

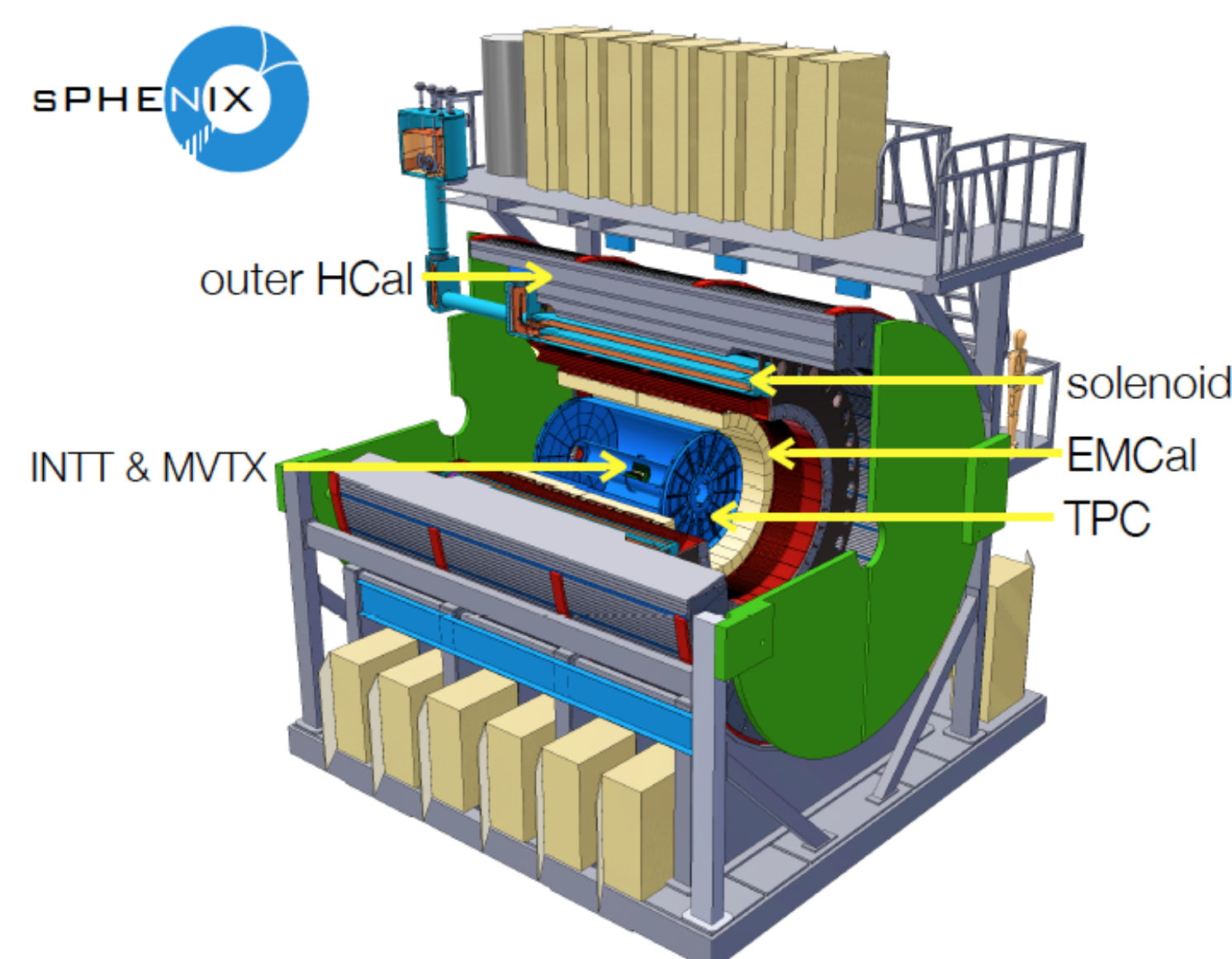


# Cold QCD Physics with sPHENIX and Potential Forward Upgrades

## sPHENIX Collaboration

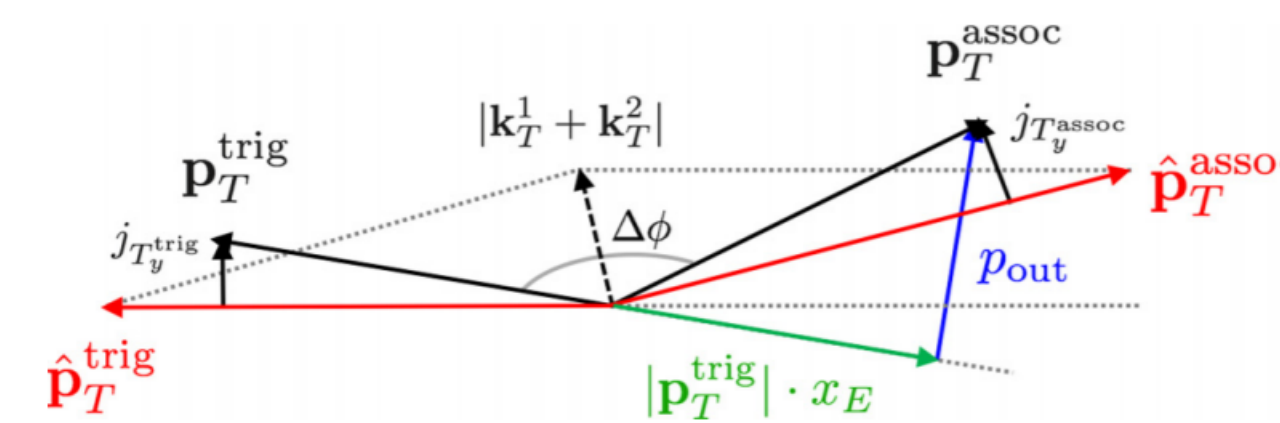
### Introduction

- Major upgrade for the PHENIX experiment at RHIC (BNL)
- For studies of the strongly interacting quark-gluon plasma using jet, photon and heavy-flavor observables.

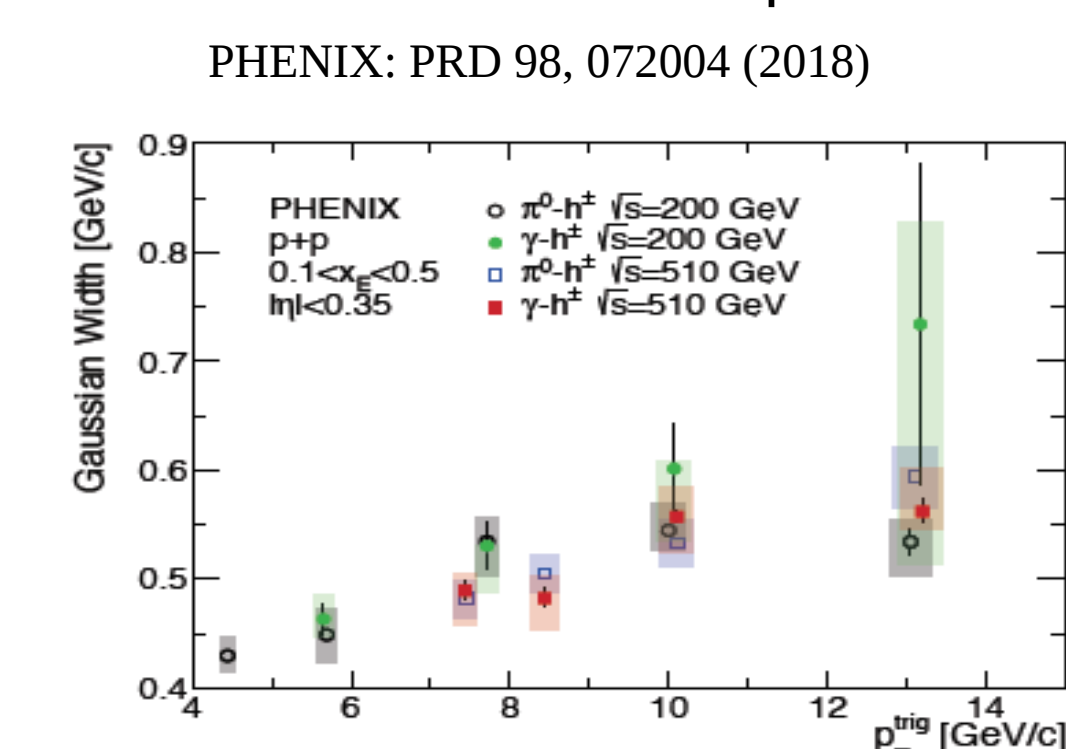


### Initial & final state modifications

Initial  $k_T$  and final  $j_T$   
(Measure  $p_{out}$  for each  $x_E$ )

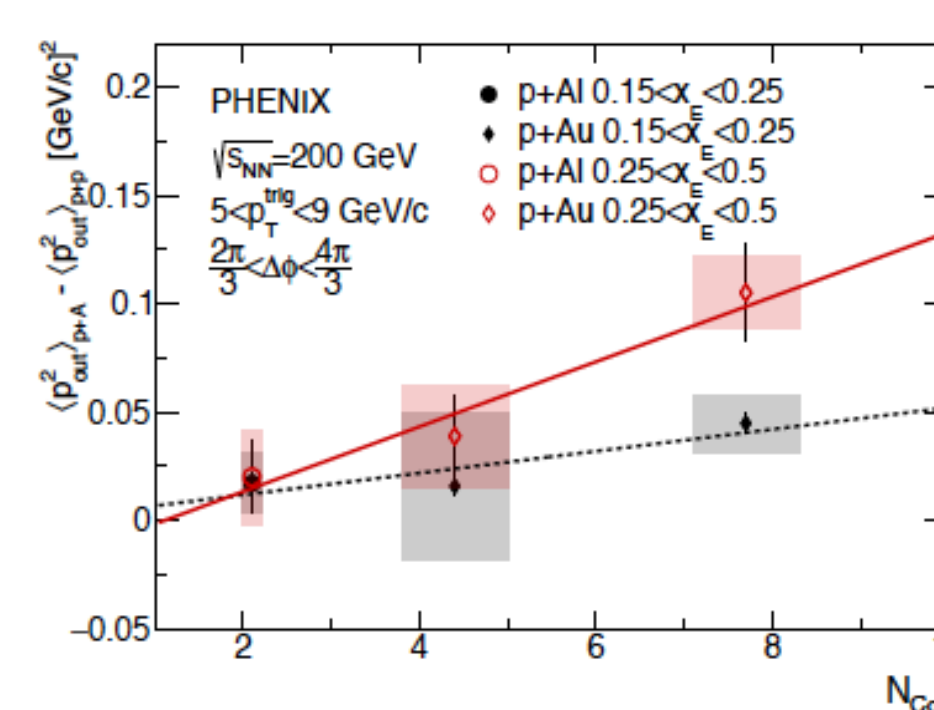


Evolution of  $k_T$  and  $j_T$



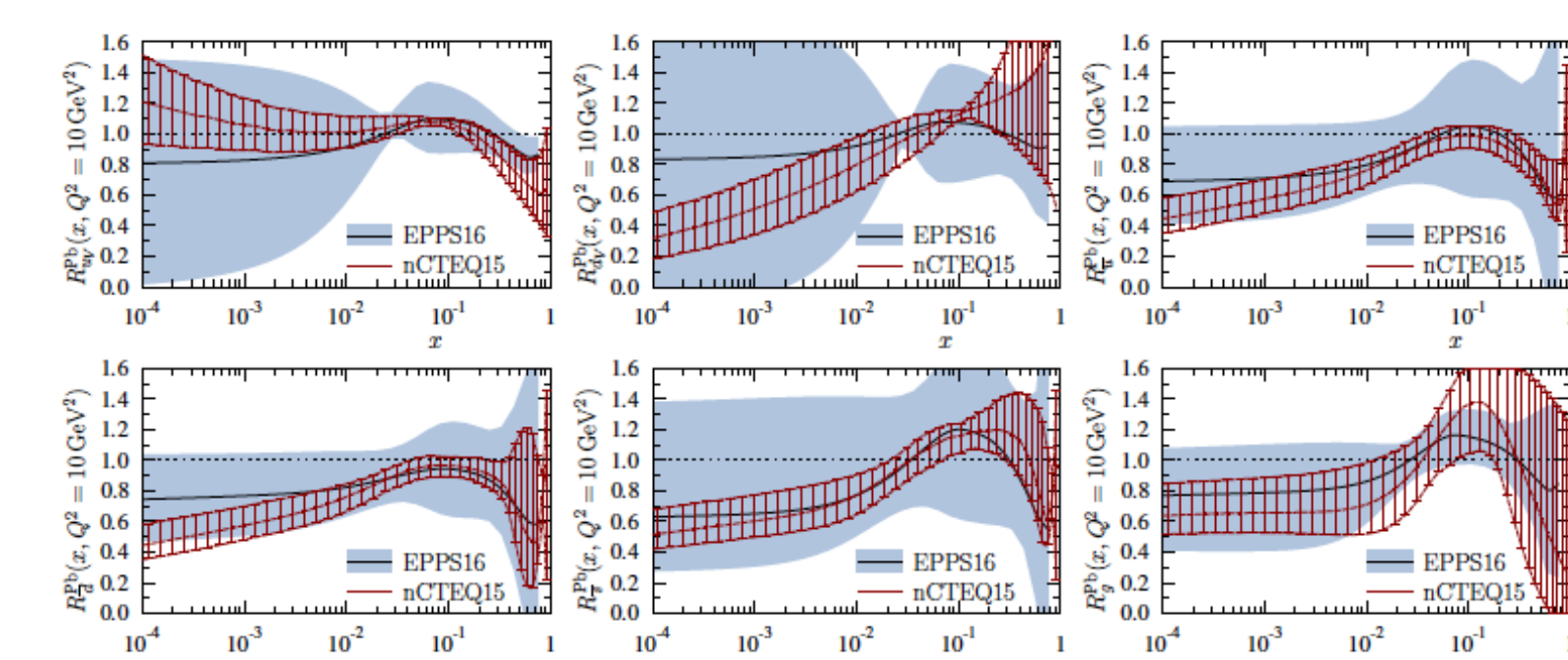
Away side peak broadening in pA

PHENIX: PRC 99, 044912 (2019)



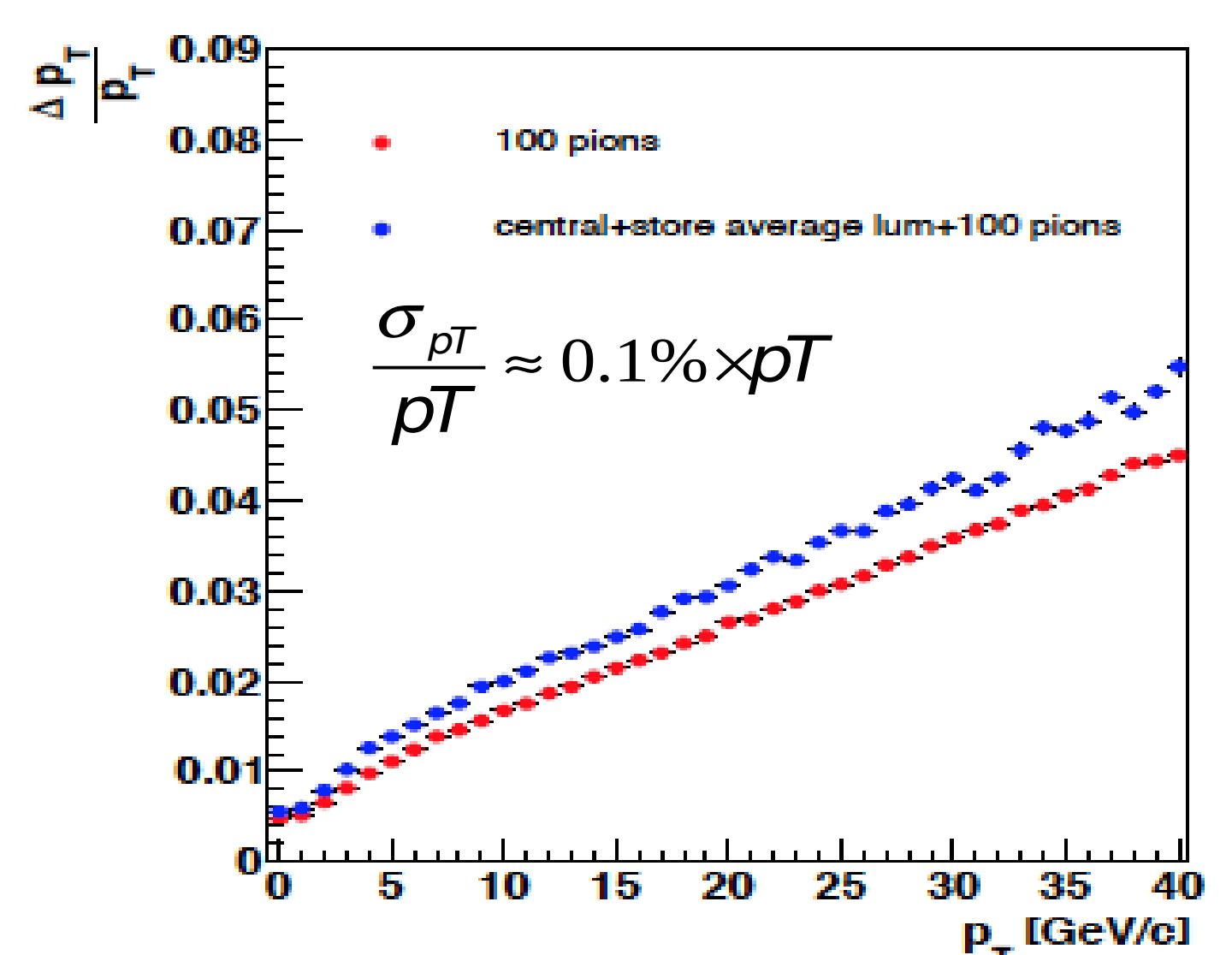
nPDF: comprehensive for h, jet, dijet,  $\gamma$ ,  $\gamma$ -jet, DY to cover  $0.02 < x < 0.4$

Eur. Phys. J. C77(3):163 (2017)

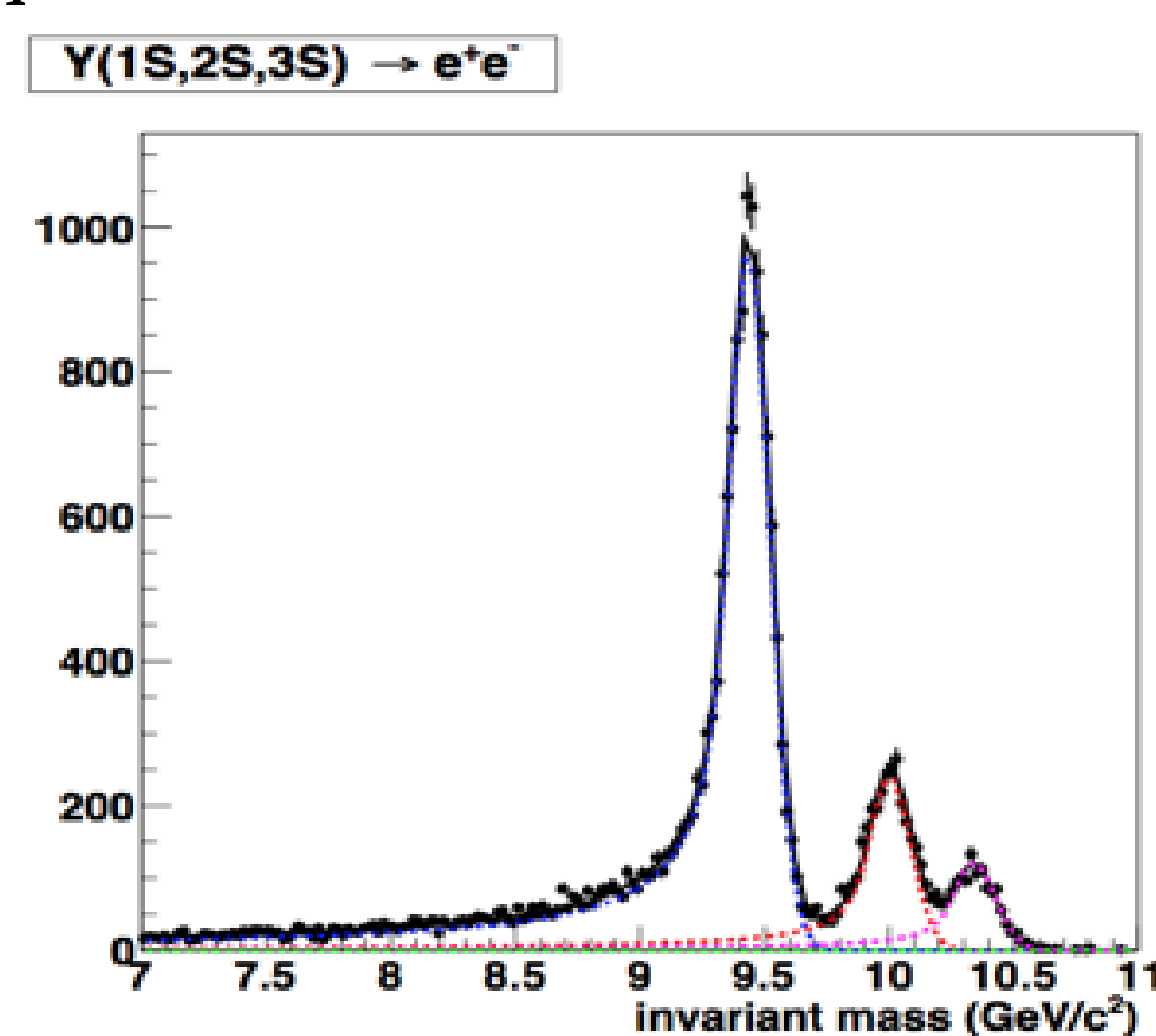


### sPHENIX strength

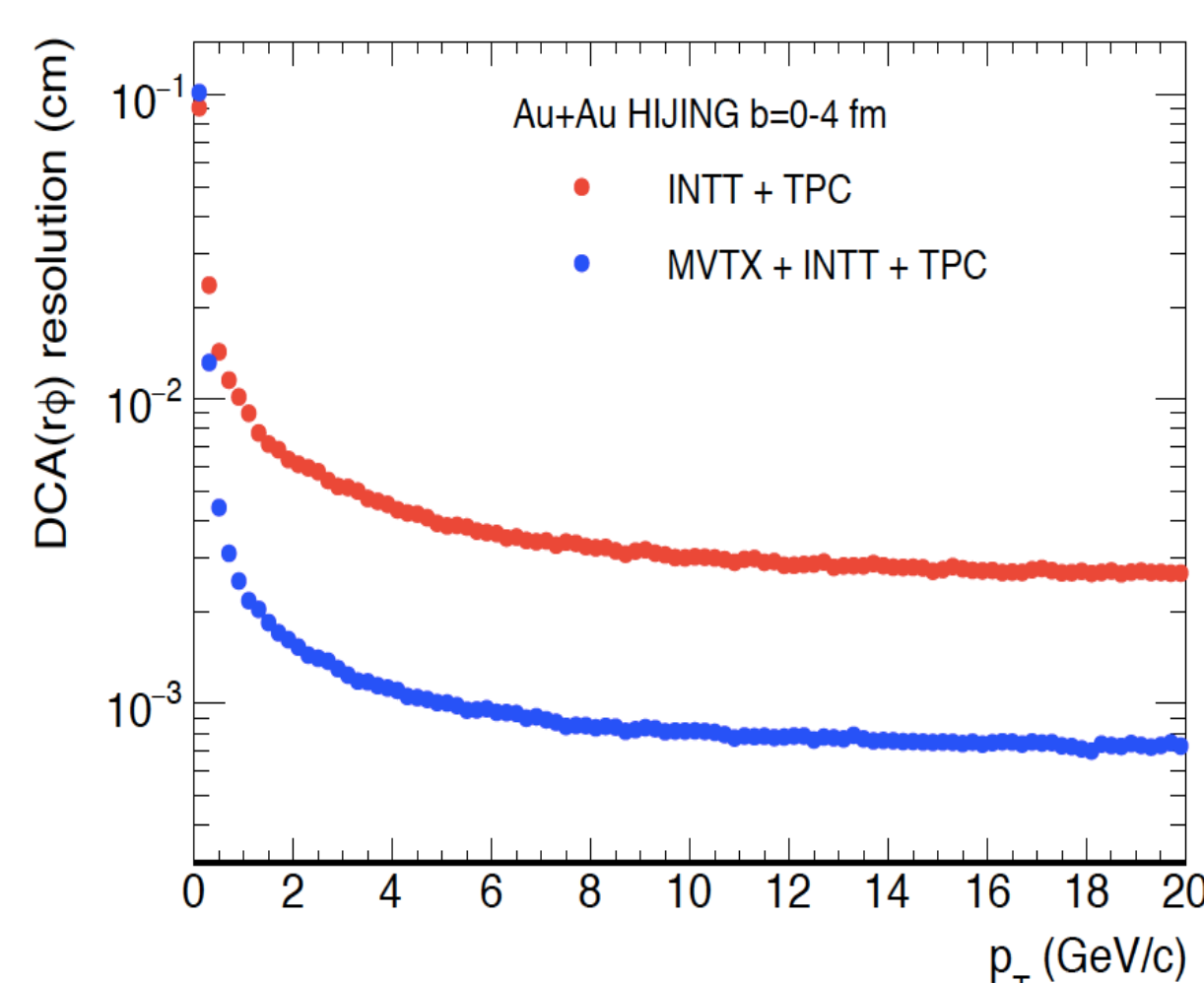
Excellent tracking



Excellent mass resolution for quarkonia states



Excellent DCA resolution (10  $\mu$ m at high pT)



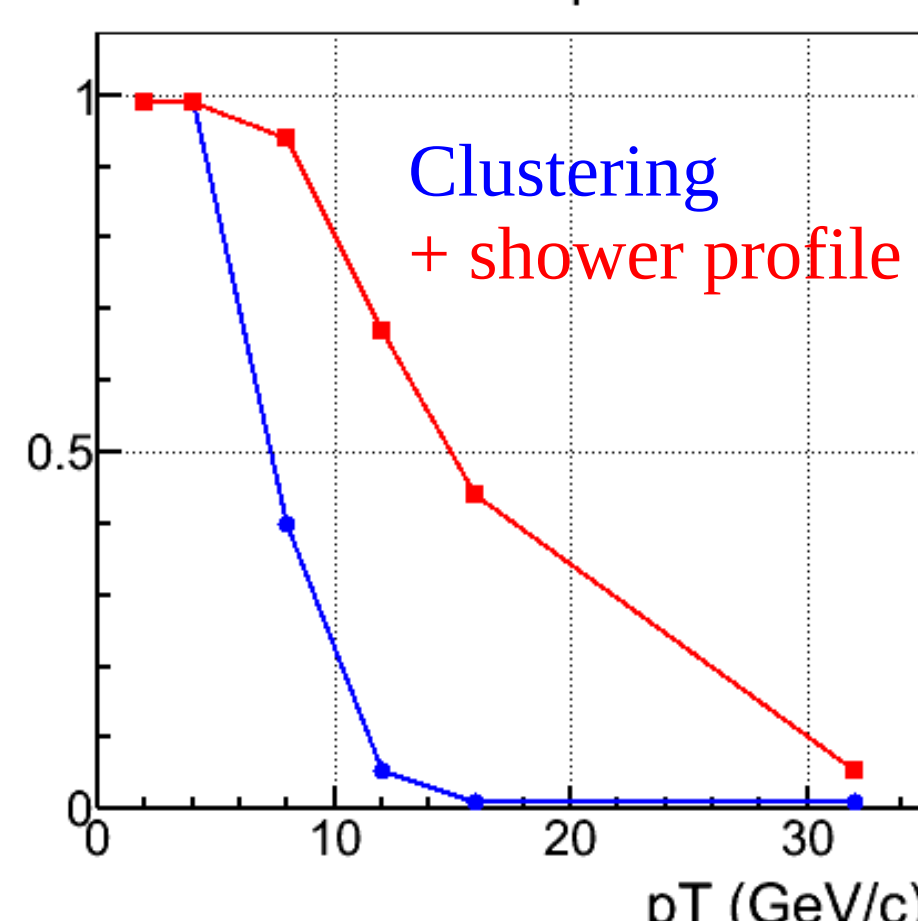
$\pi^0 \rightarrow \gamma\gamma$  merging in EMCal

$\pi^0$  eff. vs pT

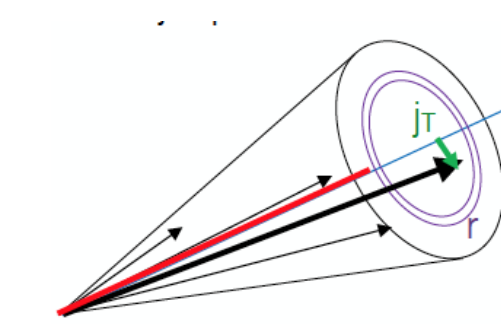
Good Calorimetry:

$$\text{EMCal: } \frac{\sigma_E}{E} \approx \frac{15\%}{\sqrt{E}}$$

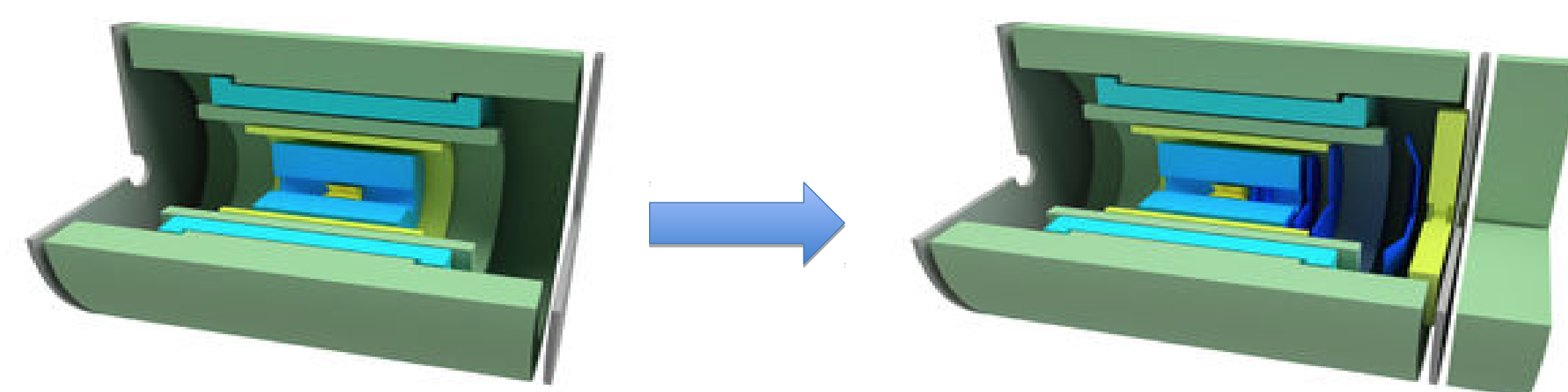
$$\text{Hcal: } \frac{\sigma_E}{E} \approx \frac{100\%}{\sqrt{E}}$$



HF Jet Hadronization



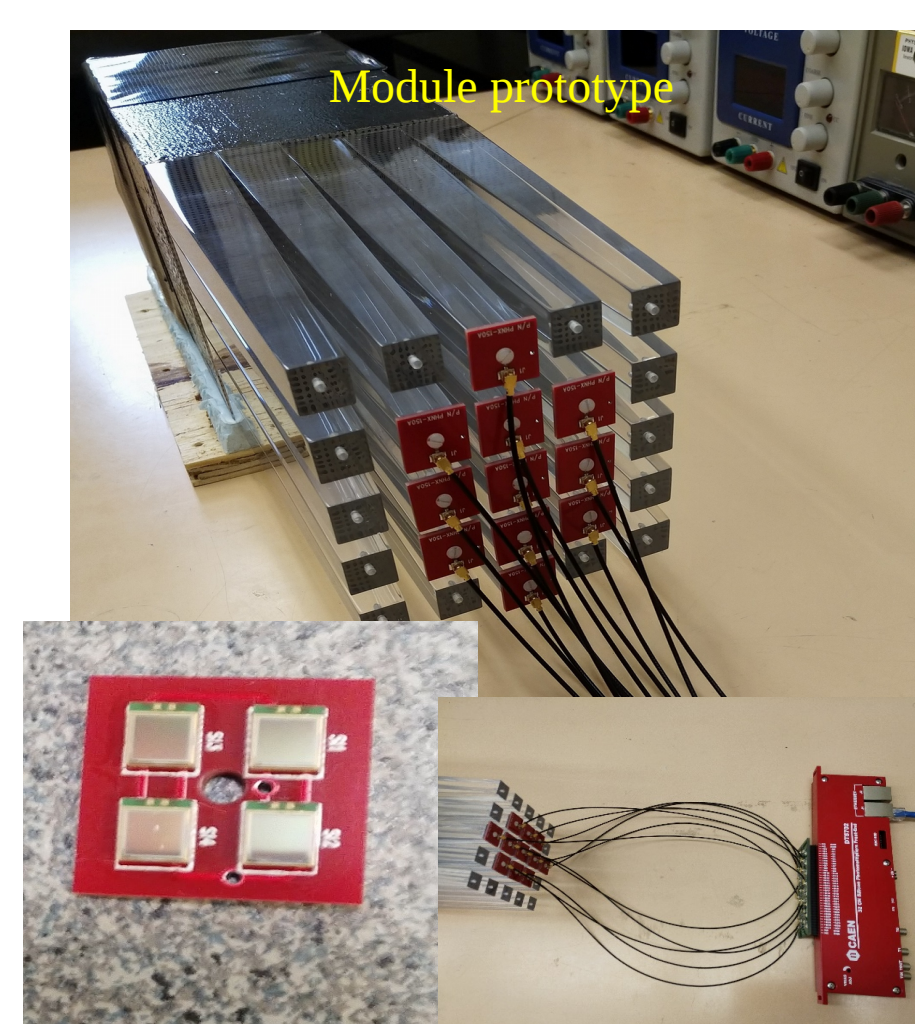
### Forward upgrade



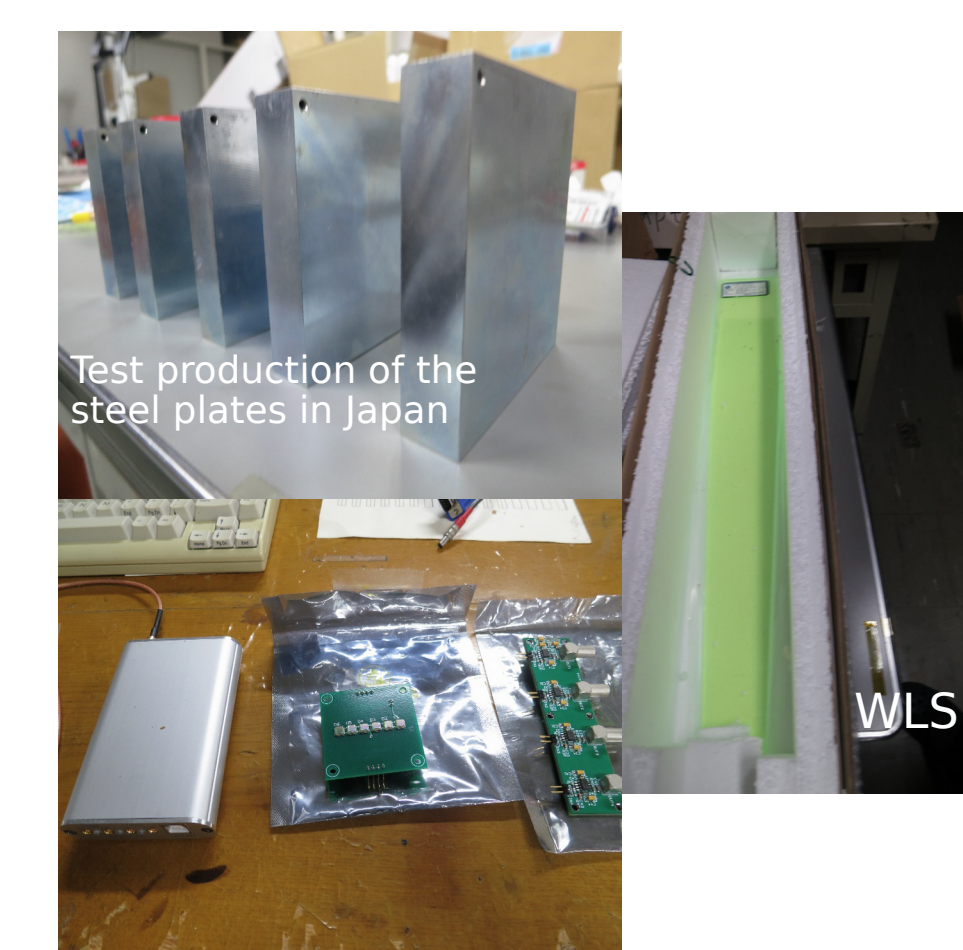
Solenoid 1.4T  
EMCal & HCal  
Tracking

+ Forward EMCal & HCal  
+ Forward tracking

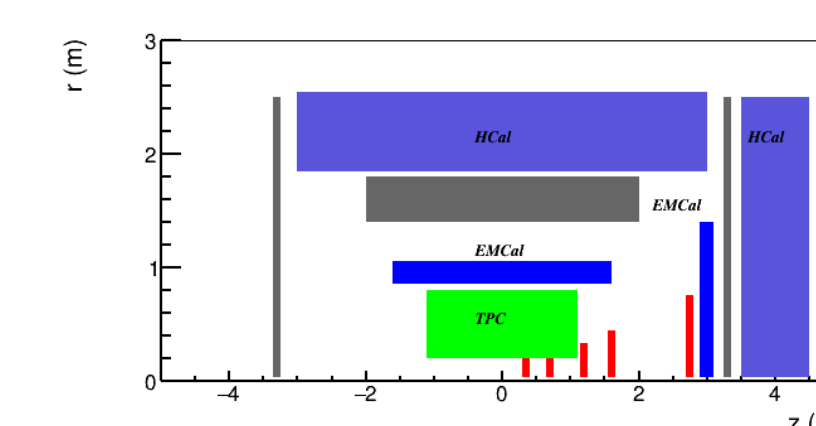
Forward EMCal R&D



HCal R&D (Test beam data in Femilab, April 2019)

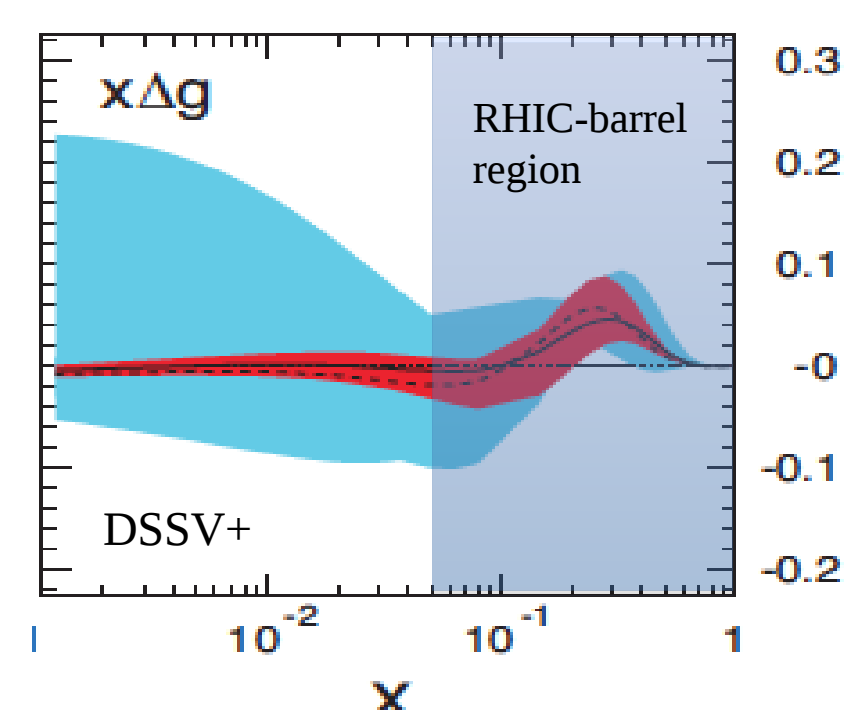


MVX for  $|\eta| < 2$ , Forward tracker needs to cover  $\eta = 2-4$



### Spin physics

Compensating gluon spin in high-x for EIC DIS+RHIC ( $\leq 2009$ ) +EIC



- sPHENIX expects to contribute high precision data for these
  - Jet detector with excellent tracking resolution and high DAQ bandwidth
  - Multi-dim binning
  - Crucial tests for factorization and universality of distr. functions

Open HF & Direct  $\gamma A_N$ :

Sensitive to Twist-3 tri-gluon & quark-gluon correlation fnct.

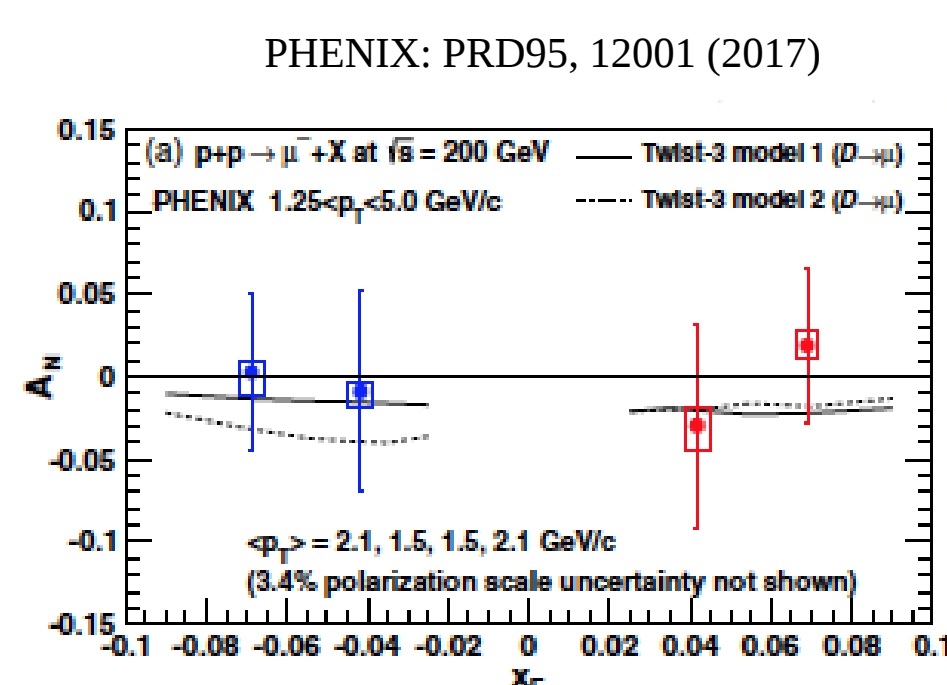
sPHENIX will considerably improve it

Decay electron + DCA

Or D reconstruction

Nobody yet measured Direct  $\gamma A_N$ ,

sPHENIX will do it!



### Summary

- In addition to exciting QGP program sPHENIX will provide a broad range of **high precision** Cold QCD measurements
  - Even more opportunities with proposed forward instrumentation
- sPHENIX – new collaboration with >70 institutions and is growing

### References

Arxiv: 1501.06197