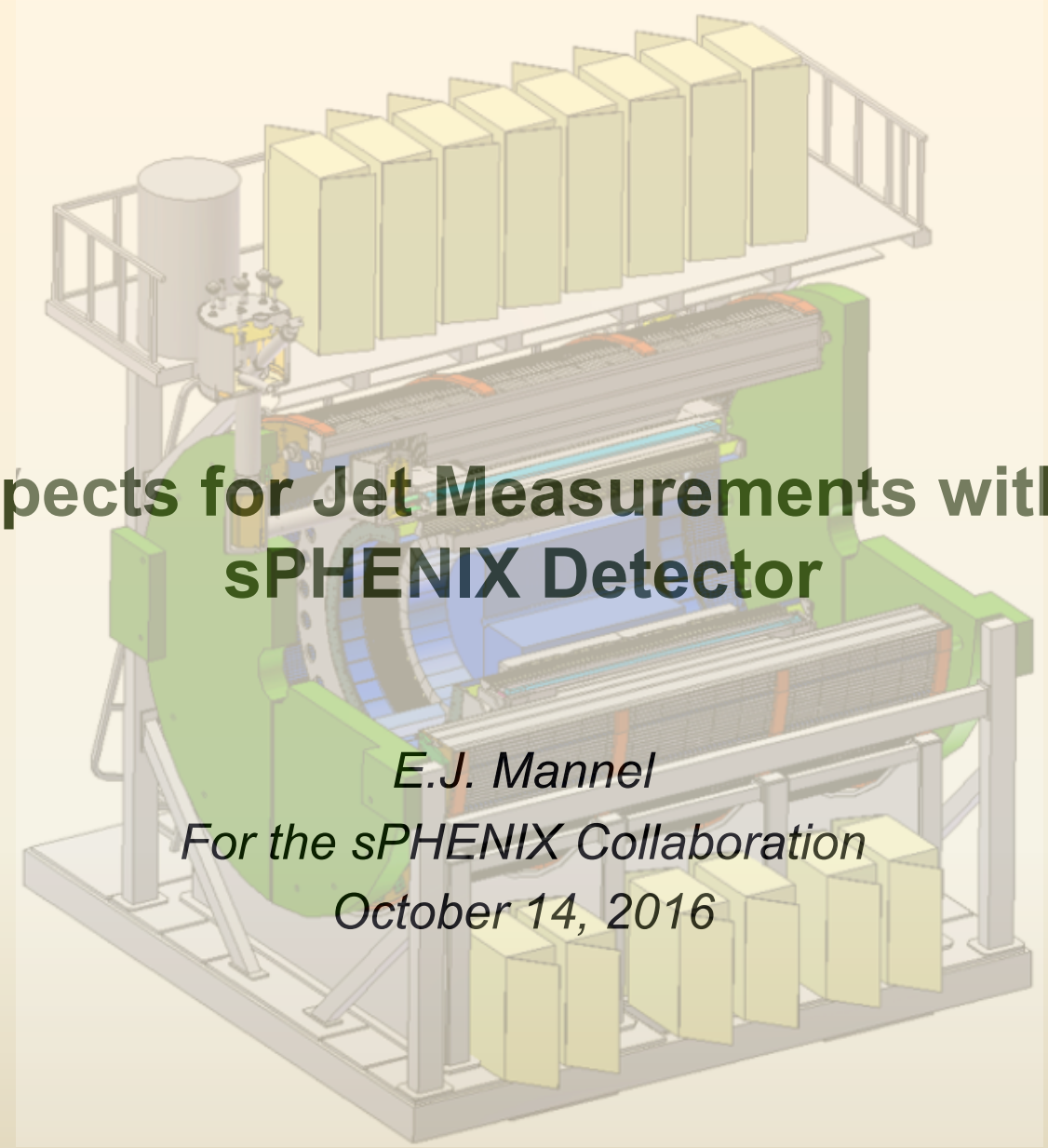


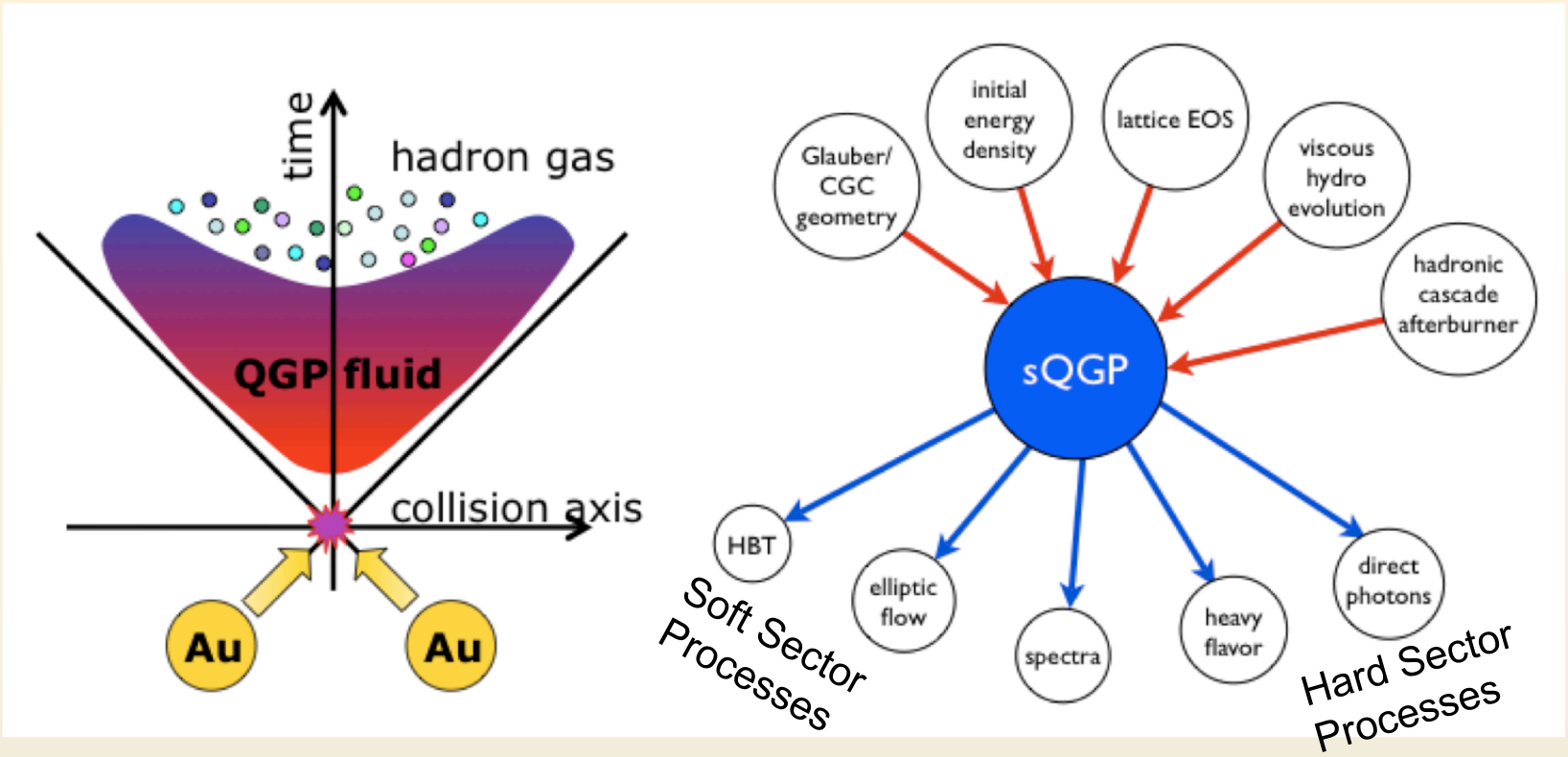
Prospects for Jet Measurements with the sPHENIX Detector

E.J. Mannel

For the sPHENIX Collaboration

October 14, 2016

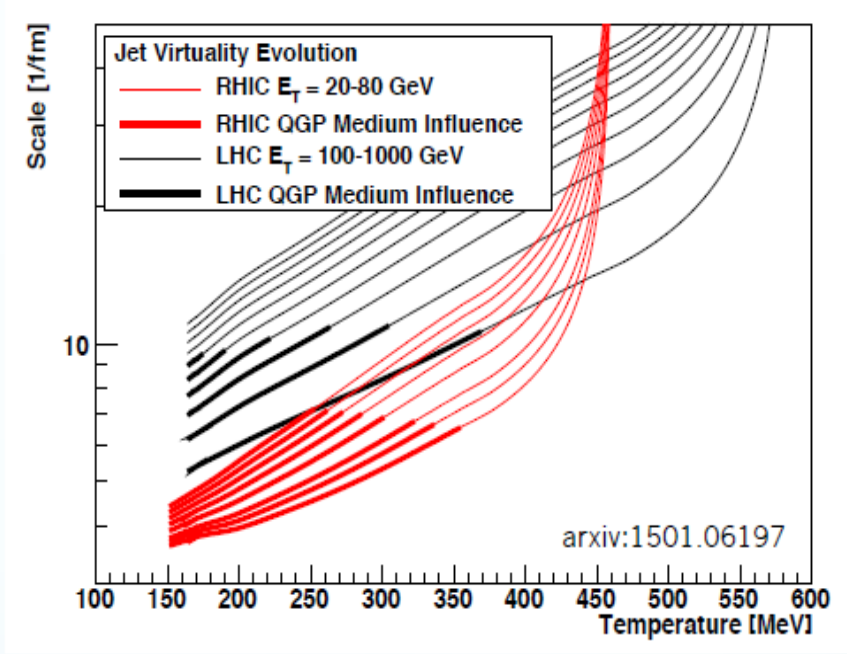
Strongly Coupled (s)QGP

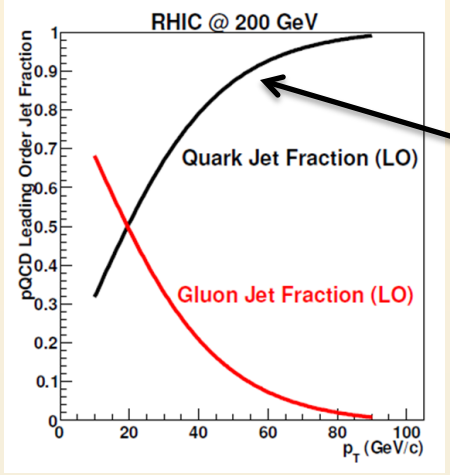


The small-viscosity hydrodynamic evolution of the QGP suggests a strong coupling. This is a key aspect of the “standard model” for heavy ion collisions.

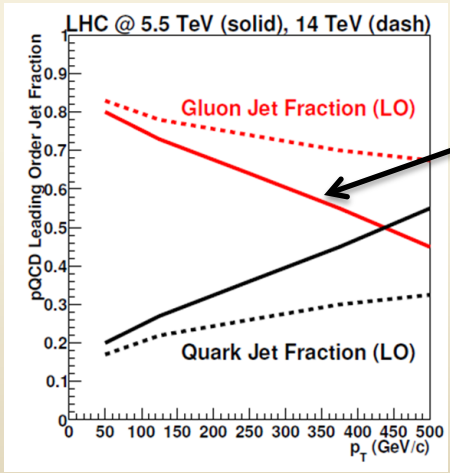
Missing is a detailed examination of the hard sector, parton energy loss, and a detailed program in the heavy quark sector

Using Jets to Probe the QGP





Higher quark-jet fraction at RHIC

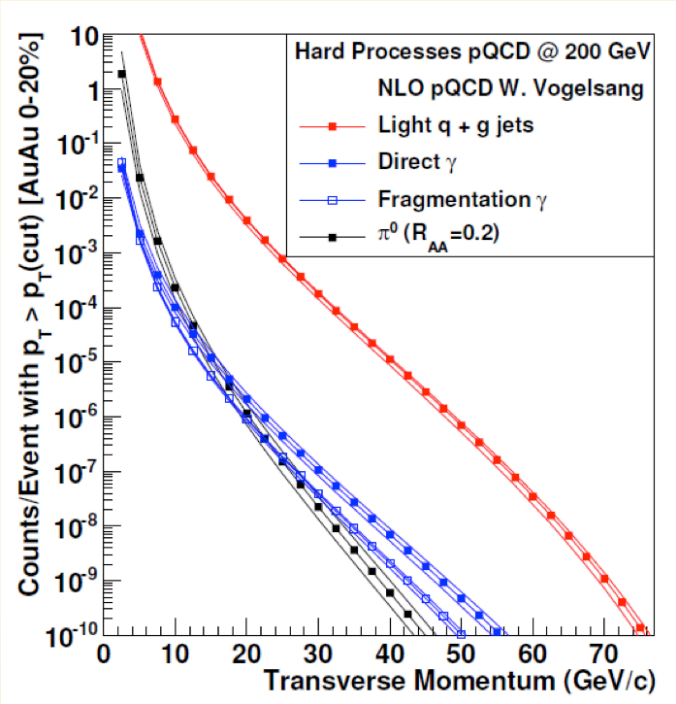


Gluon-jets dominate at LHC

Lower energy jets at RHIC have increased sensitivity to QGP interactions

Anticipated Jet Rates at RHIC

200 billion sampled, 50 billion collected
In 20 weeks of Au+Au running



-1 < η < 1	Au+Au (central 20%)	p+p	d+Au
> 20GeV	10^7 jets 10^4 photons	10^6 jets 10^3 photons	10^7 jets 10^4 photons
> 30GeV	10^5 jets 10^3 photons	10^5 jets 10^2 photons	10^4 jets 10^3 photons
> 40GeV	10^5 jets	10^4 jets	10^5 jets
> 50GeV	10^4 jets	10^3 jets	10^4 jets

Rates based on stochastic cooling, but no additional upgrades to RHIC

Large rates allow differential measurements with geometry (v_2, v_3, A+B, U+U, …) and
Precise control measurements (p(d)+Au, and p+p)
80% of events are dijets

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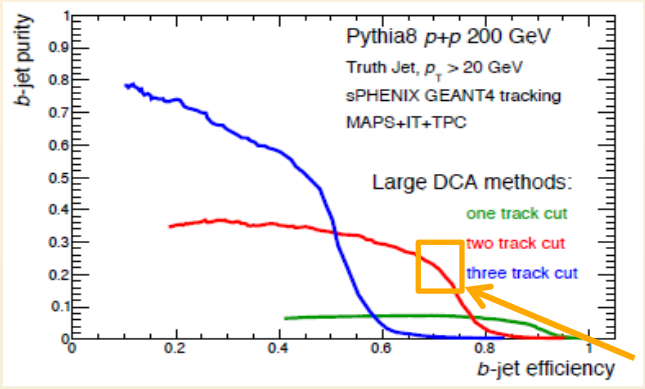
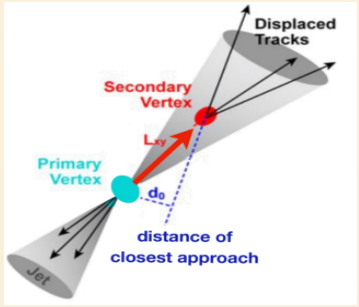
Tagging b-Jets

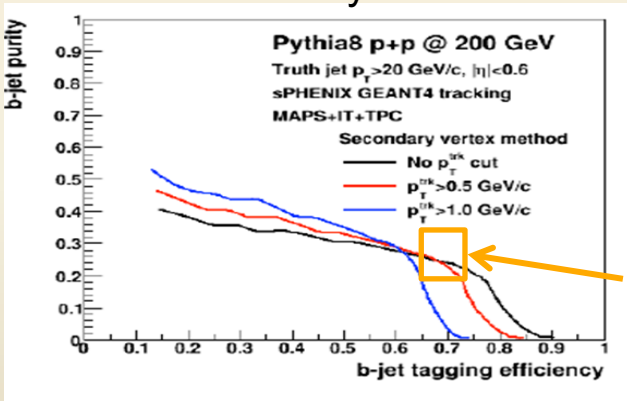
Method 1: Multiple large DCA tracks



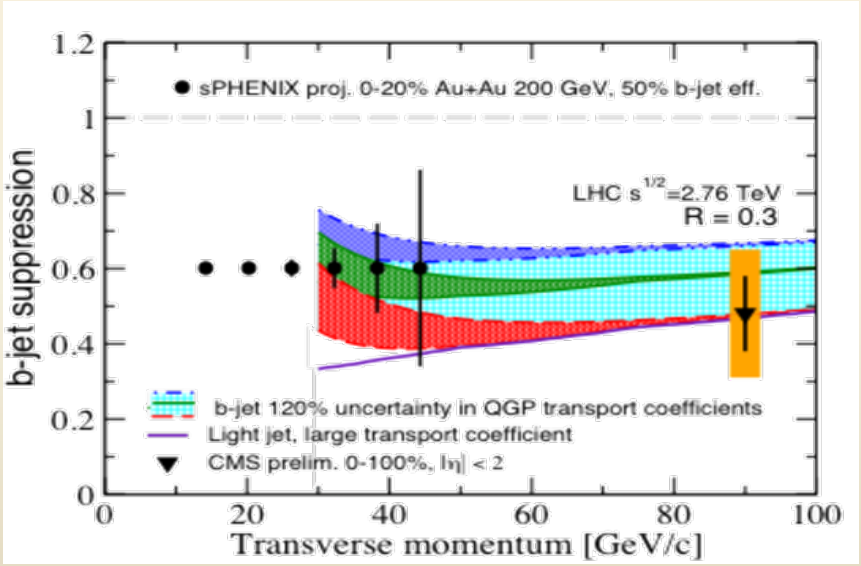


30% purity
70% eff.

Method 2: Secondary vertex



30% purity
70% eff.

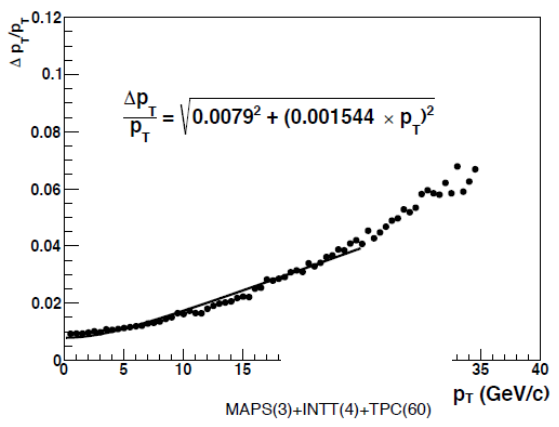


Method 3: B-meson tagging by semi-leptonic decay or by m_B → in progress

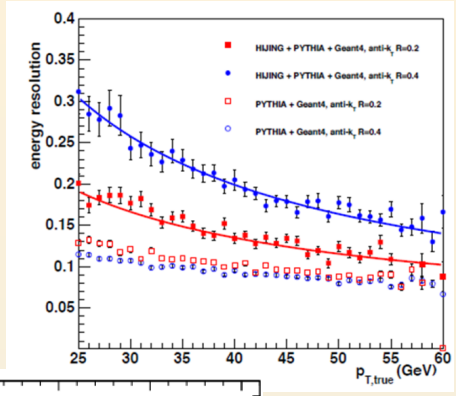
Projected Detector Capabilities

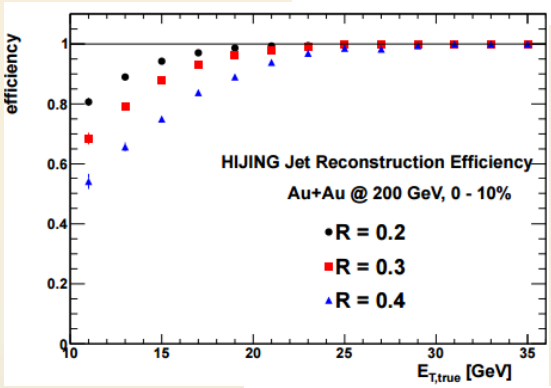
Tracking

Embedded π's in central HIJING events

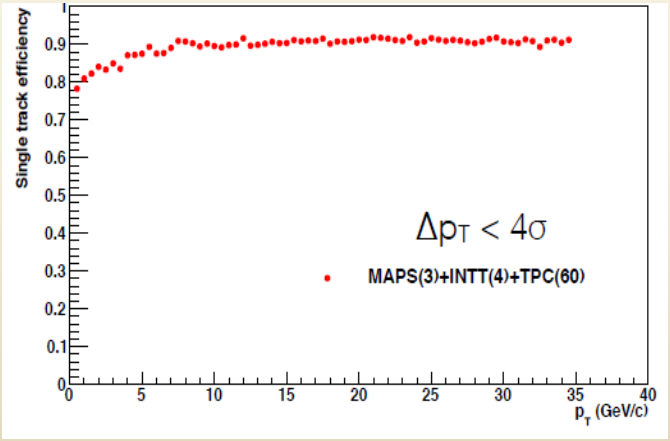


Jets

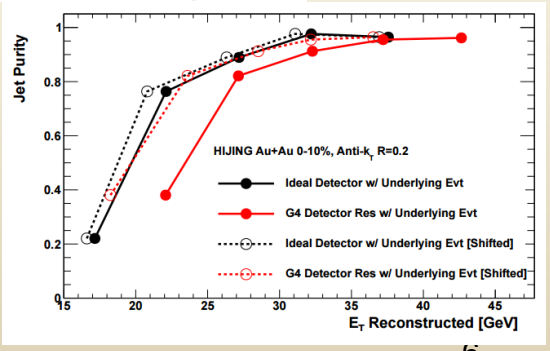




Efficient tracking out to p_T ~40 GeV/c

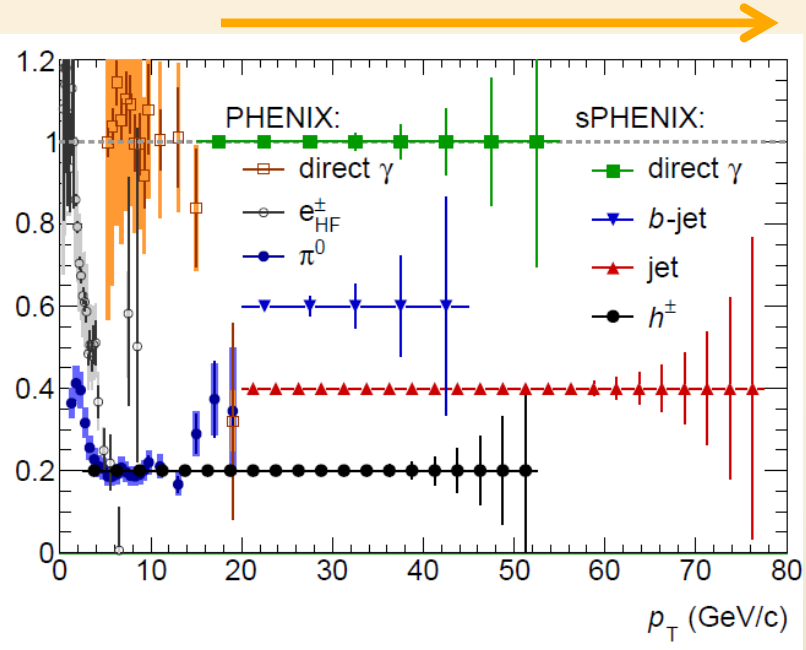


Tracking simulation improvements ongoing

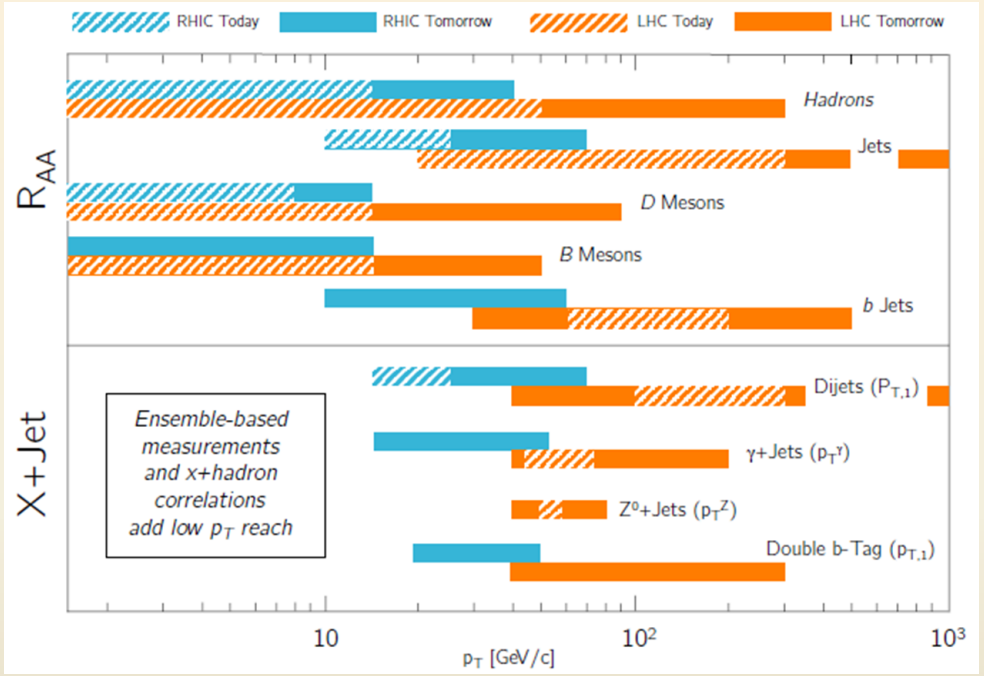


Kinematic Reach

Extends range at RHIC

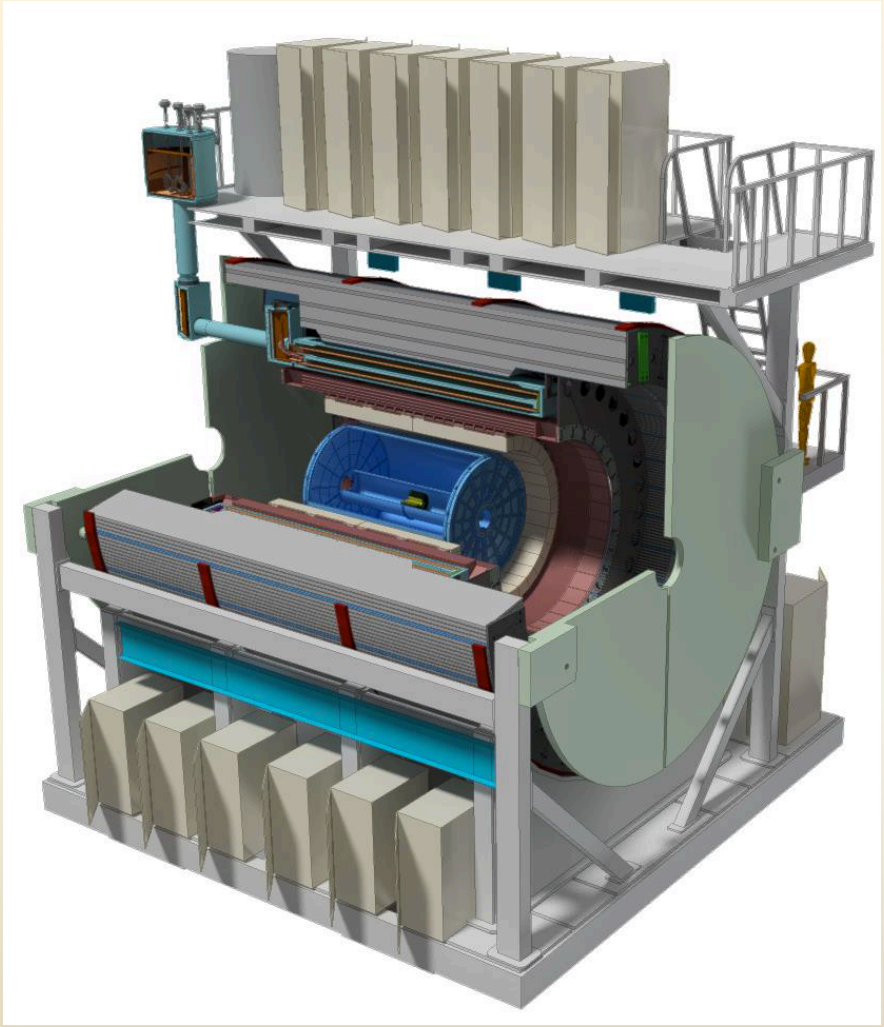


Overlaps with LHC



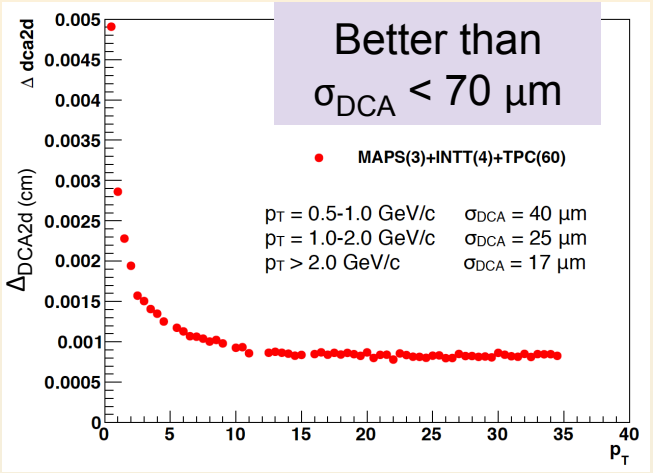
The sPHENIX Detector

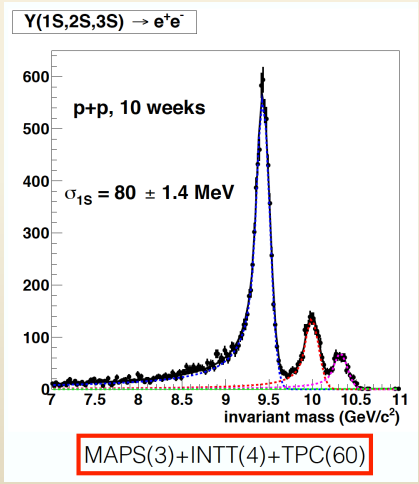
- Uniform acceptance from $-1.1 < \eta < 1.1$ and $0 < \phi < 2\pi$
- 1.5T Superconducting Solenoid Magnet
- Tracking:
  - Vertex Detector
  - Intermediate Silicon Strips
  - Outer TPC
- Calorimetery:
  - Electromagnetic; Tungsten-Scintillating Fiber (W/SciFi)
  - Inner Hadronic Calorimeter
  - Outer Hadronic Calorimeter; serves as flux return
- Possibilities for a forward program: fsPHENIX

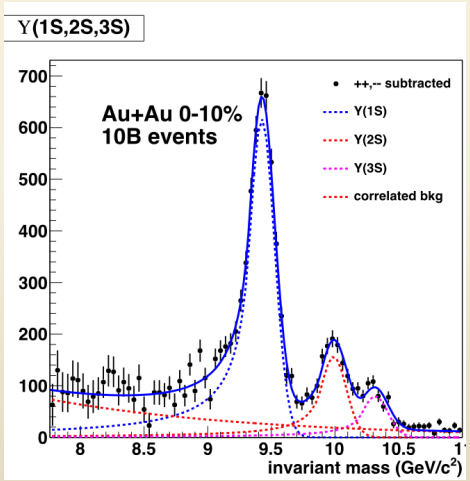


sPHENIX Tracking

- Consists of 3 subsystem
  - MAPS for vertexing: based on ALICE ITS IB
  - Silicon Strips: Based on FPHX chip
  - TPC: Continuous readout (non-gated)
- Large acceptance/high rate:
  - $-1.1 \leq \eta \leq 1.1,\ 0 \leq \phi \leq 2\pi$
  - ≈ 15 kHz
- Good Resolution:
  - $DCA_{VTX} \leq 70\mu m$
  - σ_{mass}(Upsilon) < 100 MeV

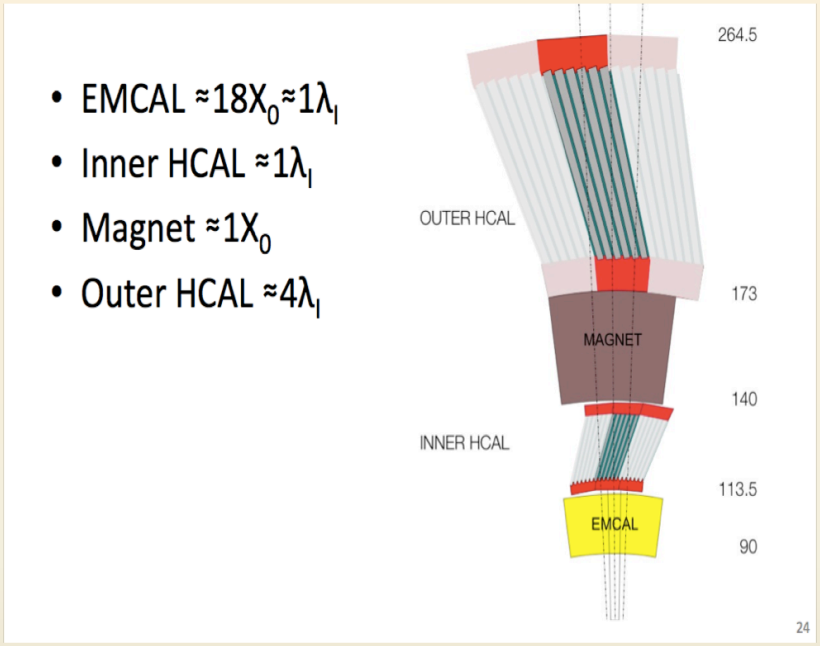






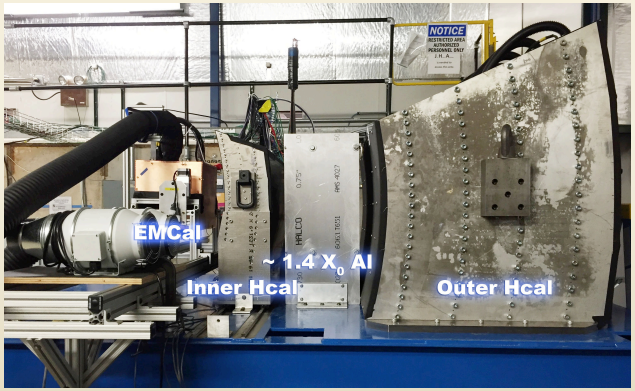
Calorimetry

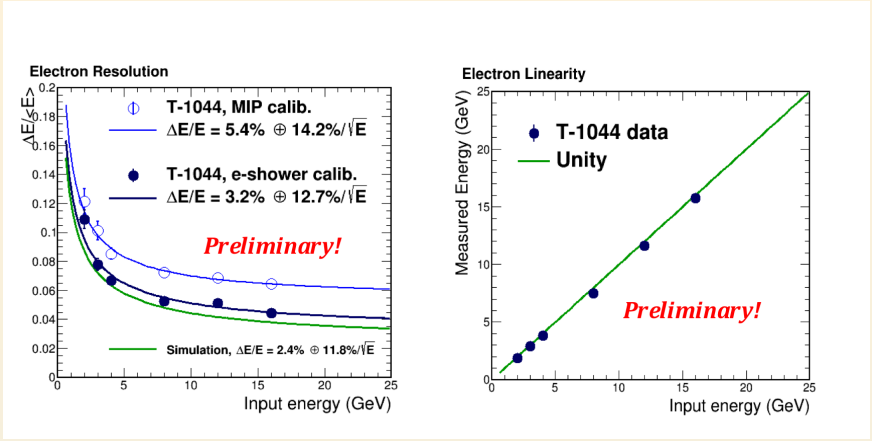
- EMCal:
  - Tungsten/Scintillating Fiber
  - 2-D Projective
  - 0.024 x 0.024 in $\Delta\eta$ x $\Delta\phi$
  - ≈ 18 Radiation lengths deep
  - Energy Resolution ≤ 15%/√E
- HCal:
  - 2 Sections, inner and outer
  - Tilted plate design: minimum of 4 crossings
  - Scinitillating tiles with wave shifting fiber readout
  - Outer HCal serves as flux return
  - Λ_L ≈ 5 combined
  - Energy Resolution ≤ 100%/√E

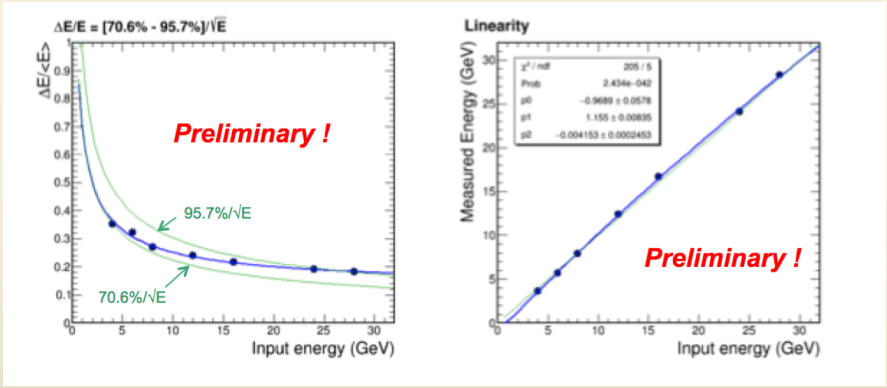


T-1044

- Second round of testing at FNAL Test Beam Facility, April 2016
- 8x8 EMCal (1-D Projective)
- 4x4 HCal (inner and outer)
- Mock Cryostat
- First generation digitizers
- Next round in Jan 2017







Prospects for the Future

- The sPHENIX MIE; Submitted to DOE, Spring 2016
- PHENIX IR is being prepared for sPHENIX.
- Last PHENIX data run ended in June of 2016 after 16 years of running
- Reference detector consisting of:
  - Large Acceptance: $-1.1 \leq \eta \leq 1.1$ and $0 \leq \phi \leq 2\pi$
  - Tracking: MAPS – Silicon – TPC
  - Electromagnetic Calorimetry
  - Hadronic Calorimetry
  - 1.5T Superconducting Solenoid
  - High Speed Data Acquisition (> 15 kHz)
- Future Schedule:
  - Expect CD-0 in FY17
  - Construction to start in 2018
  - Installation in 2021
  - First Data in 2022

T. Hallman,
RHIC/AGS Users Meeting
June 2016