

Cold Nuclear Matter Effects on J/ψ and Y Productions at RHIC with the STAR Experiment



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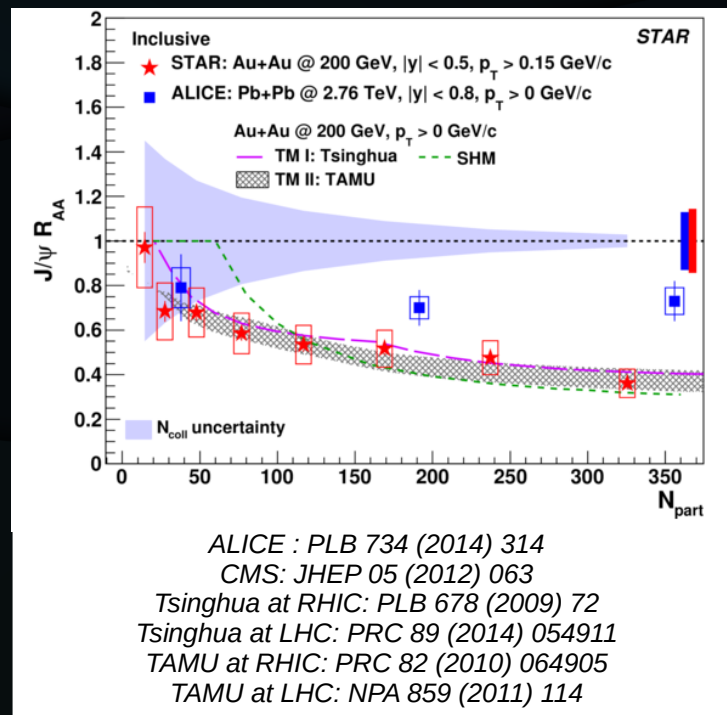
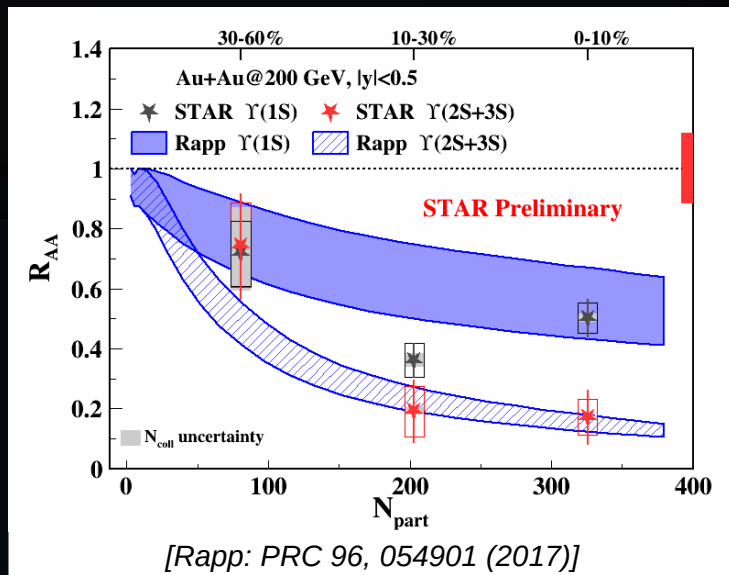
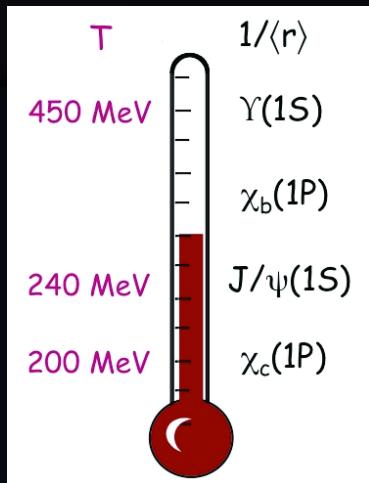
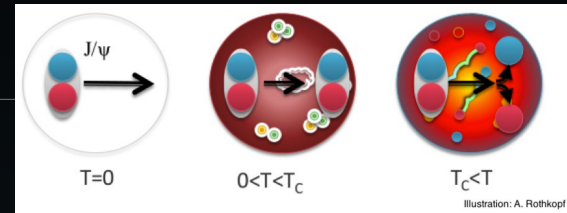
Ziyue Zhang
University of Illinois at Chicago
For the STAR Collaboration

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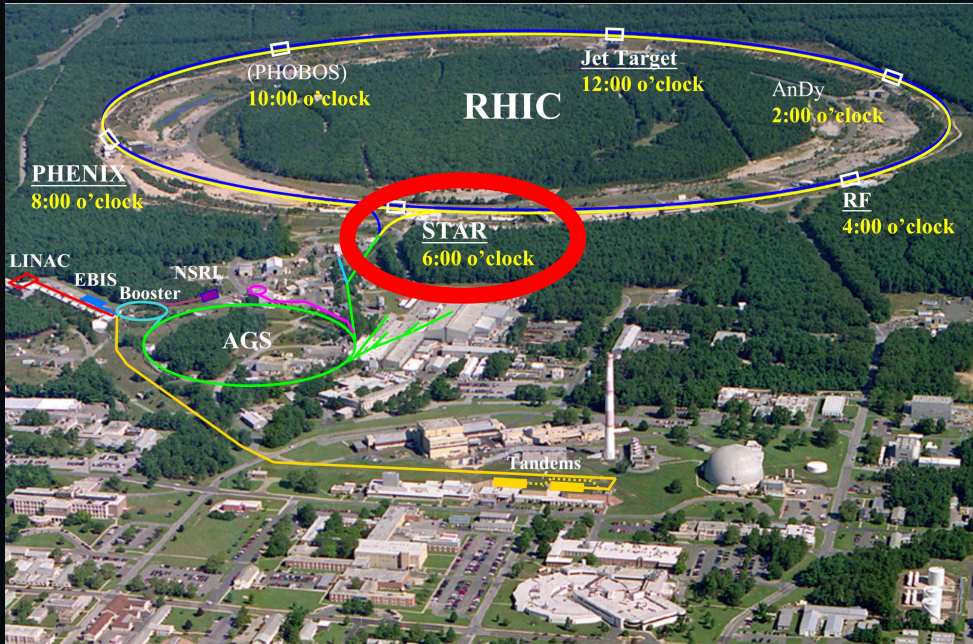
- Motivation
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- Cold Nuclear Matter Effects on Y
- Ongoing Work on J/ψ
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Motivation

- Quarkonia: Excellent probes of QGP properties
 - Hot Nuclear Matter Effects
 - Cold Nuclear Matter Effects



Relativistic Heavy Ion Collider (RHIC)



Aerial View on RHIC

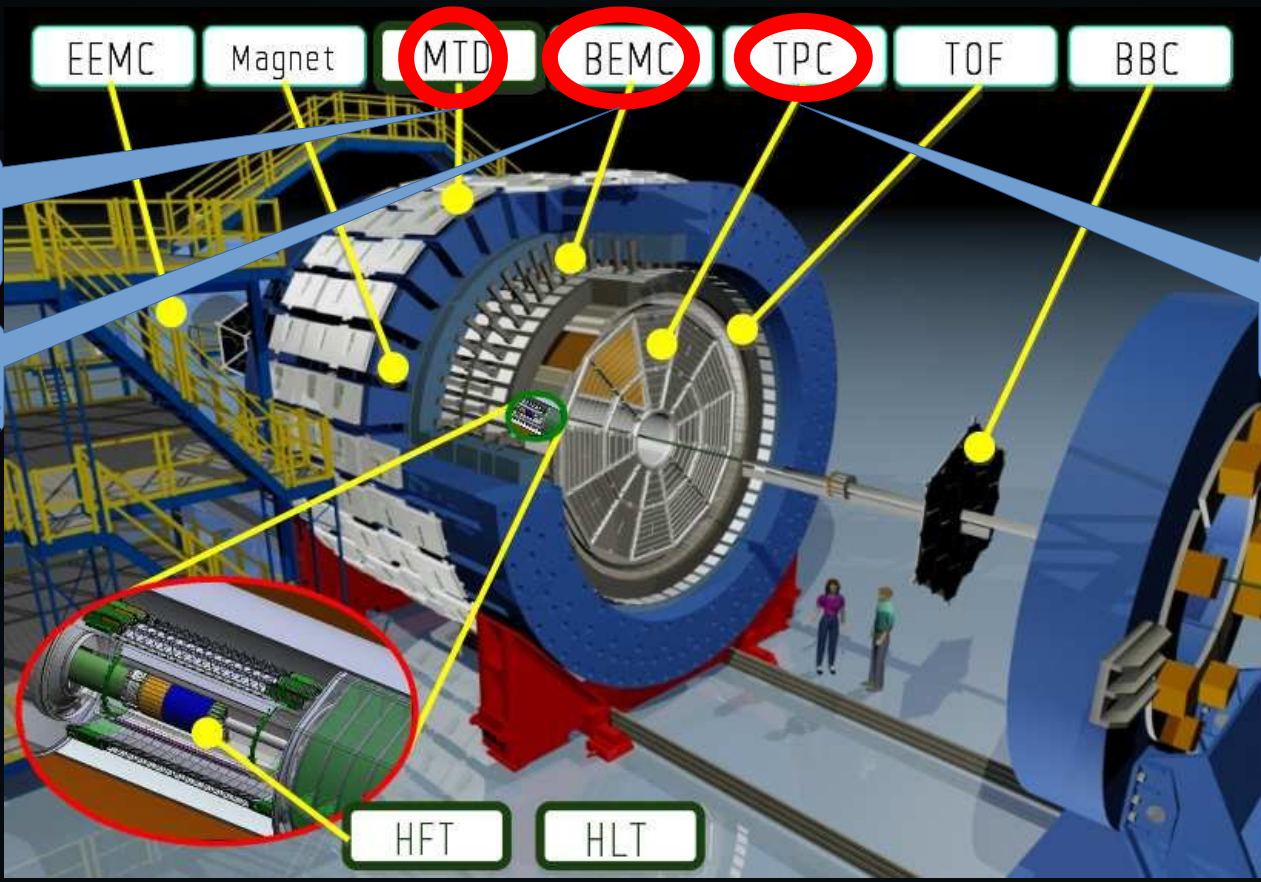
- Different collision types
- $7.7 \text{ GeV} < \sqrt{s_{NN}} < 510 \text{ GeV}$
- A versatile facility to study QGP

Solenoidal Tracker at RHIC (STAR)

Acceptance:
 $|\eta| < 0.5$; 45% in ϕ
Muon trigger;
Muon identification

Acceptance:
 $|\eta| < 1$; $0 \leq \phi < 2\pi$
Trigger, Deposited E

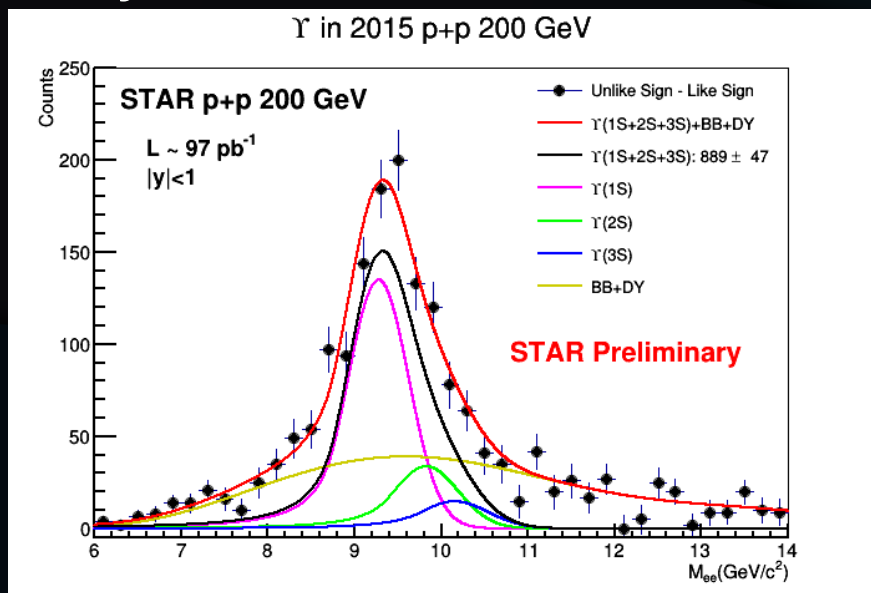
Acceptance:
 $|\eta| < 1$; $0 \leq \phi < 2\pi$
Tracking, dE/dx



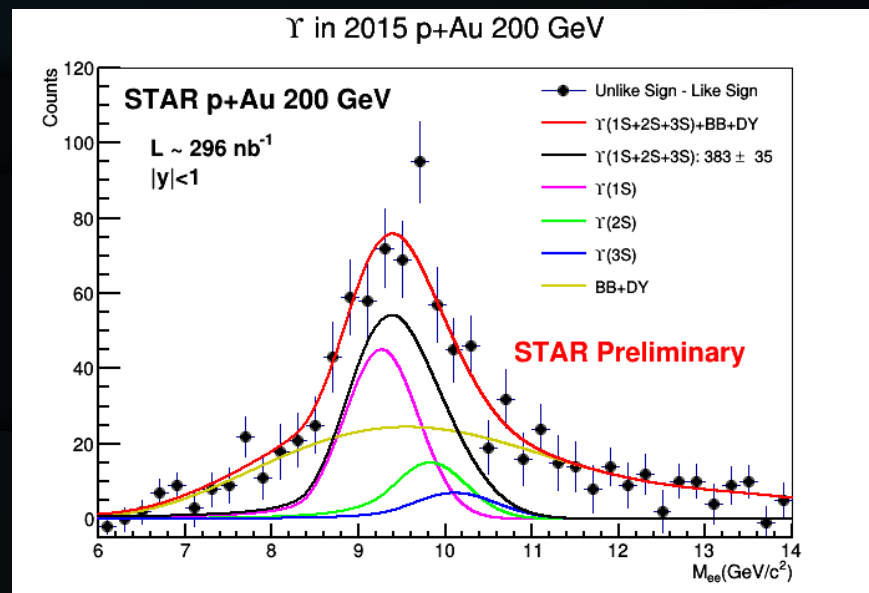
STAR Detector

Y Signal

STAR 2015, 200 GeV
Decay channel: $\Upsilon \rightarrow e^- e^+$

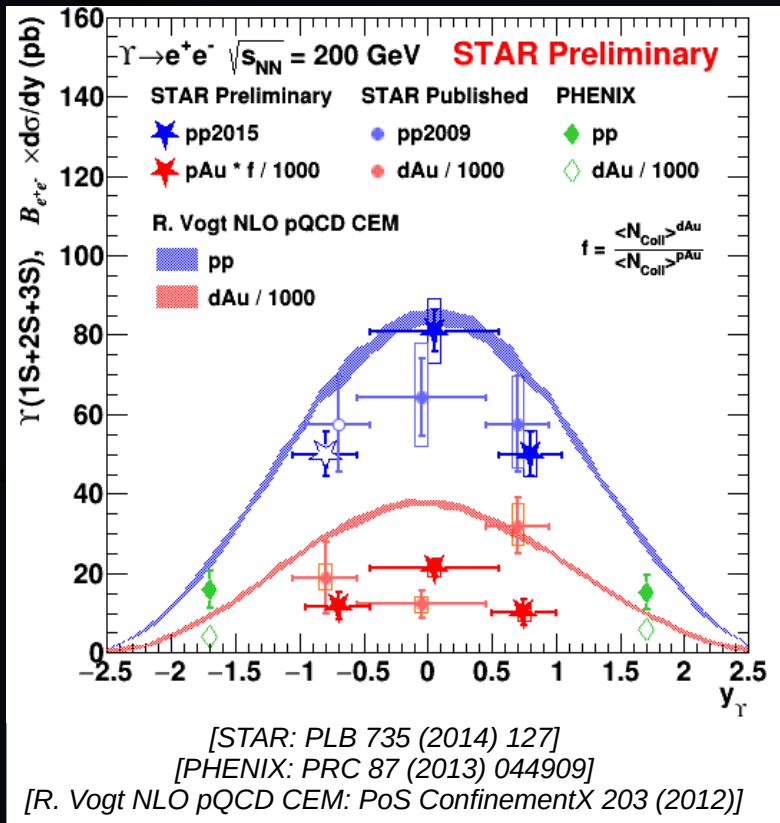


Y signal extraction in p+p collisions
(integrated over $p_T < 10 \text{ GeV}/c$)



Y signal extraction in p+Au collisions
(integrated over $p_T < 10 \text{ GeV}/c$)

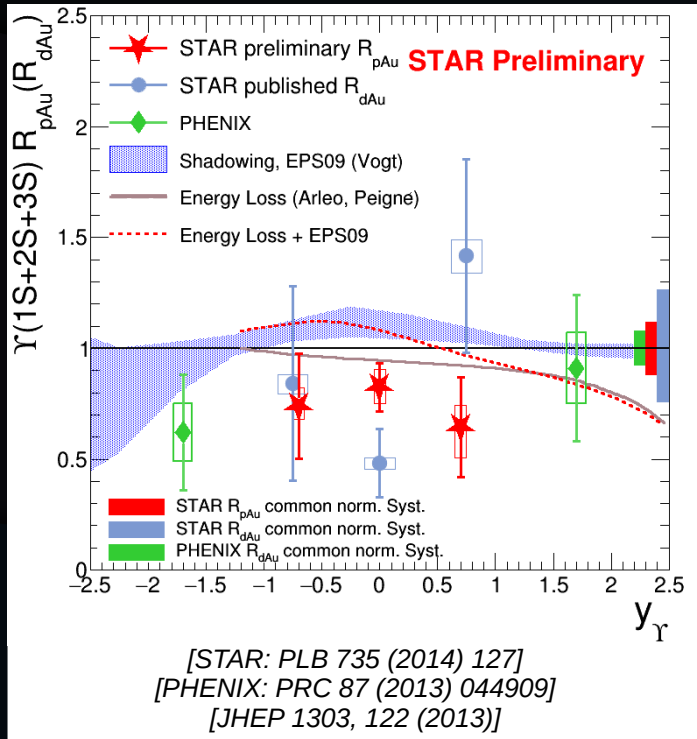
Y – Cross Section in p+p and p+Au



Centrality: 0-100%

- Cross section measurement:
 - Improved precision
 - NLO pQCD CEM overestimates the width of rapidity distribution in p+p
 - Non-negligible cold nuclear matter effects beyond nPDF

R_{pAu} of Υ



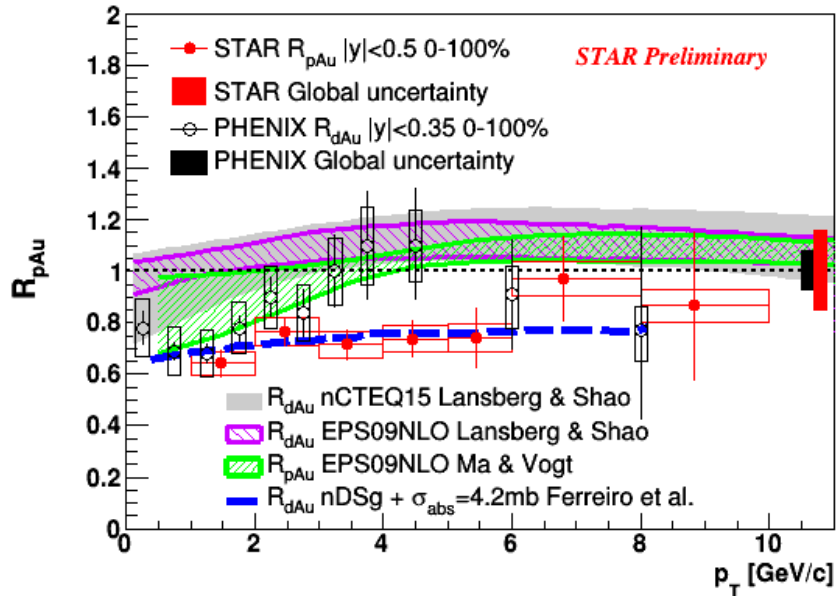
• R_{pAu} calculation

- Improved precision over previous d+Au results
- Indication of more suppression than that from nPDF effects and energy loss in cold nuclear matter

This Analysis : $R_{pAu}(|y| < 0.5) = 0.82 \pm 0.10 (stat)_{-0.07}^{+0.08} (syst) \pm 0.10 (global)$

Published : $R_{dAu}(|y| < 0.5) = 0.48 \pm 0.15 (stat) \pm 0.02 (syst)_{-0.12}^{+0.13} (global)$

Review: $J/\psi \rightarrow \mu^- \mu^+$

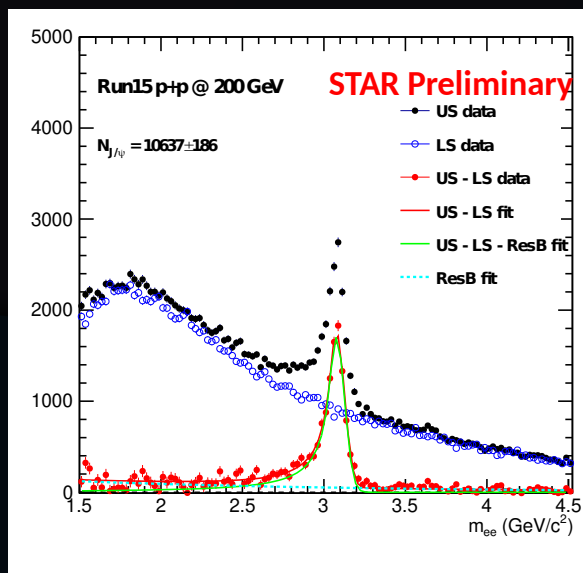


[PHENIX, PRC 87 (2012) 034903]
[EPS09+NLO, Ma & Vogt, Private Comm.]
[nCTEQ, EPS09+NLO, Lansberg Shao,]
[Eur.Phys.J. C77 (2017) no.1, 1]
[Comp. Phys. Comm. 198 (2016) 238-259]
[Comp. Phys. Comm. 184 (2013) 2562-2570]
[Ferreiro et al., Few Body Syst. 53 (2012) 27]

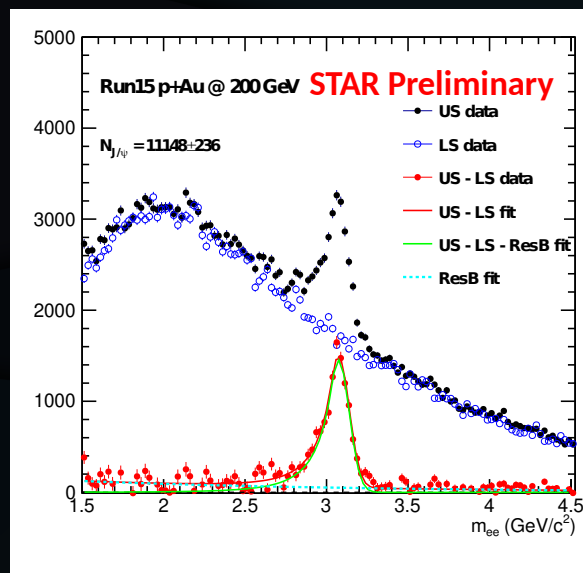
- Consistent with PHENIX d+Au result within uncertainty
- Indication of similar cold nuclear matter effects in p+Au and d+Au
- Models taking nPDF into account touch data within uncertainty
- Additional nuclear absorption being favored by data

J/ψ Signal with Di-electron

BEMC BHT1 Trigger threshold ~ 3.6 GeV



J/ψ signal extraction in p+p collisions
(integrated over $|y| < 1$)



J/ψ signal extraction in p+Au collisions
(integrated over $|y| < 1$)

- Improvement with dielectron channel: expect reduced statistical uncertainties in intermediate and high p_T range

Summary and Outlook

- R_{pAu} of Y at 200 GeV via dielectron channel:
 - Improved precision
 - Indication of Y suppression
 - Non-negligible cold nuclear matter effects beyond nPDF and energy loss
- R_{pAu} of J/ψ at 200 GeV via dimuon channel:
 - Indication of similar cold nuclear matter effects in p+Au and d+Au
 - Models taking nPDF into account touch data within uncertainty; additional nuclear absorption favored by data
- R_{pAu} of J/ψ at 200 GeV via dielectron channel:
 - Complementary to dimuon channel measurement
 - Expect reduced statistical uncertainty in intermediate and high p_T range

Thank you!



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