Reconstruction of π^0 and Theta Correction for the Electromagnetic Calorimeter of MPD

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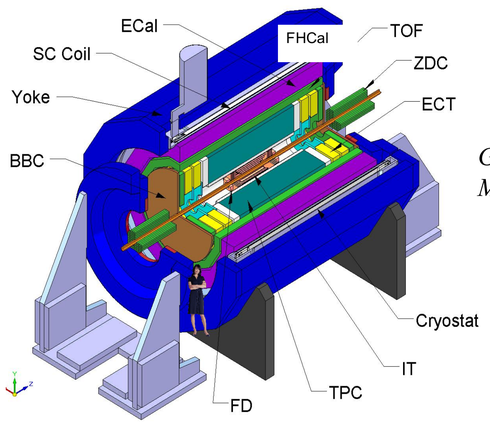
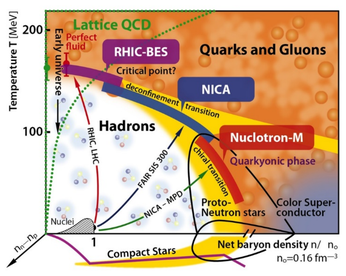
Introduction

The main goal of NICA/MPD is to investigate the hot and dense baryonic matter in heavy-ion collisions over a wide range of atomic masses, from Au+Au collisions at a center-of-mass energy of $\sqrt{s_{nn}}$ = 11GeV (for Au^{79+}) to proton-proton collisions with $\sqrt{s_{pp}}$ = 20GeV.



General view of the MultiPurposeDetector

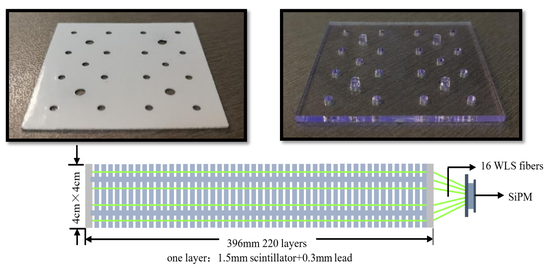
The main target of NICA is to study the hot and dense baryonic matter at the energy range of max net baryonic density, and to investigation of nucleon spin structure, polarization phenomena.



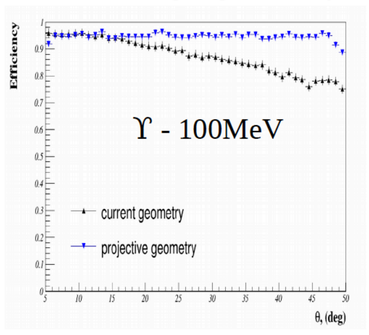
QCD phase diagram

ECal

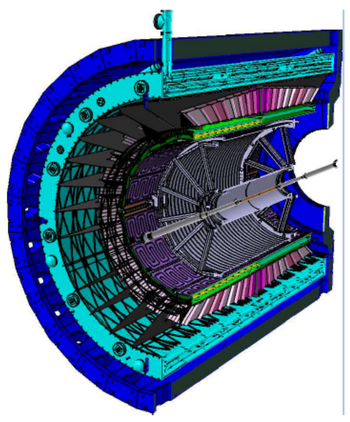
Electromagnetic calorimeter (ECal) is an important detector of the MPD to identify electrons, photons and measure their energy with high precision. This large scale project requires 43008 modules of shashlyk type. Each module consists of 220 layers Pb and scintillator.



We find that the projective geometry can improve the dead time effect, so the module is cut to trapezoid from rectangle geometry.

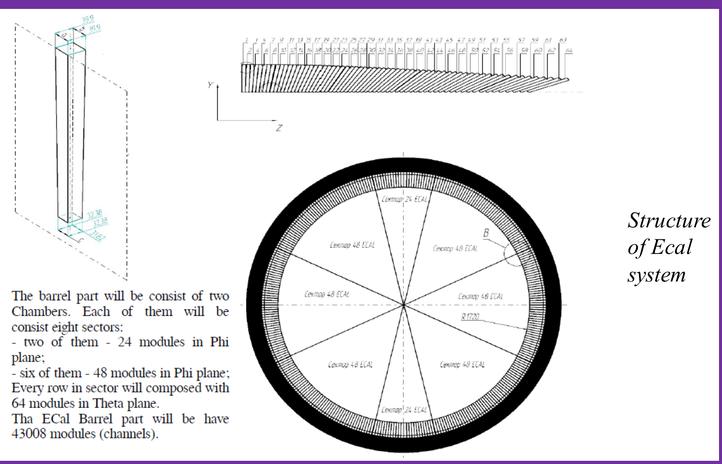


Distribution of efficiency with θ angle.



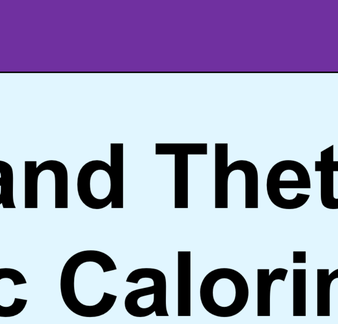
Projective geometry ECal

Figures for manufacture steps:
1.Assembling 32 towers one by one.
2. Pressurizing eight towers at the same time. .
3. cutting and gluing.
4. WLS fibers assembling (inserting, gluing and cutting).
5. connecting the PCB plate with SiPM detector.
6. wrapping.



MpdRoot simulation framework

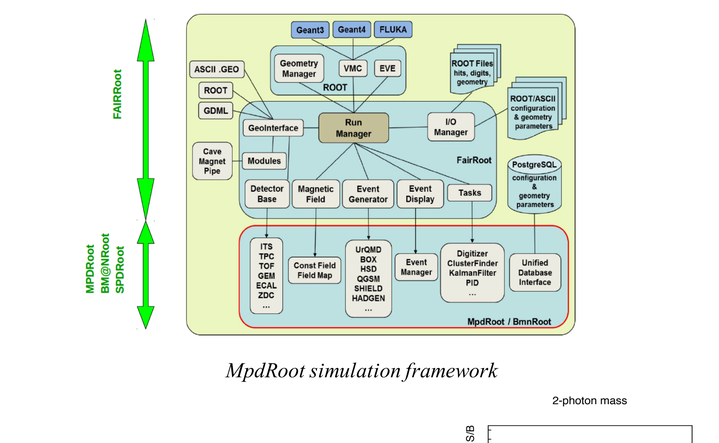
The barrel part will be consist of two Chambers. Each of them will be consist eight sectors:
- two of them - 24 modules in Phi plane;
- six of them - 48 modules in Phi plane;
Every row in sector will composed with 64 modules in Theta plane.
Tha ECal Barrel part will be have 43008 modules (channels).



Structure of Ecal system

Reconstruction of π^0

The simulation framework of MPD is based on the FairRoot as shown below. π^0 signal can be reconstructed from photons and it is a very important probe to give information of the chiral symmetry restoration and flow signal.



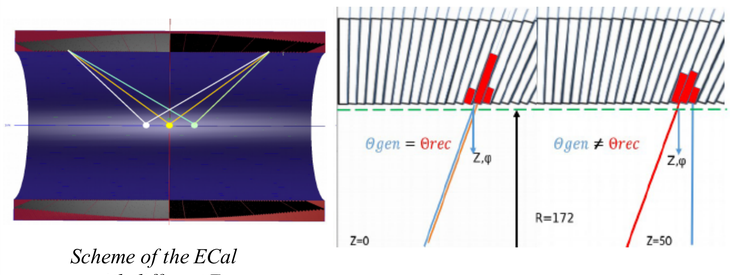
Distribution of the angle between two photons with Pt.

Reconstruction of the invariant mass of π^0 for Au+Au 11GeV

Theta Correction

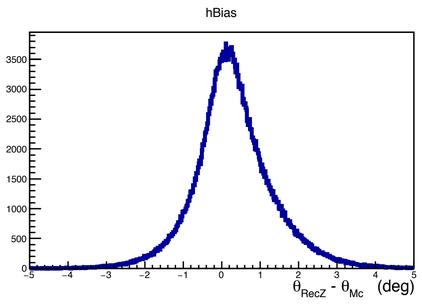
Theta angle reconstructed in the ECal has a clear deviation from real angle as a function of Z position of the interacting point.

This theta angle bias is caused by the small deviation from projective geometry for the Z position which is not equal zero.



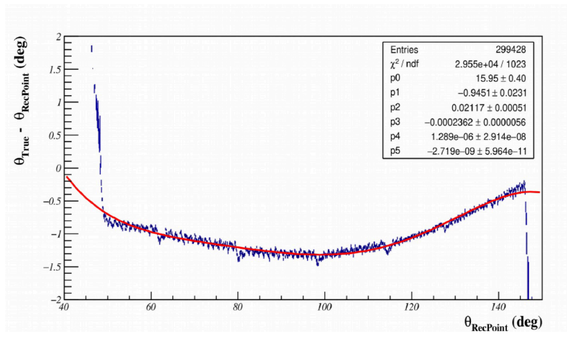
Scheme of the ECal with different Z

Hits for different interacting Z

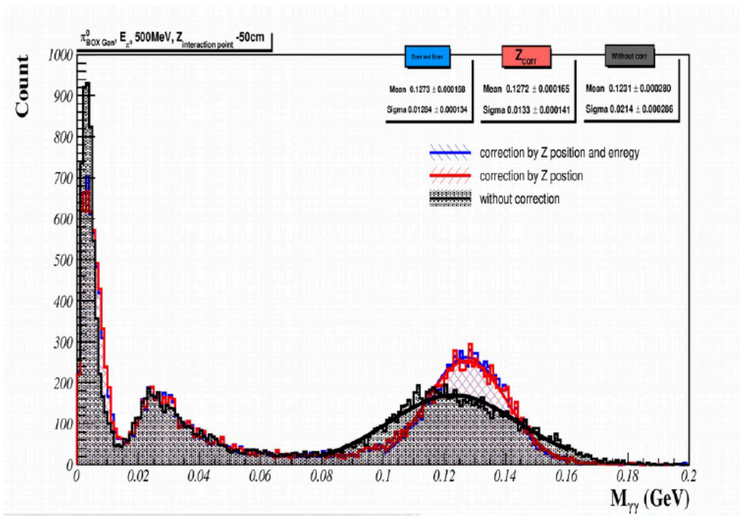


The distribution of the theta bias between θ_{real} and $\theta_{measured}$.

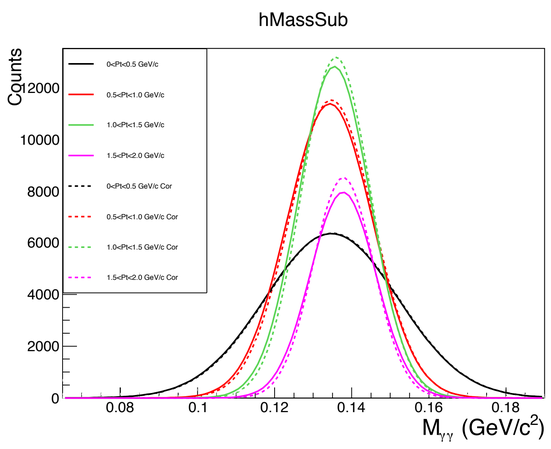
This theta bias can be corrected by a function of $\theta_{measured}$ and Z position got from the fit of the distribution of Δ_θ. And it is not affected obviously by the energy of the hit.



Distribution of Δ_θ as a function of $\theta_{measured}$ for Z = 50cm.



Reconstructed invariant mass of π^0 with different correction.



Fit of the reconstructed invariant mass of π^0 for different Pt before and after θ correction.

Conclusion

- Projective Electromagnetic Calorimeter with 43008 modules is designed and being constructed for the MPD experiment on NICA.
- Simulation and reconstruction of ECal is studied and the invariant mass of π^0 is reconstructed.
- Theta bias of several degrees is observed and corrected.
- $\frac{\sigma}{Mean}$ of the invariant mass decreased with theta correction, especially for large Pt.

References

1. NICA whitepaper
2. MPD TDR
3. ECal TDR