

The background features a detailed 3D cutaway diagram of the SPHENIX detector. The central component is the TPC (Time Projection Chamber), surrounded by the EMCal (Electromagnetic Calorimeter), inner HCal (Hadronic Calorimeter), and outer HCal. Other labeled parts include the SC magnet, cryogenic chimney, support carriage, INTT, and MVTX.

A Micromegas detector to reconstruct space charge distortions in the SPHENIX TPC

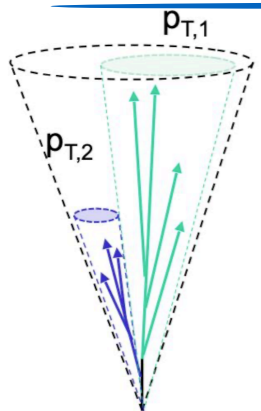
Audrey Francisco



CEA Saclay

on behalf of the **sPHENIX** collaboration

**Quark Matter 2022 - the 29th International Conference
on Ultra-relativistic Nucleus-Nucleus Collisions
4-10 April 2022, Krakow, Poland**

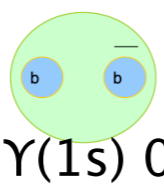
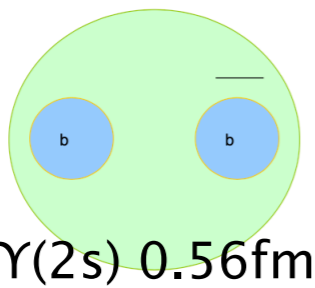
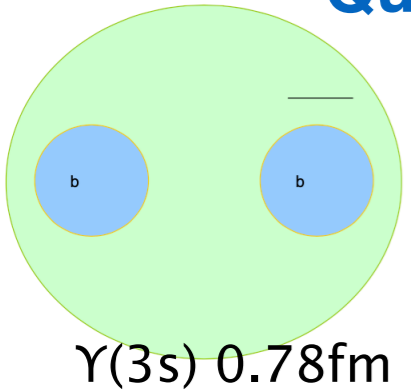


Jet structure

vary momentum/angular scale of probe

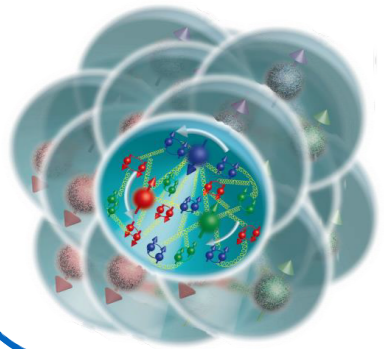
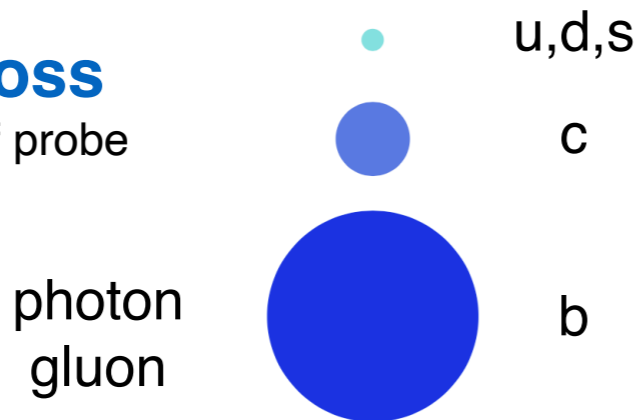
Quarkonium spectroscopy

vary size of probe



Parton energy loss

vary mass/momentum of probe



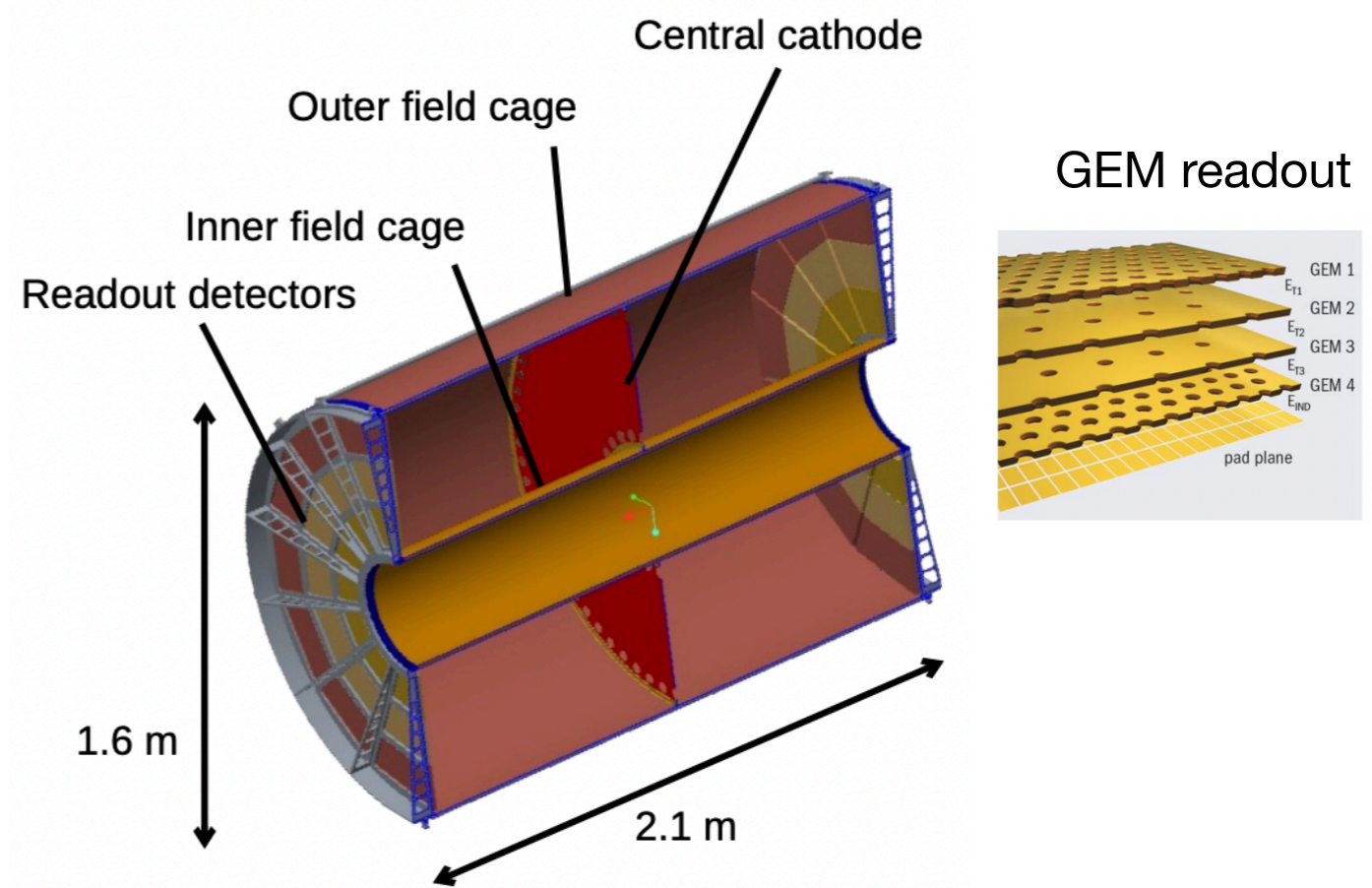
Cold QCD

study proton spin, transverse-momentum, and cold nuclear effects

Critical role of tracking
requires robust and efficient detector calibration

The Time Projection Chamber

Main tracking device



- ▶ Operated in **continuous read-out mode**
- ▶ 50kHz collision rate in Au-Au collisions
→ **high occupancy**
- ▶ **No gating grid**

in pp, p-Au and Au-Au collisions at 200GeV

In an ideal TPC: longitudinal electron drift at constant velocity

- Sources of distortions

- ▶ **static:** E,B field inhomogeneities, alignment etc.. $O(1\text{cm})$
- ▶ **beam-induced:** charges from primary ionization and IBF $O(1\text{mm})$
- ▶ **event-by-event fluctuations:** $O(100\mu\text{m})$

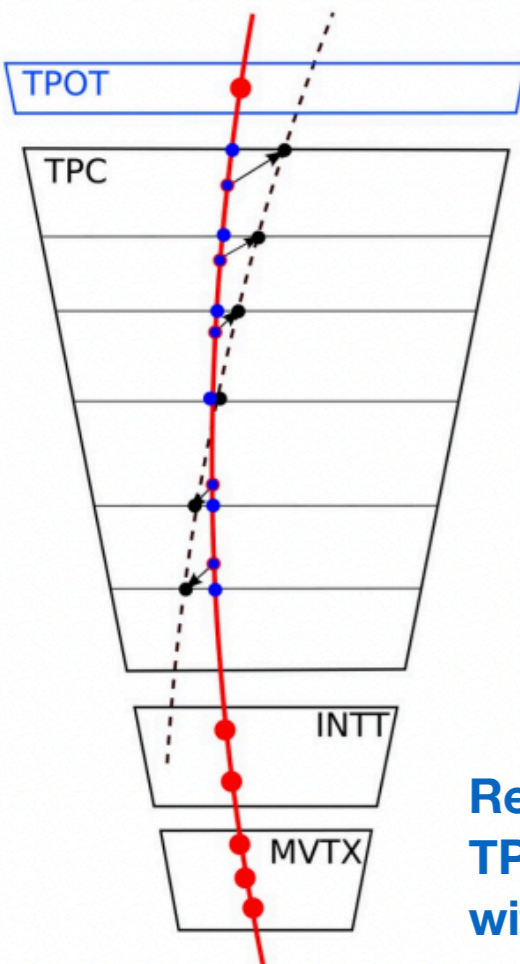
To reach desired momentum and inv. mass resolution, sPHENIX needs to measure and correct from these distortions to $< 100\ \mu\text{m}$ accuracy

See Ross Corliss's poster for detailed information

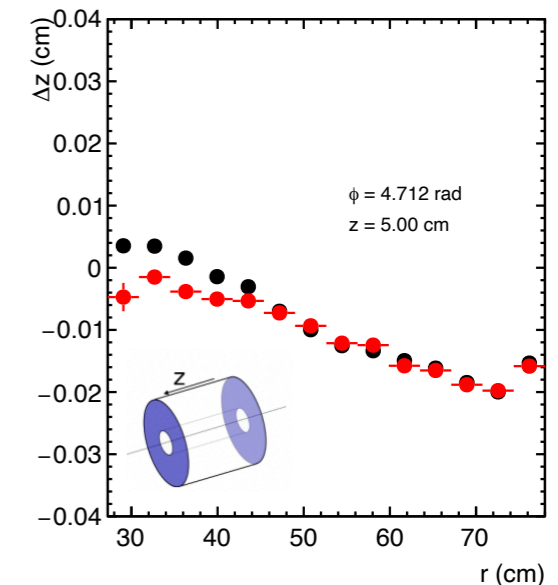
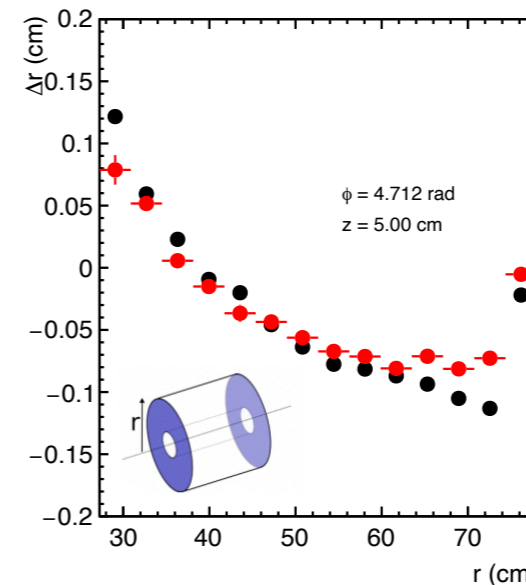
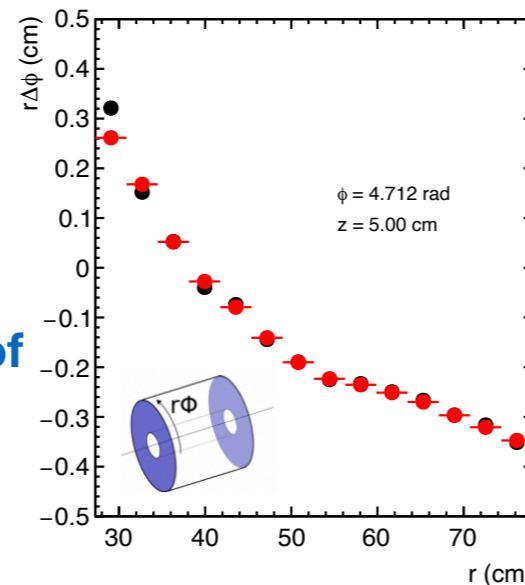
- Means of reconstructions : tracks and directed and diffuse laser systems

TPOT: the TPC Outer Tracker

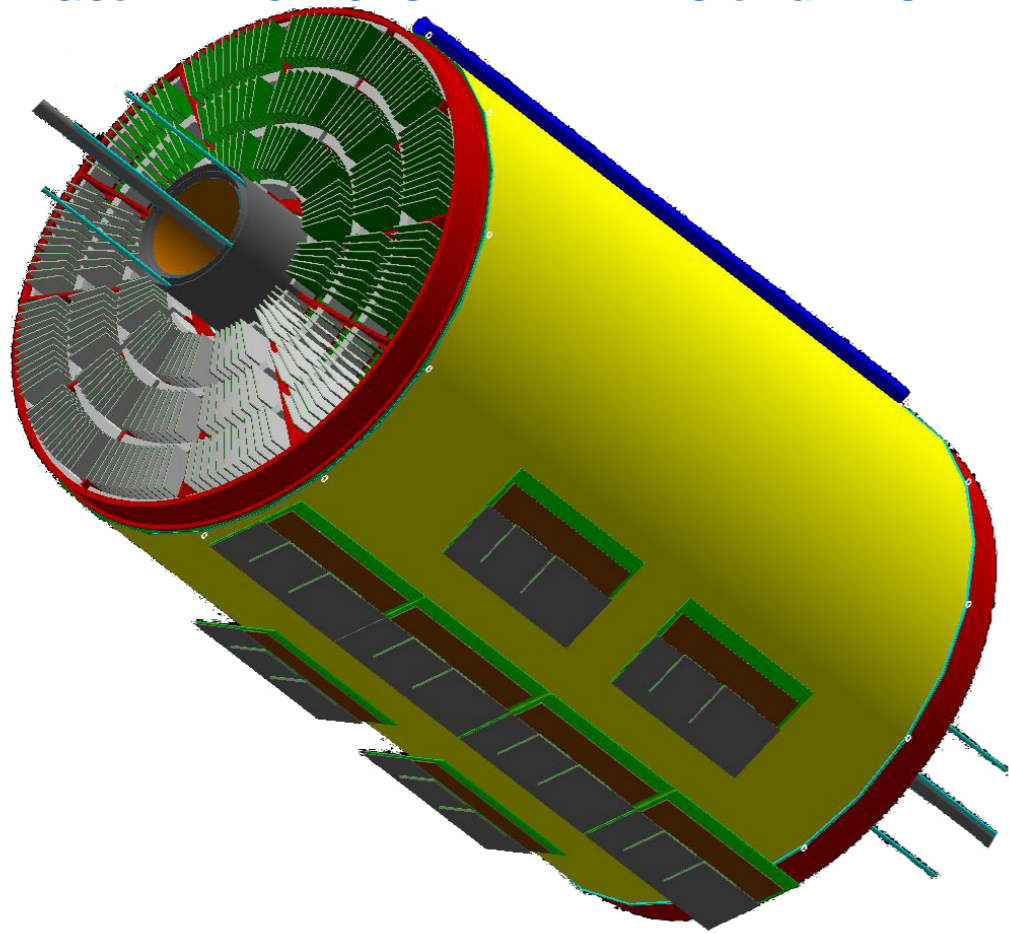
- Provides an additional space point to calibrate the TPC
- **Maximum use of tracks** to reconstruct beam-induced distortions, by improving track extrapolation accuracy in the TPC
- direct measurement of full z dependence of the distortions



Reconstruction of TPC distortions with TPOT



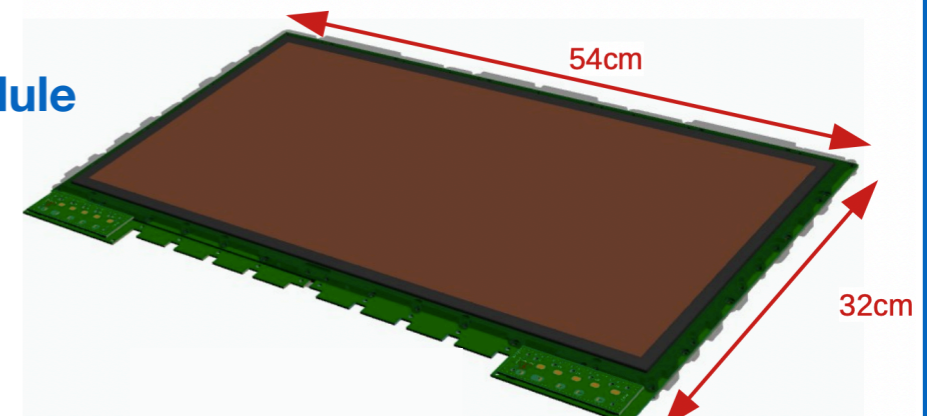
Geant4 view of sPHENIX TPC and TPOT



- Micromegas technology
- **8 modules** under the TPC
- Bottom-most TPC sector : 4 modules (**full longitudinal coverage**)
- Immediate neighbour sectors : 2 modules each to validate extrapolation procedure

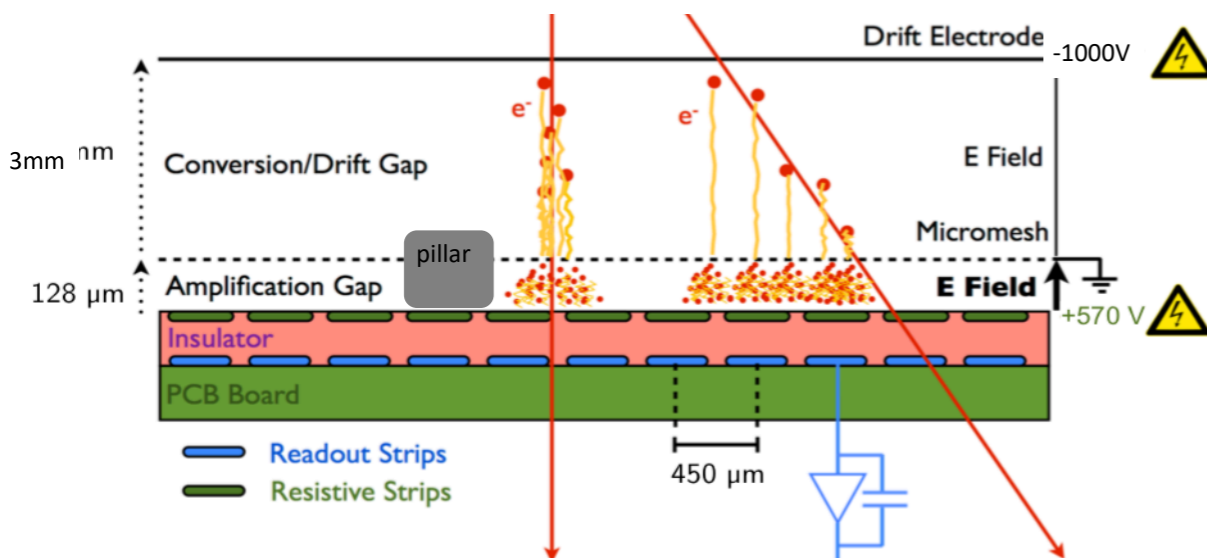
Each module = **2 bulk, resistive 1D-Micromegas detectors (back-to-back)**

TPOT module



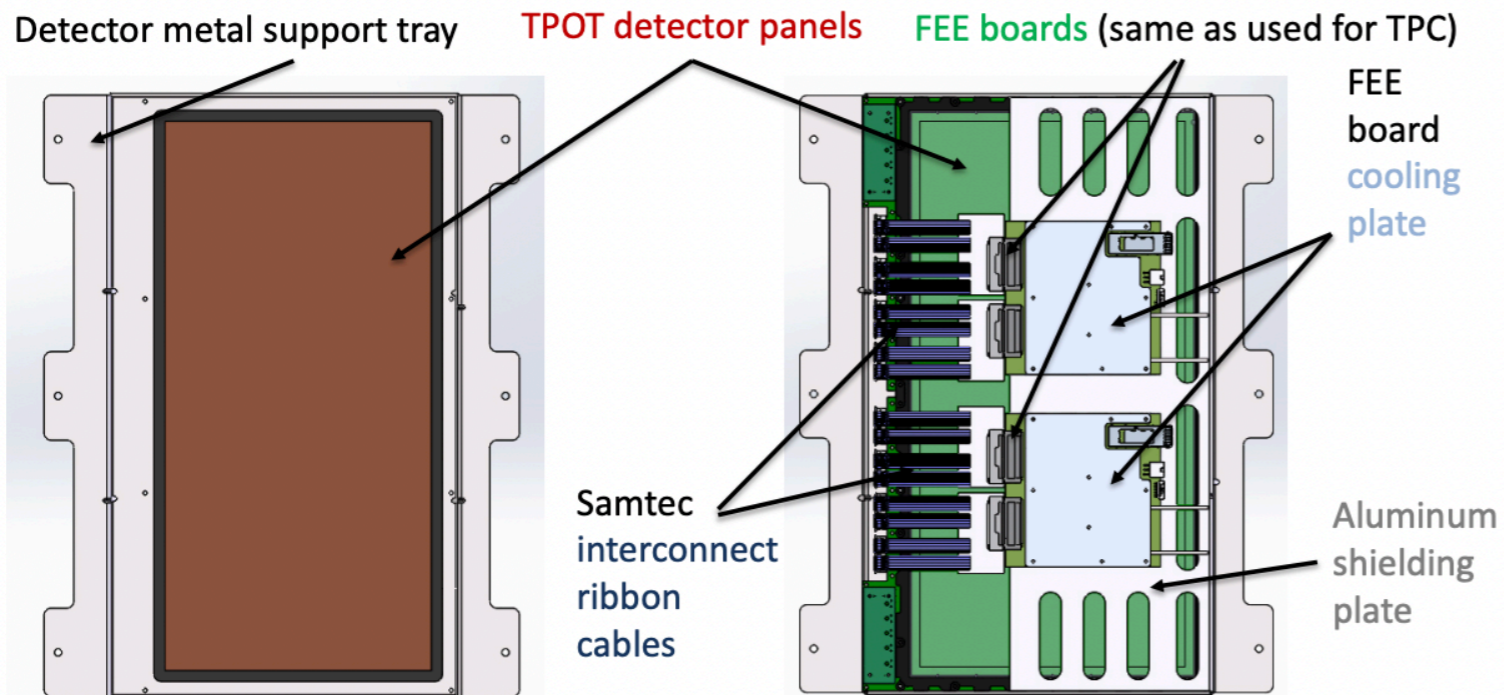
The Micromegas technology

Nucl. Inst. Meth. Phys. Res. A, 376 (1) (1996), pp. 29-35



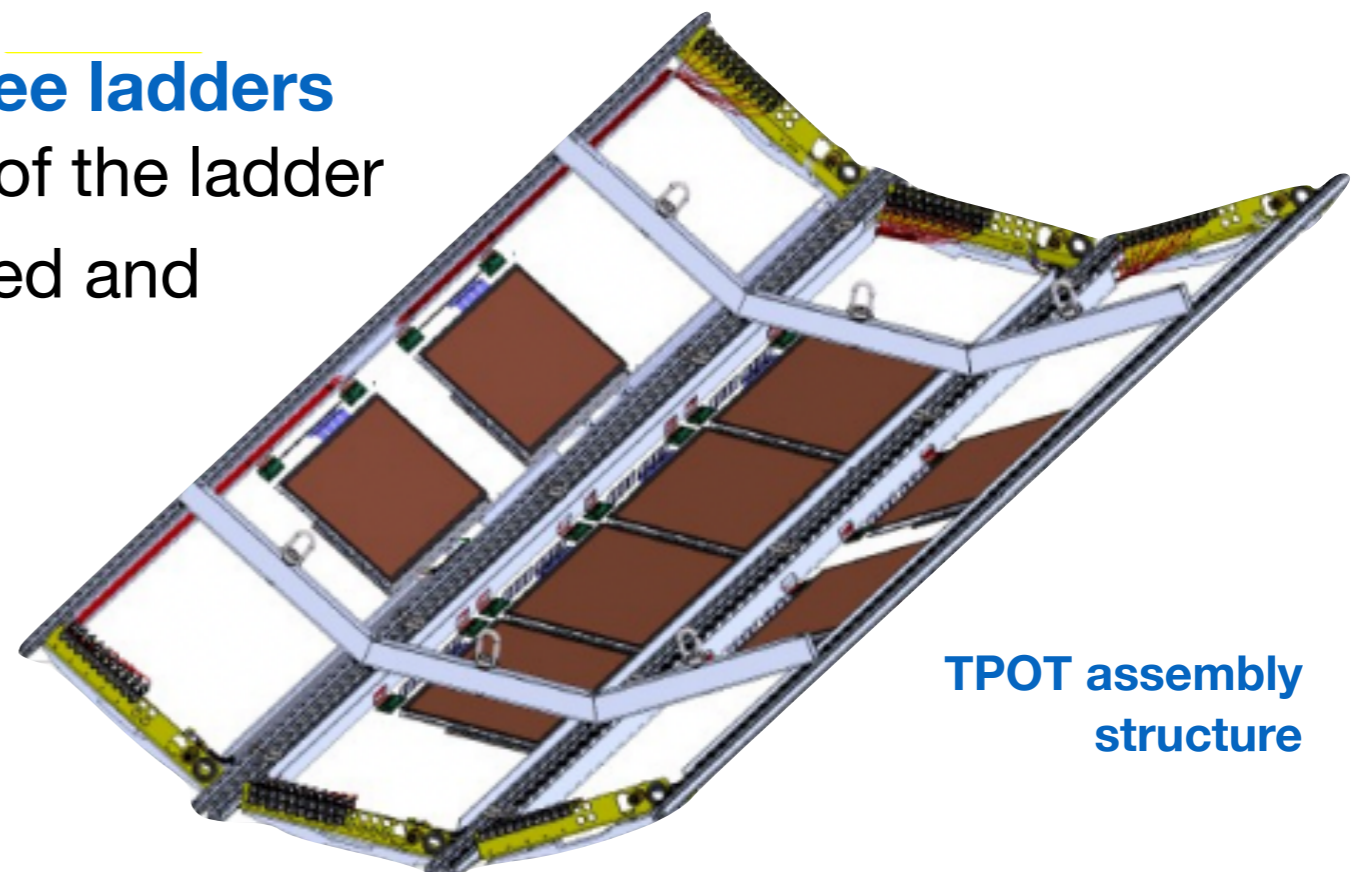
- ▶ Carbon drift
- ▶ 1mm/2mm pitch
- ▶ Ar/Isobutane (95/5)
- ▶ **Resistive** layer with strips

TPOT detector module assembly



- Each module is on a **support tray**
- The **electronics** is mounted on the back with **cooling plates**
- Estimated power dissipation 20 watts/FEE board, 40 watts per module

- Detectors assembled, face down, on **three ladders** connected to patch panels, at each end of the ladder
- Each ladder can be assembled, connected and tested independently from sPHENIX
- The ladders will be installed at once as a cradle using the same I-Beam as that used to insert the TPC



TPOT assembly structure

TPOT is a Micromegas tracker to monitor space-charge distortions in the TPC of sPHENIX

- Will provide an **extra space-point** to use tracks for **distortion reconstruction** by improving extrapolation accuracy in the TPC
 - **Installed at the bottom of the TPC** (between the TPC and the EMCAL)
- ➔ Installation is scheduled in the next months (before the TPC insertion),
- ➔ Efficient collaboration between BNL, LANL, MIT and CEA Saclay

Thank you!

sPHENIX is supported by



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