Expected calorimeter jet performance of the sPHENIX detector

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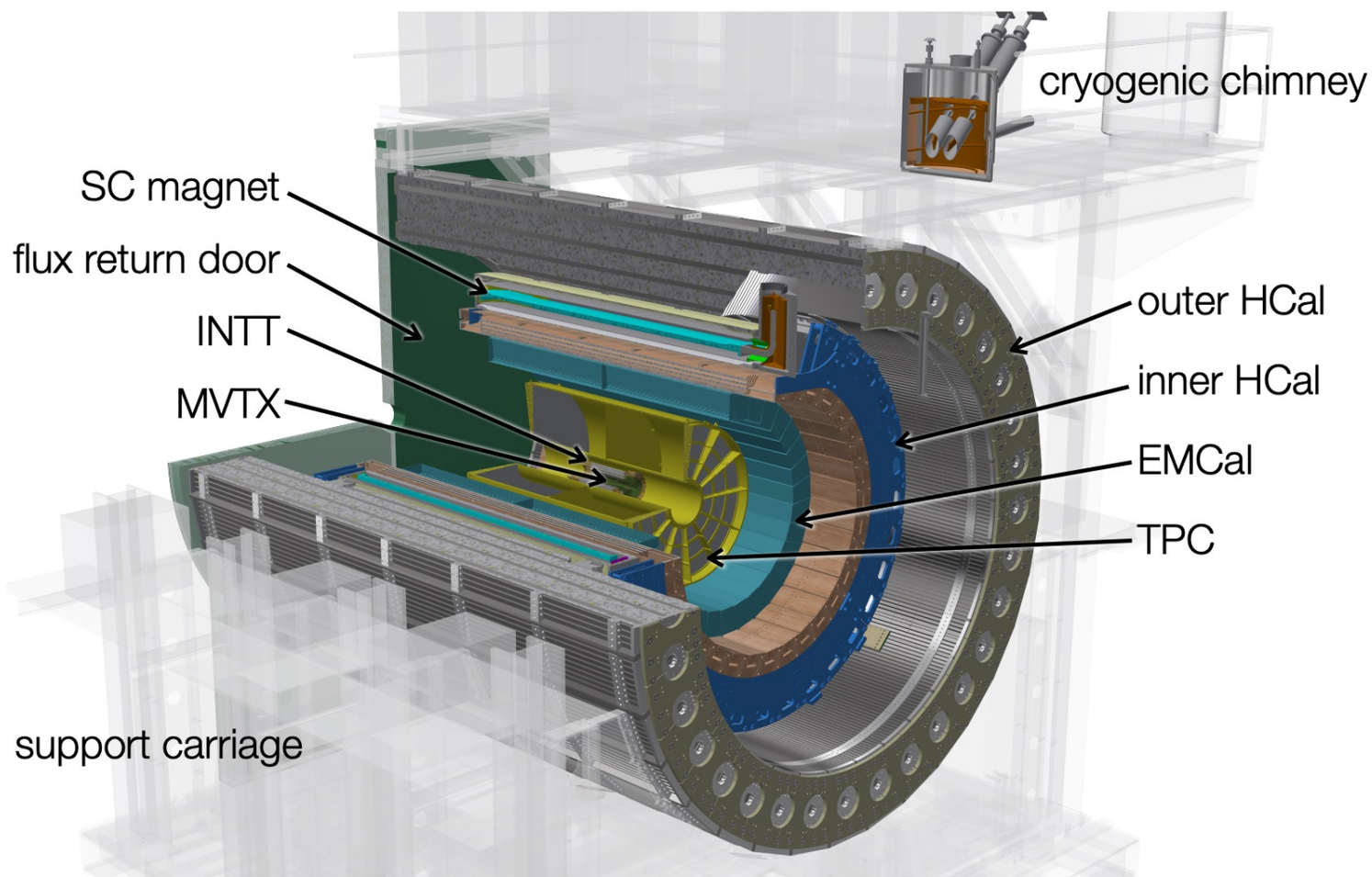
ILLINOIS

sPHENIX

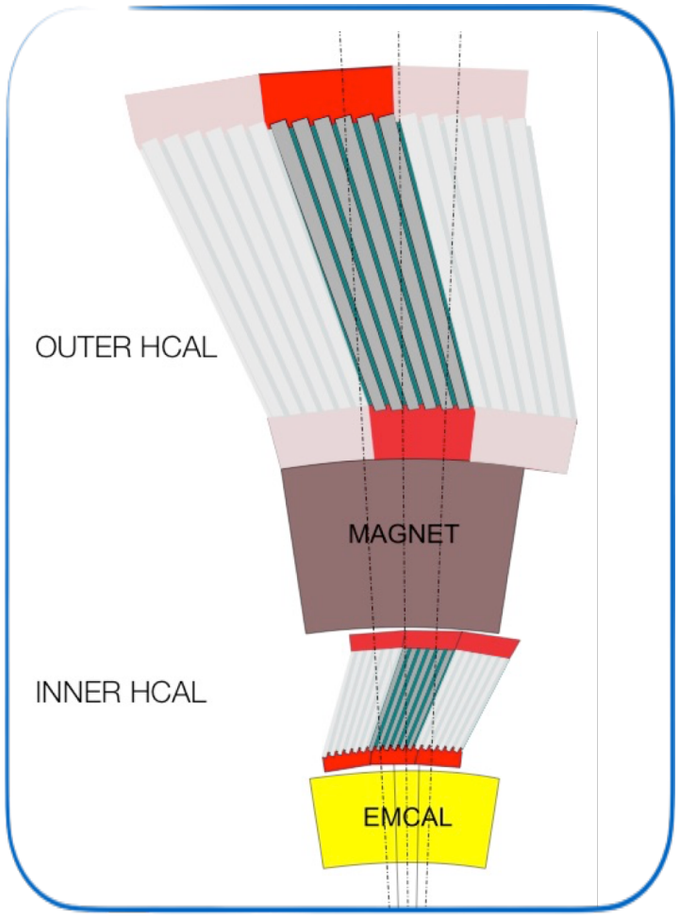
sPHENIX detector

The **sPHENIX** detector at the Relativistic Heavy Ion Collider is designed to measure high transverse momentum probes of the quark-gluon plasma such as jets, which can offer insight into the small-scale structure of the QGP.

- Tracking detector:
  - MAPS-based Vertex Tracker (MVTX)
  - Intermediate Silicon Tracker (INTT)
  - Time Projection Chamber (TPC)
- Superconducting Magnet
  - 1.4T solenoid magnet
- Calorimeter:
  - Electromagnetic calorimeter
  - Inner hadronic calorimeter
  - Outer hadronic calorimeter
- High rate DAQ and trigger systems
  - 15 kHz trigger



Calorimeter jets in sPHENIX



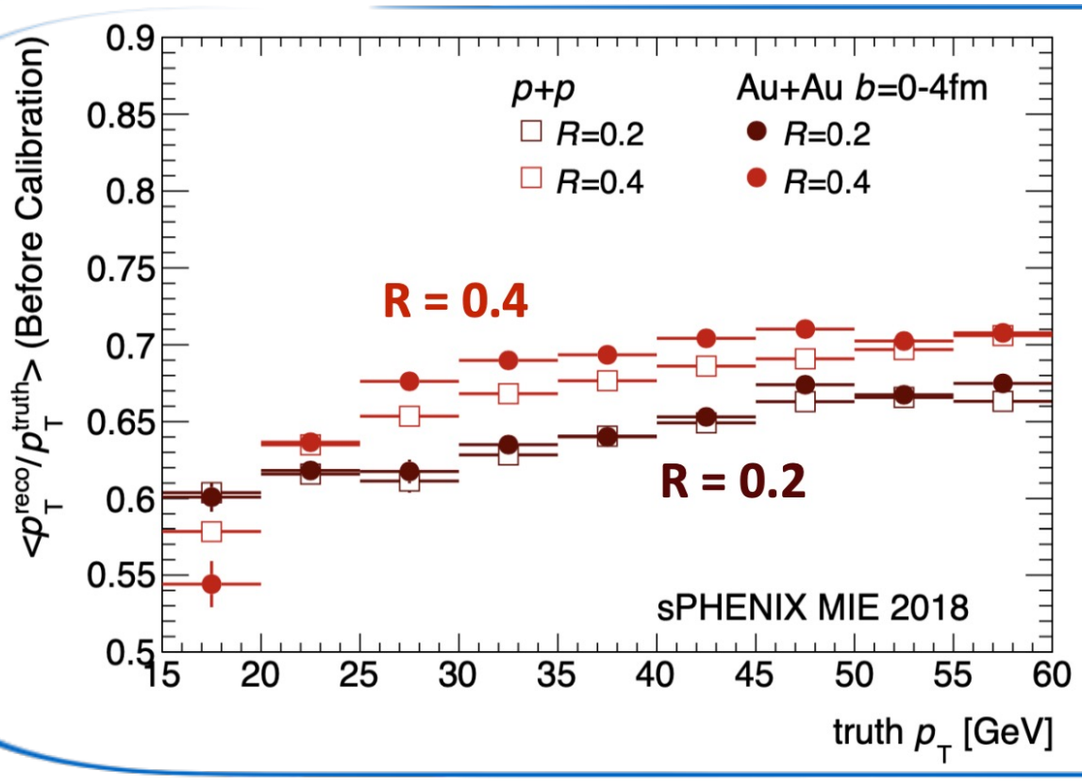
UE determined event-by-event

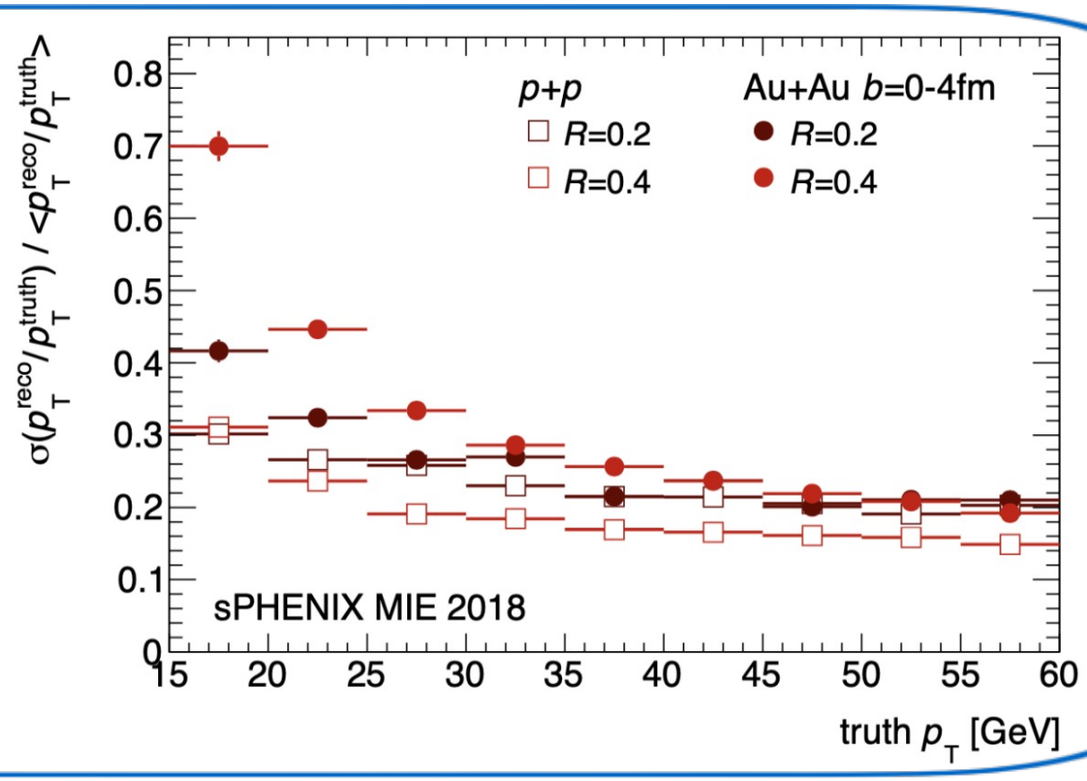
$$\frac{d^2E_T}{d\eta d\phi} = \frac{dE_T}{d\eta}\left(1 + 2\sum_n v_n \cos\left(n\left(\phi - \Psi_n\right)\right)\right)$$

Average energy density, excluding regions with jet candidates

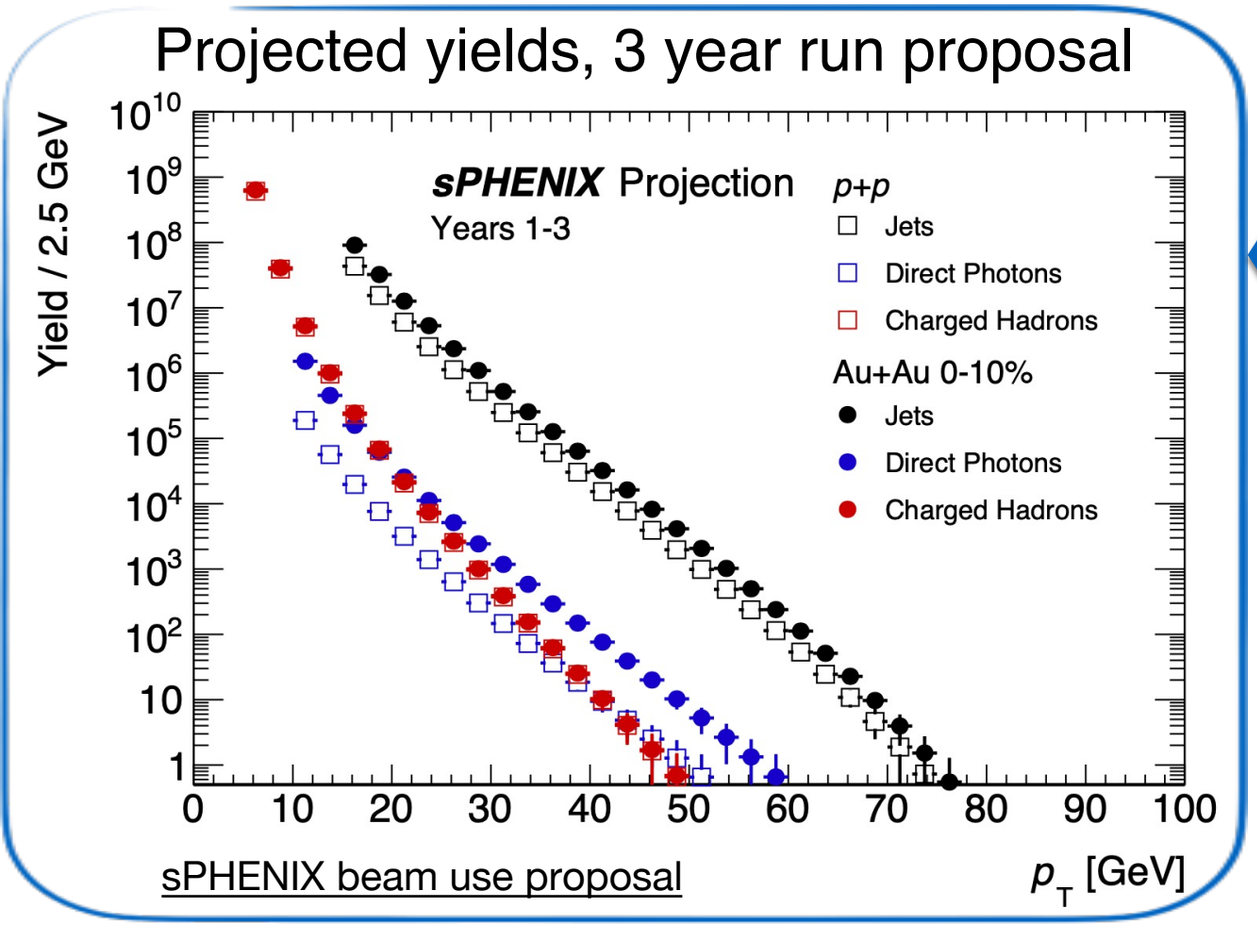
Flow modulation: v_2, v_3, v_4

Method from: *Phys.Rev.C* 86 (2012) 024908





Jet physics

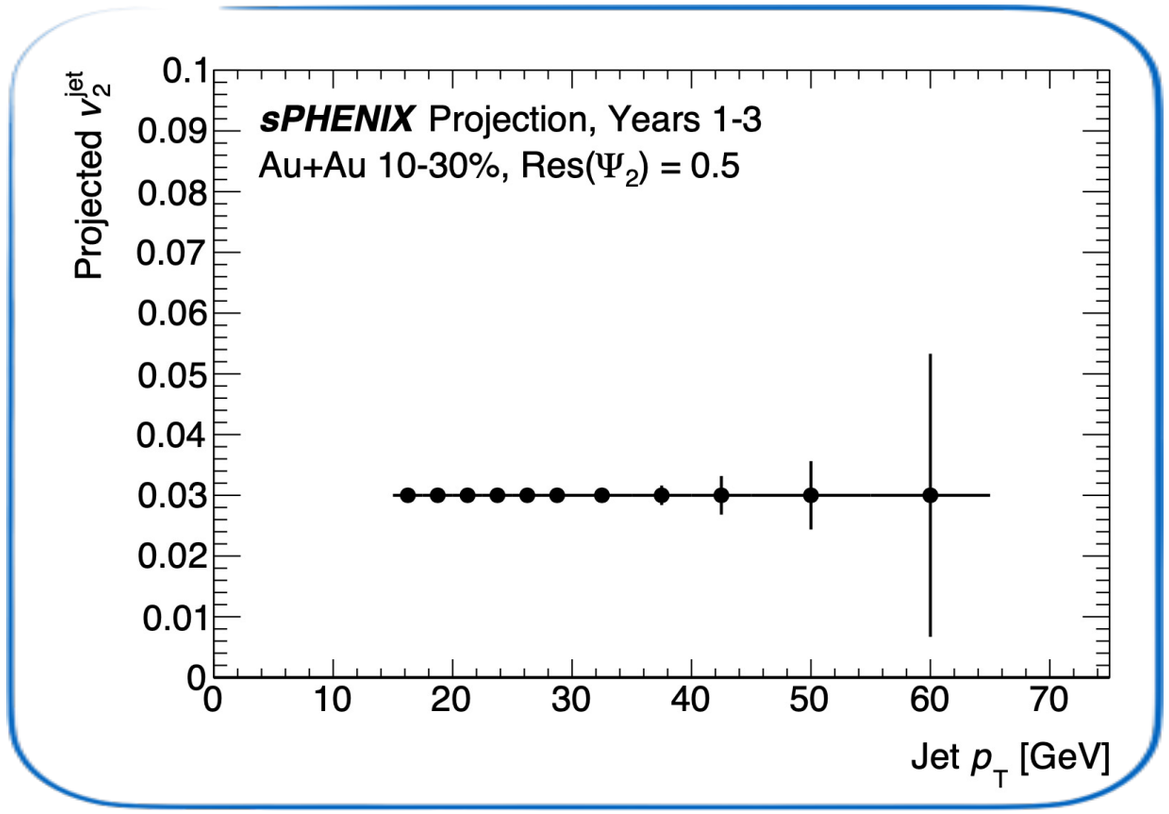


3 years

Signal	Au+Au 0–10% Counts	p+p Counts
Jets $p_T > 20$ GeV	22 000 000	11 000 000
Jets $p_T > 40$ GeV	65 000	31 000
Direct Photons $p_T > 20$ GeV	47 000	5 800
Direct Photons $p_T > 30$ GeV	2 400	290
Charged Hadrons $p_T > 25$ GeV	4 300	4 100

Year one

Year	Species	$\sqrt{s_{NN}}$ [GeV]	Cryo Weeks	Physics Weeks	Rec. Lum. $\lvert z\rvert$ <10 cm	Samp. Lum. $\lvert z\rvert$ <10 cm
2023	Au+Au	200	24 (28)	9 (13)	3.7 (5.7) nb^{-1}	4.5 (6.9) nb^{-1}



- Jet measurements out to 70 GeV
  - overlap with LHC measurements
- High stats also for
  - photons (γ-jet measurements)
  - charged hadrons (fragmentation functions, substructure)
- Large luminosity Au+Au in first year
  - dijets, jet v_2

Summary

- sPHENIX detector will provide:
  - Full coverage electromagnetic and hadronic calorimetry
  - High precision tracking
  - Fast readout rate
- Design allows for:
  - High statistics samples of hard probes (jets, photons, high p_T charged hadrons)
  - Full jet reconstruction → complimentary jet measurements to LHC
- Measurements will improve our understanding of small-scale behavior of the QGP
- Data taking to begin in Feb. 2023!

February 28, 2022

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