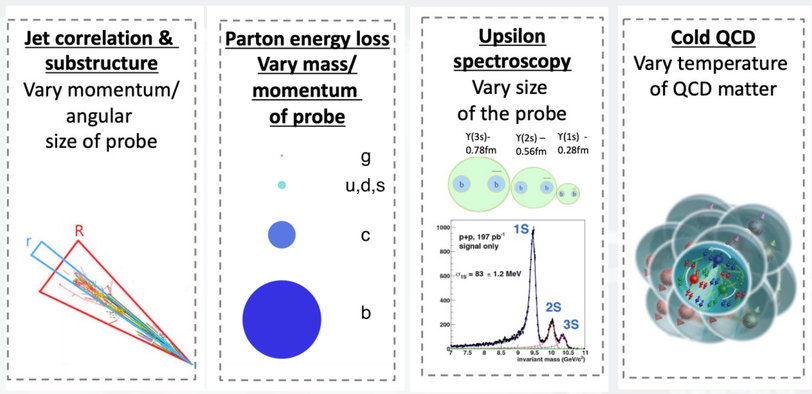
# Track Reconstruction with the sPHENIX Experiment

Joe Osborn, Brookhaven National Laboratory *for the sPHENIX Collaboration*

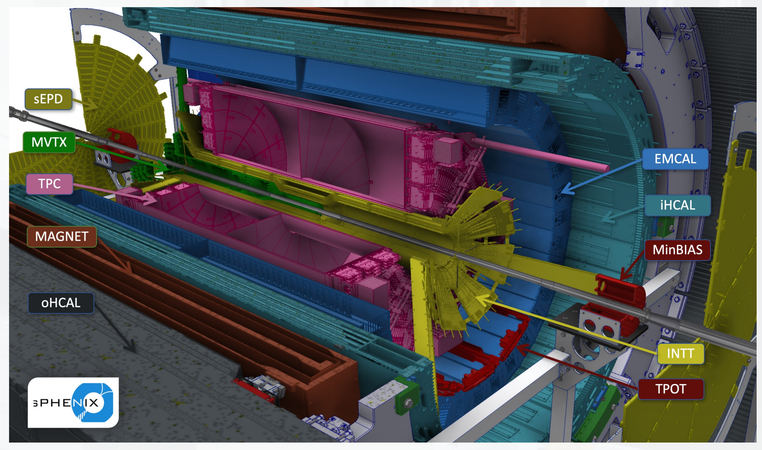

## Abstract

The sPHENIX detector at Brookhaven National Laboratory's Relativistic Heavy Ion Collider (RHIC) has a broad experimental QCD physics program focused on jets, their substructure, and open and closed heavy flavor production. To measure these observables, the sPHENIX tracking system is composed of a silicon vertex and strip detector, continuous-readout time projection chamber, and micromegas-based modules for calibration. Precise and efficient track reconstruction is required to achieve the sPHENIX science goals. The high luminosity provided by RHIC, large occupancies of heavy ion events, and streaming readout mode of the tracking system produce a challenging environment in which track reconstruction must take place. In this poster, we provide a general overview of the track reconstruction at sPHENIX and discuss its status utilizing the A Common Tracking Software package with the first data taking period of the sPHENIX experiment. Future track reconstruction plans as sPHENIX enters its primary data taking phase will also be discussed.


## sPHENIX Physics and Detector



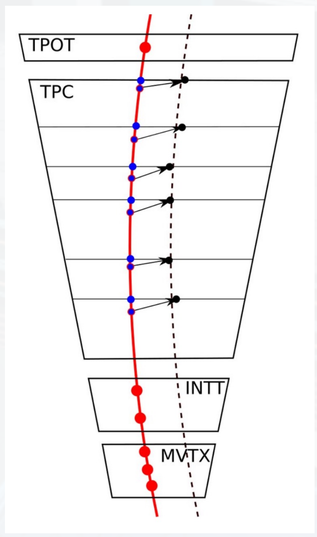

- sPHENIX physics program requires precise and fast track reconstruction



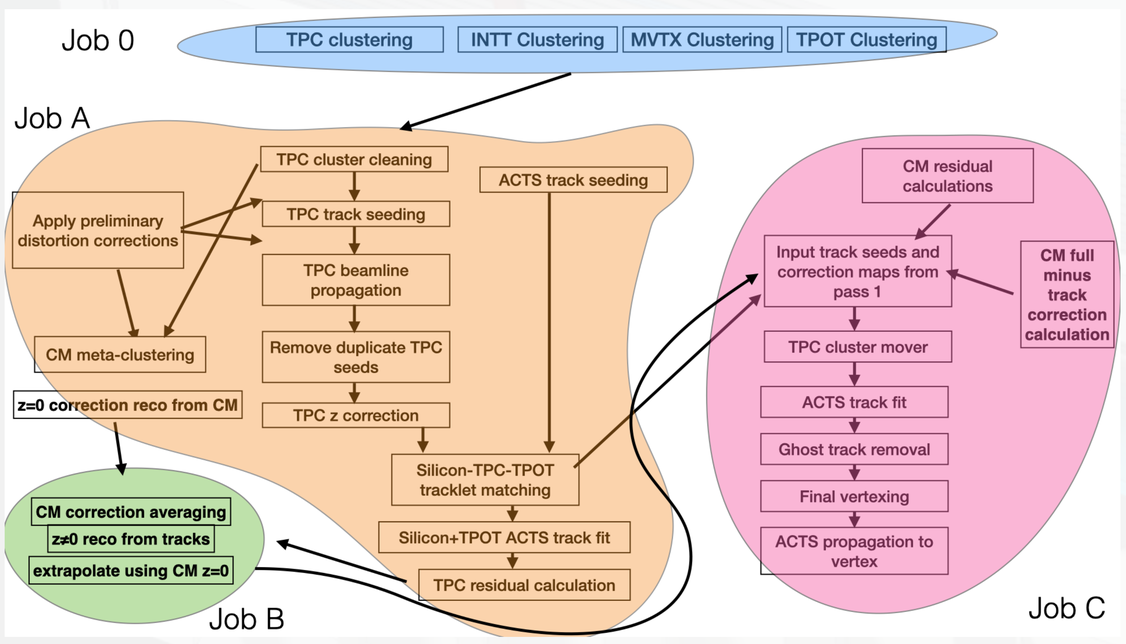

- sPHENIX detector is hermetic at $|\eta|<1.1$ with complete calorimeter and tracking coverage

## 4 Dimensional Track Reconstruction

- MVTX – MAPS based silicon pixel detector for primary and secondary vertex reconstruction
- INTT – Silicon strip detector with fast timing for pile up rejection
- TPC – 48 layer GEM continuous readout TPC for precise momentum identification
- TPOT – Micromegas sectors for additional space point to aid TPC calibration

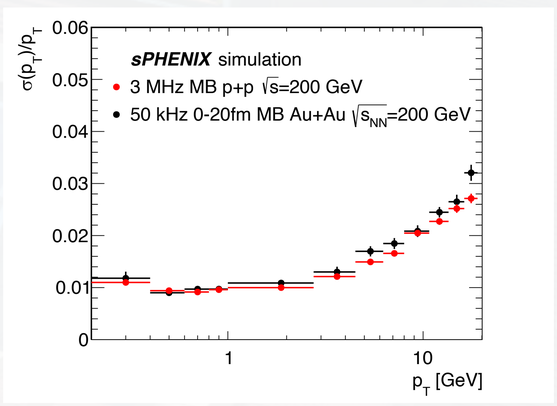


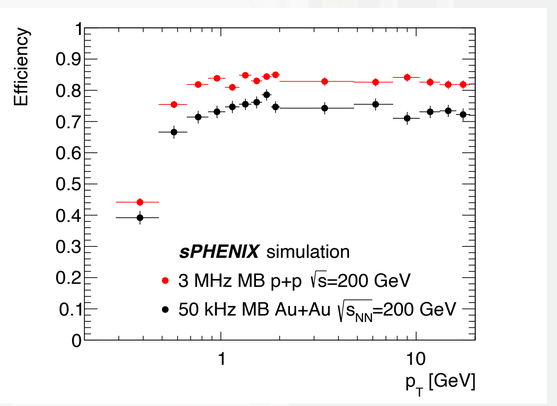

- Implemented A Common Tracking Software (ACTS) in production to meet physics and CPU performance requirements needed to process expected ~300 PB sPHENIX data

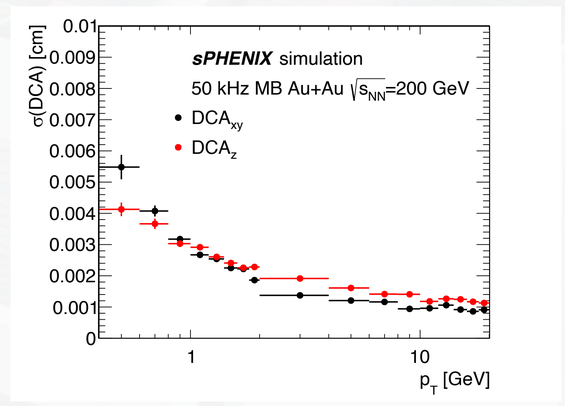


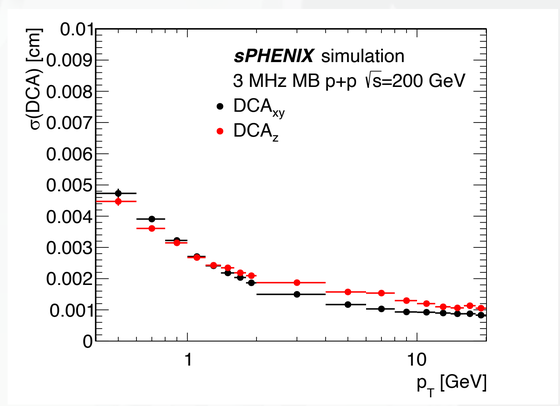

- Full reconstruction workflow split into four jobs to limit memory needed per job to fit within sPHENIX reconstruction nodes
- **Job 0** – Clustering hits
- **Job A** – Full track seeding pass including beam induced space charge distortion correction determination
- **Job B** – Space charge distortion correction aggregation
- **Job C** – Final track fitting and vertexing

## Track Reconstruction Performance




- Physics requirements driven by heavy flavor and upsilon program
  - O(10s) micron DCA resolution at $p_T$~1 GeV
  - <2% momentum resolution at $p_T$~10 GeV
- Speed requirements driven by CPU budget
  - Reconstruction takes 13s per minimum bias Au+Au event

## Conclusions and more sPHENIX Tracking Posters

- **Clustering hits of TPC using machine learning and neural networks at sPHENIX** – Zhongling Ji (514)
- **Track seeding in the sPHENIX experiment** – Michael Peters (515)
- **Vertex determination in sPHENIX** – Tony Frawley (517)
- **Alignment of the sPHENIX tracking detectors** – Reese Boucher (536)

- First data taking campaign recently finished – starting to exercise readout and global tracking calibrations towards first physics measurements


- Reference: *Comput. Softw. Big Sci.* 5 (2021) 1, 23



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