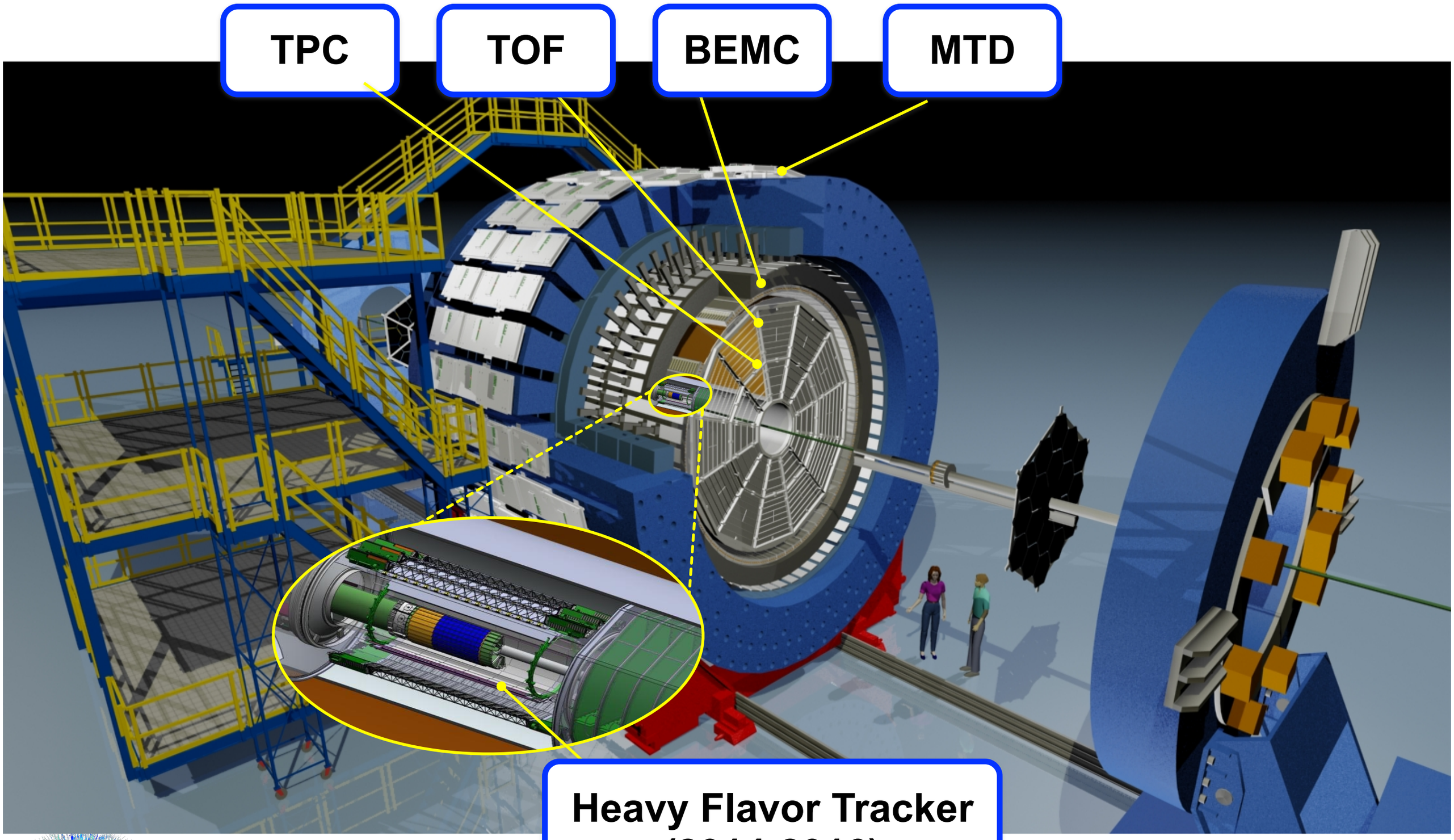
Future Heavy Flavor Program at STAR

Xin Dong (for the STAR Collaboration)
Lawrence Berkeley National Laboratory

2014-2016	2017	2018	2019-2021	2022	2023 —
Open HF, Quarkonia	**Cold QCD**	**Isobar**	**BES-II**	**Cold QCD**	**Quarkonia, Dileptons, Jets**
HFT, MTD		***EPD***	***iTPC, eTOF***	***FTS+FCS***	

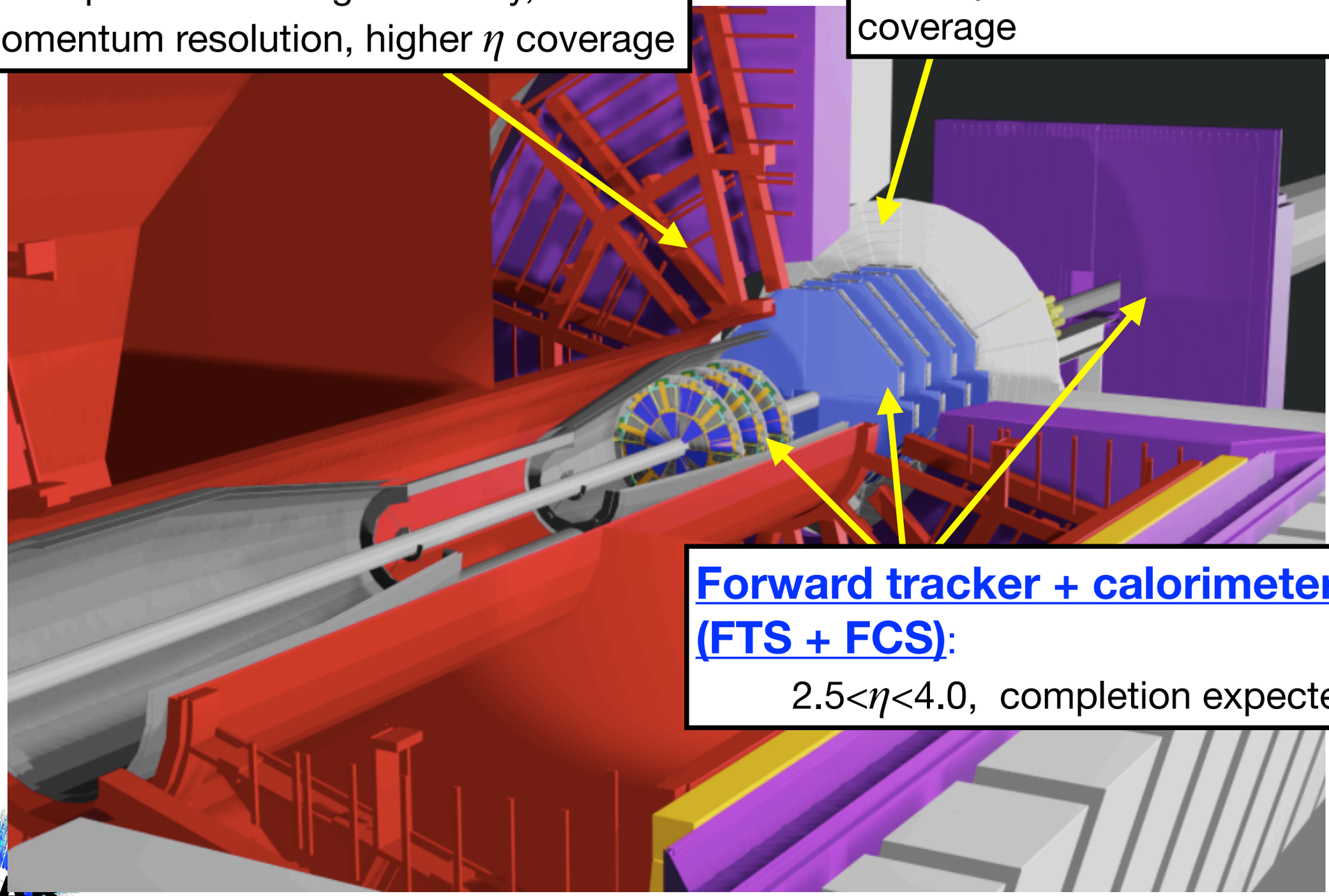
STAR Detector at Mid-Rapidity



Key Upgrades to STAR

iTPC: completed 2018
improved tracking efficiency, momentum resolution, higher η coverage

EPD: completed 2017
improved EP resolution, forward coverage



Forward tracker + calorimeters (FTS + FCS):
$2.5<\eta<4.0$, completion expected in 2021

Physics Plan

High statistics + mid/forward rapidity coverage + low material

2018: iTPC and EPD upgrades completed

2021: Completion of forward upgrade

2021/2022: p+p 500 GeV - mid/forward quarkonium production

- quarkonium production mechanism

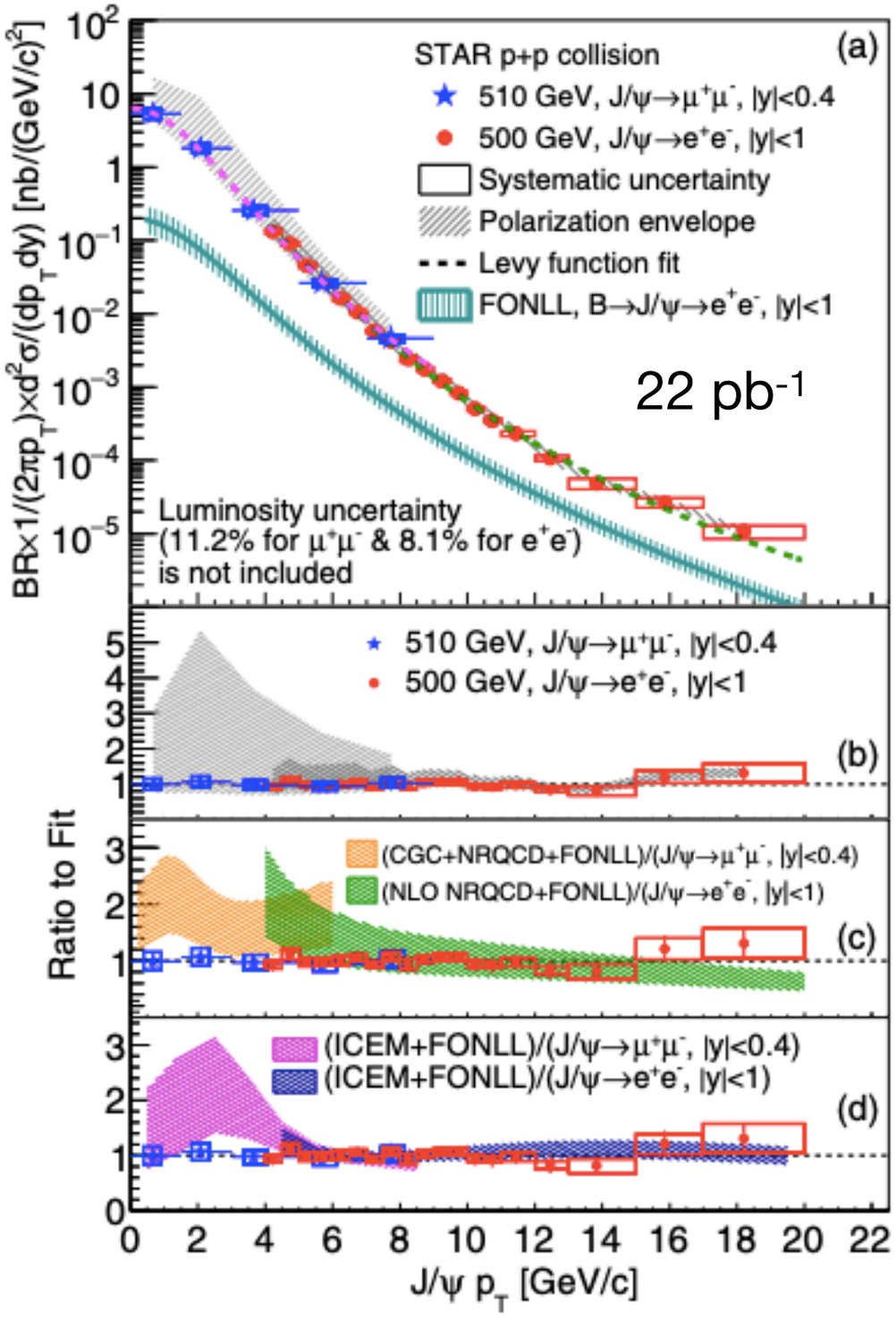
2023+: Au+Au 200 GeV, p+p/A 200 GeV

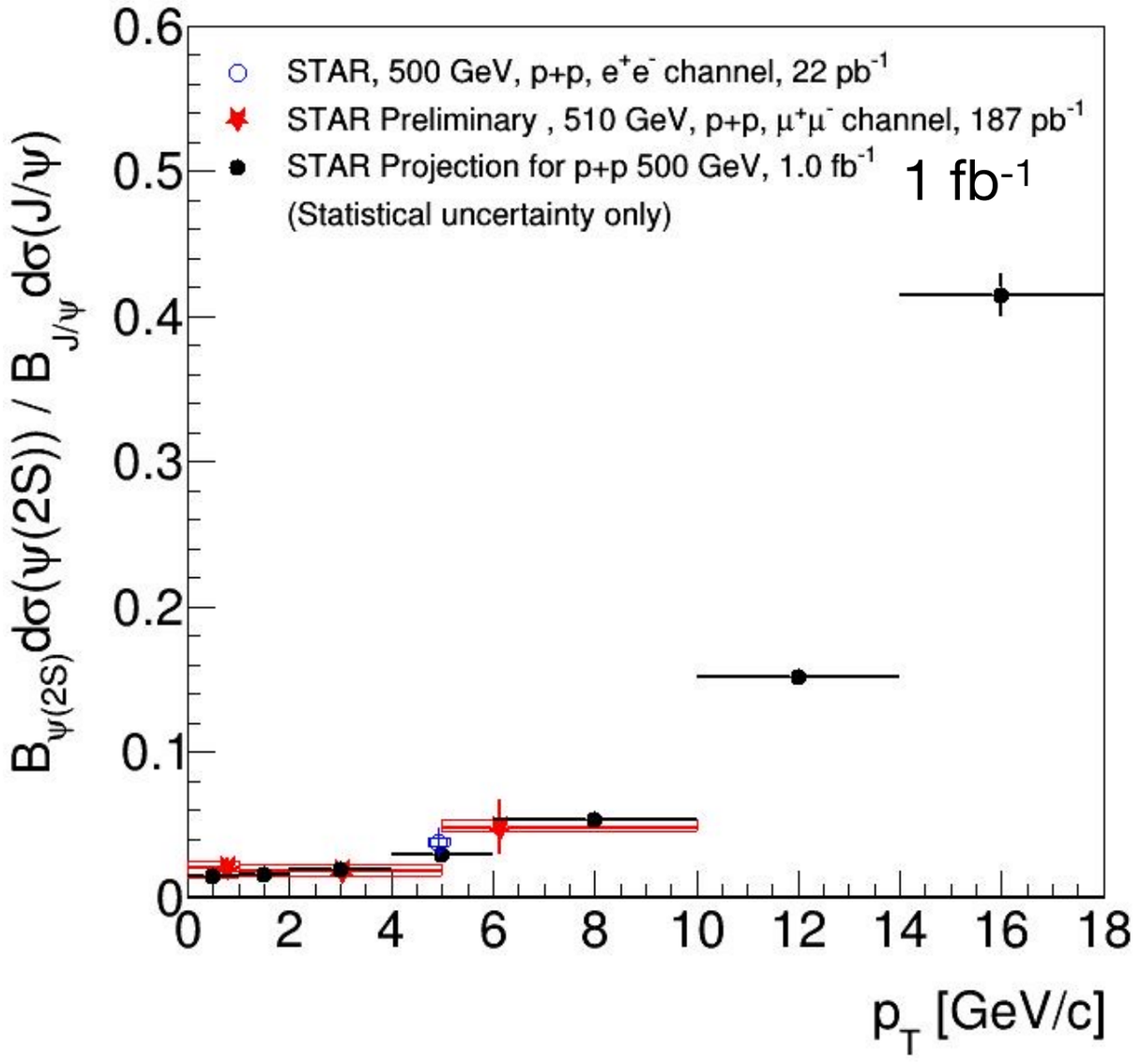
- cold/hot QCD medium properties

Future Heavy Flavor Physics Goals

- Precision quarkonia p+p data for deep understanding of production mechanism
- Wide kinematic region coverage in p+p/A collisions for gluon nPDF
- High statistics Au+Au data for hot QGP properties ($J/\psi\ v_2$ and $\Upsilon\ R_{AA}$)

Inclusive Charmonia Production in p+p



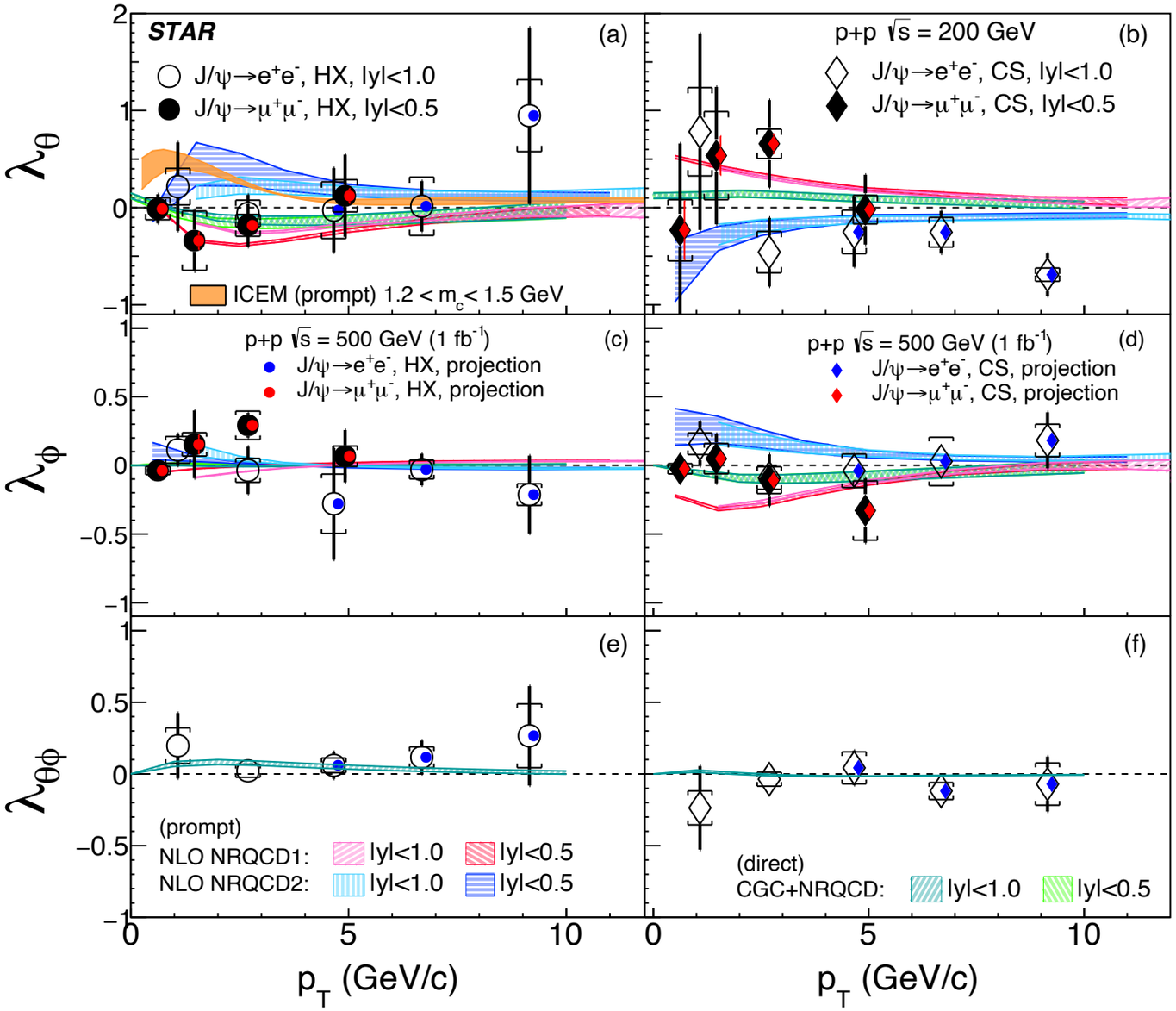


High statistics p+p 500 GeV run
- further p_T extension in J/ψ and $\psi(2S)$ measurements

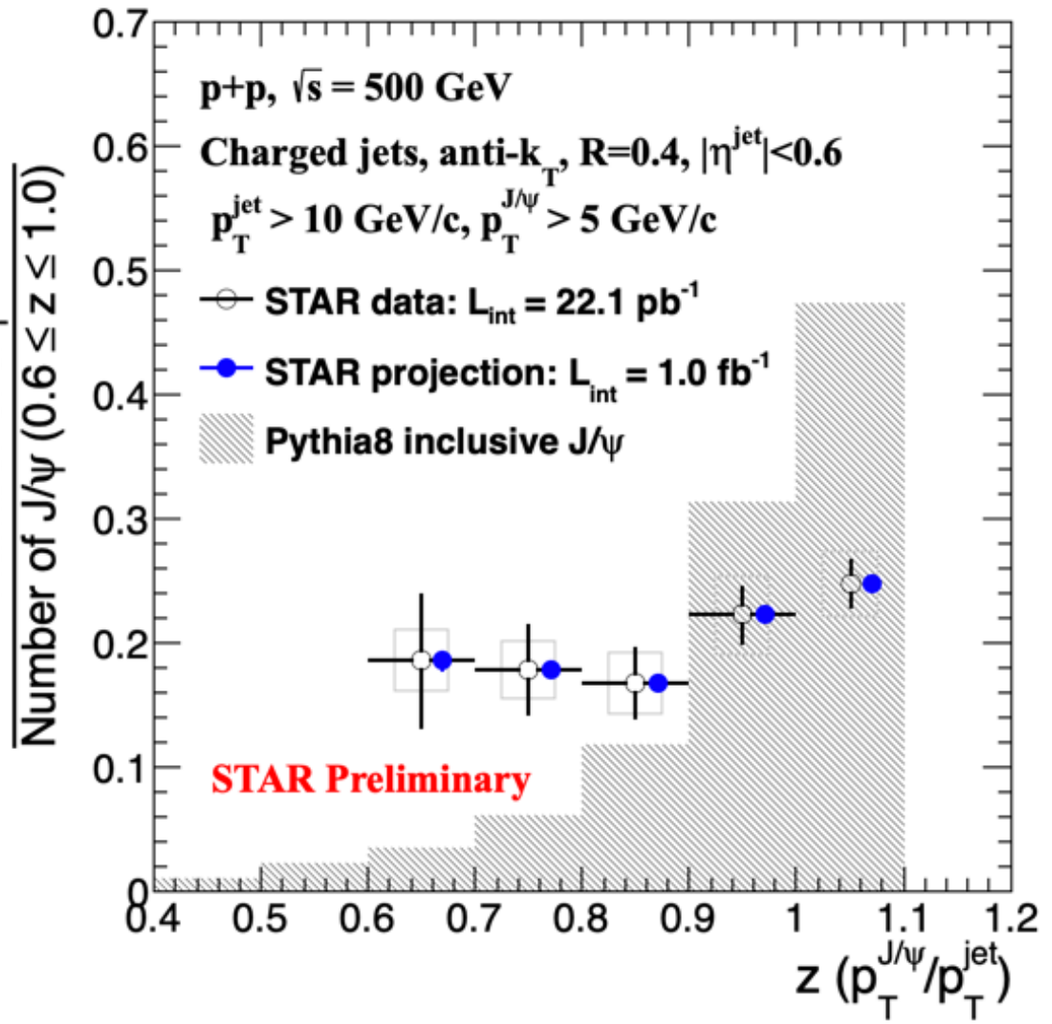
STAR, PRD 100 (2019) 052009

J/ψ Polarization / in-jet Production

J/ψ polarization



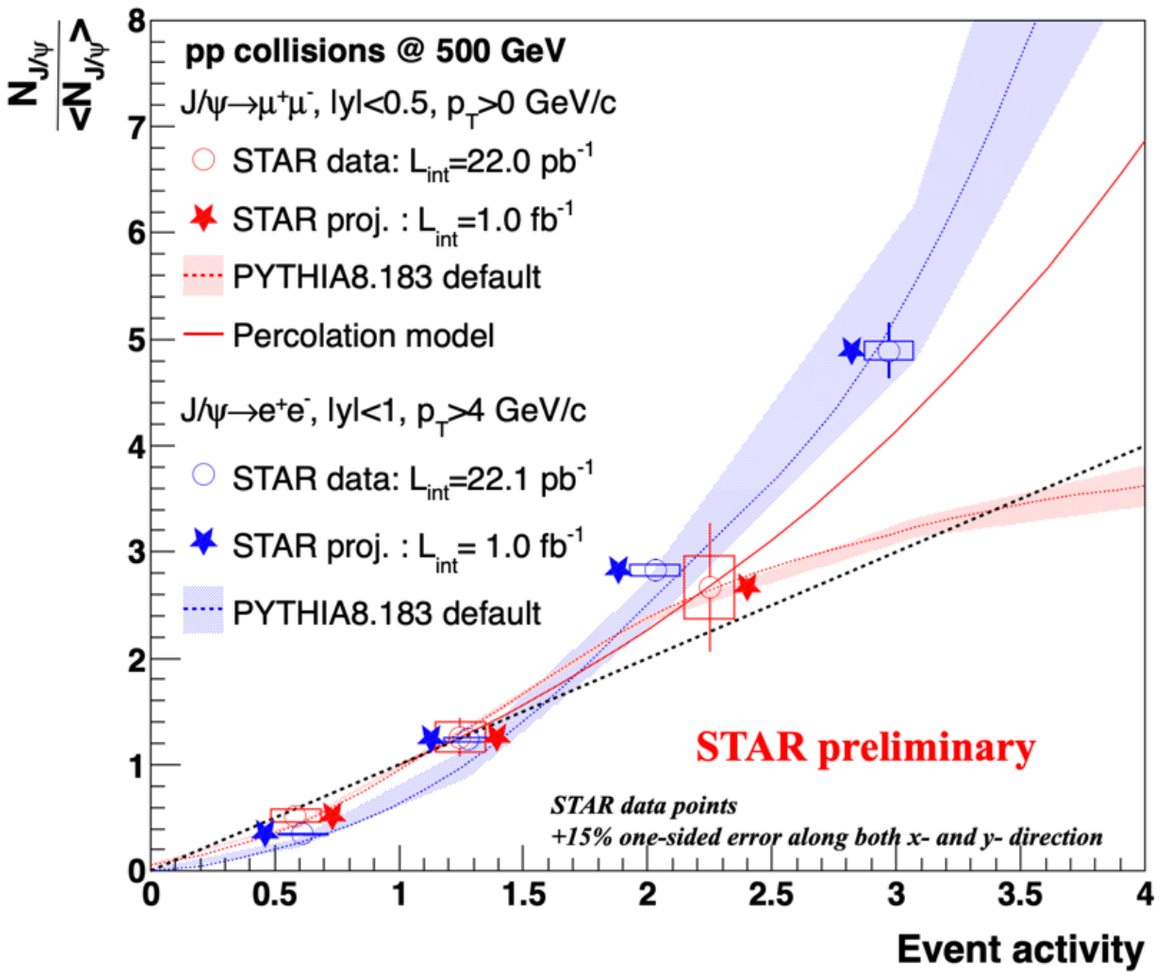
J/ψ in-jet



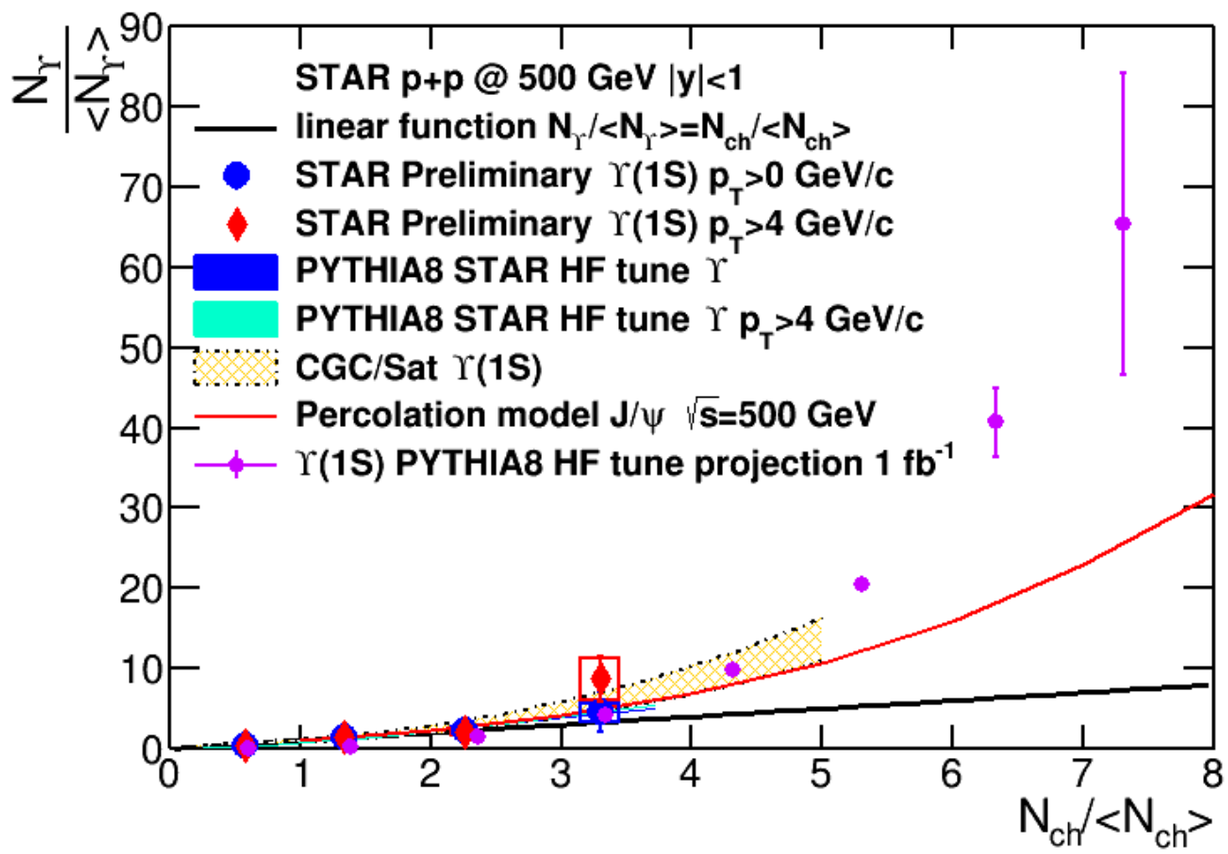
- Significantly improved precision in J/ψ polarization measurement
- J/ψ-in-jet extended to lower z range & lower jet p_T range
  - *-MTD allows J/ψ p_T reach down to 0*

J/ψ, Υ in High Multiplicity p+p Collisions

J/ψ

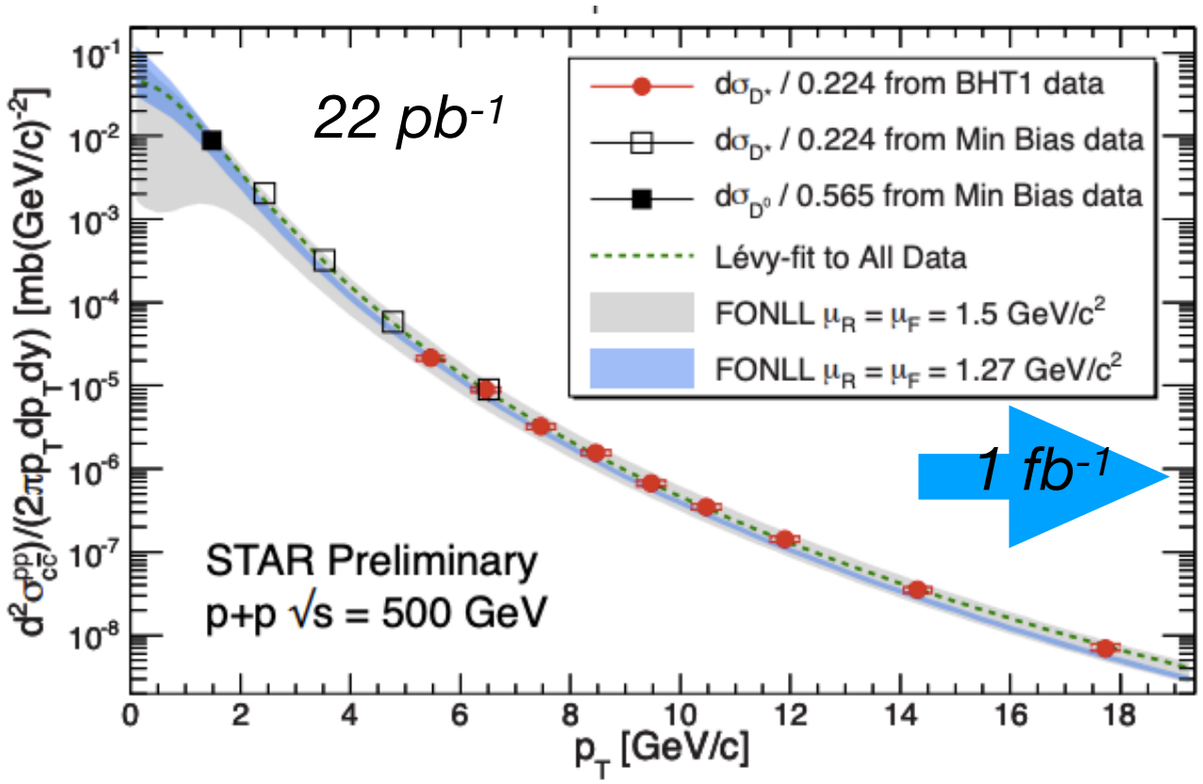


Υ

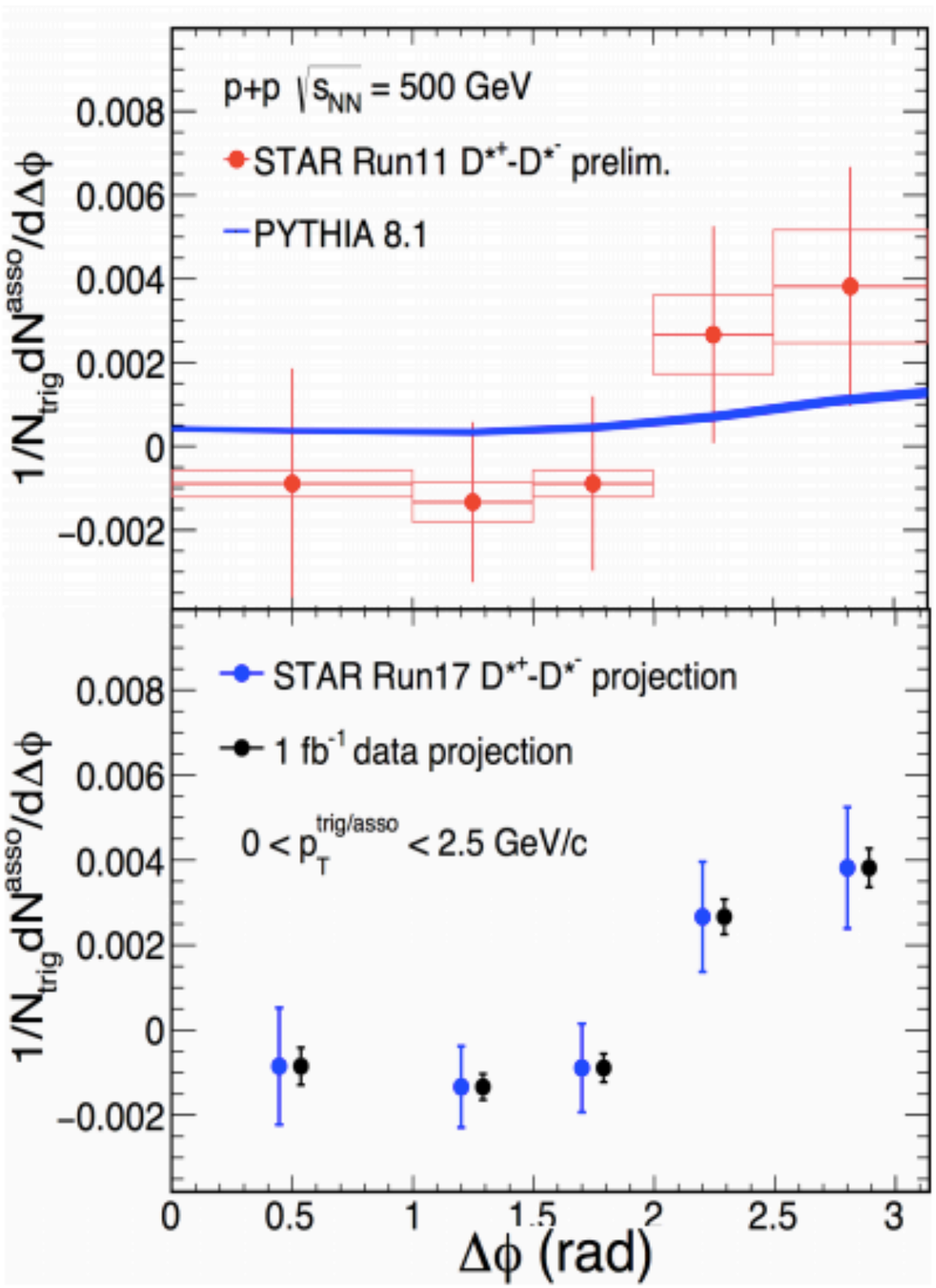


- Discrimination power for different models at high multiplicity events

Open Charm in p+p Collisions



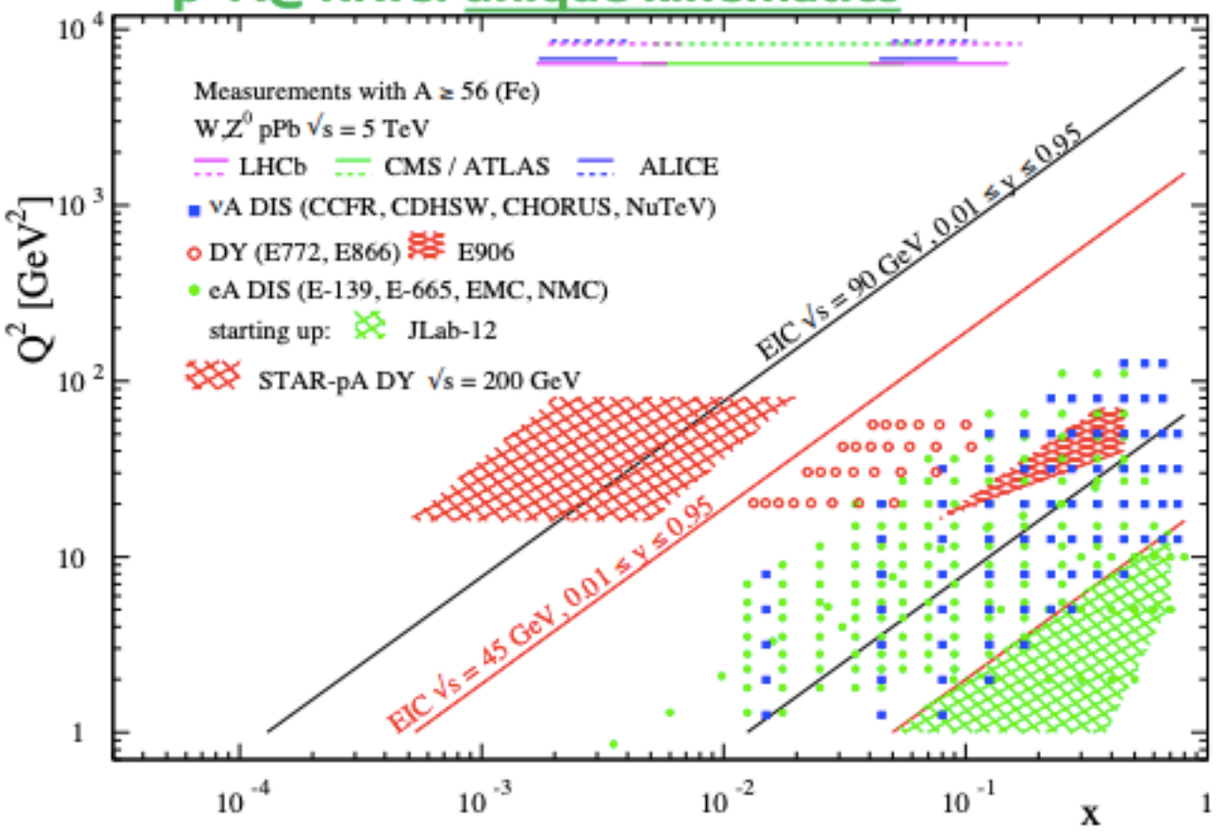
$D^{*+} - \overline{D^{*-}}$

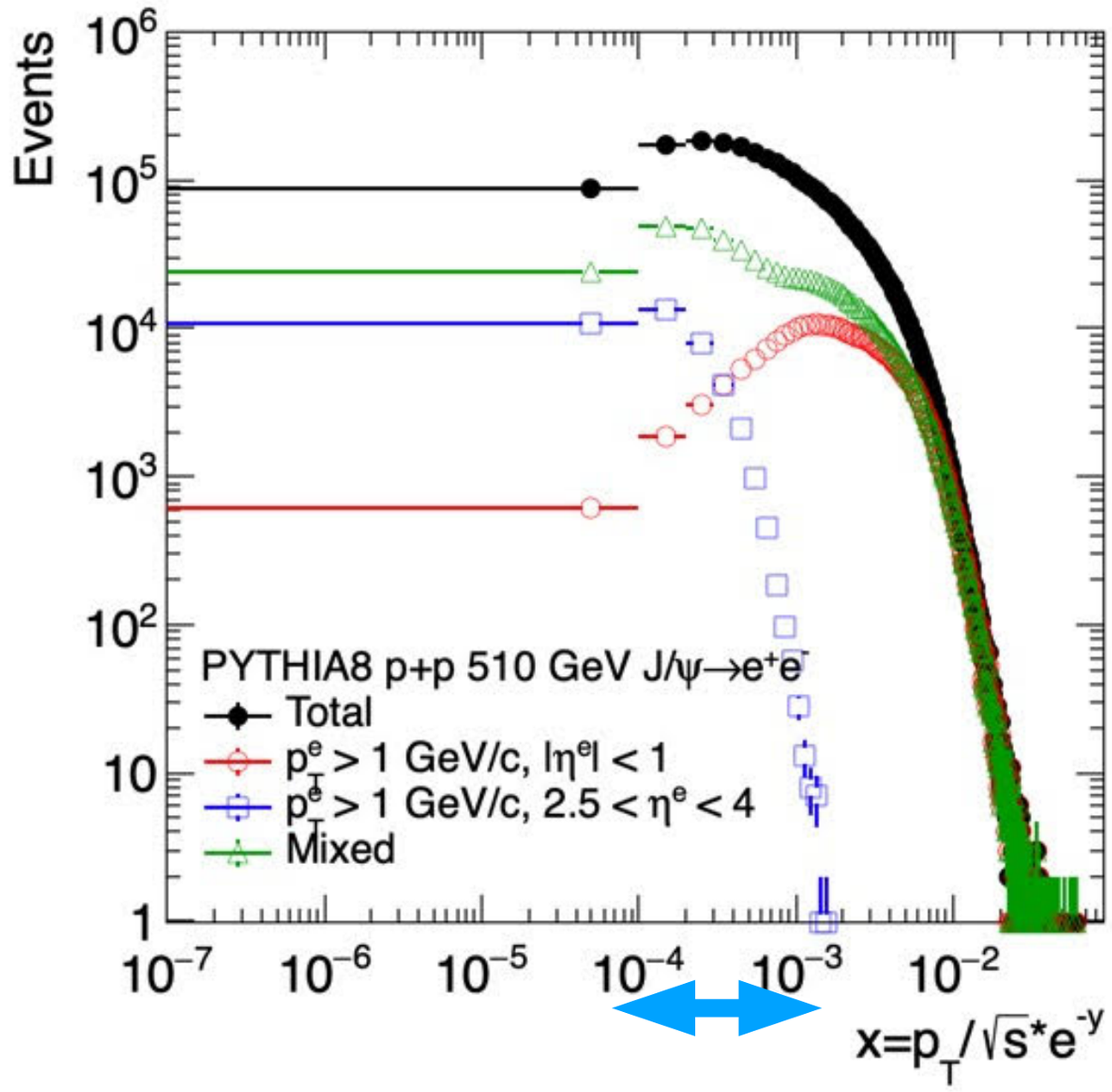


High statistics p+p 500 GeV

- precision spectrum to further high p_T
- improved D*-jet measurement
- enable $D^{*+} - \overline{D^{*-}}$ measurement

p+p/A Quarkonia Production in Forward Region

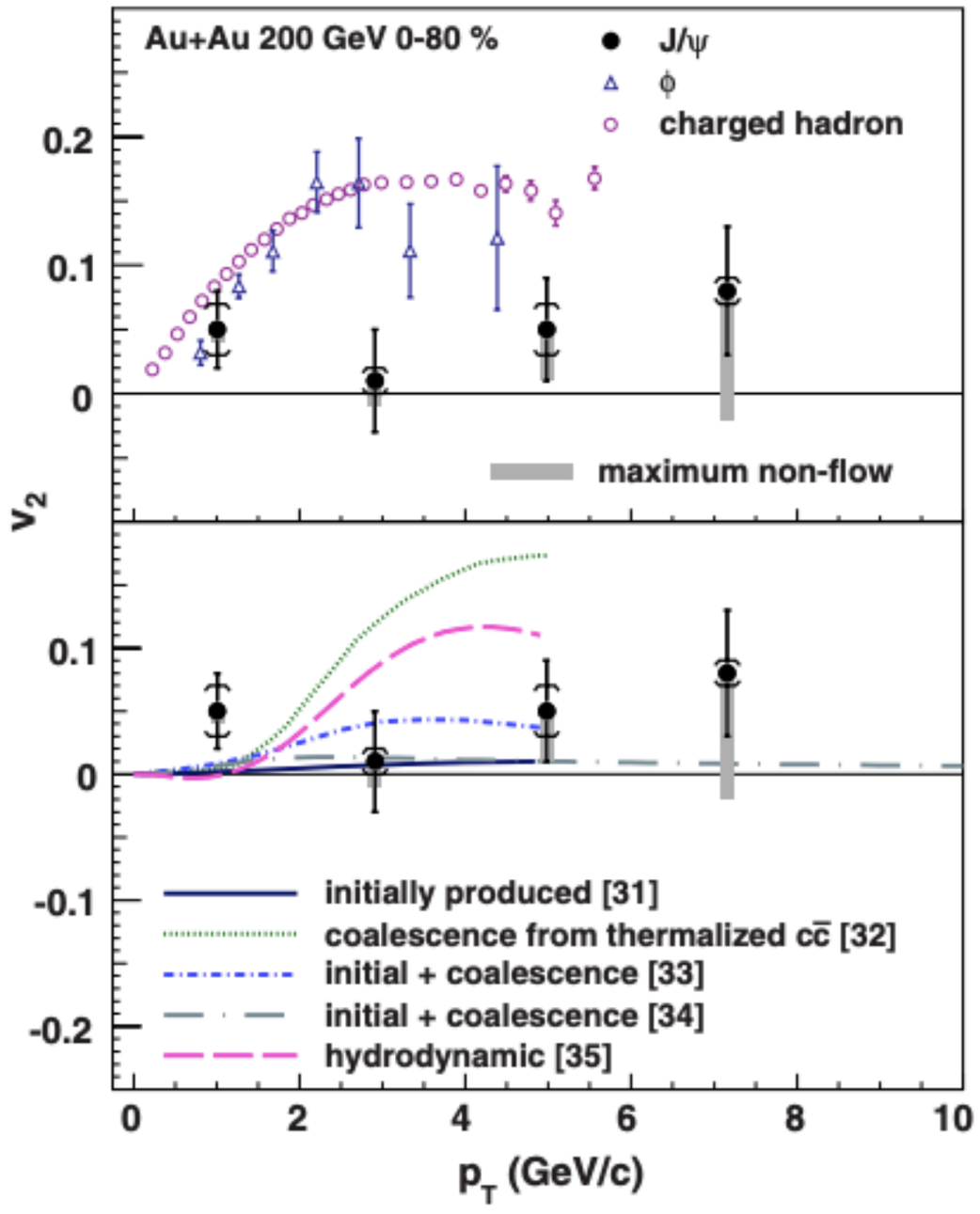




Forward quarkonia (and DY) production at STAR
- unique kinematic access to gluons at small-x region

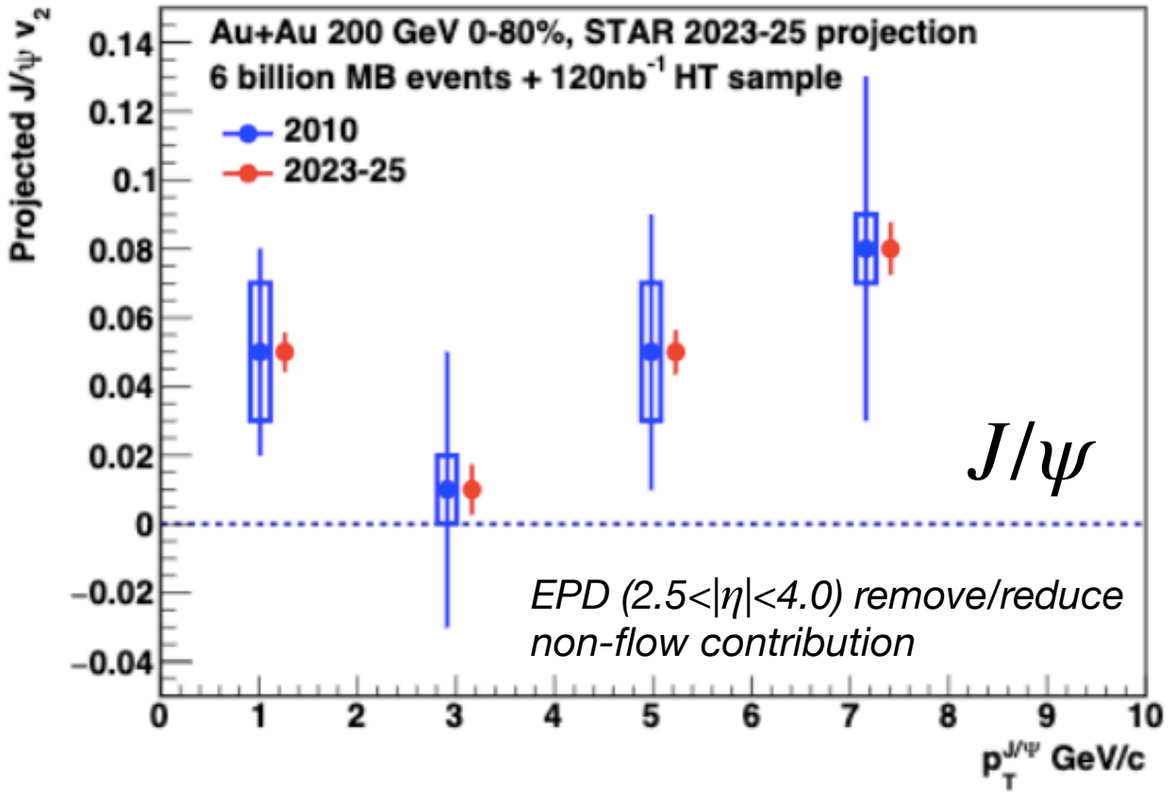
J/ψ v_2 in Au+Au 200 GeV

Previous pub.: 360M MB + 1 nb^{-1}

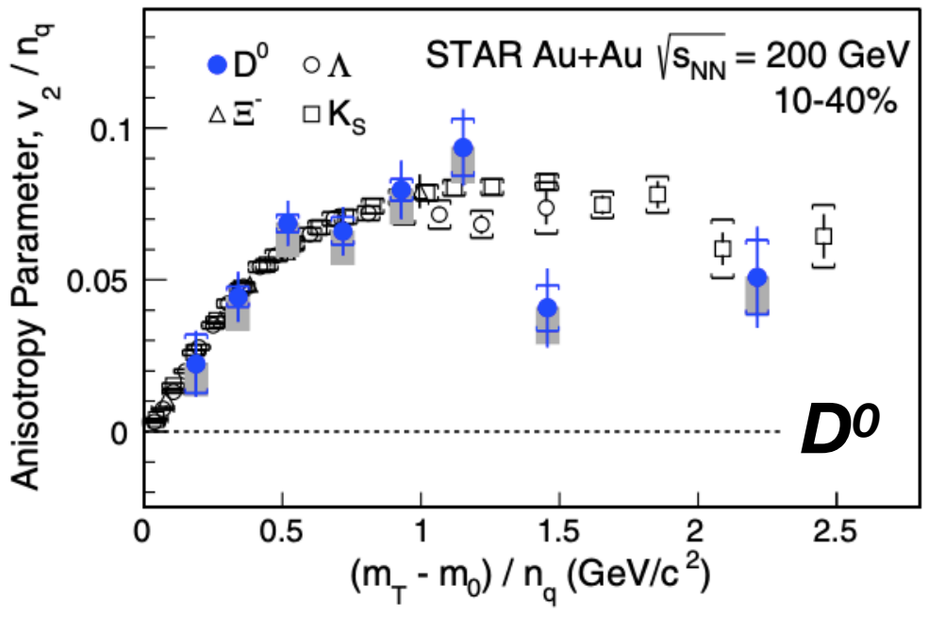


STAR, PRL 111 (2013) 052301

Projection w/ 6B MB + 120 nb^{-1}

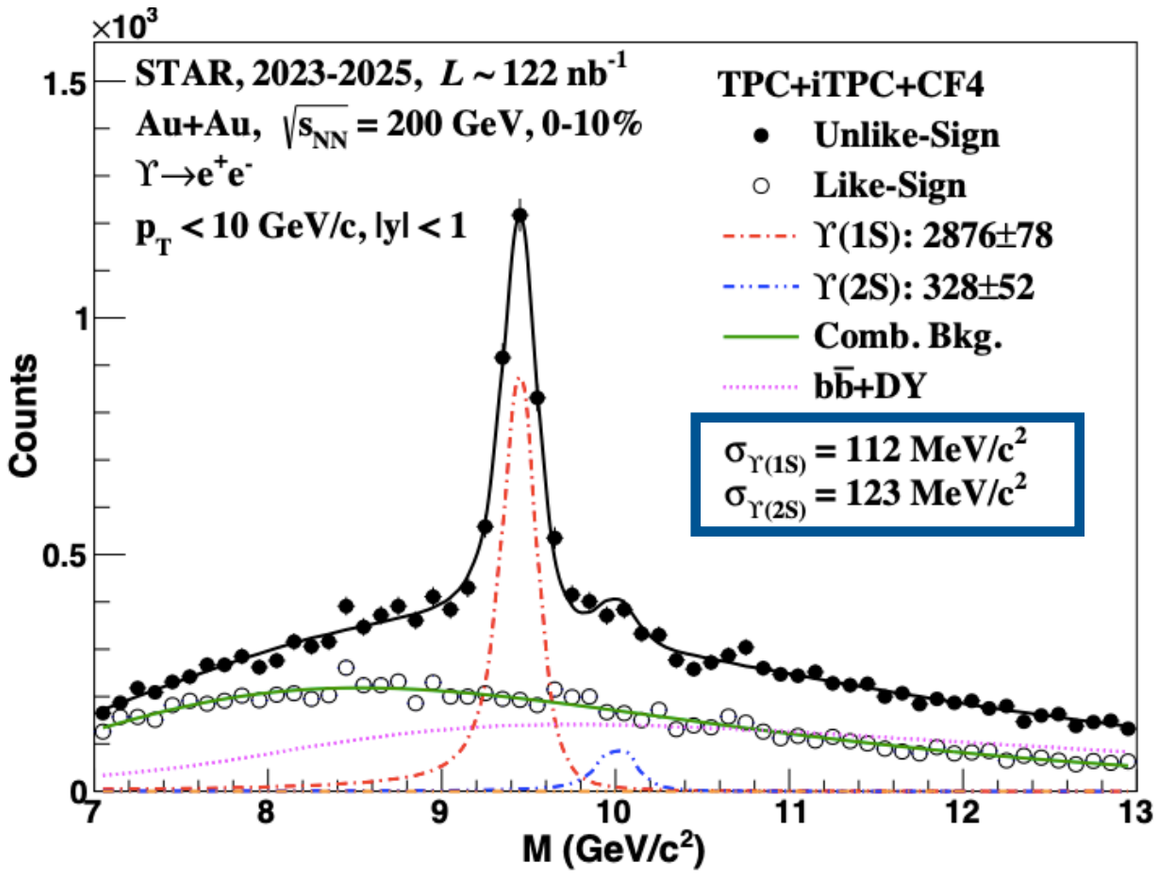


STAR, PRL 118 (2017) 212301

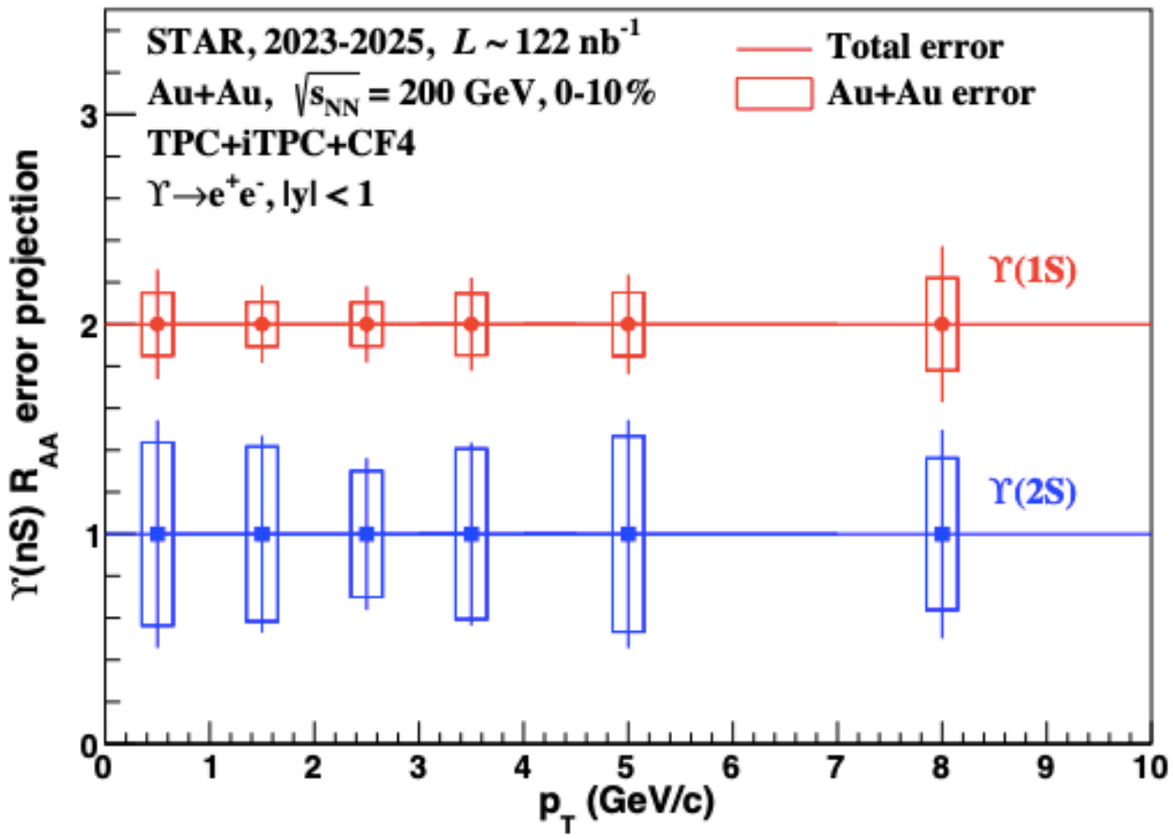


Upsilon R_{AA} in Au+Au 200 GeV

iTPC + TPC (w/ CF4)
- momentum resolution improve by ~x2

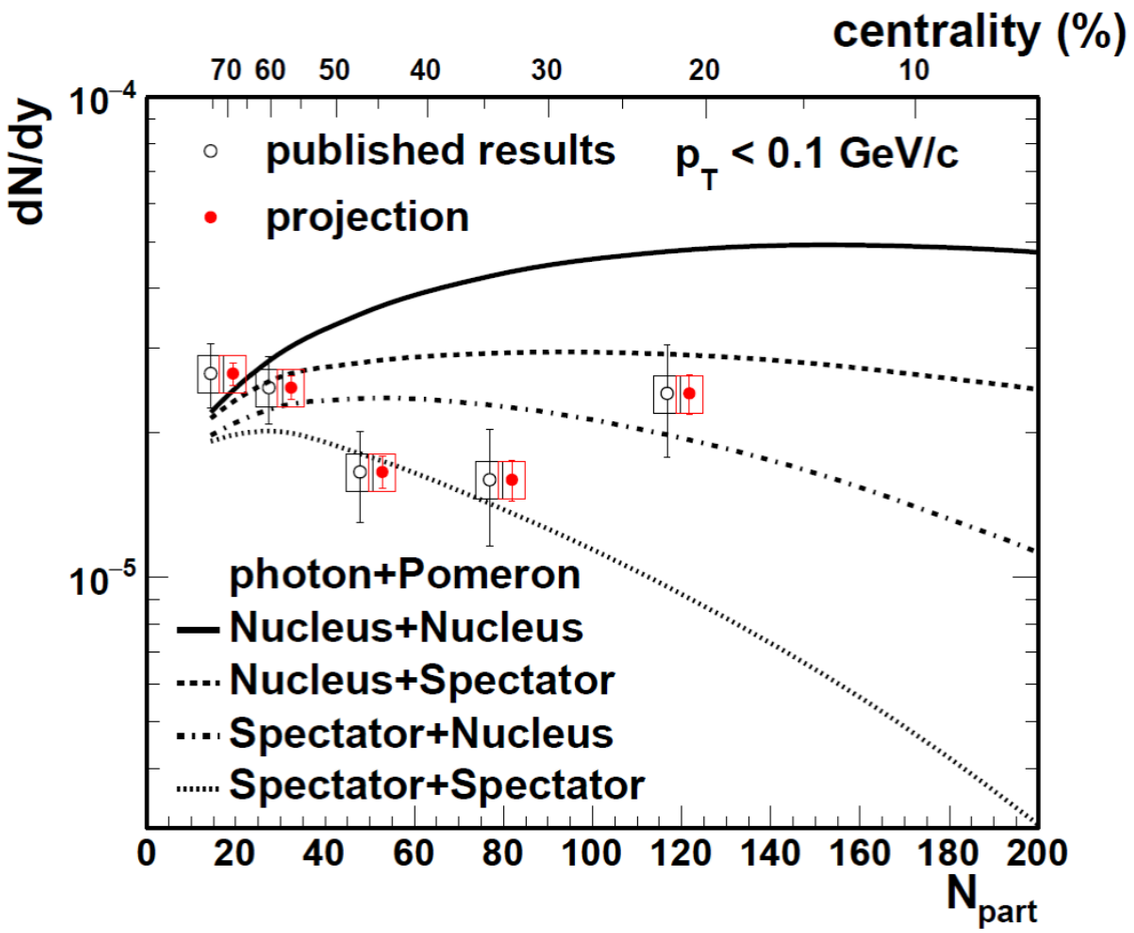


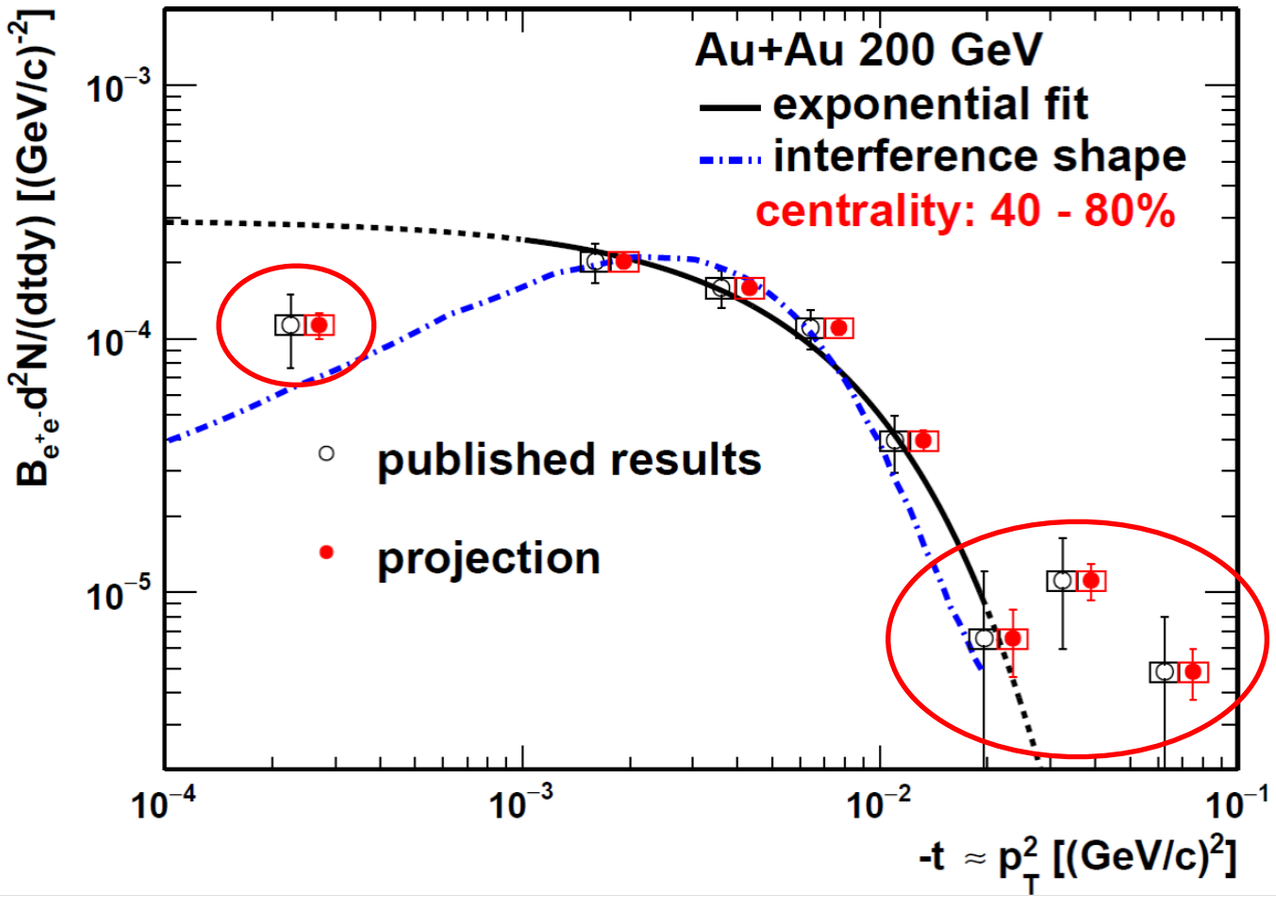
Au+Au 200 GeV 0-10%



High statistics + improved momentum resolution + low material budget
- centrality / p_T dependence of Υ(1S), Υ(2S) R_{AA}

Photoproduction of J/ψ in Peripheral Au+Au Collisions





- Model: W. Zha et al, PRC 97 (2018) 044910

- Centrality dependence: powerful to distinguish different scenarios
- t-dependence:
  - significant to identify interference and incoherent contributions

Summary

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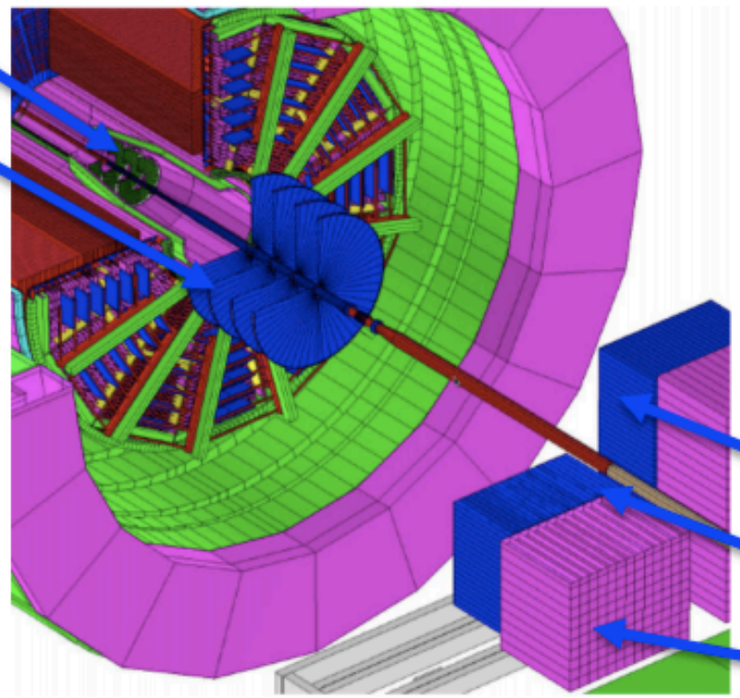
Forward Upgrade

- **Detectors from BES-II upgrade (iTPC and EPD) will keep going**
- The forward ($2.5 < \eta < 4$) upgrade includes **Trackers** (silicon microstrip tracker **&** small-strip **Thin Gap Chamber)** and **Calorimeters (ECAL & HCAL)** dedicated to study nuclear structure, QGP.

Detector	pp and pA	AA
ECAL	~10%/√E	~20%/√E
HCAL	~60%/√E	---
Tracking	Charge separation Photon suppression	$0.2 < p_T < 2$ GeV/c with 20 – 30% $1/p_T$

Forward Tracker
- 3 silicon disks
- 4 sTGC layers



Preparing for data-taking from 2021+

Forward Calorimeters
- Pre/post-shower: scintillator
- ECAL: PbSc towers (18 X_0)
- HCAL: FeSc plates (4.5 λ)