Performance study for measurement of jets and heavy flavor using sPHENIX

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XXIV QUARK MATTER DARMSTADT 2014

PHENIX

Quark Physics Laboratory Hiroshima University, Japan

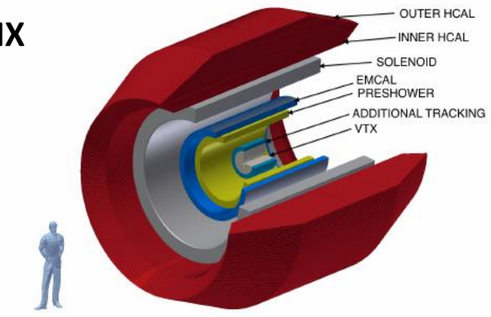
sPHENIX (Major upgrade to the PHENIX experiment at RHIC)

PHENIX Schedule

2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Run 14	Run 15	Run 16	Shut down CeC	BES II	BES II	Shut down sPHENIX installation	sRun 1	sRun 2	Shut down eRHIC		eRun 1

sPHENIX

Upgrade points
- Larger acceptance and Fast readout ($\phi = 2\pi$, $|\eta| < 1$)
- Additional tracking
- Pre-Shower for PID
- EMCal and HCal for measurement of Jets



Physics motivation

- QGP screening study by measuring upsilon states etc.
- Jet quenching study via full (tagged) jet reconstruction.
- Jet fragmentation function modification.
- Nuclear suppression of π^0 yields up to p_T = 40GeV/c
- γ-jet correlation

Optimize segmentation and width in Pre-shower by GEANT4 simulation

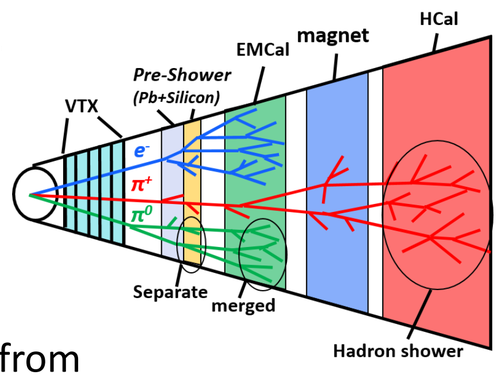
Motivation of Pre-Shower

e/π separation

Improves electron identification in the high p_T region

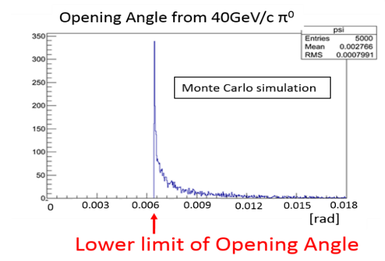
γ/π^0 separation

Distinguish direct photon and 2γ from high p_T π^0.



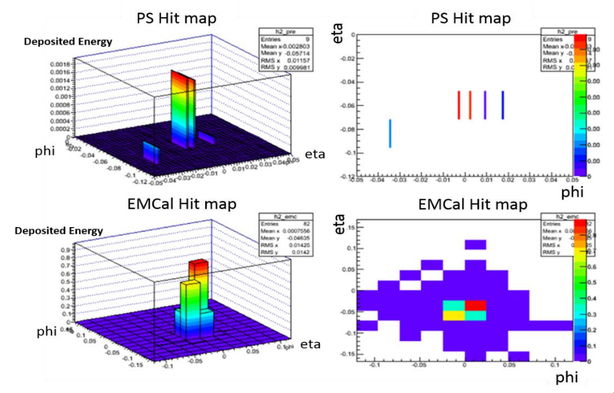
γ/π^0 separation up to 40GeV/c

- High p_T π^0(~40GeV/c) decay 2gamma with very low angle
- Lower limit of opening angle of 0.006[rad]

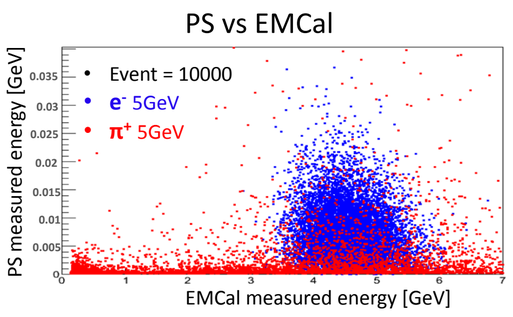


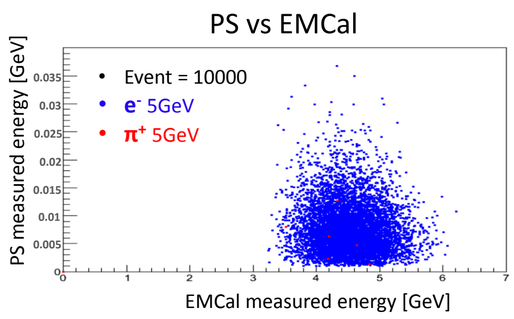
☐ Pre-Shower
- Size of cell (dϕ=0.01,dη=0.12)
- Thickness = $1X_0$
- 2γ are separated

☐ EMCal
- Size of cell (dϕ=0.24,dη=0.24)
- Thickness = $19X_0$
- 2γ are merged



e/π separation by 10^3 up to 5 GeV/c



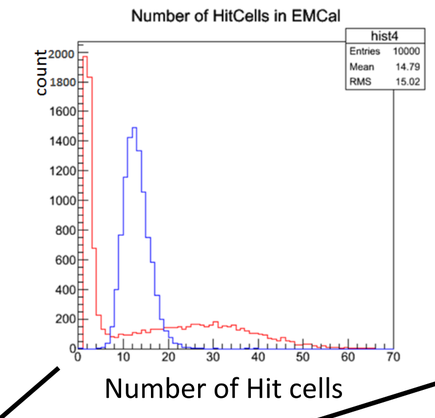


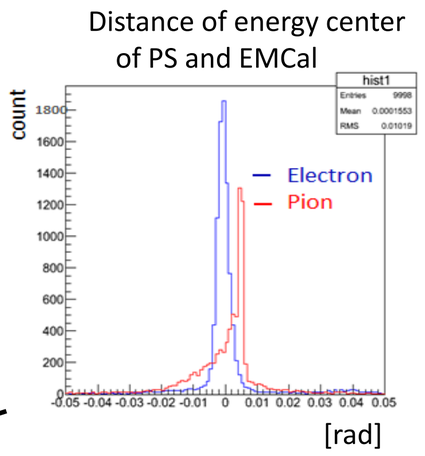
Apply cut

Cut by EMCal
Electron efficiency = 0.7
Pion Rejection = 166

Cut parameter
- Energy
- Number of Hit Cells
- Matching of center

Cut by PS and EMCal
Electron efficiency = 0.7
Pion Rejection = 1160

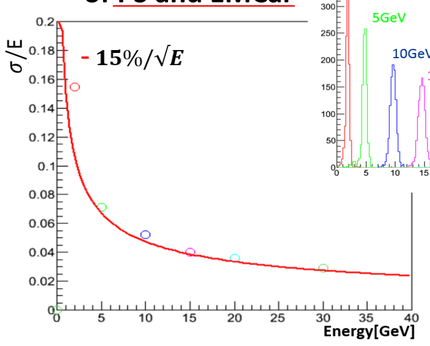




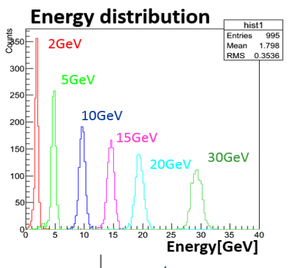
Pion rejection of 100 using EMCal only. Pion rejection grows x10 adding PS. In this study, we evaluate the performance of PS+EMCal for single particle, as baseline. In Au+Au collisions, high occupancy in the detector have a large effect on the performance. We are working on HIJING simulation.

Energy resolution by PS and EMCal

Energy resolution of PS and EMCal

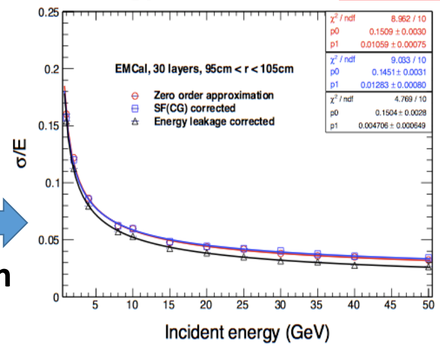


Energy distribution



Energy resolution is consistent

Earlier study (Liang Xue)
Energy resolution of EMCal only



Installing the Pre-Shower does not worsen the energy resolution. But resolution required is 12%/√E for sPHENIX. So we are mostly considering two designs of EMCal that both are more like 10%/√E.

Outlook

We are studying for further improvement Electron identification. We focus attention on longitudinal shower development at EMCal. The figure on the right shows the difference between electromagnetic shower and hadronic shower where an E/p cut has been applied. Pion deposited large energy in HCal. In this result, Leak energy is good tool to identify electron. We are studying in conditions more realistic by HIJING.

Apply E/p cut
(0.8 < E/p < 1.2)