

Tomography of high-energy heavy-ion collisions with asymmetries of dijet and γ -jet

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Based on:

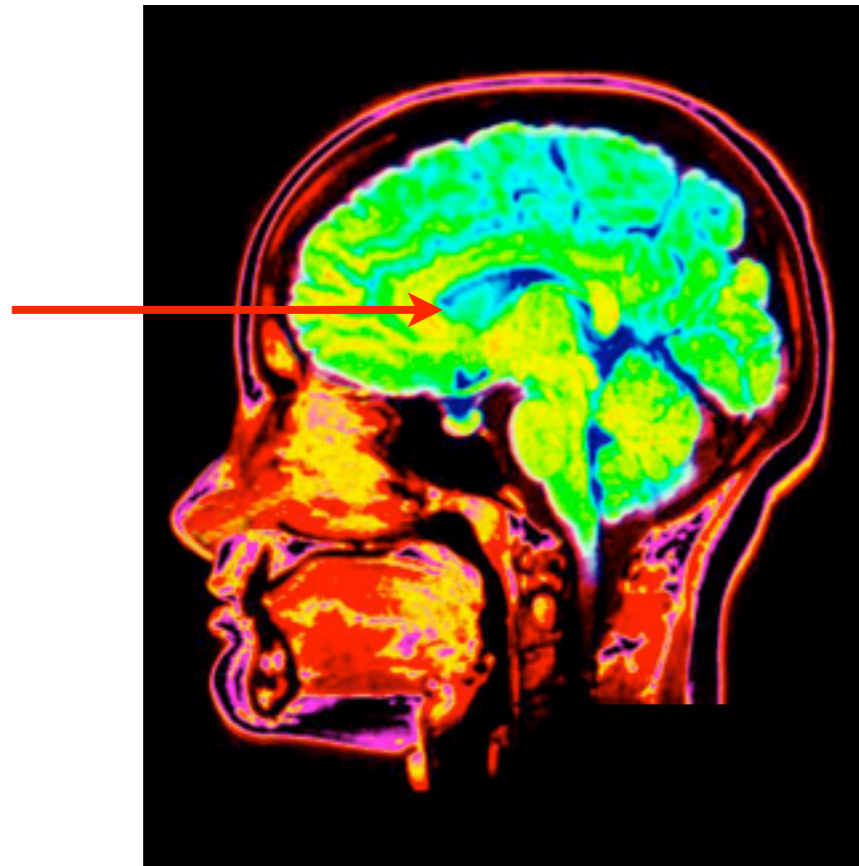
Guo-Liang Ma, Phys. Lett. B, 724 (2013) 278 [arXiv: 1302.5873].

Guo-Liang Ma, Phys. Rev. C, 87 (2013) 064901 [arXiv: 1304.2841].

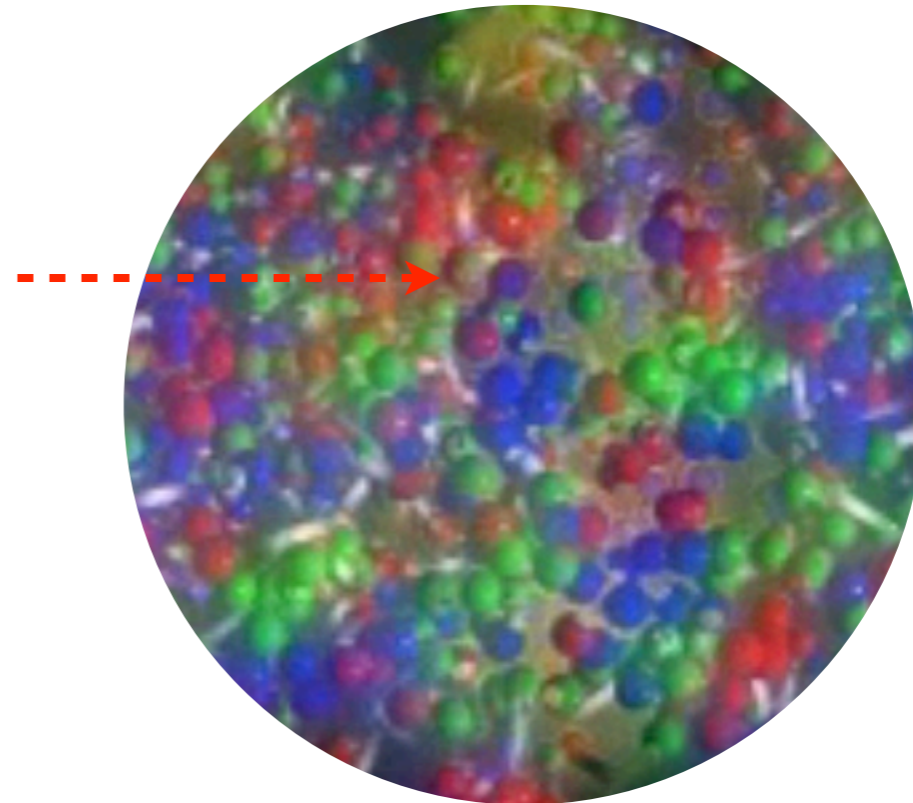
Outline

- Introduction
- Dijet asymmetry
- γ -jet asymmetry
- γ -jet tomography
- Summary

Tomography of QGP



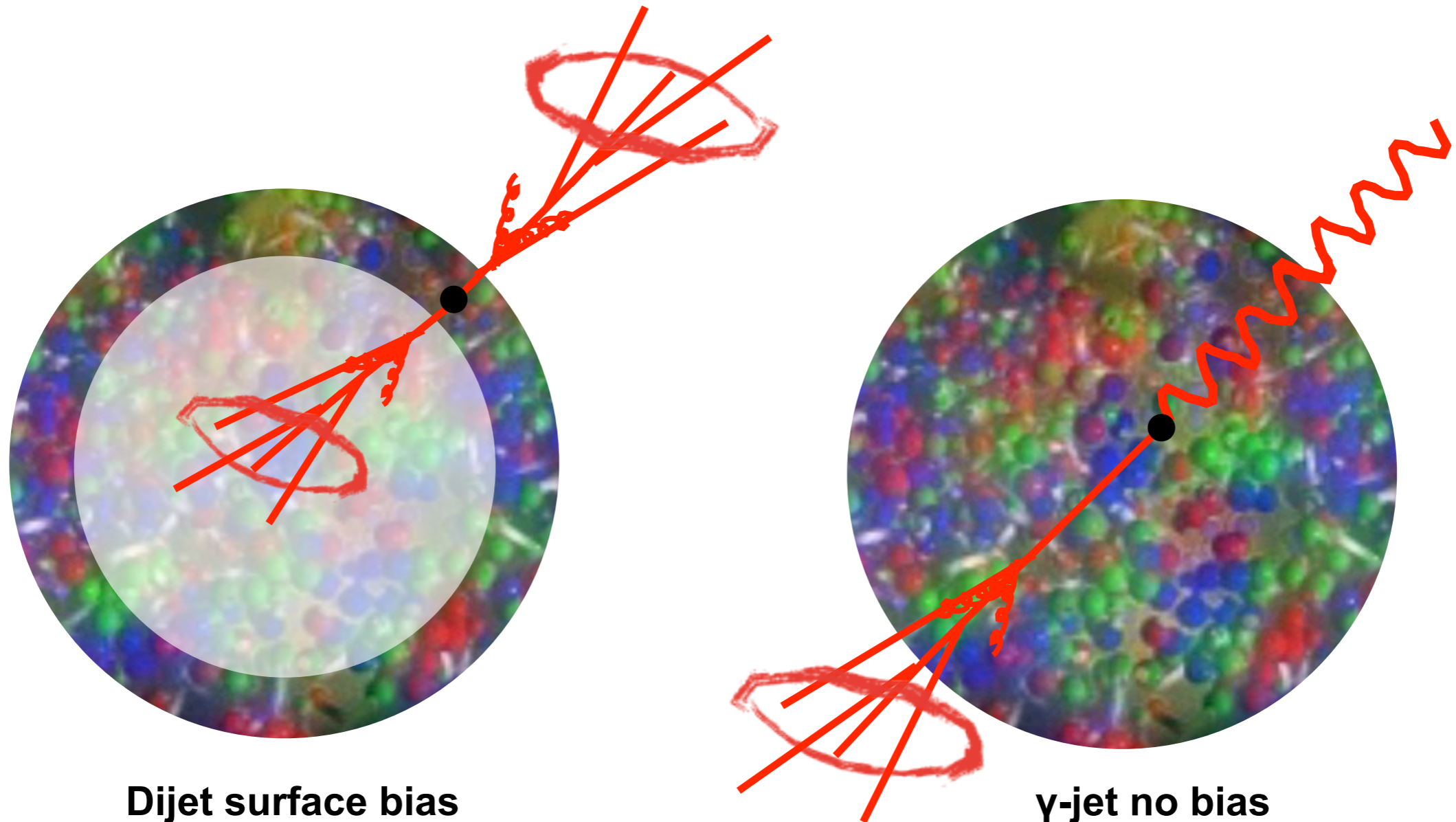
X-ray-tomography of brain



?-tomography of QGP

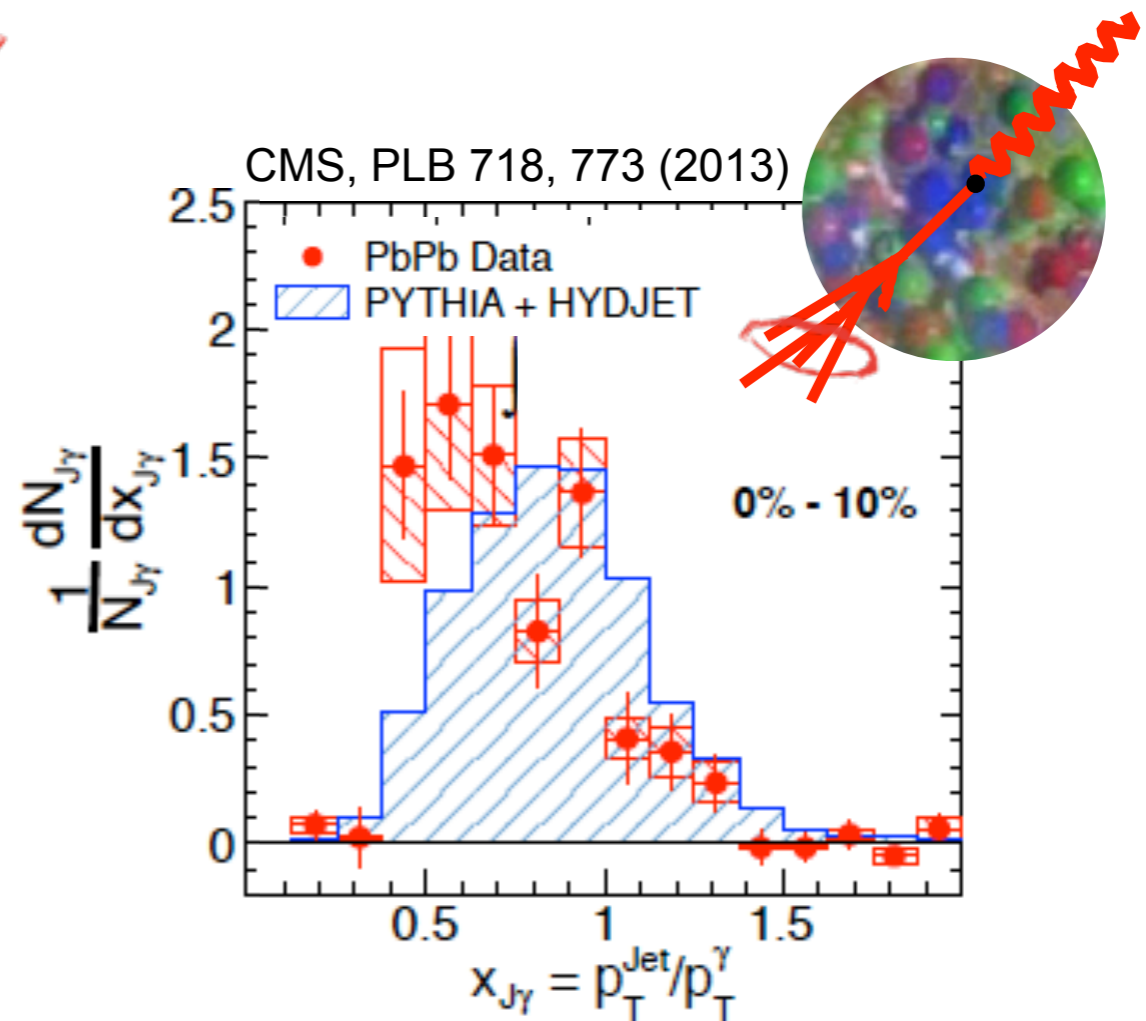
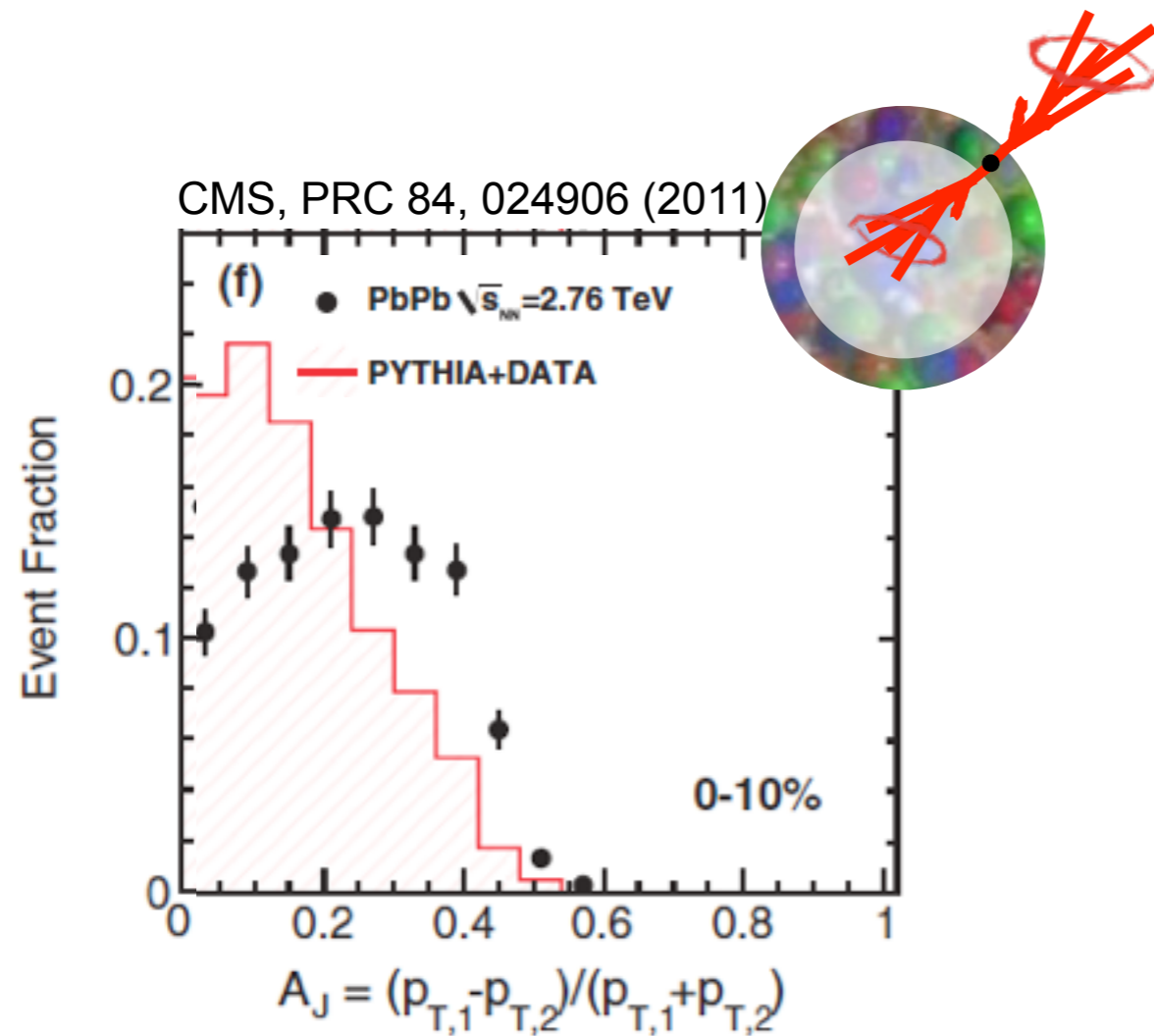
- Sensitive and easy-operating probe?

Dijet vs γ -jet in QGP



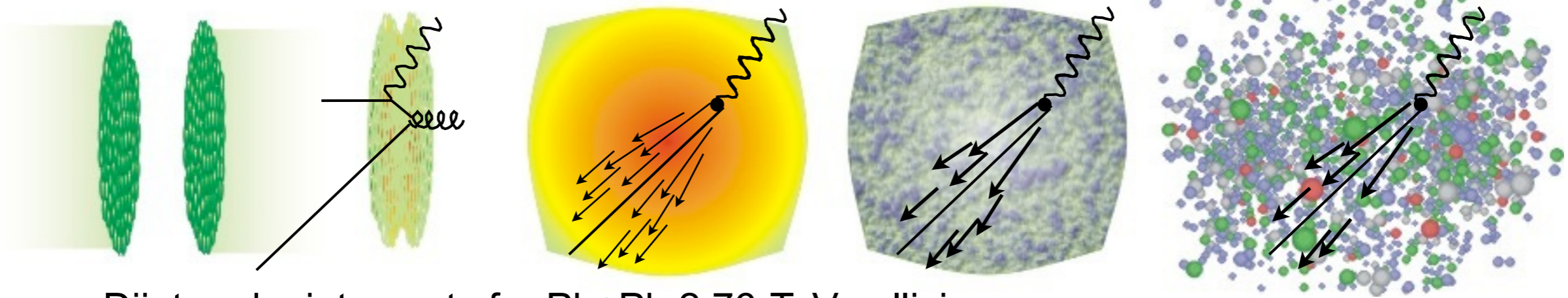
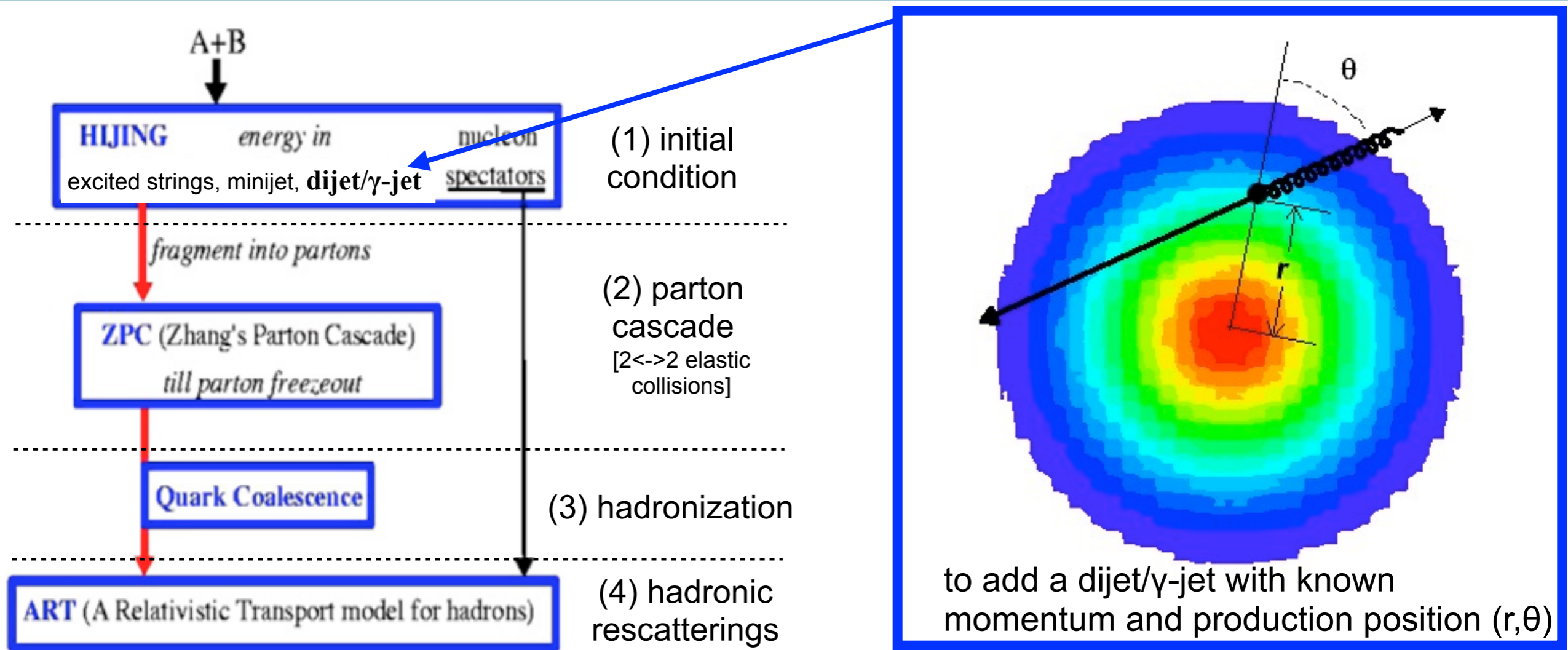
- Jet energy loss in QGP \Rightarrow p_T -asymmetries of dijet and γ -jet.
- Dijet surface bias vs γ -jet no bias.

Dijet and γ -jet in PbPb @LHC



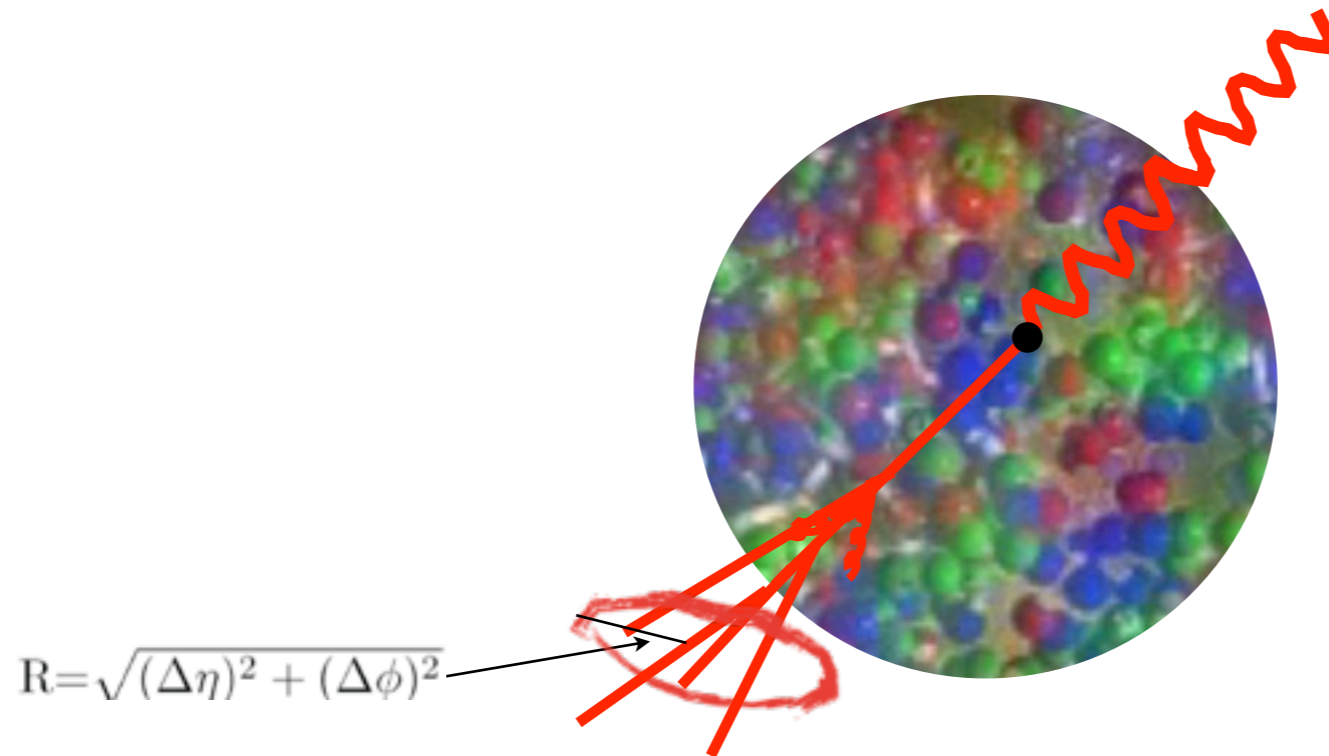
- Large dijet and γ -jet p_T -asymmetries in central PbPb collisions.

AMPT model with triggered jets



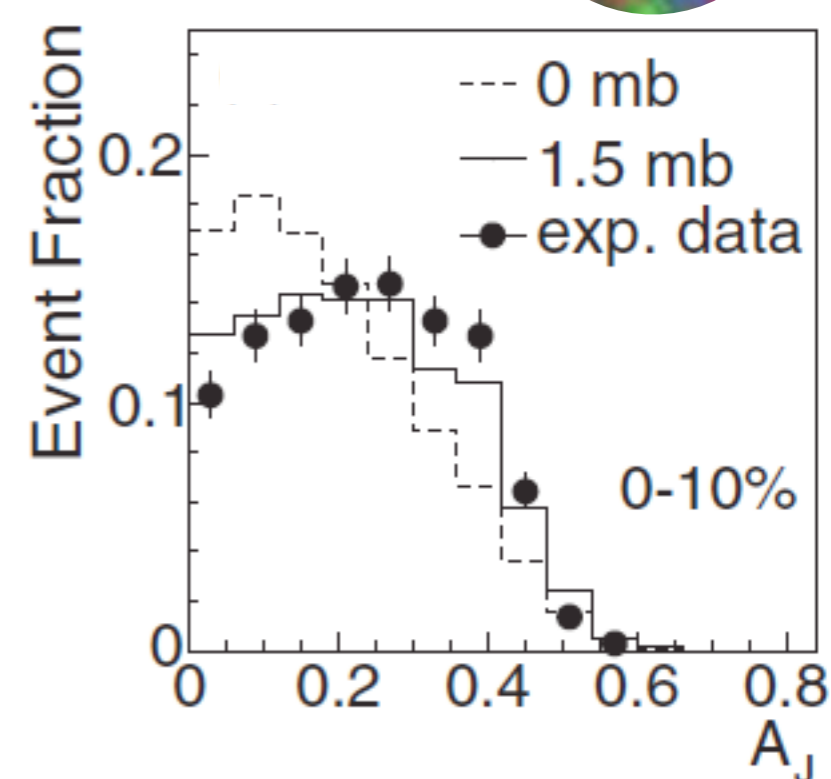
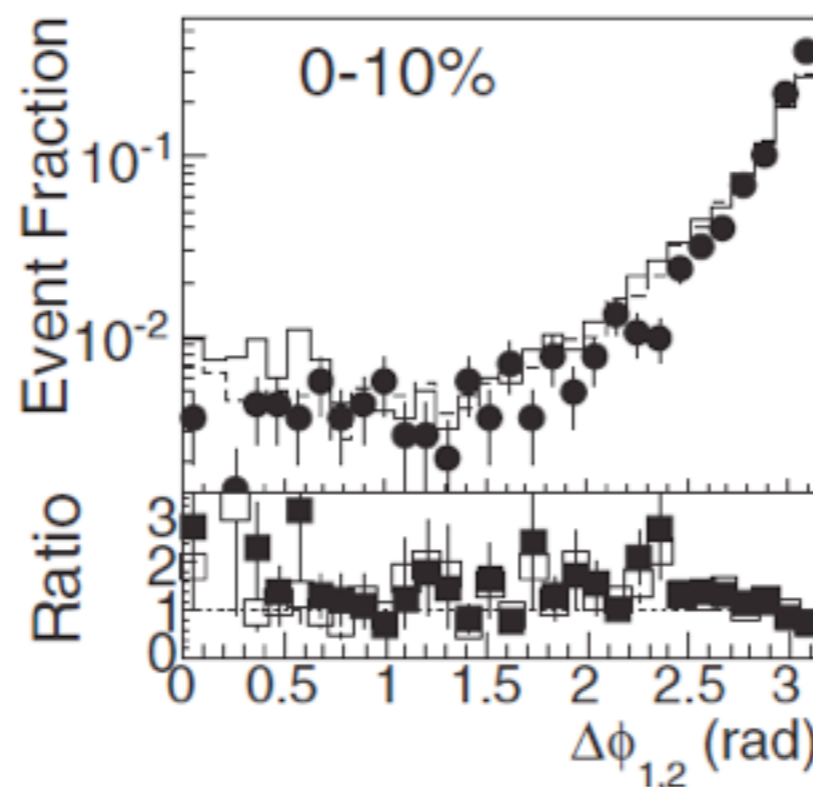
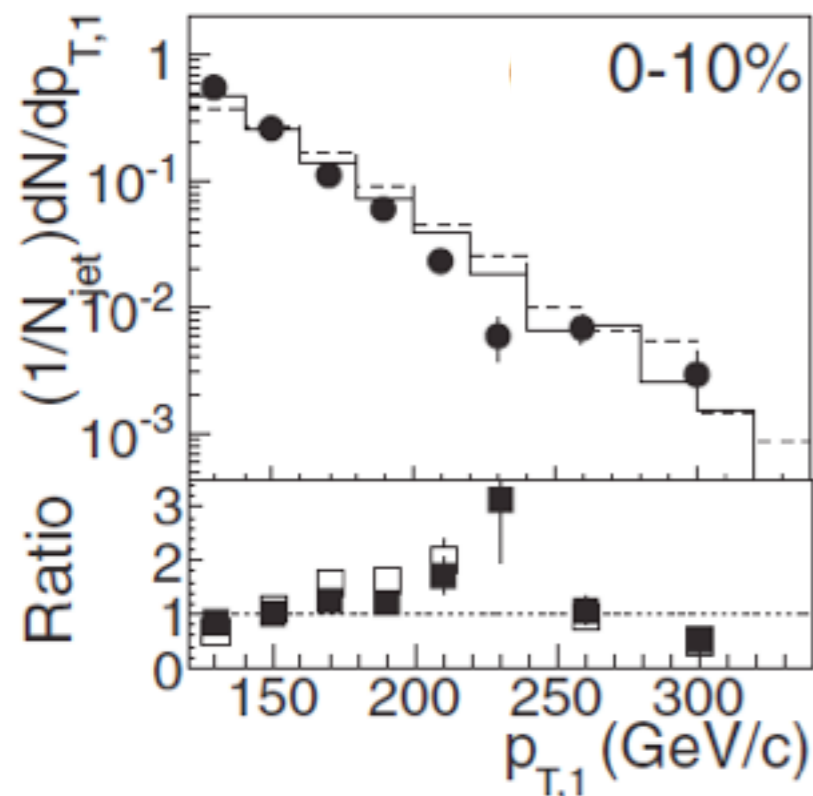
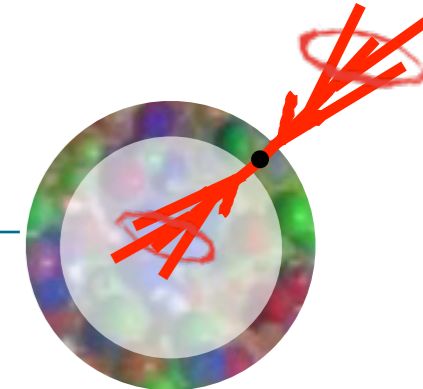
- Dijet and γ -jet events for Pb+Pb 2.76-TeV collisions.
- String-melting AMPT simulations: 1.5 mb / 0 mb (turn on/off QGP stage)

Jet reconstruction



- Jet reconstruction: anti-kt algorithm, [Fastjet package, background subtraction, jet energy scale correction, jet efficiency correction]
- Dijet asymmetry: $R=0.5$, $p_{T,1} > 120$ GeV/c, $p_{T,2} > 50$ GeV/c, $|\eta_{1,2}| < 2$, $\Delta\phi_{12} > 2\pi/3$
- γ -jet asymmetry: $R=0.3$, $p_{T}^{\text{jet}} > 30$ GeV/c, $|\eta^{\text{jet}}| < 1.6$; $p_{T}^{\gamma} > 60$ GeV/c, $|\eta^{\gamma}| < 1.44$, $\Delta\phi_{j\gamma} > 7\pi/8$

Dijet characters



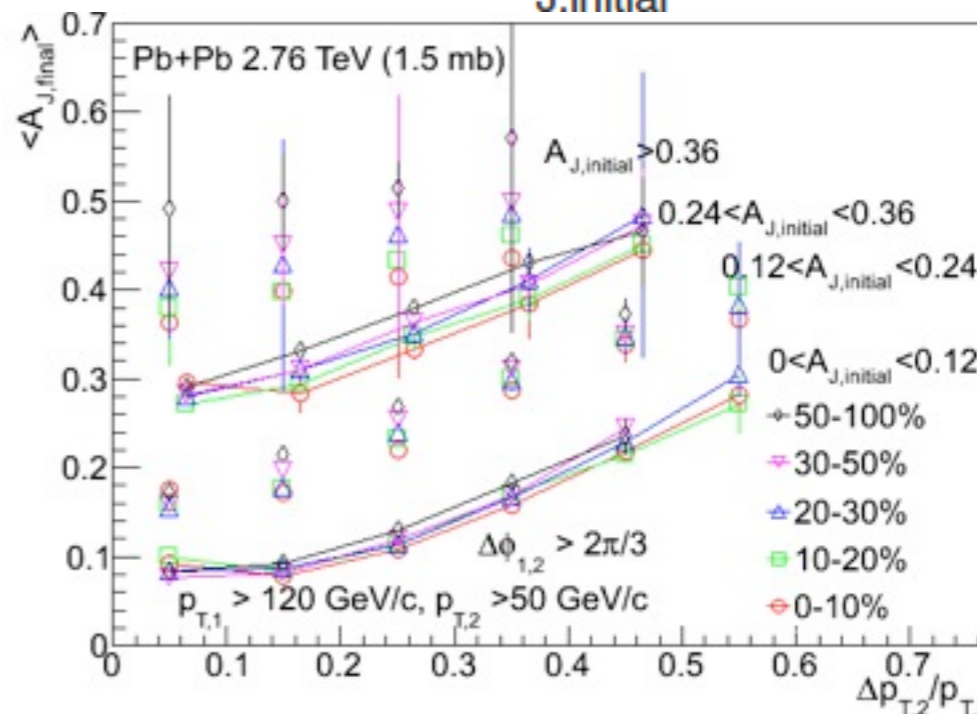
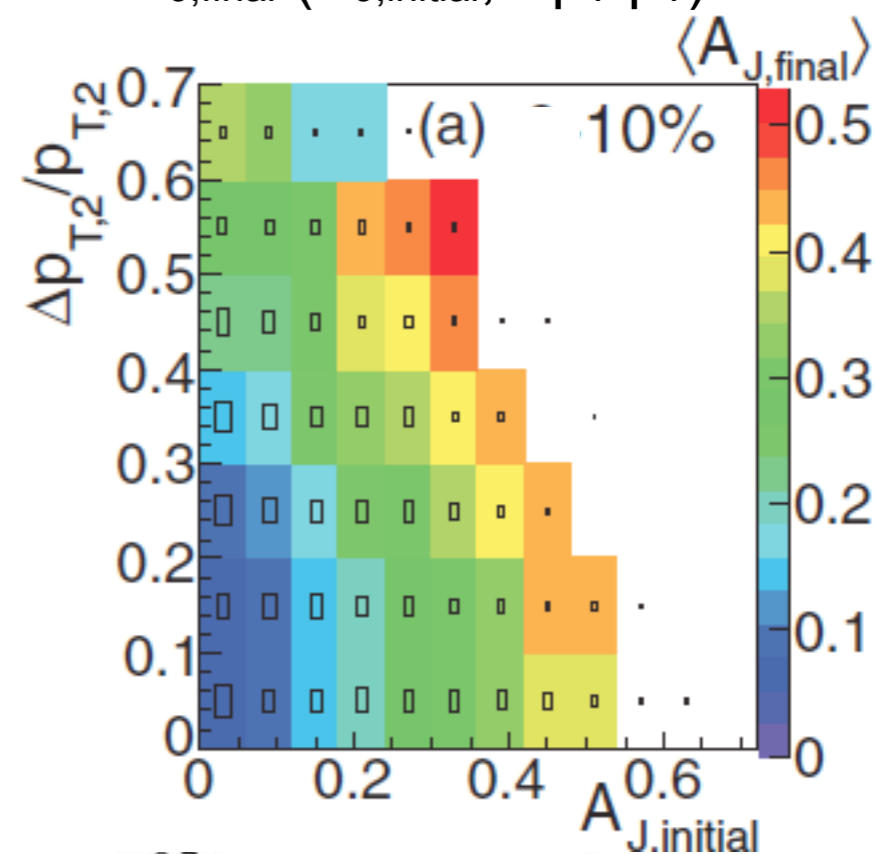
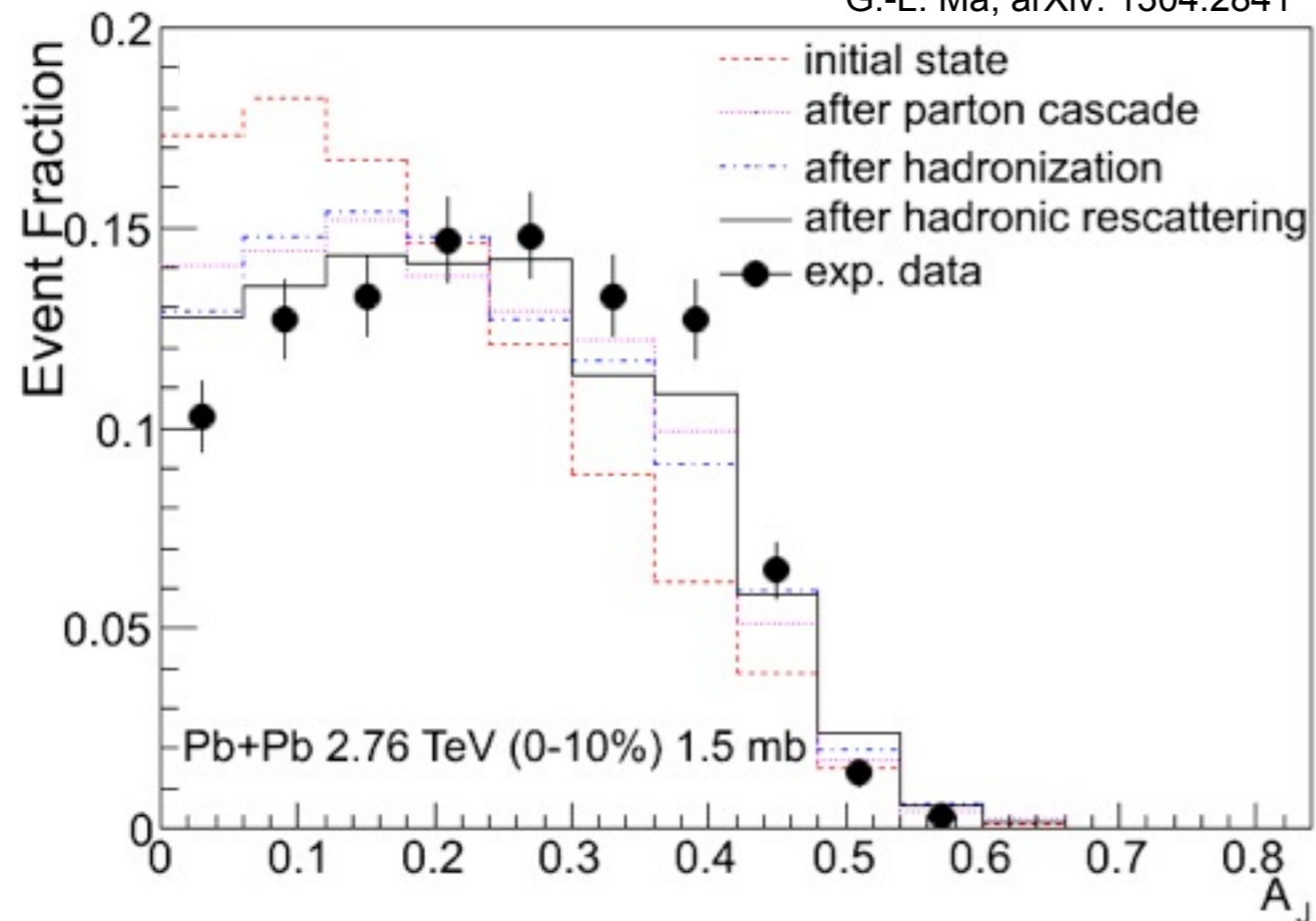
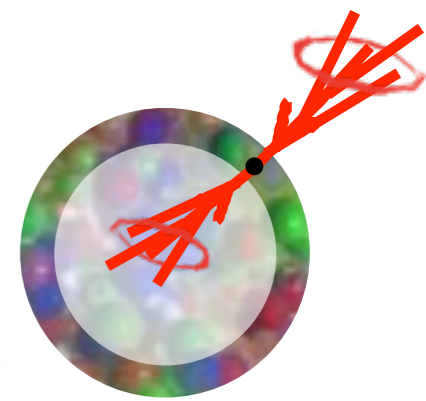
G.-L. Ma, arXiv: 1304.2841

- Dijet p_T spectra and back-to-back azimuthal correlation are not sensitive to the existence of partonic phase.
- However, dijet asymmetry is enhanced due to strong parton cascade.

Dijet asymmetry

G.-L. Ma, arXiv: 1304.2841

A_J evolution function:
 $A_{J,final}(A_{J,initial}, \Delta p_{T,2}/p_{T,2})$

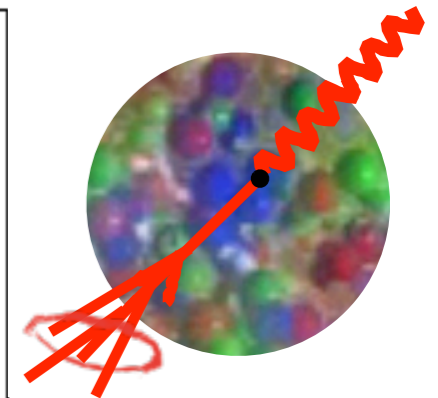
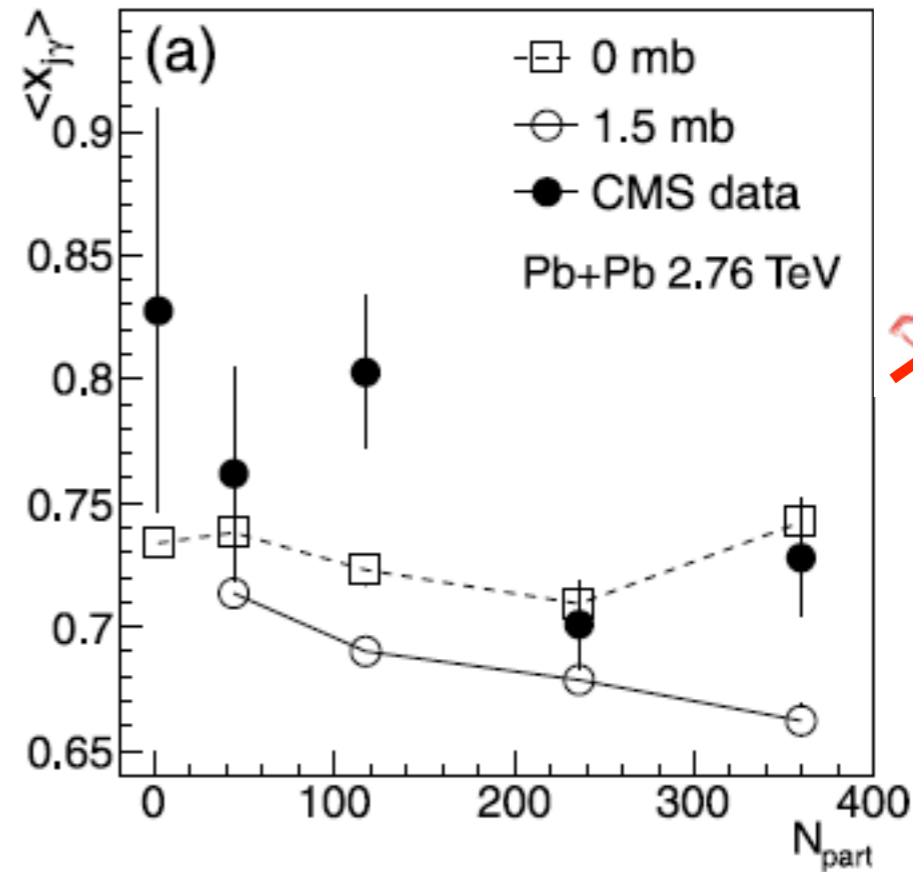
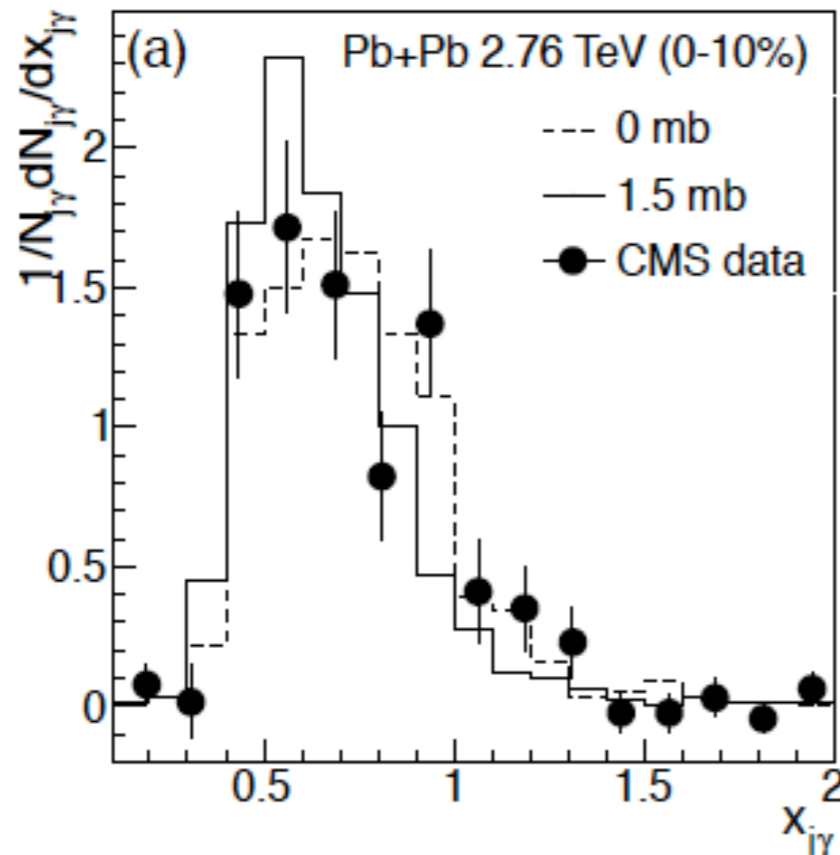


- A large dijet asymmetry (A_J) is produced by strong interactions between jets and partonic matter.

- The final A_J is driven by both initial A_J and partonic jet energy loss.

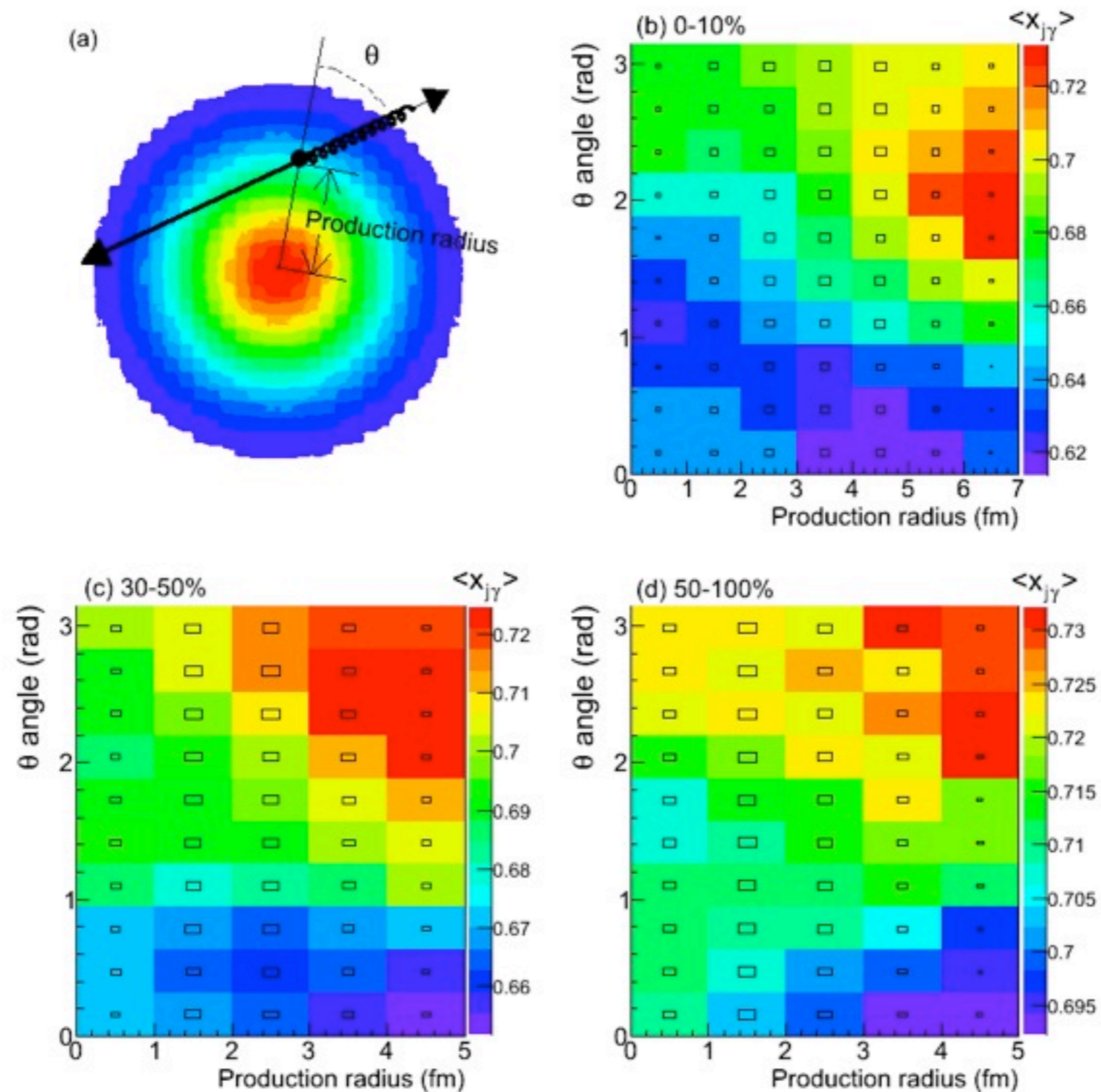
γ -jet asymmetry

G. -L. Ma, arXiv: 1302.5873



- Jet losses more energy by strong partonic interactions than by hadronic interactions only.

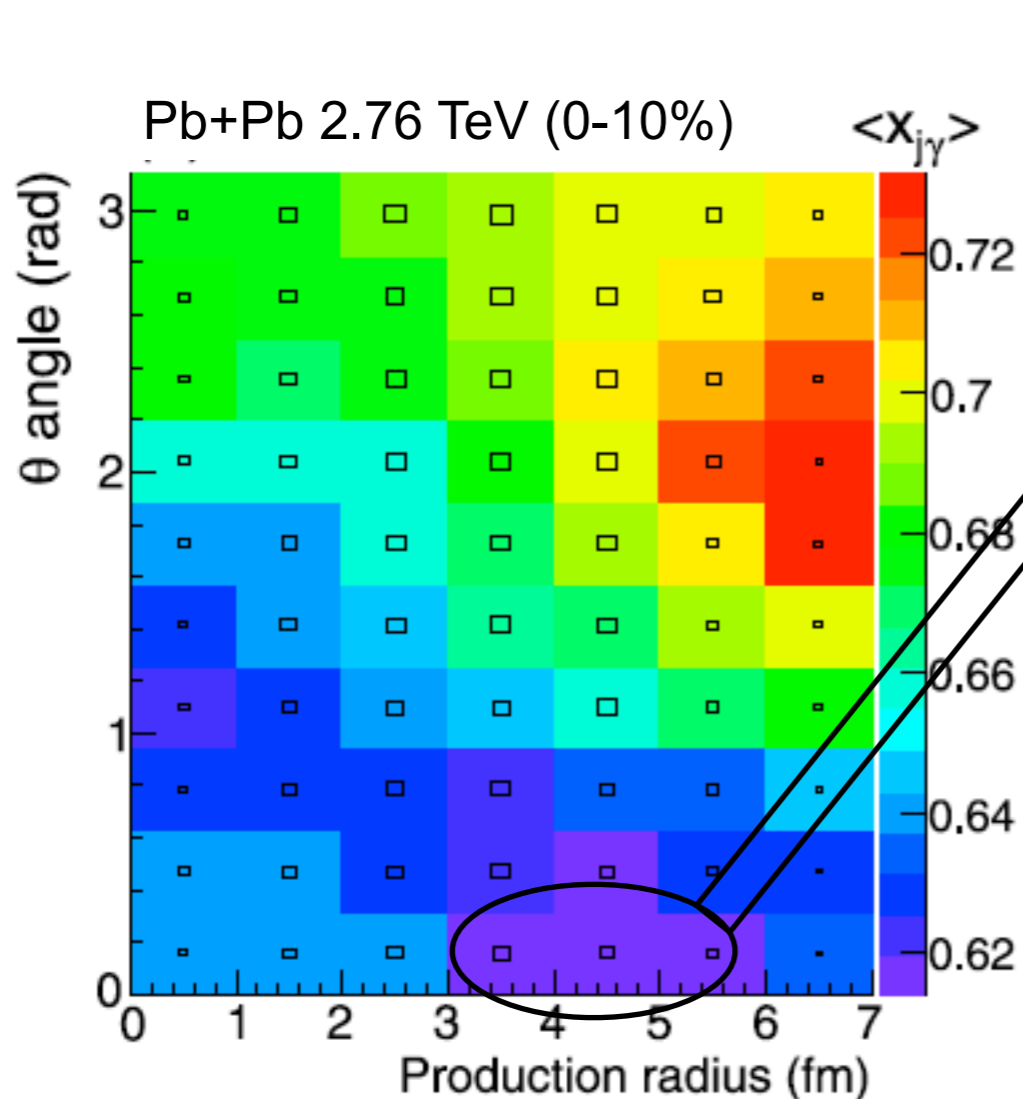
γ -jet tomography of QGP



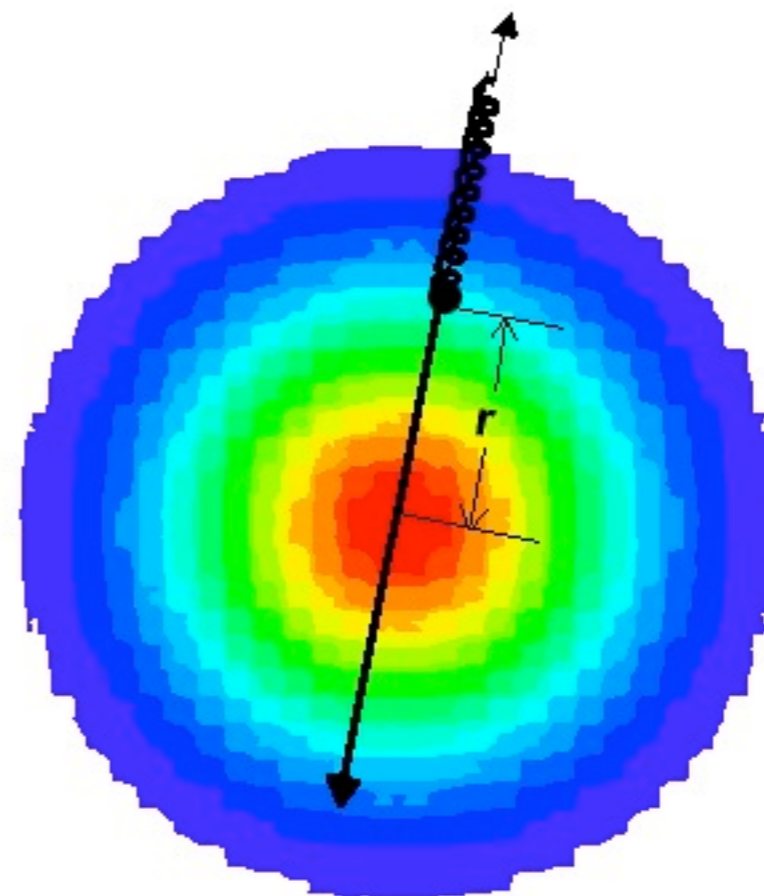
G. -L. Ma, arXiv: 1302.5873

- $X_{j\gamma}$ is sensitive to the birth information (r, θ) of γ -jet.

γ -jet tomography of QGP



Pouch-through jet case:



$$x_{j\gamma} = p_T^{\text{Jet}}/p_T^\gamma$$

Pb+Pb 2.76 TeV (1.5 mb)

$p_T^\gamma > 60$ GeV/c $|\eta^\gamma| < 1.44$

$p_T^{\text{jet}} > 30$ GeV/c $|\eta^{\text{jet}}| < 1.6$

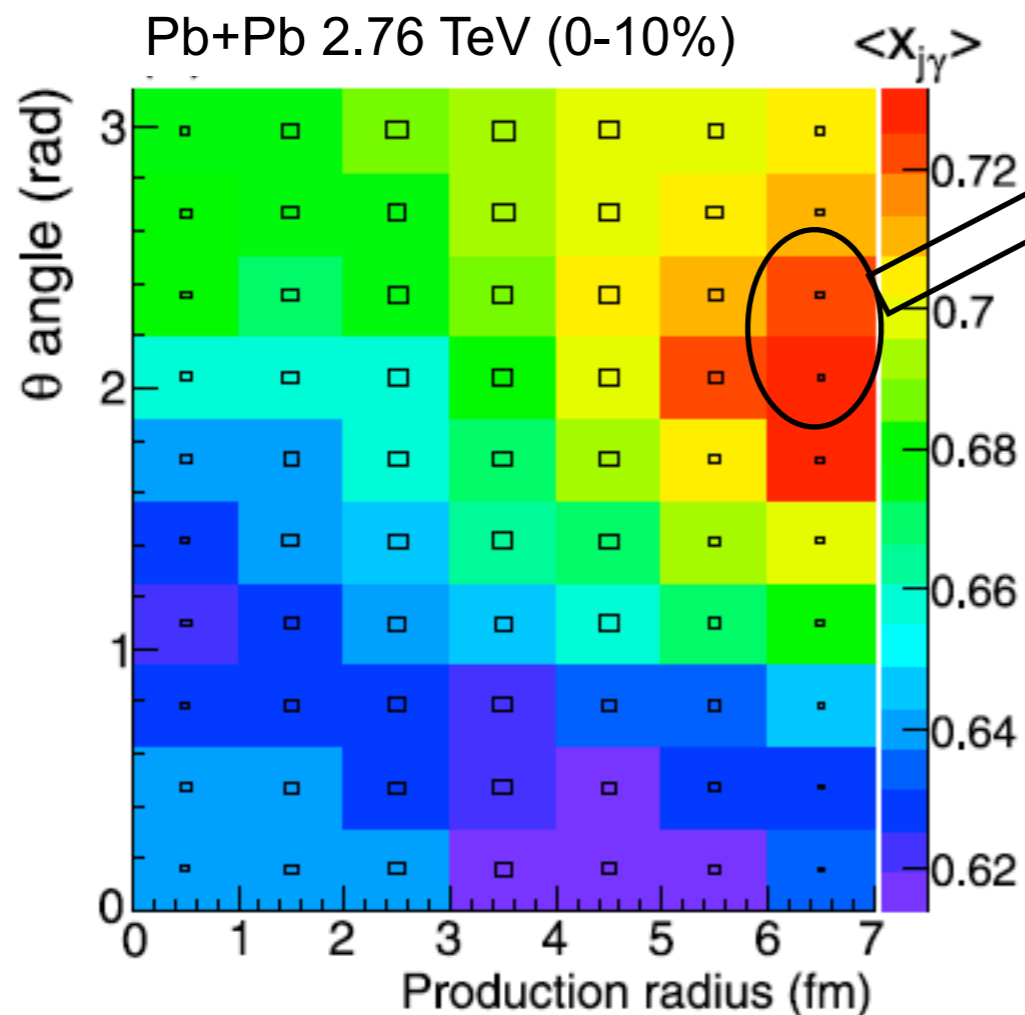
$\Delta\phi_{j\gamma} > 7/8 \pi$

G. -L. Ma, arXiv: 1302.5873

- Small $x_{j\gamma} \Leftrightarrow$ Pouch-through jet case

γ -jet tomography of QGP

G. -L. Ma, arXiv: 1302.5873



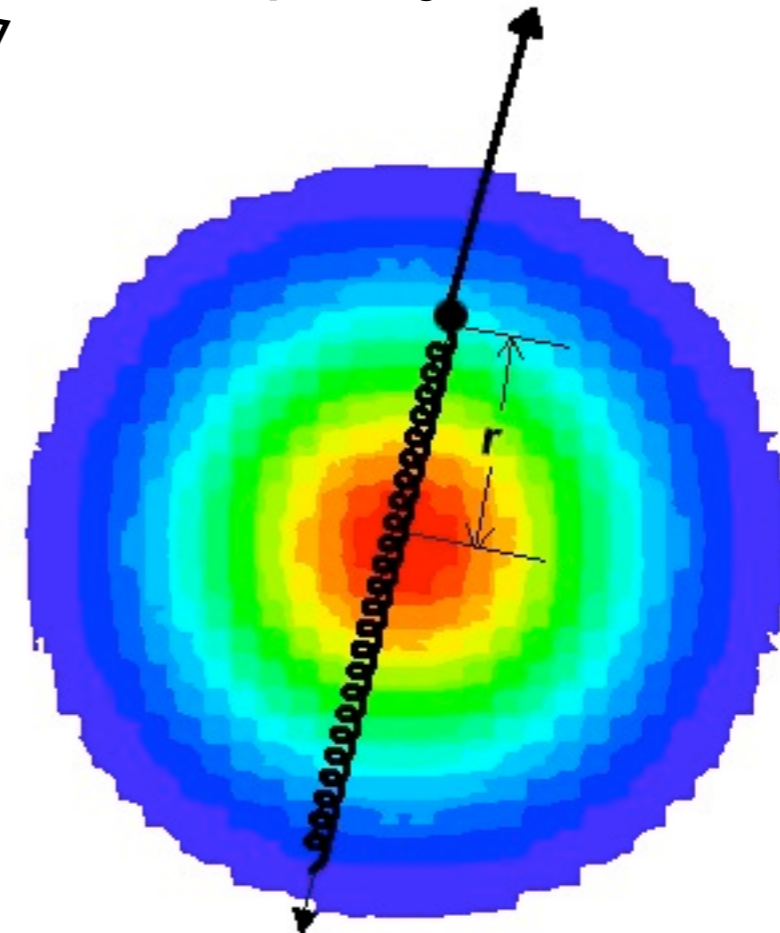
Pb+Pb 2.76 TeV (1.5 mb)

$p_T^\gamma > 60$ GeV/c $|\eta^\gamma| < 1.44$

$p_T^{\text{jet}} > 30$ GeV/c $|\eta^{\text{jet}}| < 1.6$

$\Delta\phi_{j\gamma} > 7/8 \pi$

Escaped-jet case:



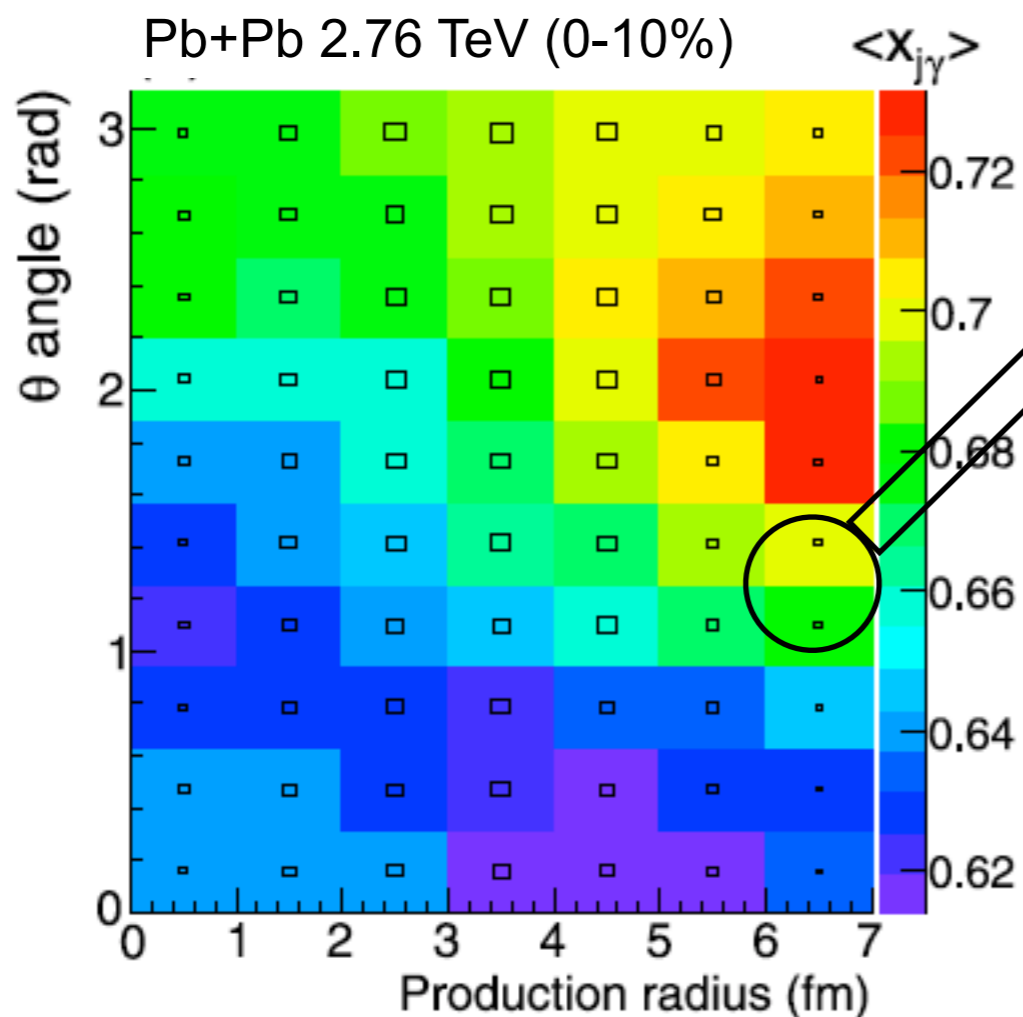
$$x_{j\gamma} = p_T^{\text{Jet}}/p_T^\gamma$$

G. -L. Ma, arXiv: 1302.5873

- Large $x_{j\gamma} \Leftrightarrow$ Escaped-jet case

γ -jet tomography of QGP

G. -L. Ma, arXiv: 1302.5873



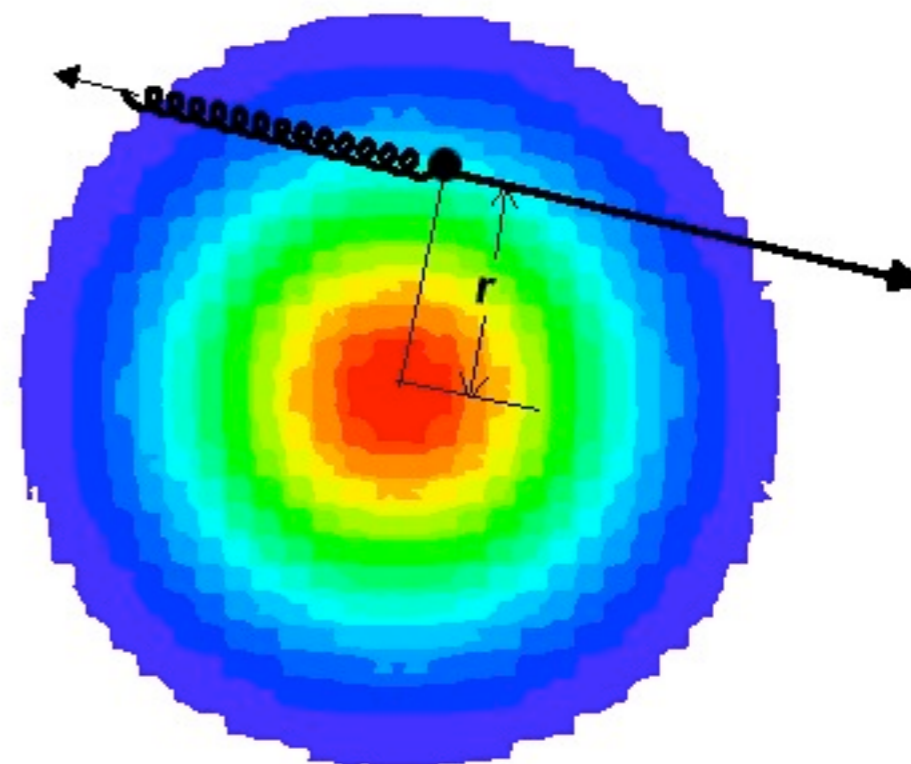
Pb+Pb 2.76 TeV (1.5 mb)

$p_T^\gamma > 60$ GeV/c $|\eta^\gamma| < 1.44$

$p_T^{\text{jet}} > 30$ GeV/c $|\eta^{\text{jet}}| < 1.6$

$\Delta\phi_{j\gamma} > 7/8 \pi$

Tangential-jet case:

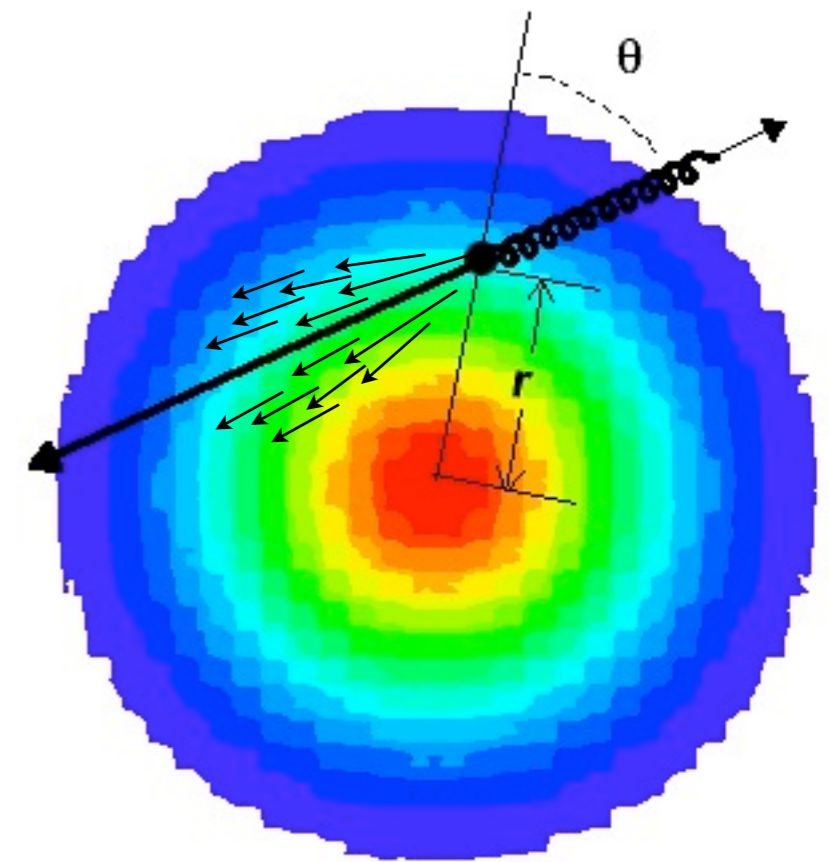
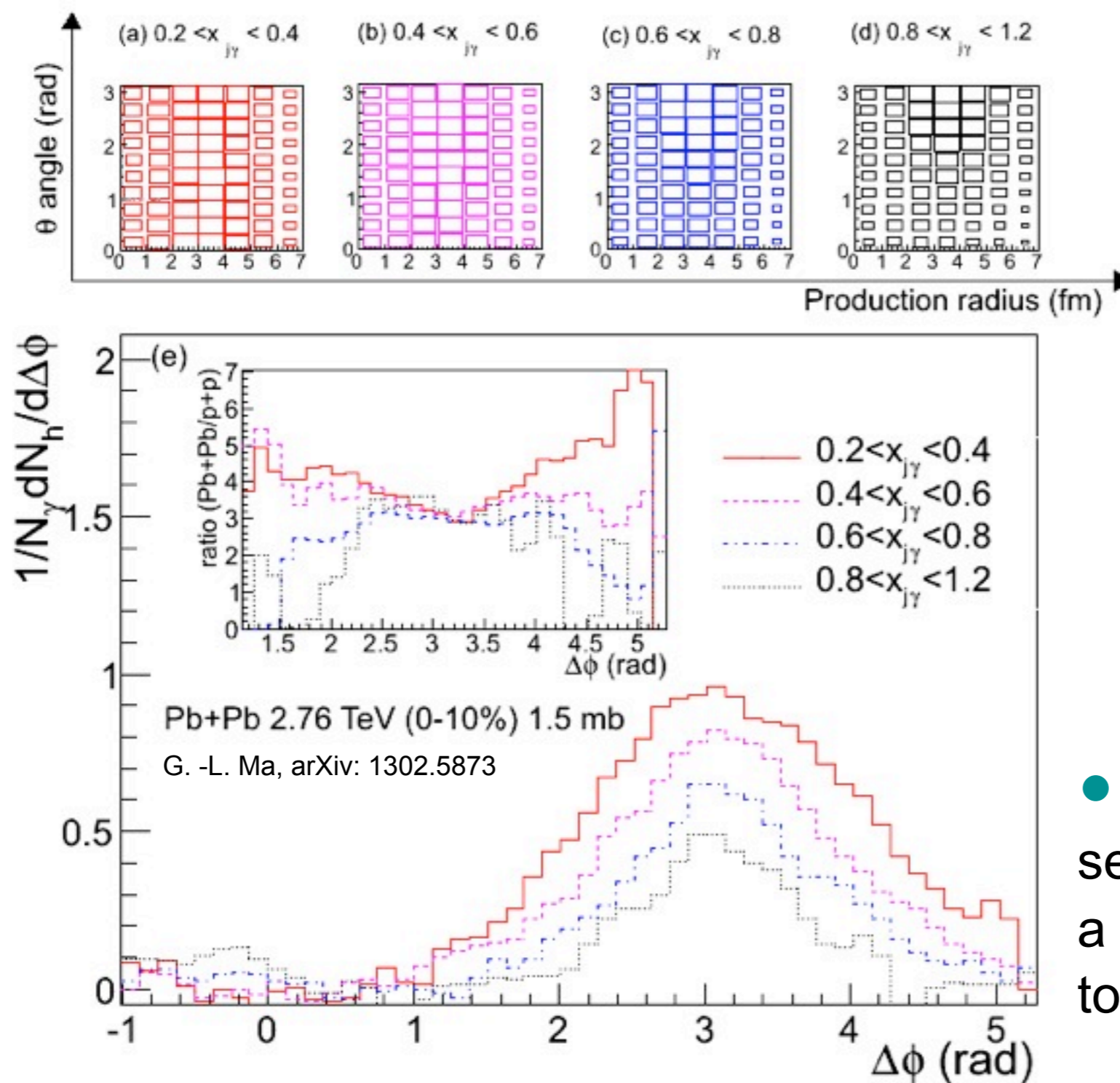


$$x_{j\gamma} = p_T^{\text{jet}}/p_T^\gamma$$

G. -L. Ma, arXiv: 1302.5873

- Middle $x_{j\gamma} \Leftrightarrow$ Tangential-jet case

A tomography tool: γ -hadron + γ -jet



- γ -hadron correlation with selected $x_{j\gamma}$ is proposed as a good tool to do detail tomography of QGP.

Summary

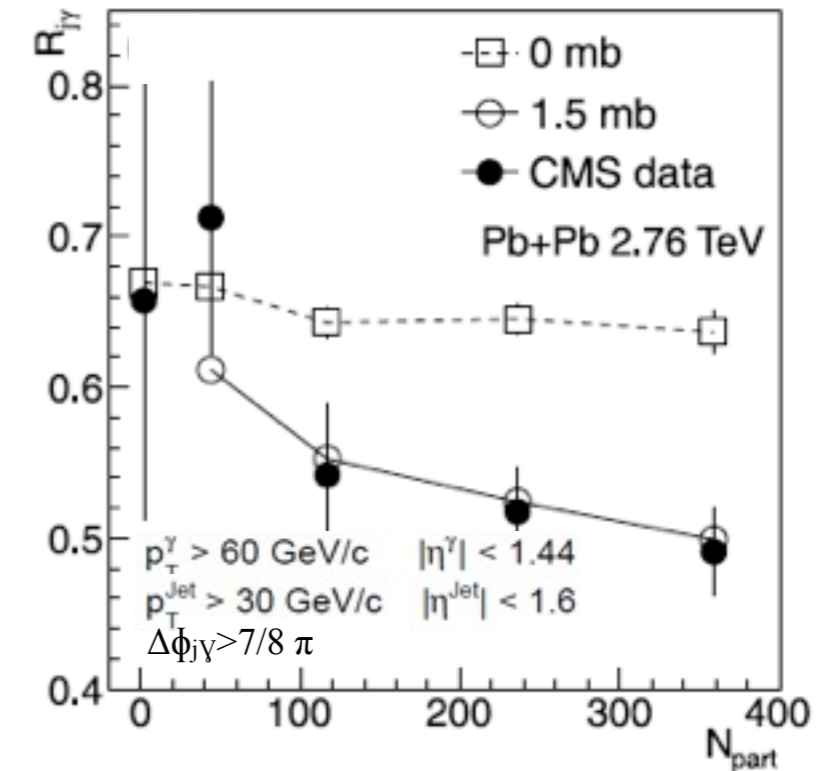
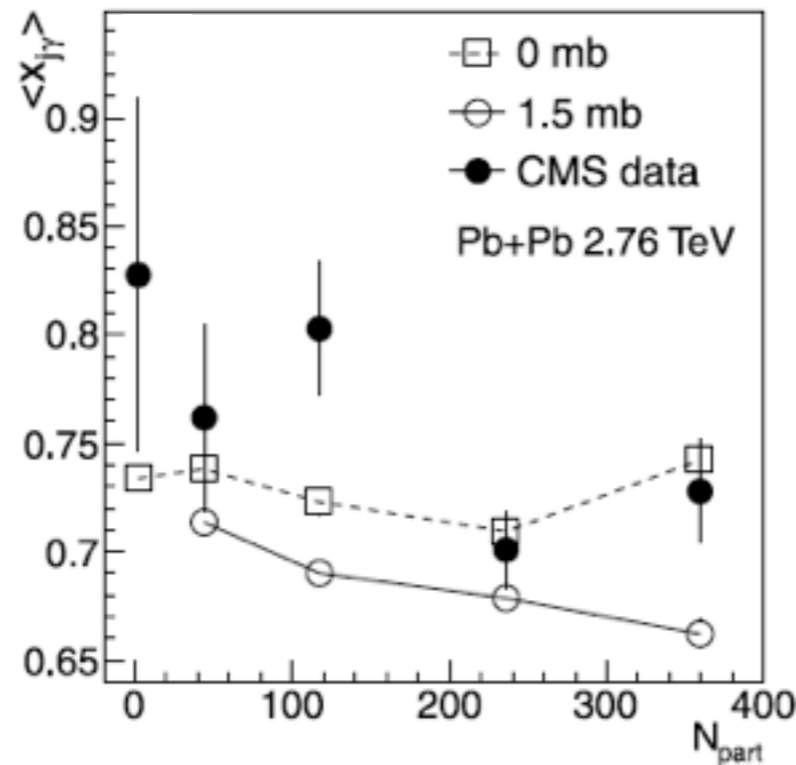
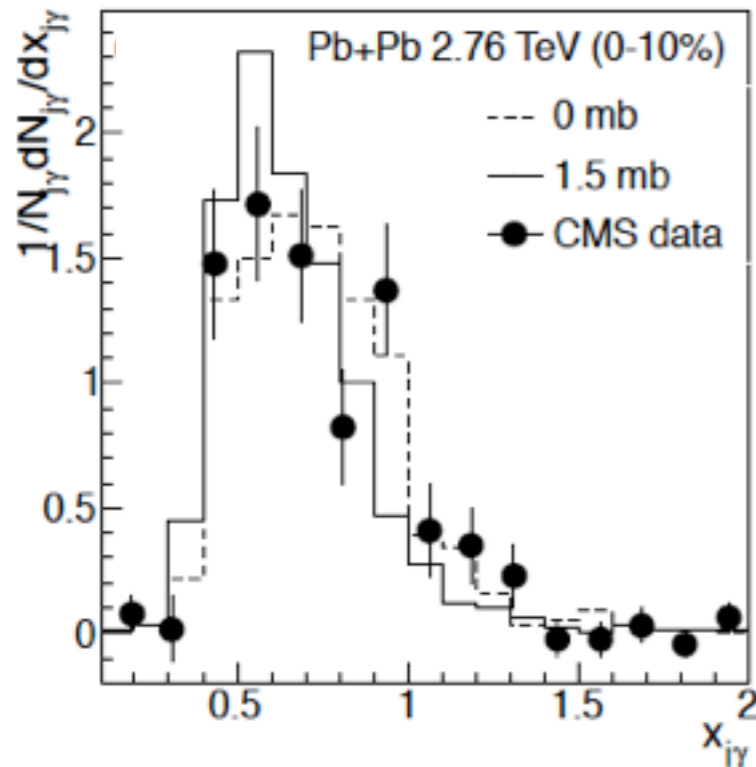
- Large dijet and γ -jet asymmetries are produced by strong interactions between jets and partonic matter.
- Final asymmetry is driven by both initial asymmetry and partonic jet energy loss.
- The asymmetry ratio ($x_{j\gamma}$) is sensitive to birth information about γ -jet, which could enable detail tomography of QGP .

Thanks!

Back up

γ -jet asymmetry

Guo-Liang Ma, Phys. Lett. B, 724 (2013) 278, [arXiv: 1302.5873]



- Jet losses more energy by strong partonic interactions than by hadronic interactions only.
- R_{jY} favors a partonic jet energy loss scenario.