

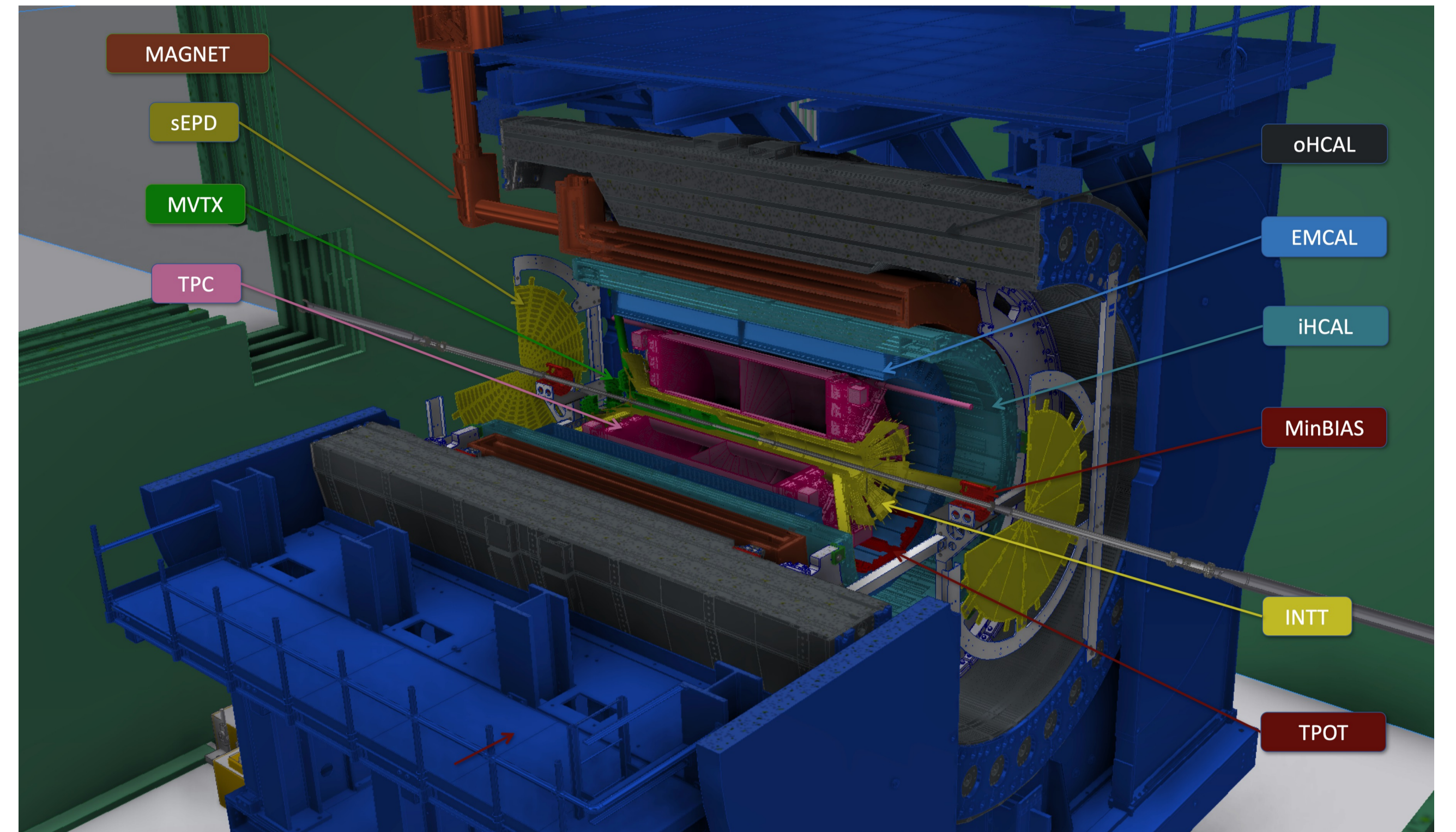
Introduction

In Spring 2023, the sPHENIX detector at BNL's Relativistic Heavy Ion Collider (RHIC) will begin measuring a suite of unique jet and heavy flavor observables with high statistics and kinematic reach at the RHIC energies.

The combination of electromagnetic calorimetry, hadronic calorimetry, precision tracking, and the ability to record data at a very high rates enables measurements of jets, jet substructure, and jet correlations at RHIC with a kinematic reach that will overlap with similar measurements at the LHC.

Jet observables are a particularly useful probe of the Quark Gluon Plasma (QGP) formed in heavy-ion collisions since the hard scattered partons that fragment into final state jets are strongly "quenched", losing energy to the medium as they traverse it.

The sPHENIX Detector



Calorimeters: Inner and outer hadronic calorimeters (iHCAL, oHCAL), electromagnetic calorimeter (EMCAL)
Tracking: Time projection chamber (TPC), TPC outer tracker (TPOT), intermediate silicon tracker (INTT), MAPS-based vertex detector (MVTX)
Event characterization: minimum bias detector (MinBIAS), event plane detector (sEPD)

Calorimeter Jets in sPHENIX

Jets reconstructed using calorimeter towers

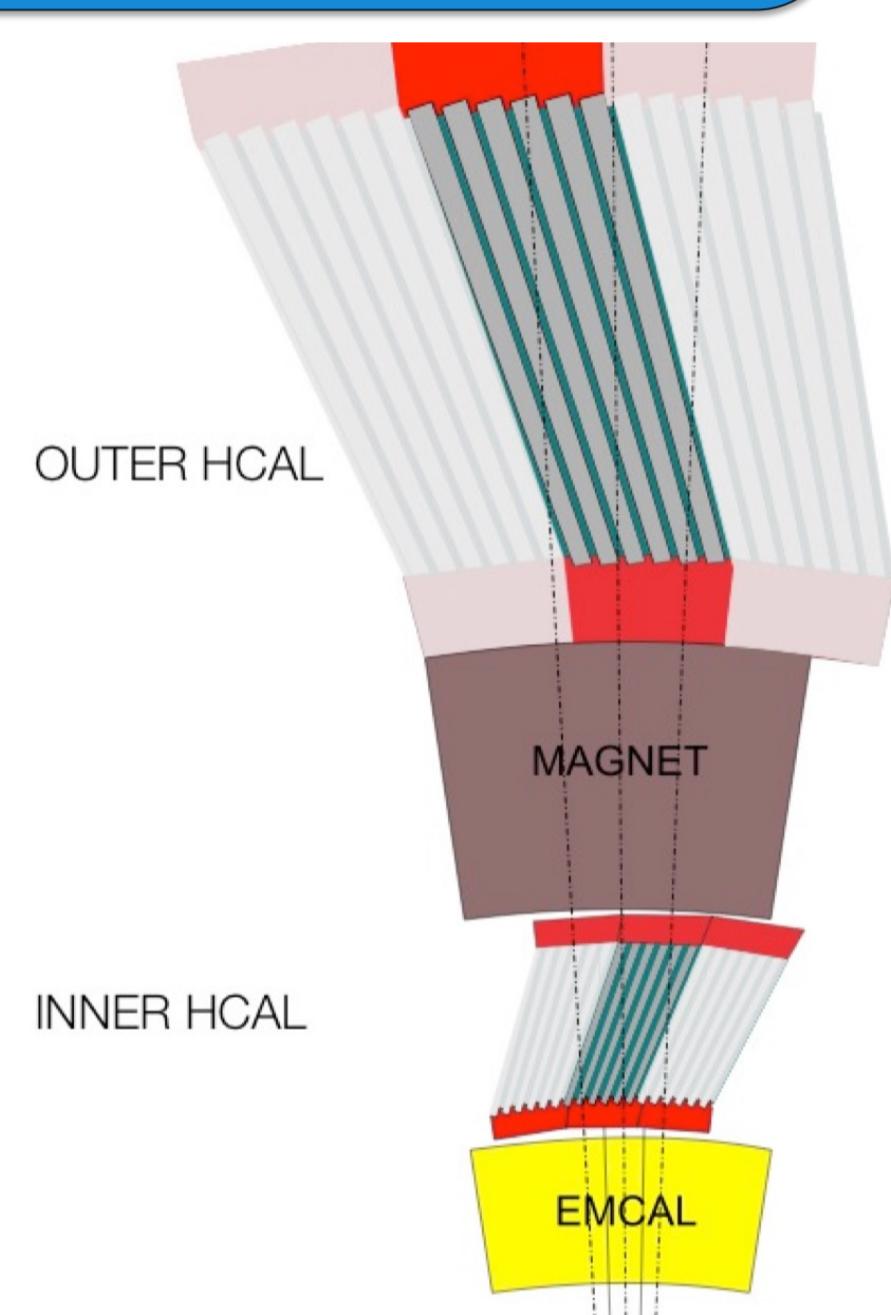
Event by event underlying event determination

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

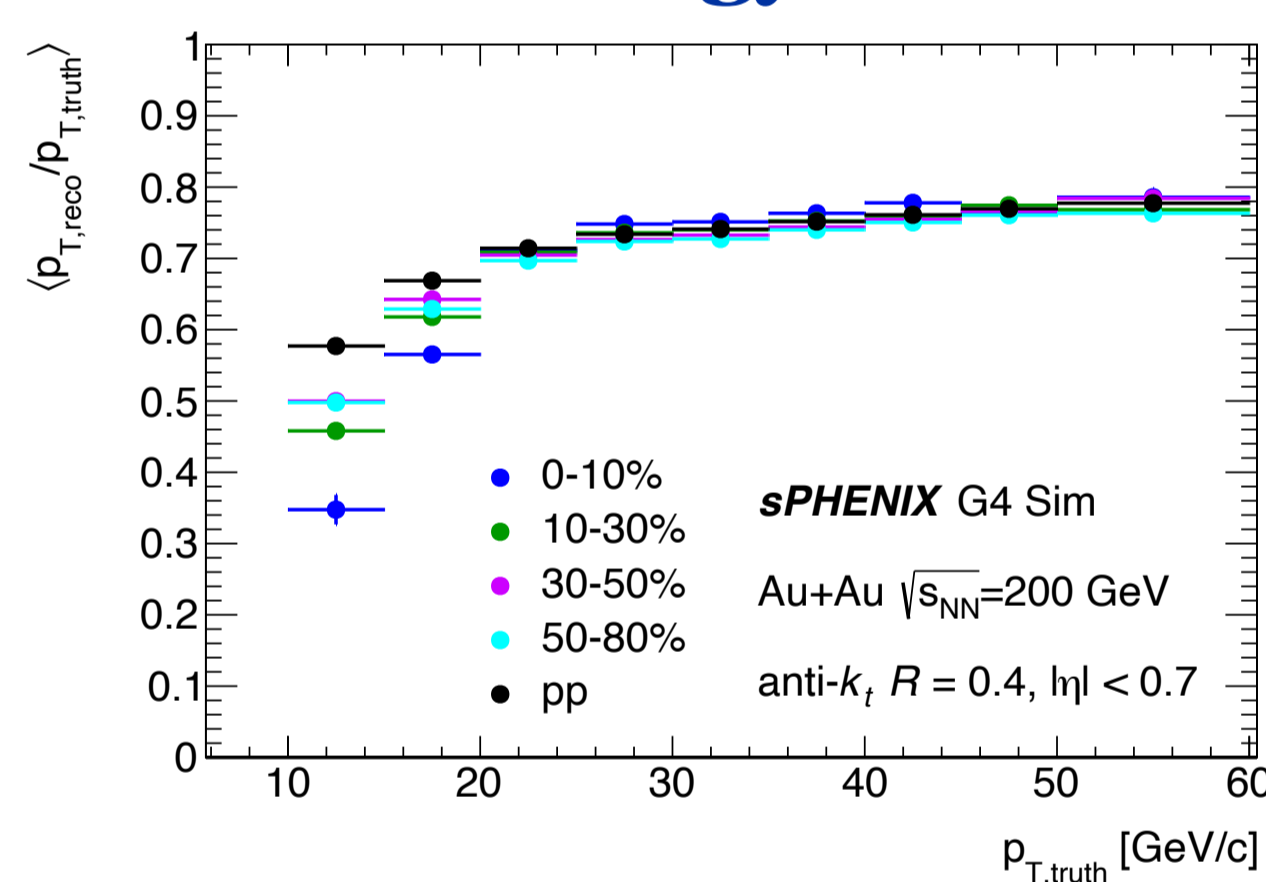
Average energy density, excluding regions with jet candidates

Flow modulation: v_2

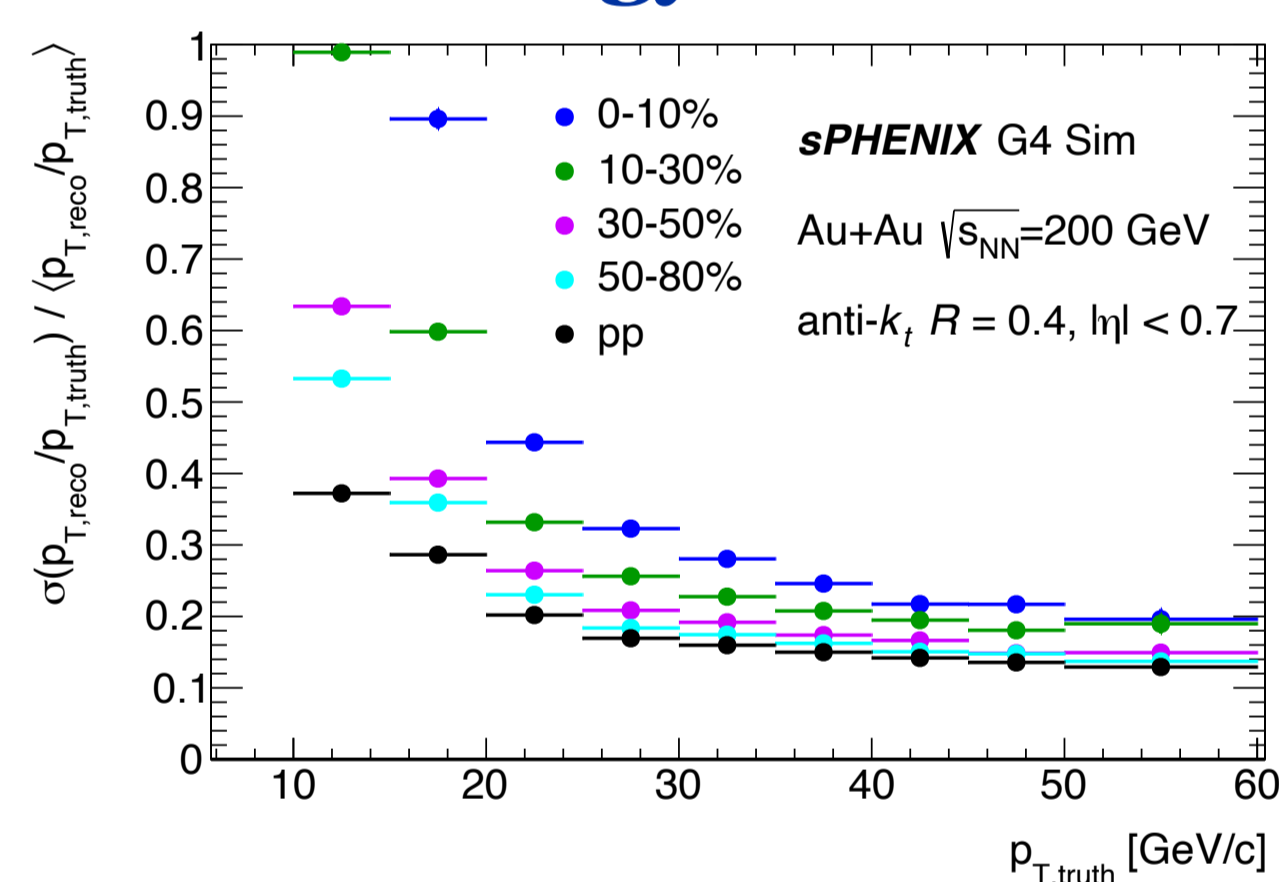
Method from: *Phys.Rev.C* 86 (2012) 024908



Jet energy scale



Jet energy resolution



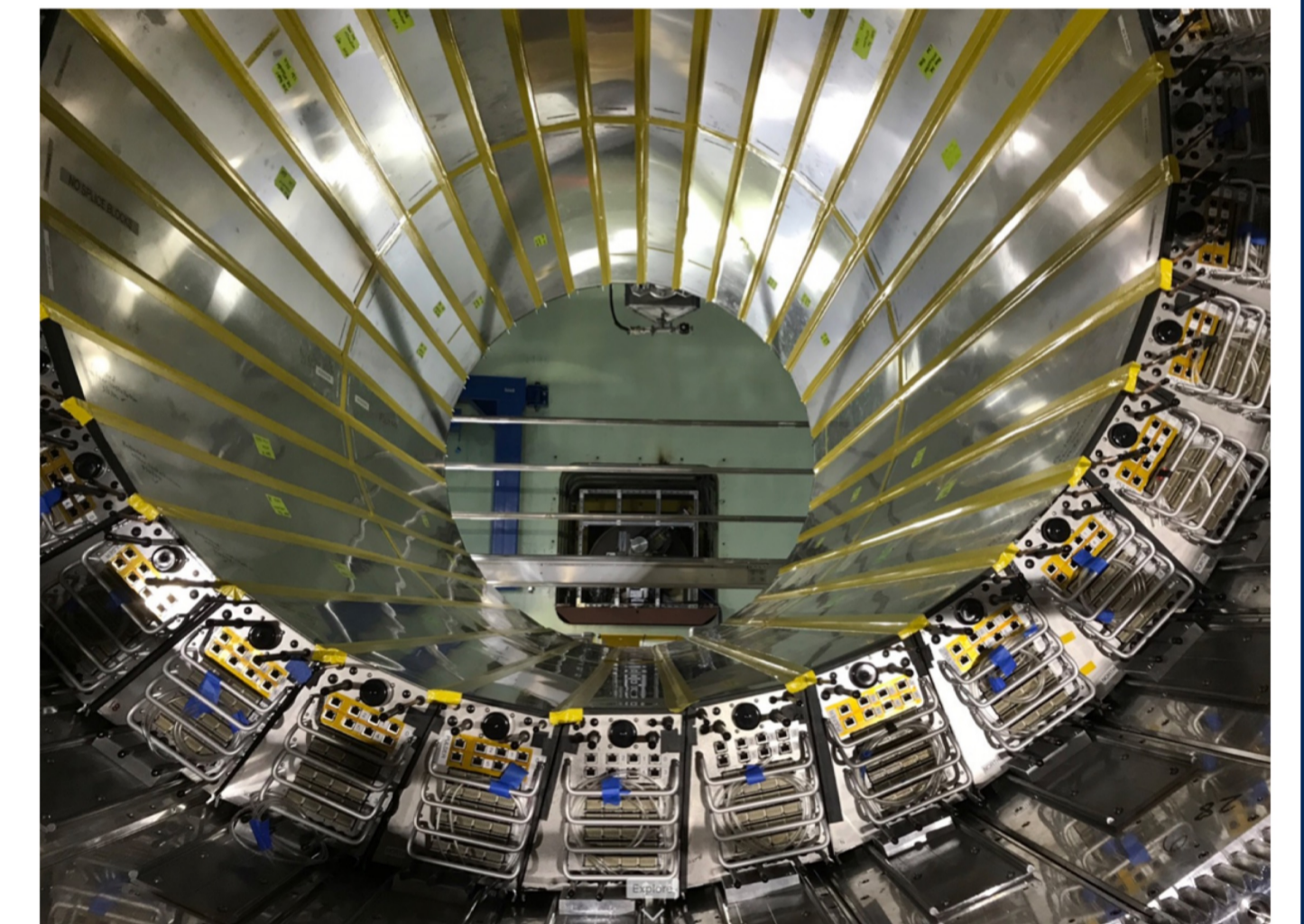
JES and JER are for uncalibrated jets and do not include flow subtraction

Installation

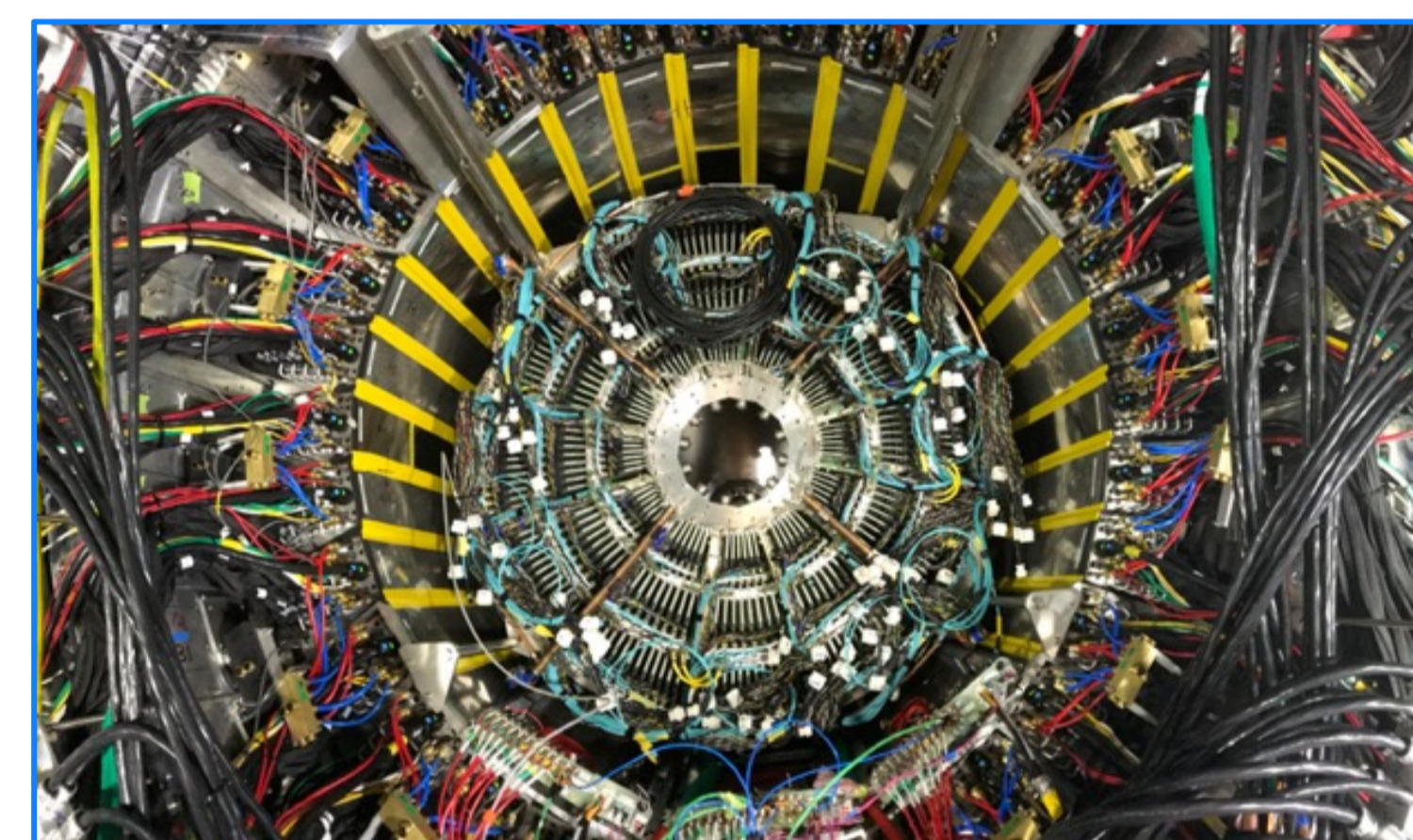
Inner and Outer HCals



EMCal



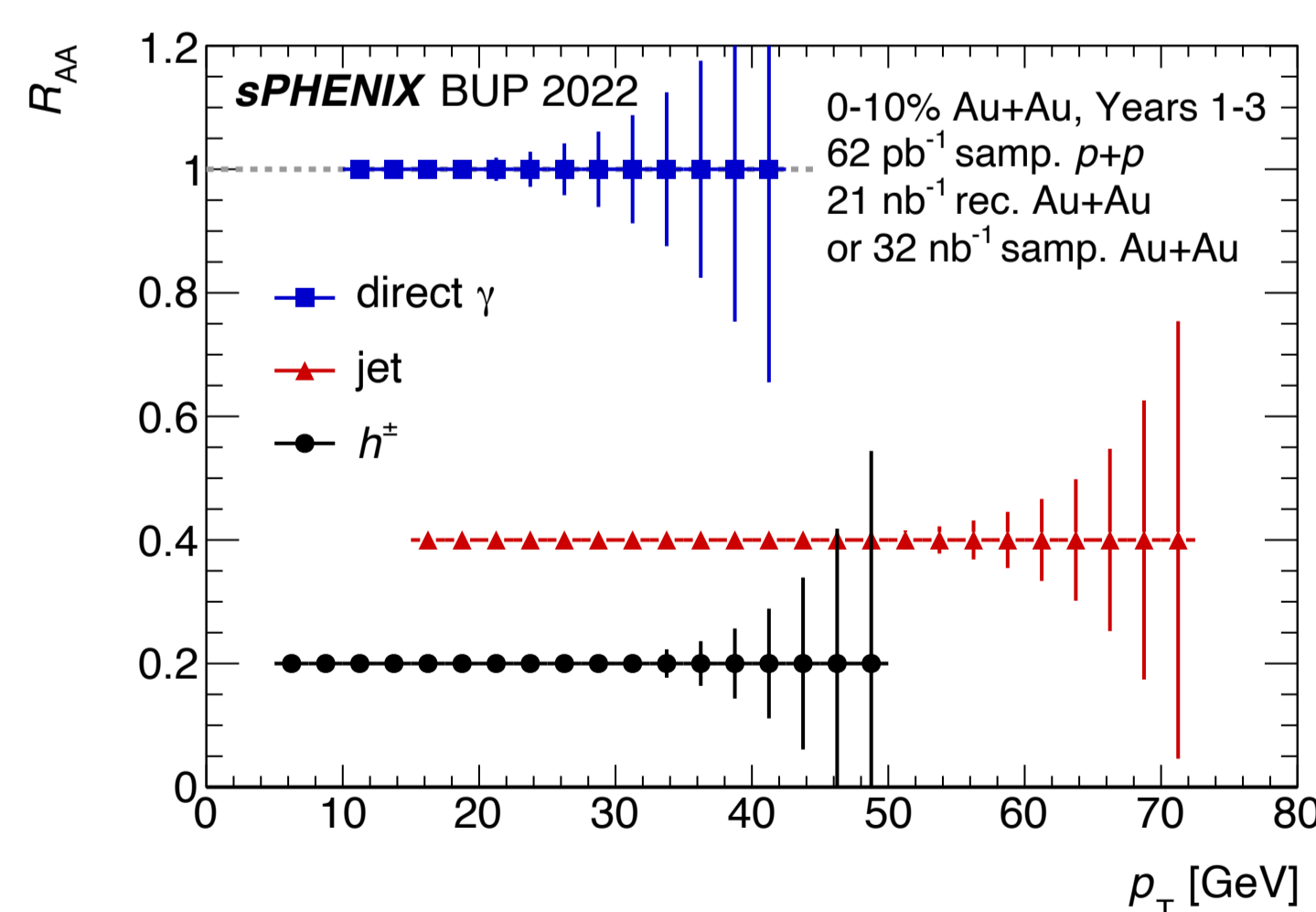
TPC



INTT



Jet Physics



Jet measurements at:

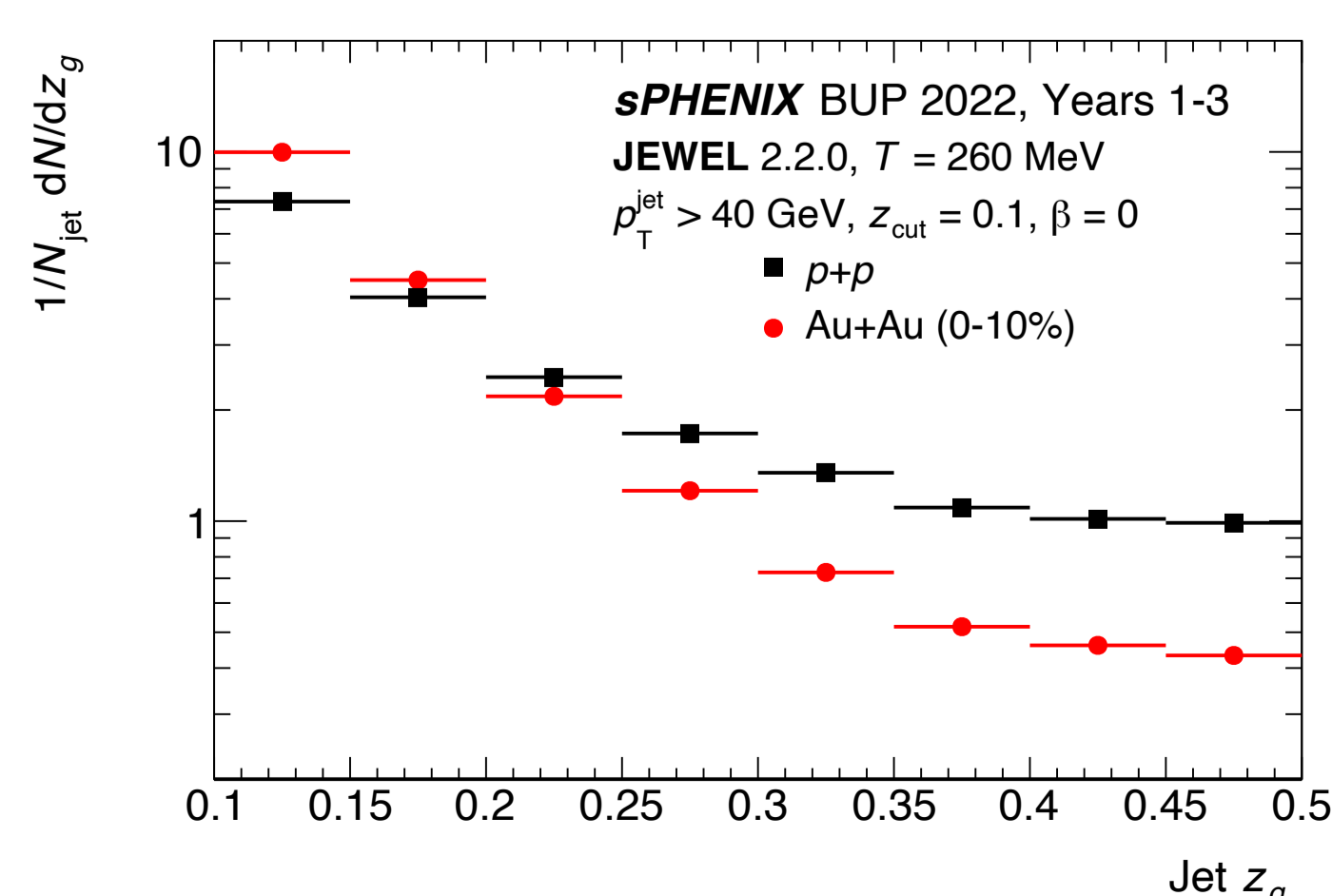
- high p_T overlap with LHC
- low p_T high precision

High statistics:

- Photons for γ + jet measurements
- Charged hadrons for substructure

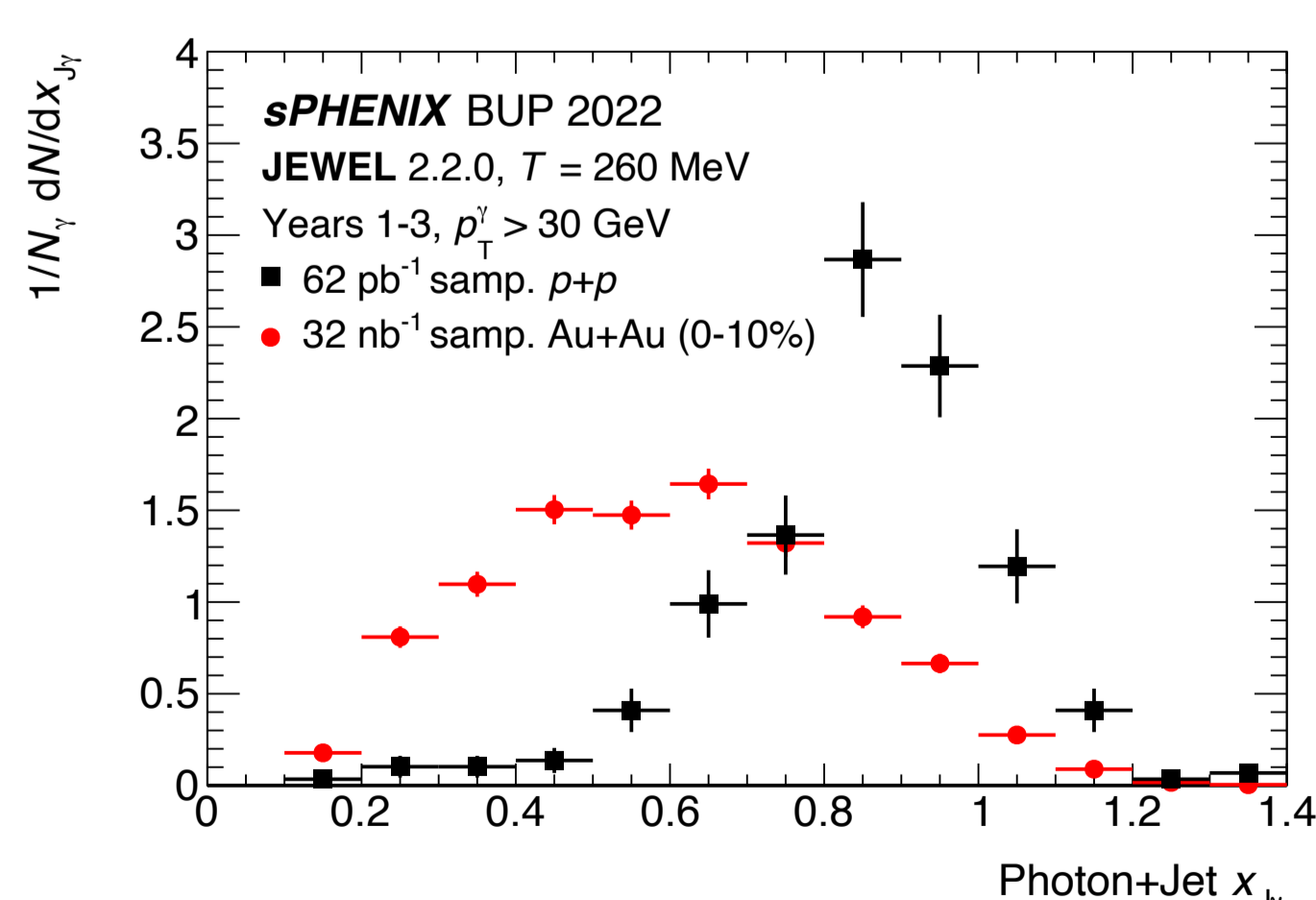
Heavy flavor jets

- see talk by A. Silva on Tuesday

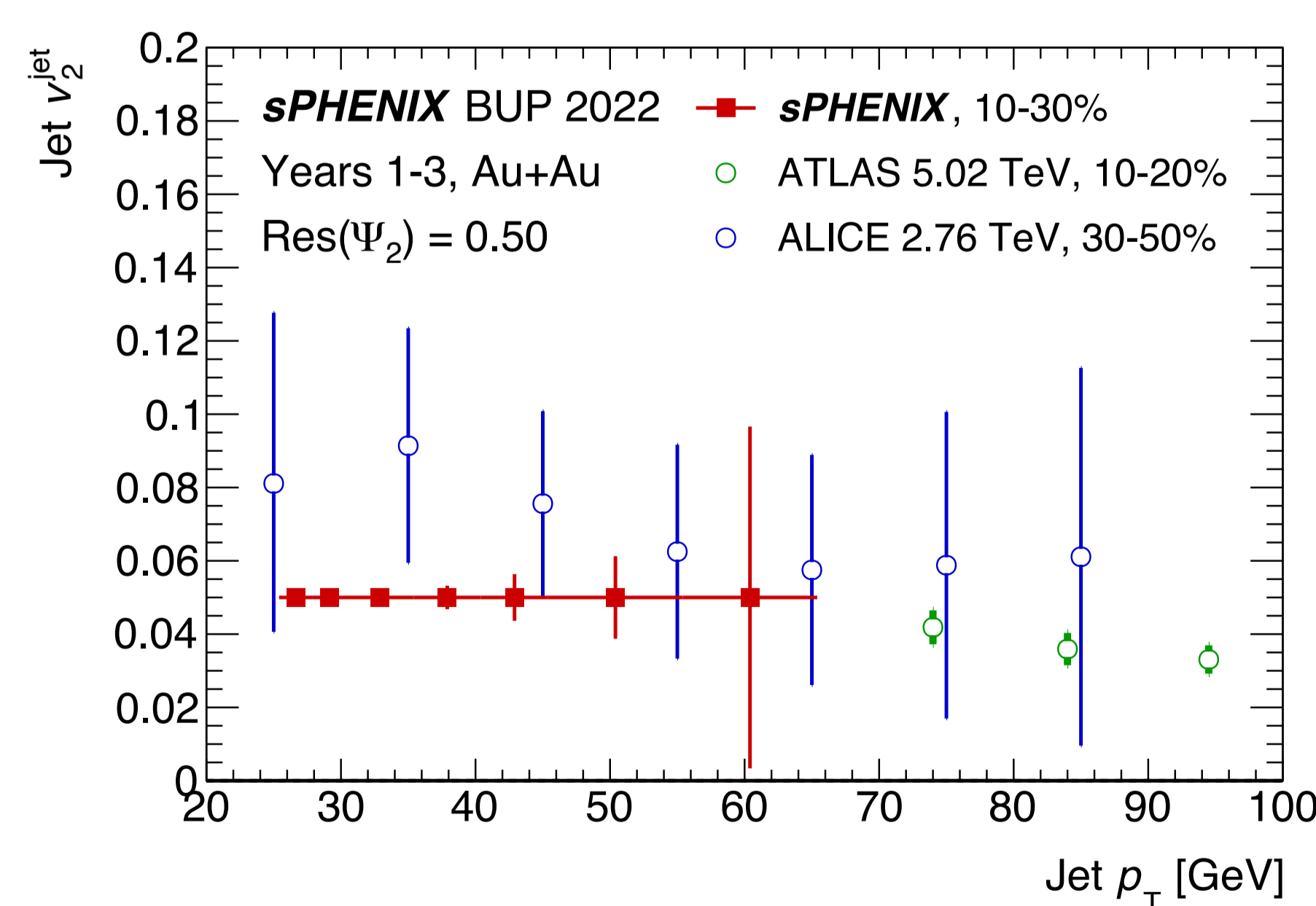


Expected yields based on 3 year run plan

| 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 |



Complimentary to the LHC



Jet v_2

Constrain models of path-length dependence of energy loss for jets near QGP medium scale

R-dependence of jet quenching

Expect precision in region of tension between LHC experiments

