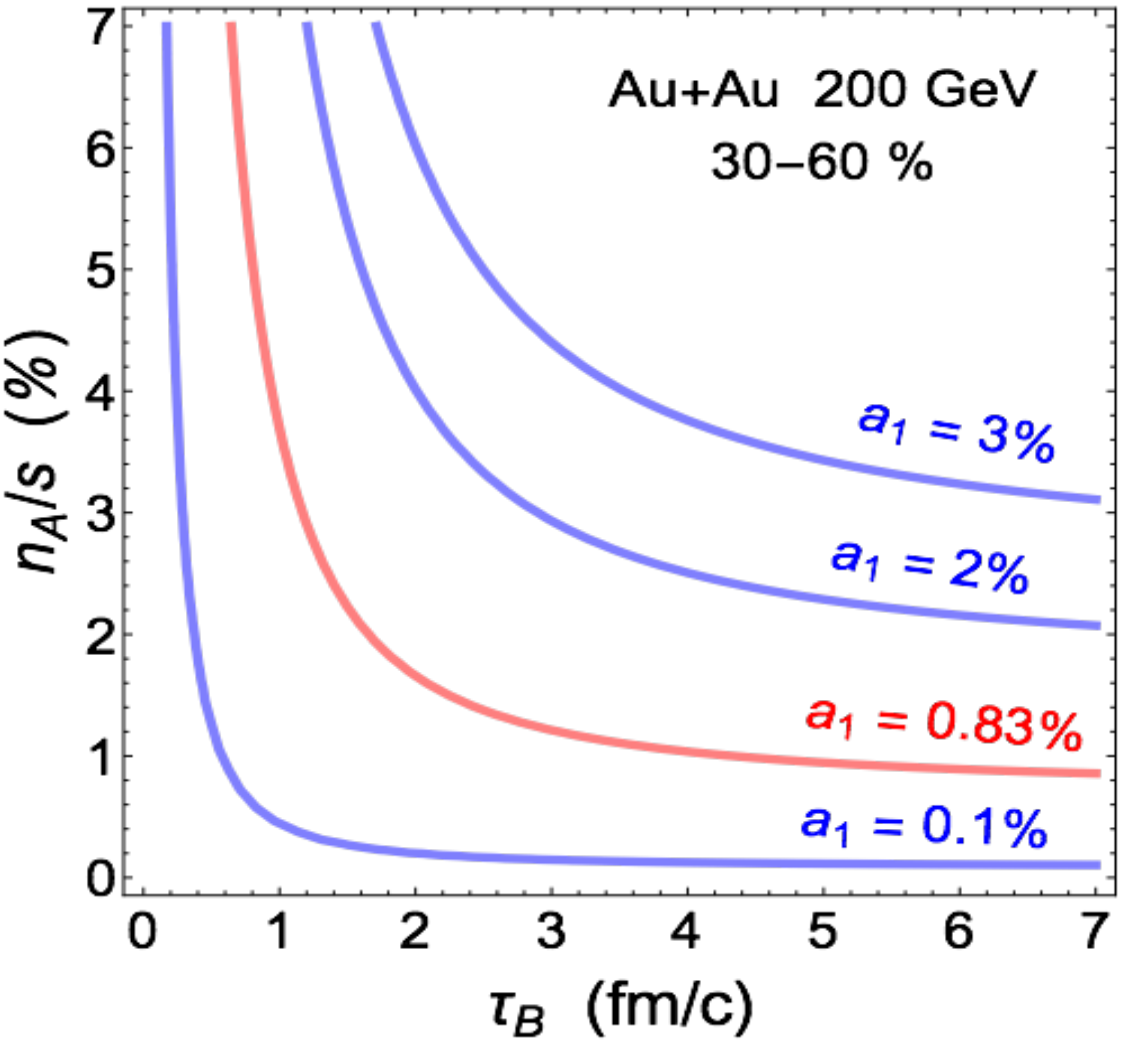
Mild

B field lifetime

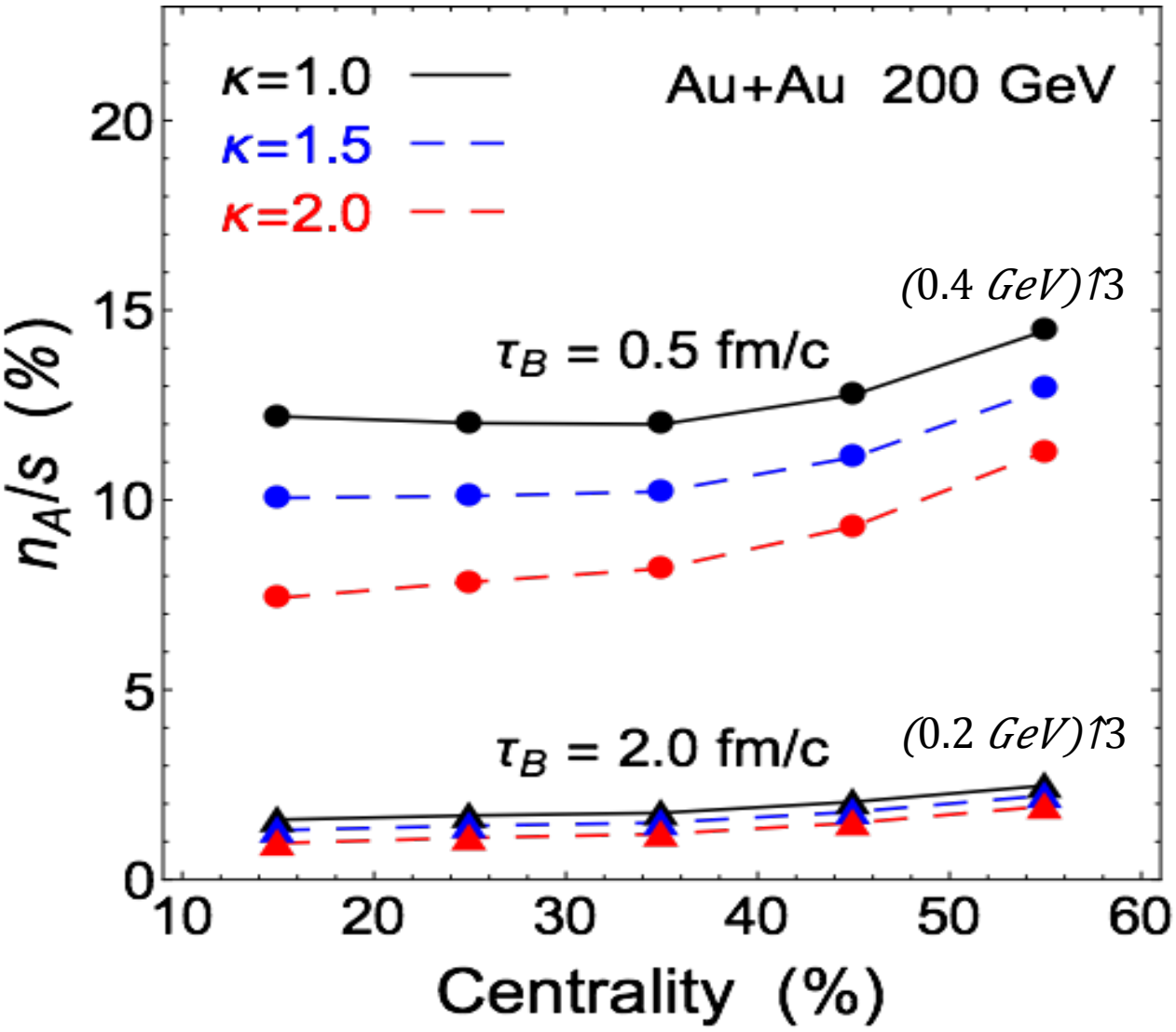
$$B_y = B_0 / (1 + (\tau/\tau_B)^2)$$



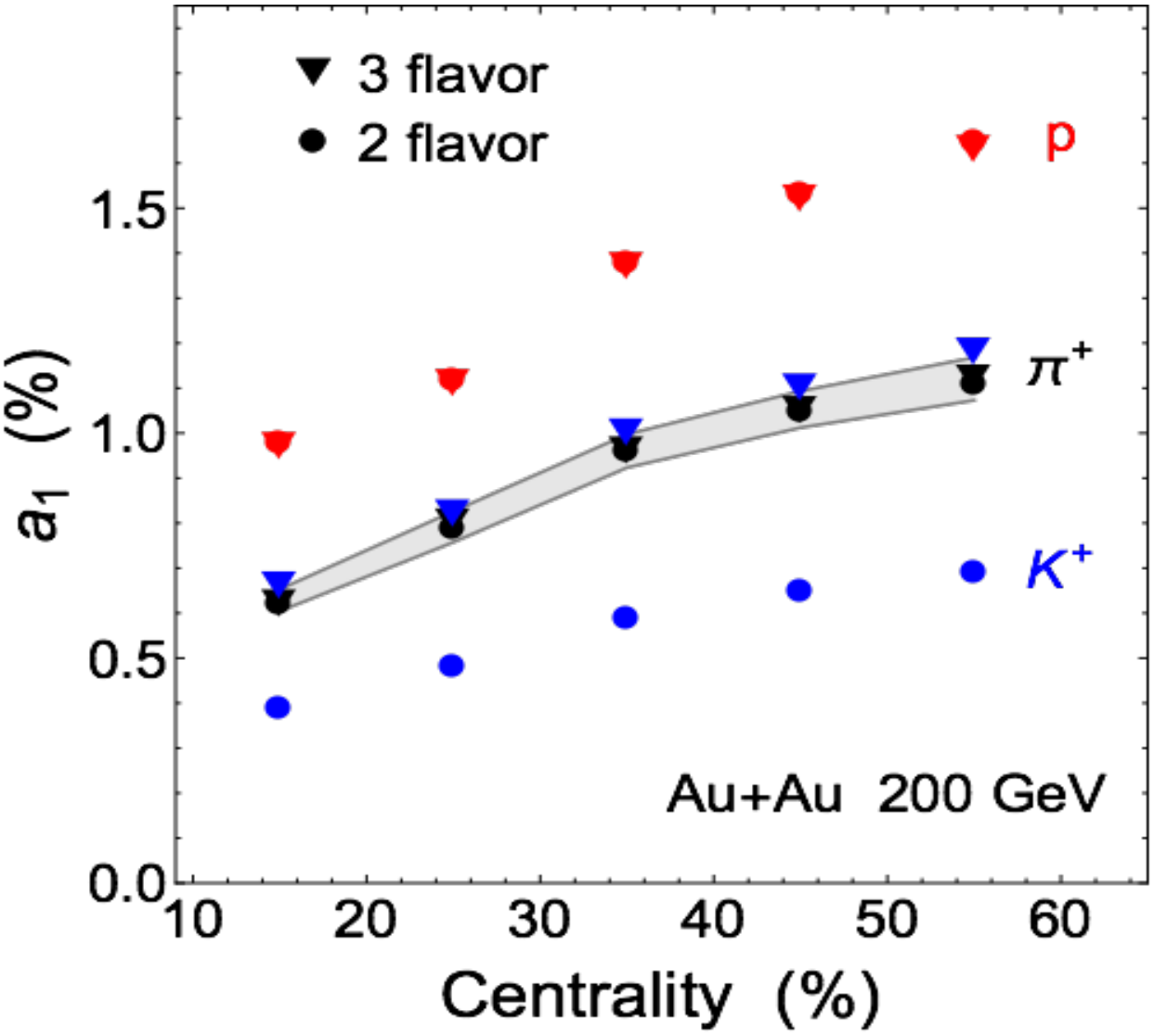
Comparison with data



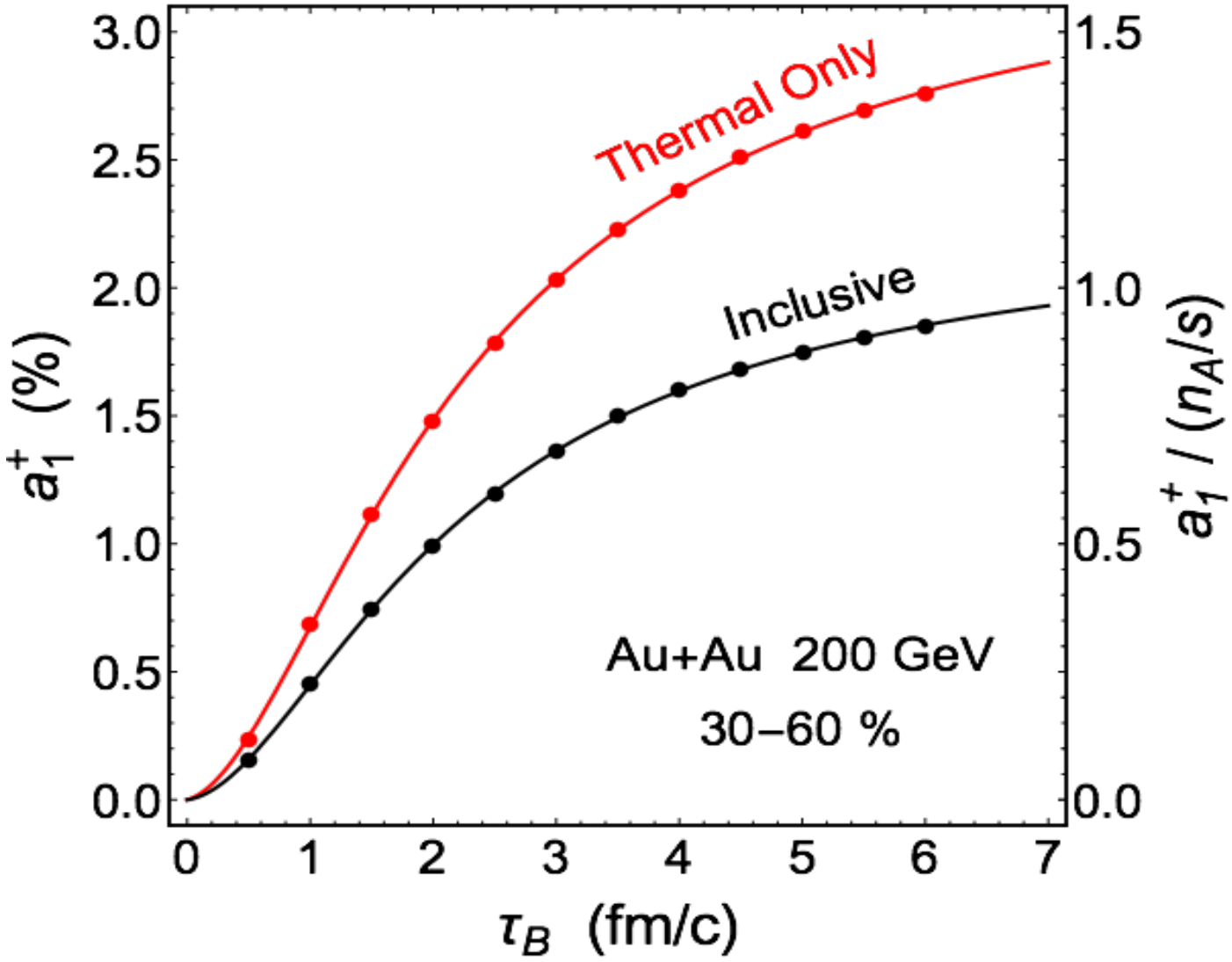
Comparison with data



How chiral is the strange quark



Resonance decay contribution



Summary and outlook

- ✓ Experimental signal might be quantitatively explained by CME.
- ✓ Initial axial density & B field lifetime are most relevant.

asymmetry measurement would tell us more about strange quark.

- event-by-event simulation, with hadron cascade
- different type of time-dependent B field
- more anomalous effects, e.g. CMW

Thank you for your attention!