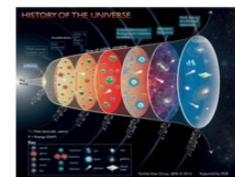


数理物質融合科学センター光量子計測器開発推進室発足会議

シリコン電磁カロリメータ等

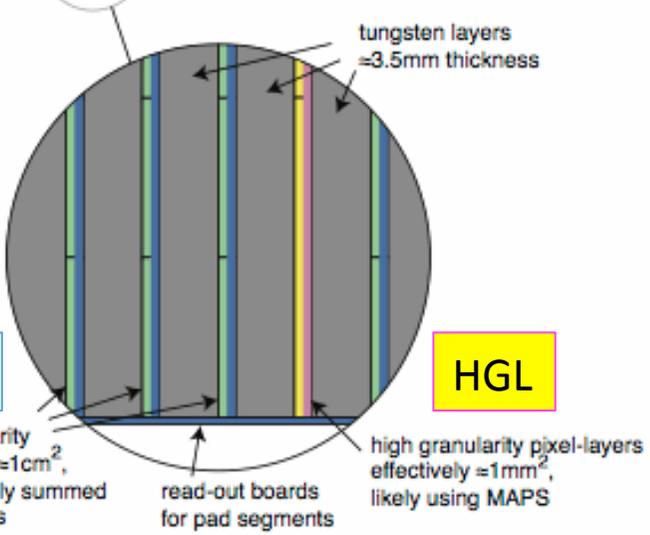
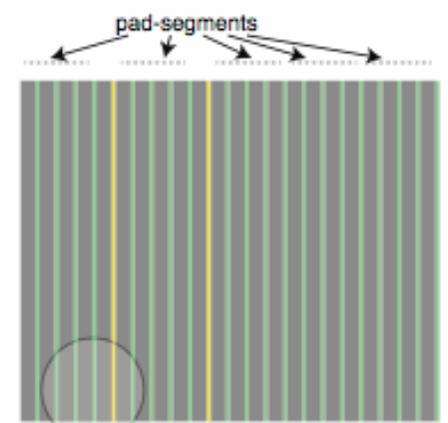
筑波大学 数理物質融合科学センター
宇宙史国際研究拠点 クォーク・核物質部門
数理物質系 物理学域 江角 晋一

- Si/W calorimeter for ALICE FoCal upgrade
- Pre-shower for PHENIX MPC EM-cal
- Calorimeters for new Jet detector at RHIC (sPHENIX)
- Event Plane Detector, iTPC and Fixed target mode for STAR-BES2
- MRPC(multi-gap resistive plate chamber) for High-resolution TOF
- RICH(Ring-imaging Cherenkov) detector for J-parc Heavy-Ion experiment
- MAPMT(multi-anode PMT), MPPC(multi-pixel photon counter), drift-chamber
- TRD-fast readout, GEM-TPC upgrade, MFT upgrade for ALICE



ALICE FoCal upgrade

for forward photon and pi0
 W/Si sampling EM-calorimeter
 Moliere radius ~9mm
 Radiation length ~3.5mm/layer

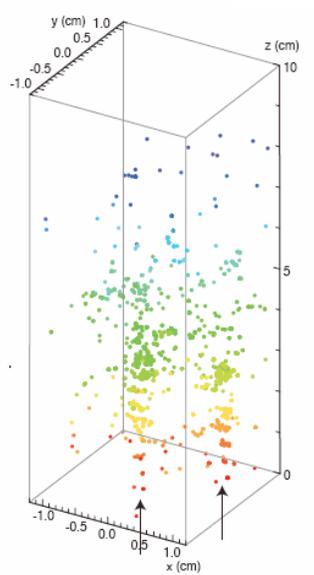
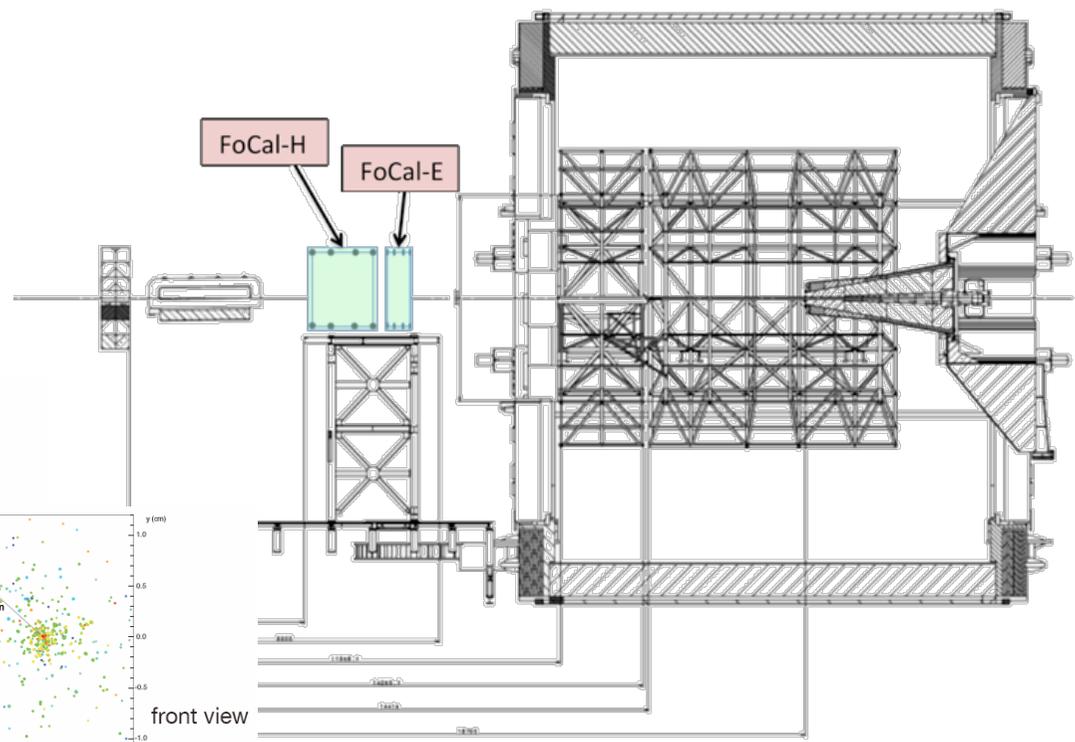
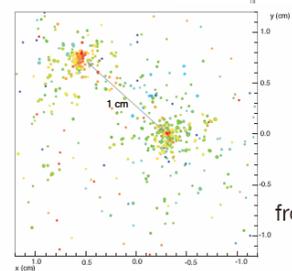


LGL

HGL

low granularity pad-layers $\approx 1\text{cm}^2$, longitudinally summed in segments

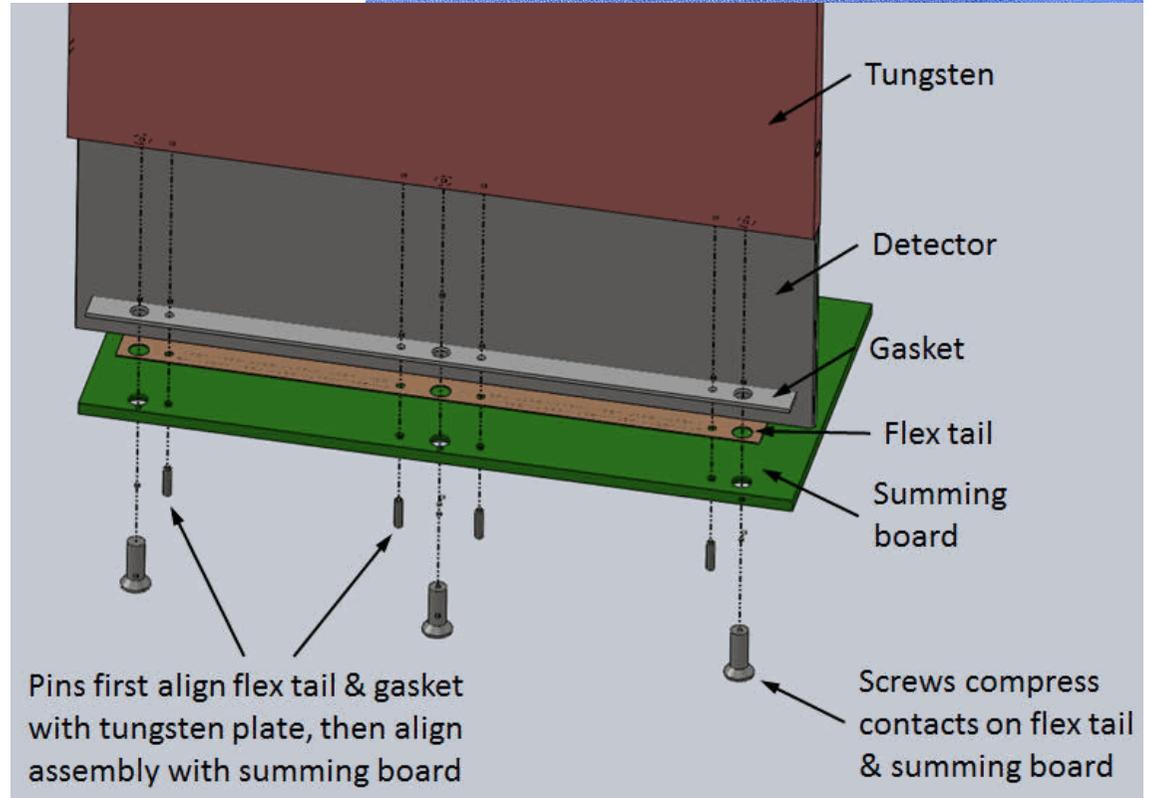
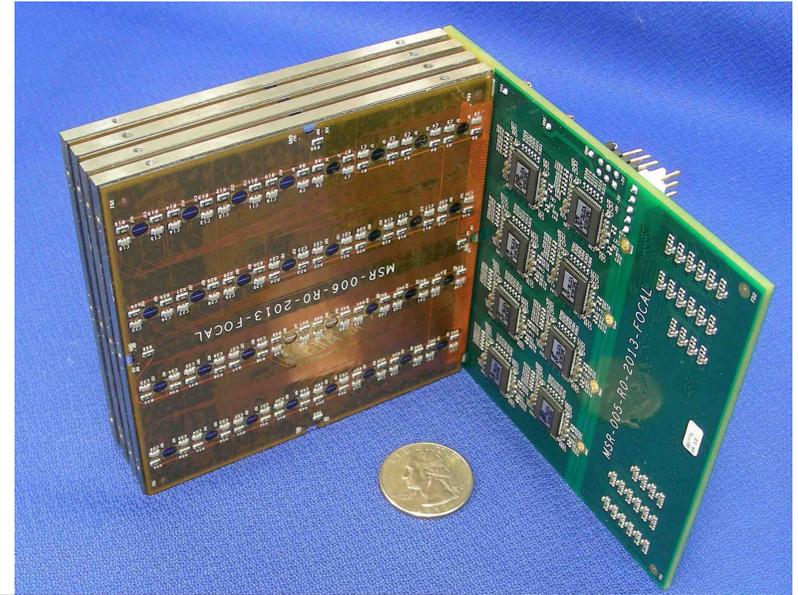
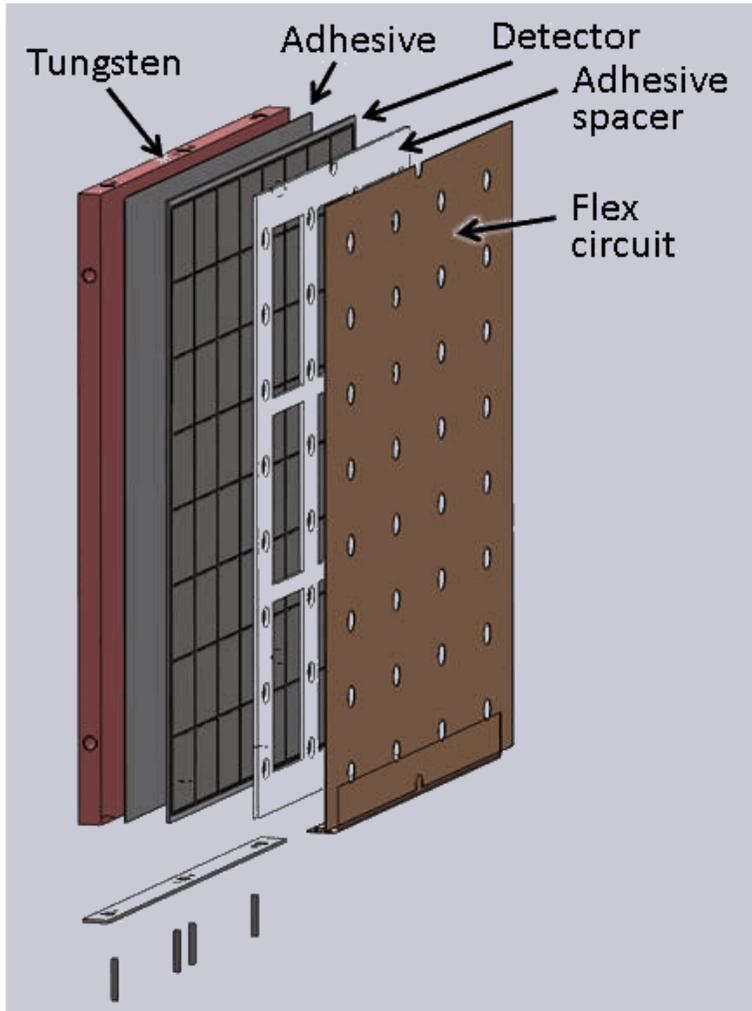
high granularity pixel-layers effectively $\approx 1\text{mm}^2$, likely using MAPS



LGL : low granularity layer
 1x1 cm² Si-pad
 Analog read-out per 4 layers
 5 LGL modules

HGL : high granularity layer
 25x25 μm^2 CMOS-pixel (MAPS)
 digital sum (40x40 pixels)
 1x1 mm² effective cell per 1 layer
 2 HGL modules

4-layer LGL module

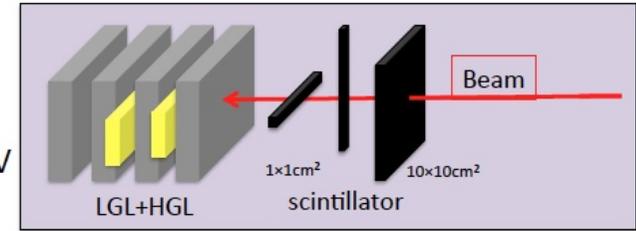


SPS test beam experiment

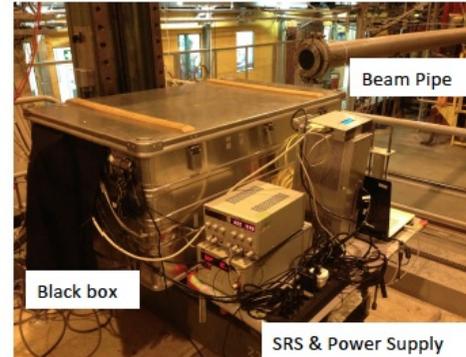
test beam experiments

- Sep-Oct/2014 at PS
- Nov/2014 at SPS
- Oct/2015 at PS,SPS

T4-H8 beam line
 期間：2014年11月
 エネルギー：30～100GeV
 rate ~300Hz



筑波大、中條先生
 筑波技術大、稲葉先生
 佐藤 (H26年度修士論文)
 伊藤 (H26年度卒業論文)
 平野 (H27年度修士論文)



エレクトロニクス

- APV25-S1 chip

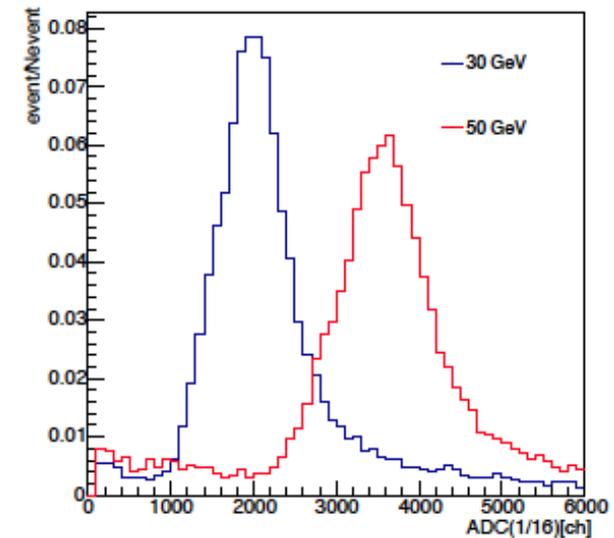
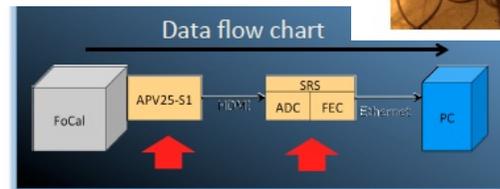
- 128ch、40MHz(25nsec)のサンプリング
- 読み出し極性を変える事で
 Low Gain(1/16) or High Gain(1/1)
 の切り替えが可能



-SRS(Scalable Readout System)

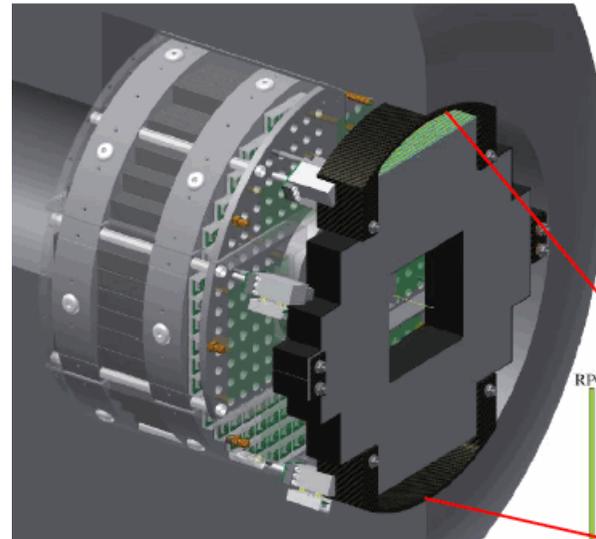
-> ADC board
 12 bit ADC
 8port(計16枚)のAPVを同時読み出し

-> FEC board
 ADCから送られて来た情報を
 処理するフロントエンド



The MPC-EX Detector

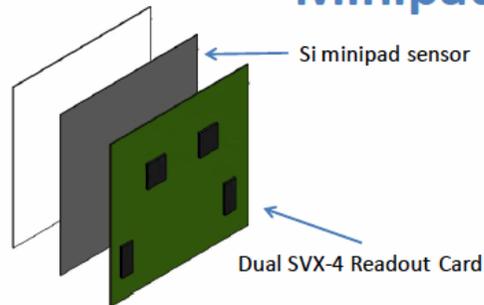
EPC-EX (pre-shower)
in front of MPC (EMcal)
at RHIC-PHENIX



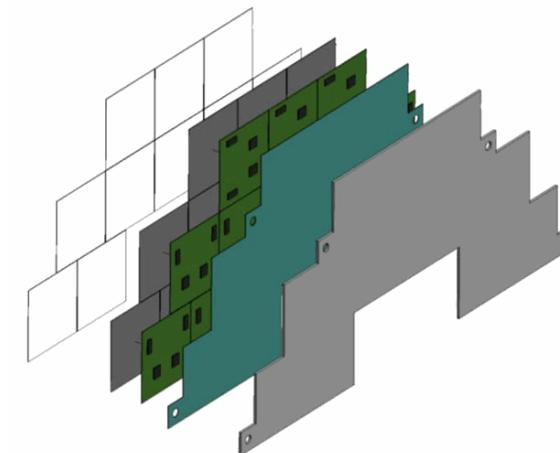
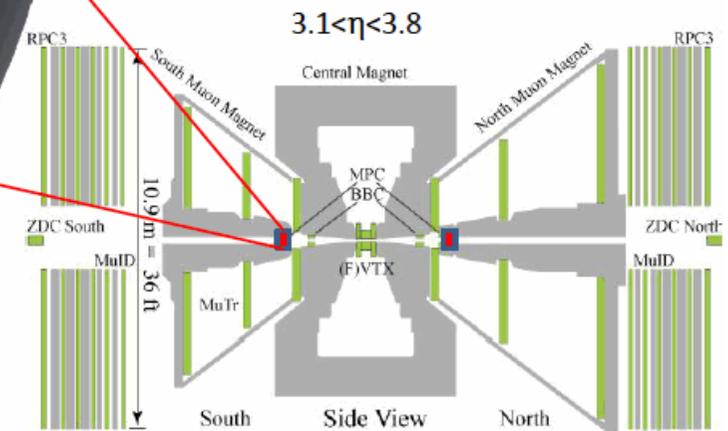
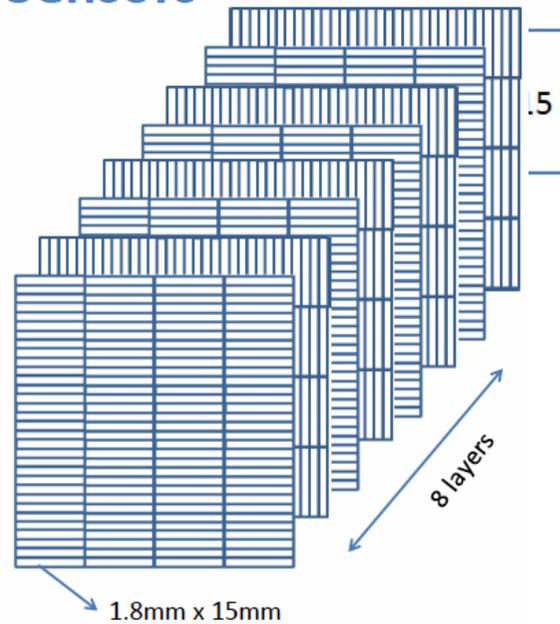
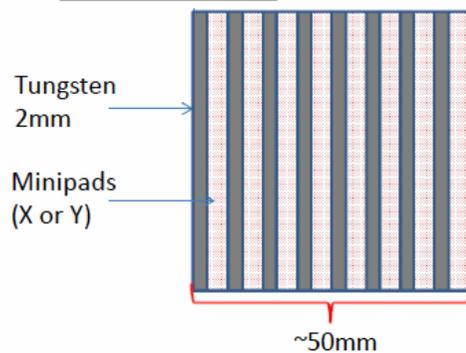
A combined charged particle tracker and EM preshower detector – dual gain readout allows sensitivity to MIPs and full energy EM showers.

- π^0 rejection (prompt photons)
- π^0 reconstruction out to $>80\text{GeV}$
- Charged track identification

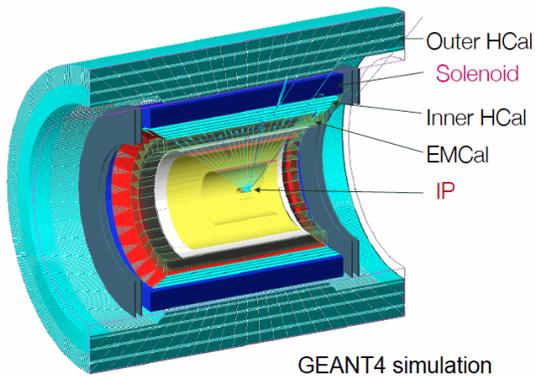
Minipad Sensors



Cross-Section View:

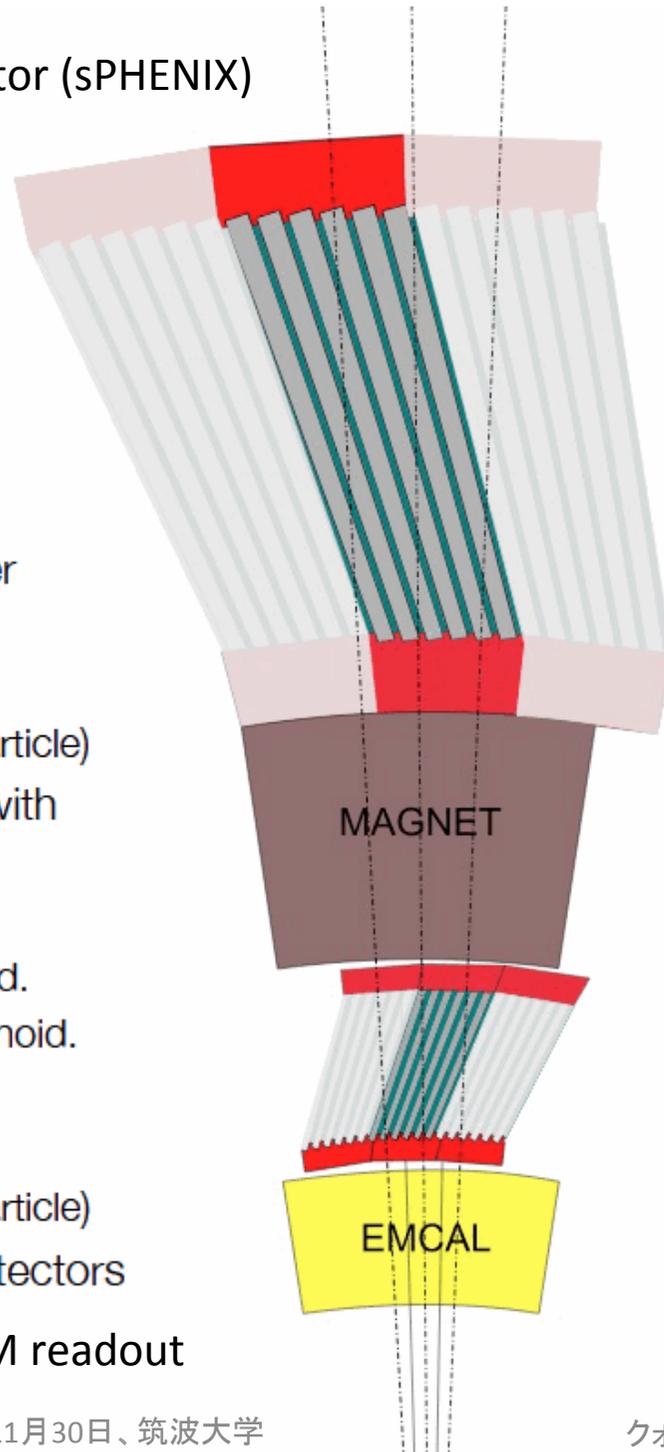


A new RHIC Jet and Upsilon detector (sPHENIX)



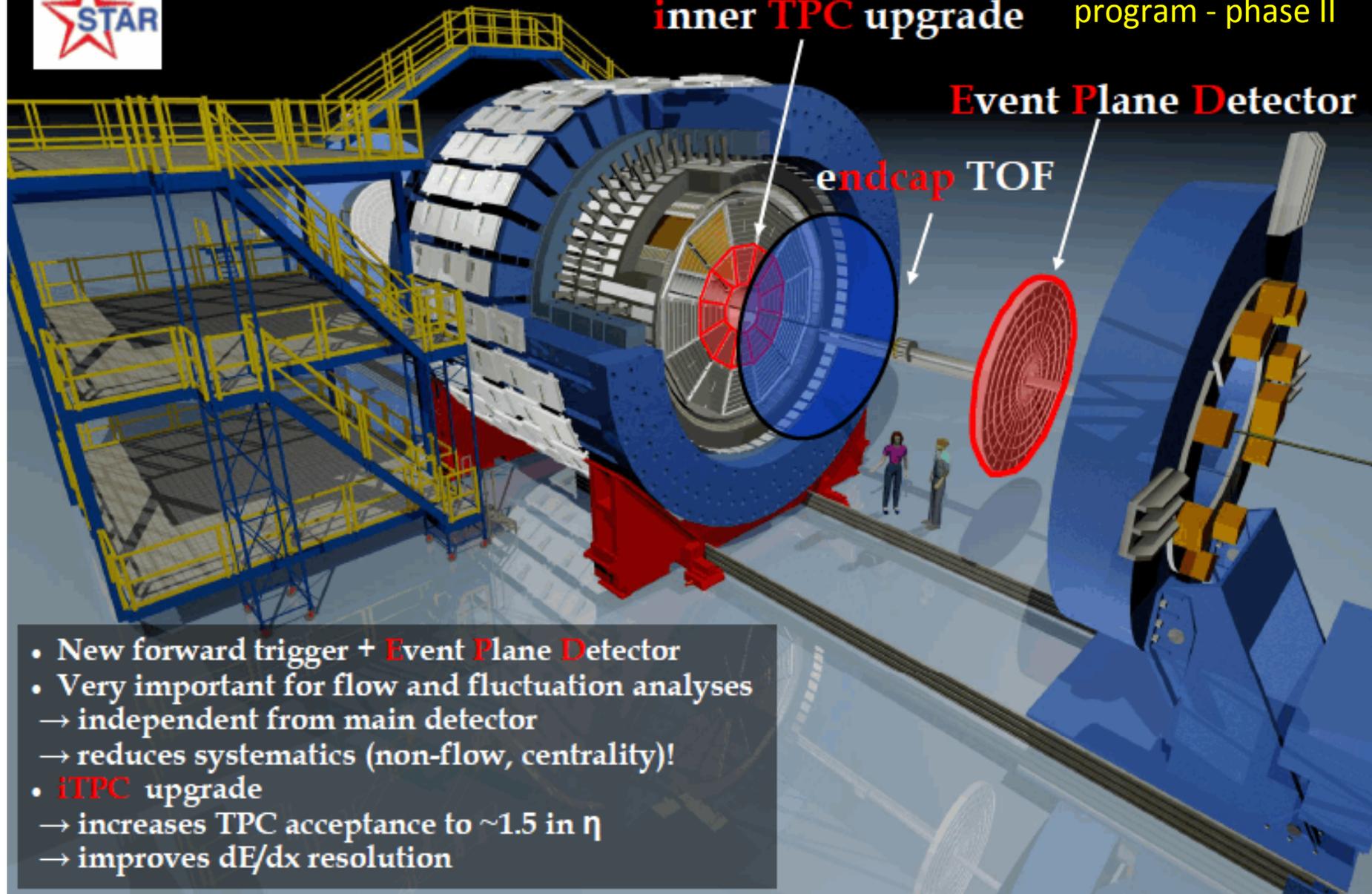
- EMCAL Tungsten-scintillating fiber
 - $\Delta\eta \times \Delta\phi \approx 0.025 \times 0.025$
 - 96 x 256 readout channels
 - EMCal $\sigma_E/E < 15\%/\sqrt{E}$ (single particle)
- HCAL steel and scintillating tiles with wavelength shifting fiber
 - 2 longitudinal segments.
 - An Inner HCAL inside the solenoid.
 - An Outer HCAL outside the solenoid.
 - $\Delta\eta \times \Delta\phi \approx 0.1 \times 0.1$
 - 2 x 24 x 64 readout channels
 - HCAL $\sigma_E/E < 100\%/\sqrt{E}$ (single particle)
- Readout with solid state photodetectors (silicon photomultipliers)

SiPM readout



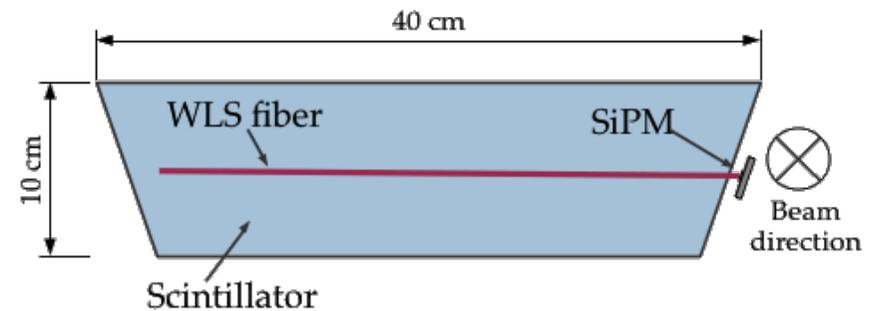
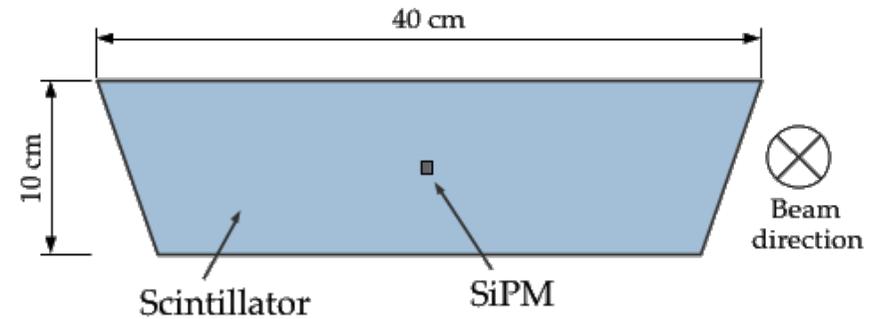
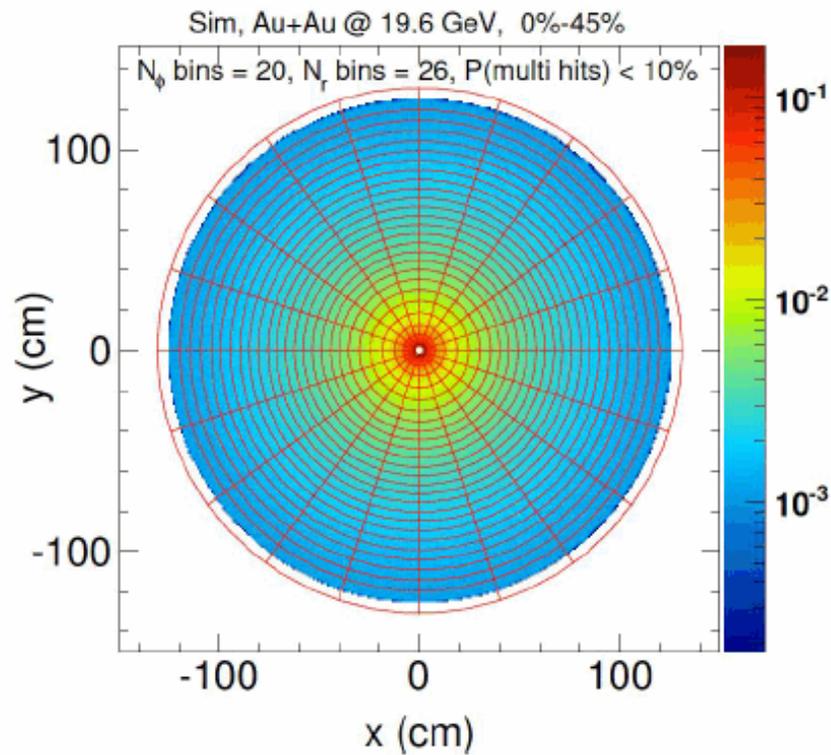
Detector Developments for BES II

Beam Energy Scan
program - phase II

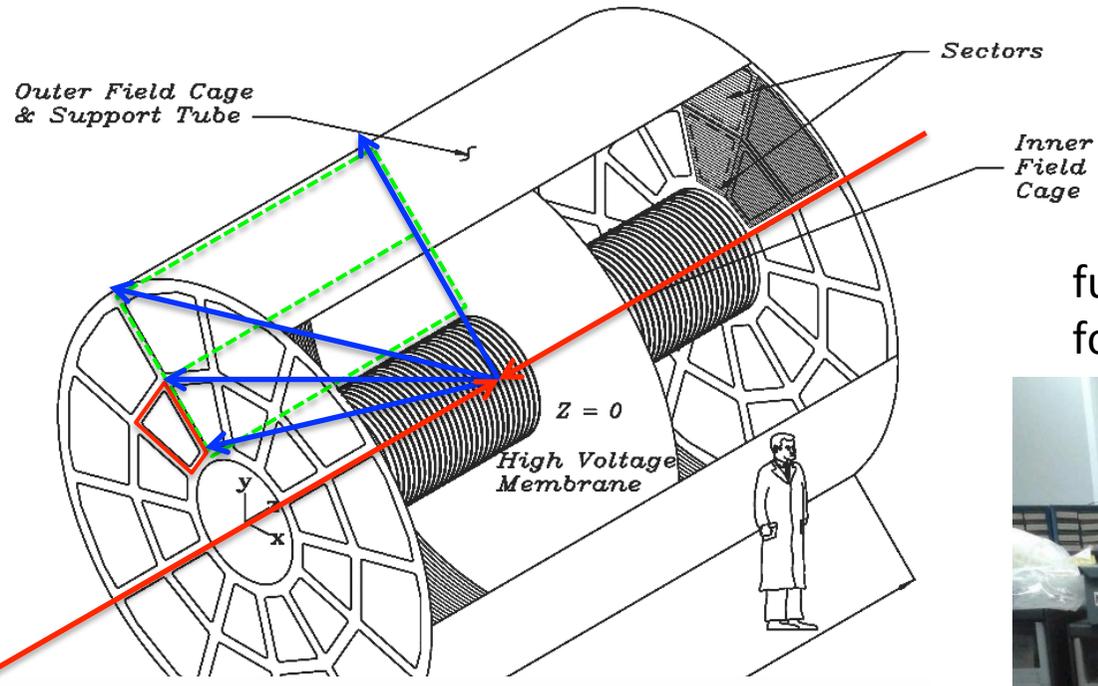


- New forward trigger + **Event Plane Detector**
- Very important for flow and fluctuation analyses
→ independent from main detector
→ reduces systematics (non-flow, centrality)!
- **iTPC** upgrade
→ increases TPC acceptance to ~ 1.5 in η
→ improves dE/dx resolution

Event Plane Detector for BES2 at STAR

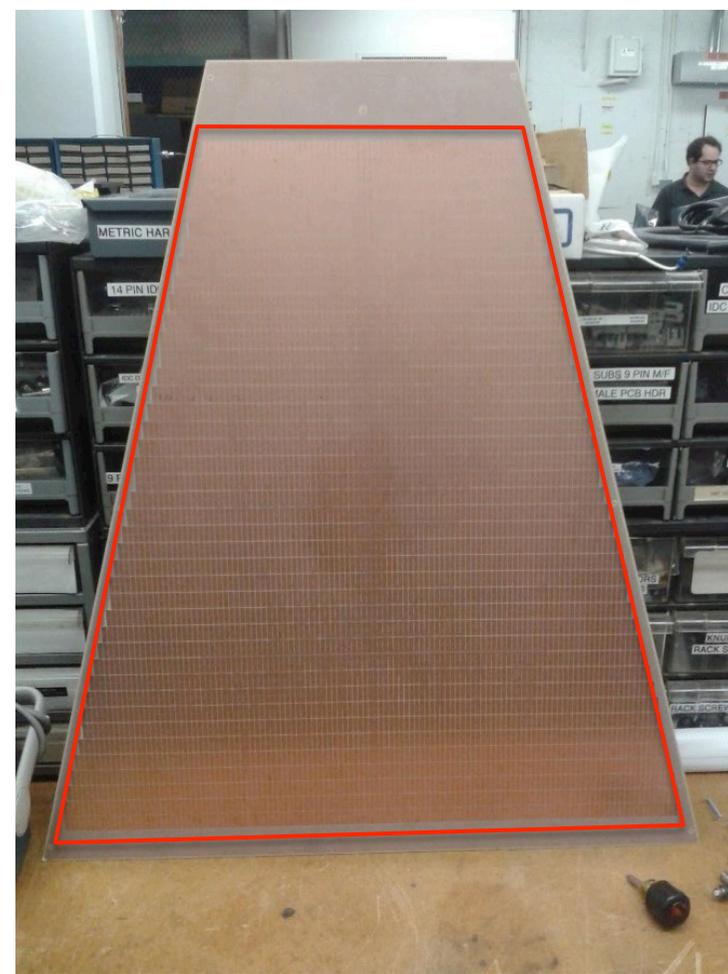
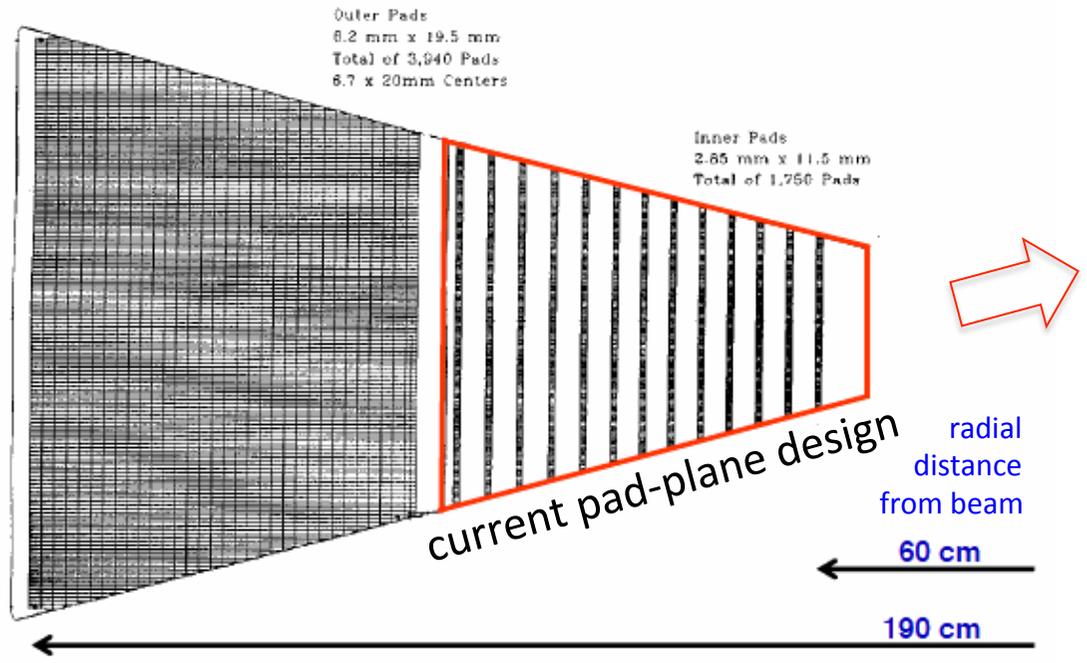


- **Large area coverage**
 - plastic scintillator
(fast, efficient, cheap)
- **Silicon PhotoMultiplier (SiPM)**
 - for readout of tiles
 - cheap, equivalent to standard photomultiplier

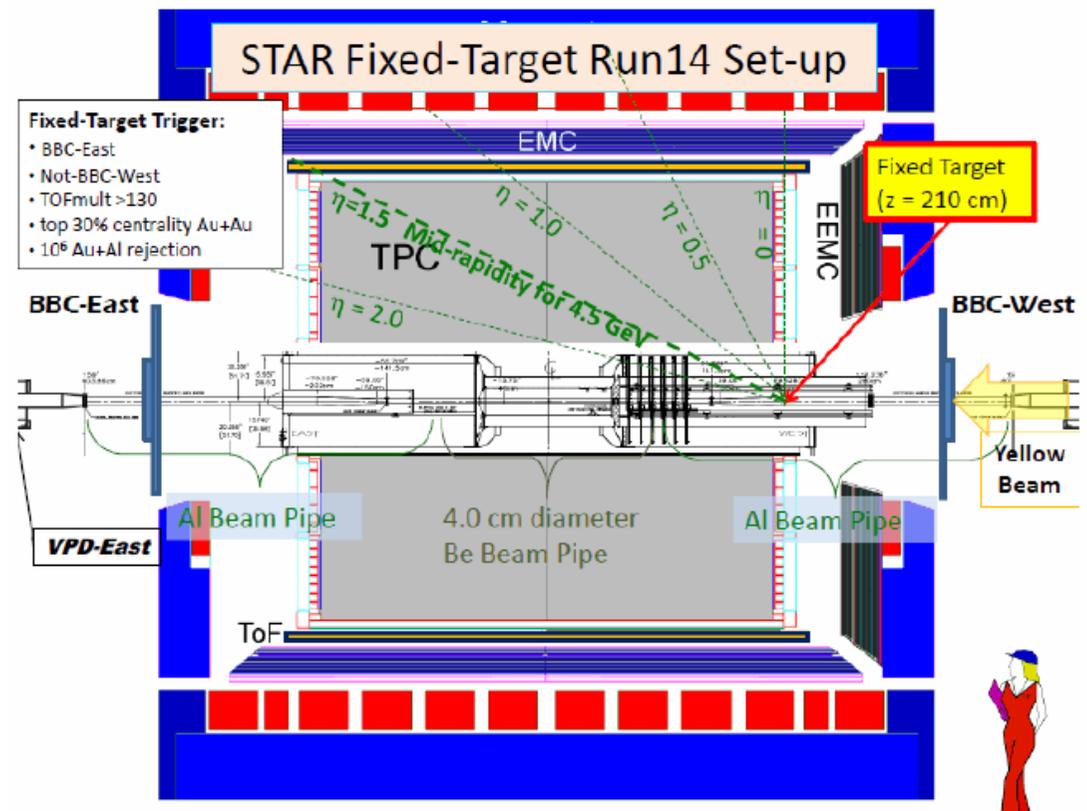
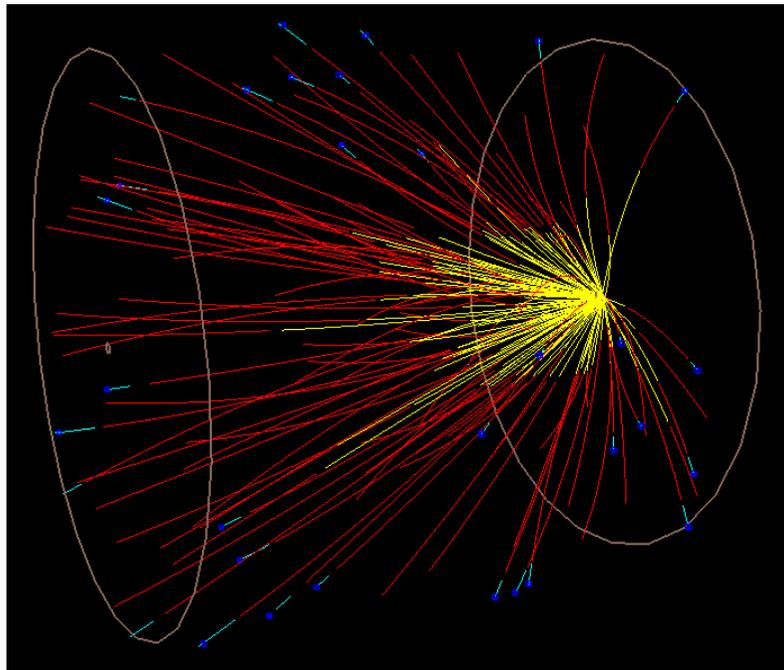
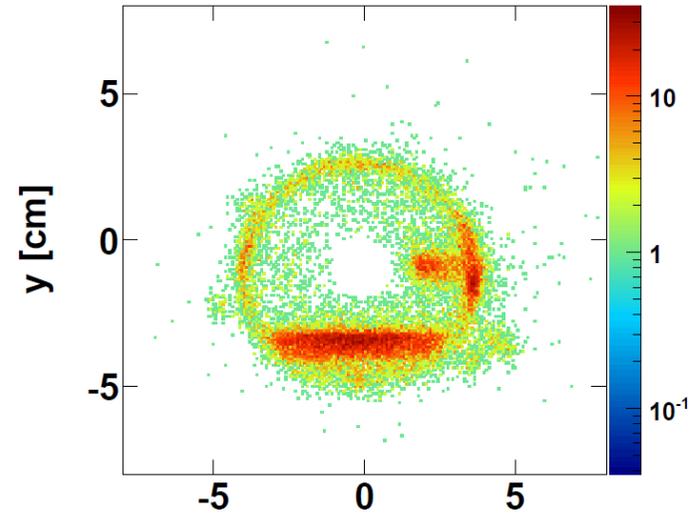


iTPC upgrade
for BES2 at STAR

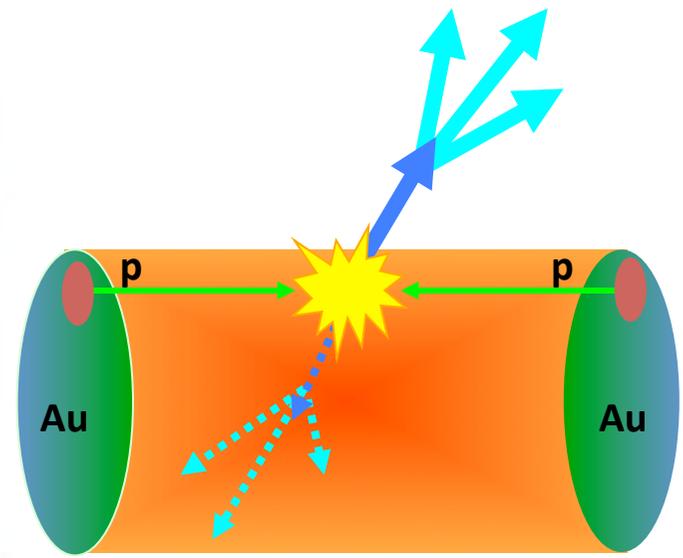
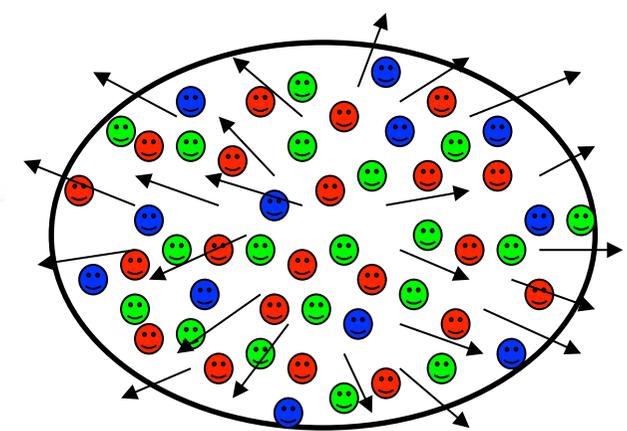
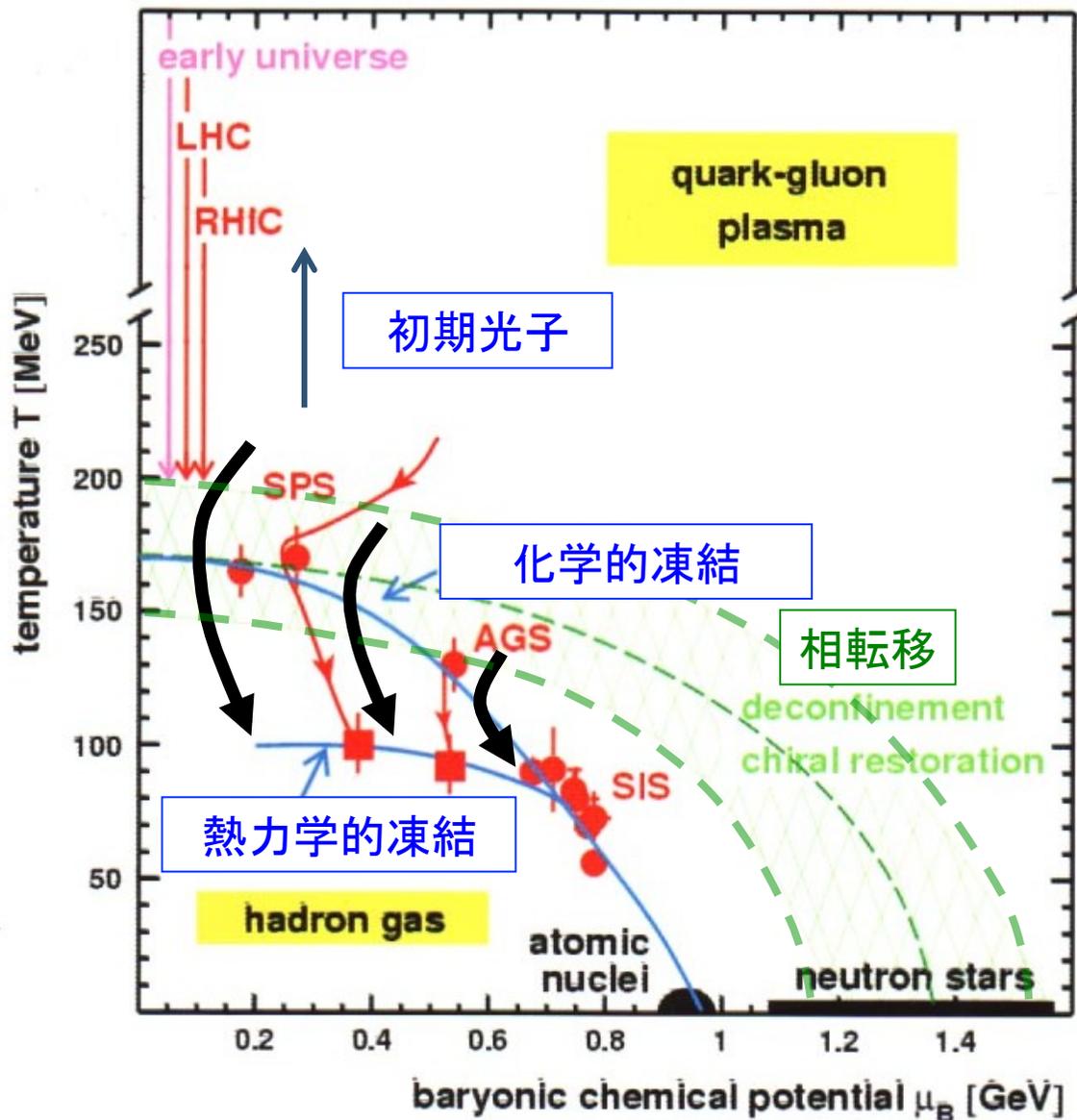
full read-out of inner TPC part
for wider eta-acceptance



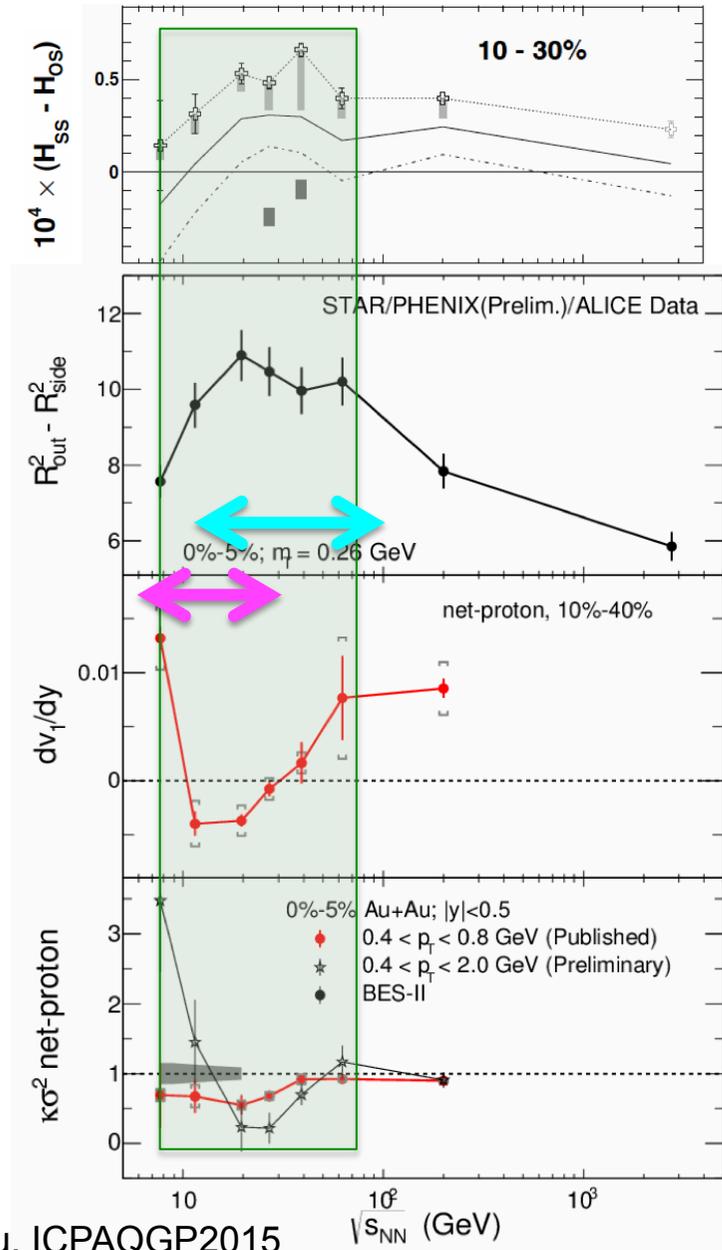
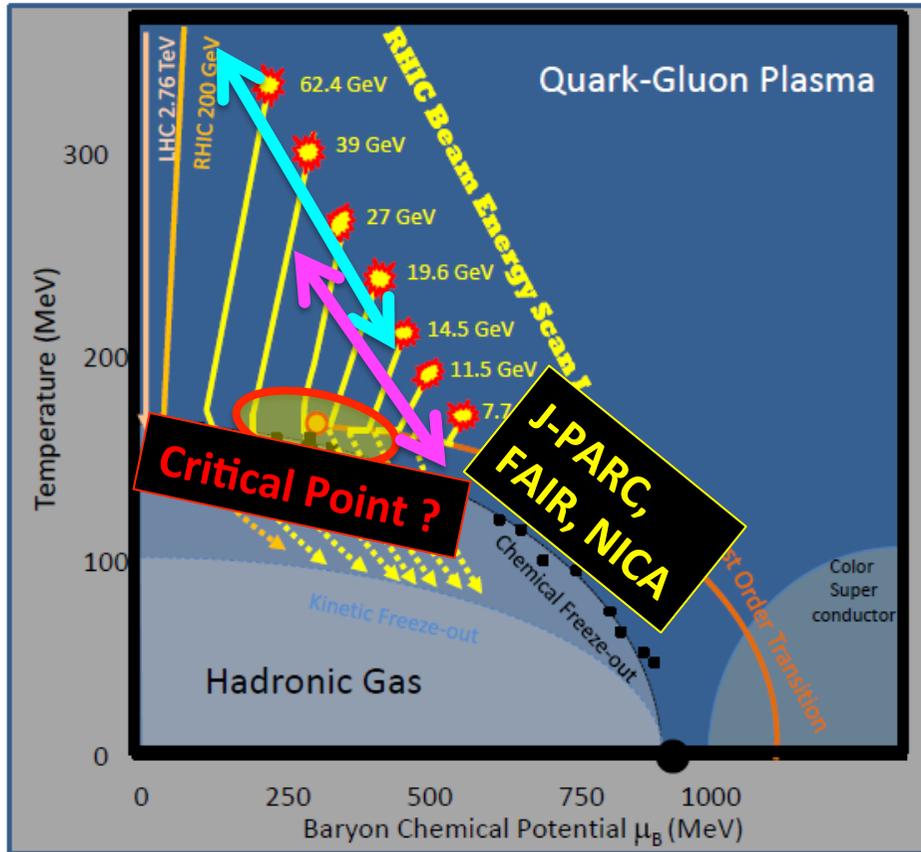
Fixed target mode at STAR



Backup slides



RHIC beam energy scan program
from phase I to phase II



Z. Xu, ICPAQGP2015

	SiPM (S12572-025P)	MAPM (H7546A/B)
Effective Photosensitive Area	3 mm x 3 mm	18.1 mm x 18.1 mm
Spectral response range	320 – 900 nm	300 – 650 nm
Gain	5×10^5	3×10^5
Supply voltage	68 V	800 V
Sensitive to magnetic field?	No	Yes
Photon Detection Efficiency (PDE)	35%	~25%
Time resolution	250 ps	~1 ns
Dark count rate	1MHz	few Hz