



# Performance of the Muon Telescope Detector (MTD)

## in STAR at RHIC

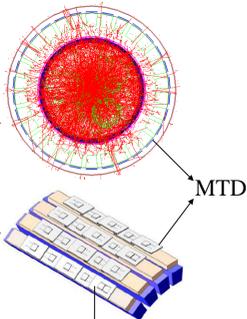
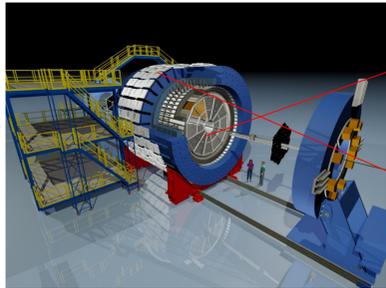
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A large area muon telescope detector (MTD) at mid-rapidity will provide excellent muon identification and trigger capabilities at mid-rapidity in the high-luminosity era at RHIC. This novel and compact detector can provide crucial measurements for many exciting physics perspectives. We can measure and separate different Upsilon states and measure  $J/\psi$  over a broad transverse momentum range through di-muon decays to study color screening features. The measurement of e-muon correlations can distinguish heavy flavor contributions from initial lepton pair production. The construction of the MTD at STAR is in progress. In 2012, about 10% of the full system has been installed in STAR and data were taken smoothly. In this poster, we report on the performance of the MTD including its trigger capabilities and spatial resolution from Run-12.

### STAR detector

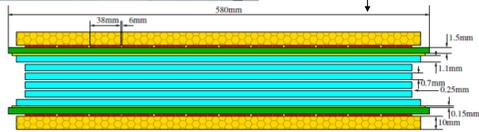


### Concept of Design of the STAR-MTD

- A detector with long-MRPCs will cover STAR magnet backlegs and leave the gaps in between uncovered.
- Acceptance:  $45\% \cdot 2\pi$  at  $|\eta| < 0.5$
- 118 modules, 1416 readout strips, 2832 readout channels
- Strip length: 87cm
- Each strip is read out from both ends
- 10% (13 modules) of the full system installed
- Intrinsic timing resolution:  $< 100$  ps
- Spatial resolution:  $\sim 1$  cm

### Multi-gap Resistive Plate Chamber (MRPC)

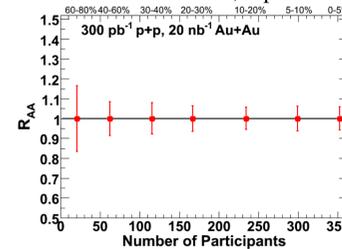
- Gas detector, avalanche mode
- Long-MRPC detector technology, electronics same as used in STAR-TOF



End view of an LMRPC module for the full MTD

### Motivation

- di-muon pairs from QGP thermal radiation, quarkonia, light vector mesons, resonances in QGP, and Drell-Yan production
- single muons from the semi-leptonic decays of heavy flavor hadrons
- advantages over electrons: no  $\gamma$  conversion, much less Dalitz decay contribution, less affected by radiative losses in the detector materials
- excellent mass resolution, separate different Upsilon states



simulation results of  $Y(1S+2S+3S) R_{AA}$  versus  $N_{participant}$

- trigger capability for low to high  $p_T J/\psi$  in central Au+Au collisions
- distinguish heavy flavor decayed lepton pairs from initial lepton pair production

### MTD trigger capabilities

Cosmic trigger :

coincidence with 2 TOF sectors, trigger for cosmic-ray events

MTD&VPD(vertex position detector) trigger :

coincidence with minbias trigger, trigger for MTD&VPD minbias events

MTD&BHT(EM calorimeter high tower) trigger :

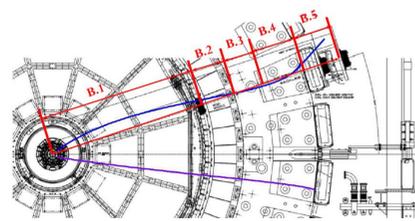
coincidence with hits on energy deposition in EMC, trigger for events with e- $\mu$

MTD 2hits trigger :

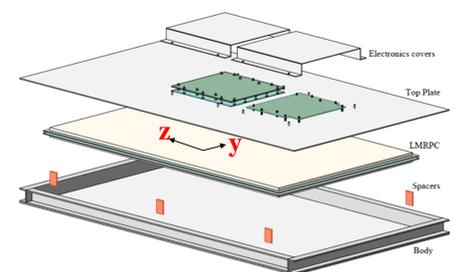
require at least two hits on MTD, trigger for events with  $\mu$ - $\mu$

### Track projection steps

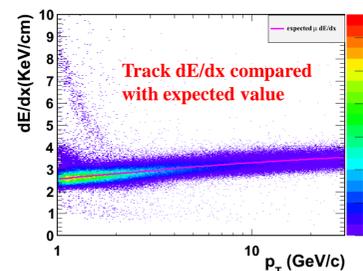
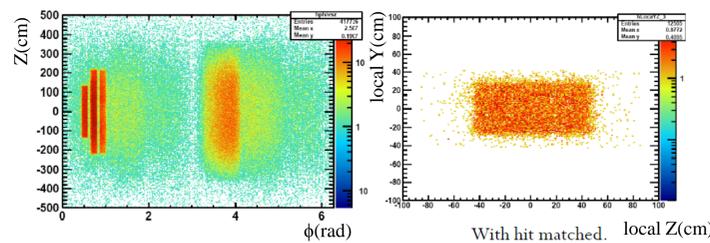
	B.1(TOF)	B.2(EMC)	B.3(Inner steel)	B.4(steel)	B.5(MTD)
Radius(cm)	211	225-247	303	303-364	403
Bfield(T)	0.5	0.5	0.5	-1.26	0
cross(GeV/cm)	0	0.0075	0	0.012	0



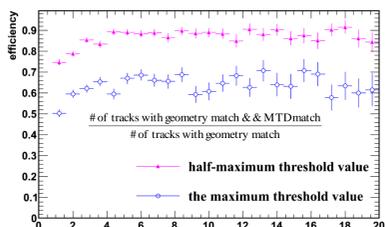
### Exploded view of a MTD tray with the local coordinate system



### Track projected position

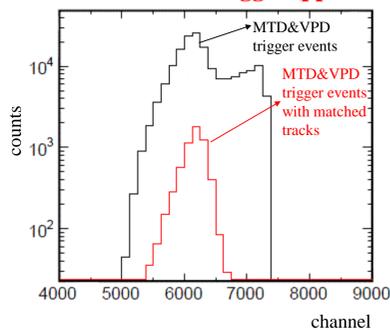


### MTD efficiency for cosmic-ray with different thresholds

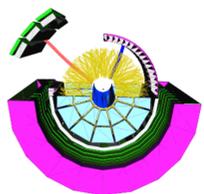


In the future, we will use the half-maximum threshold (about 90% efficiency).

### MTD&VPD TAC difference for MTD&VPD trigger (pp500GeV)



### Event display

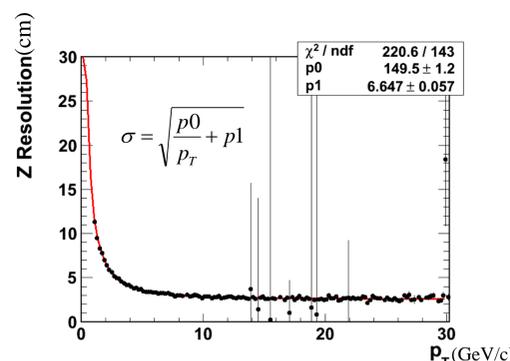
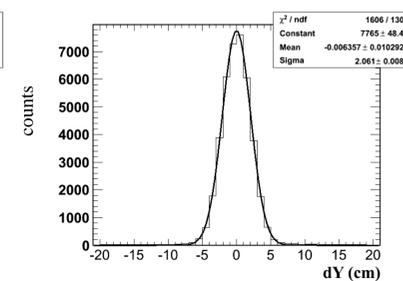
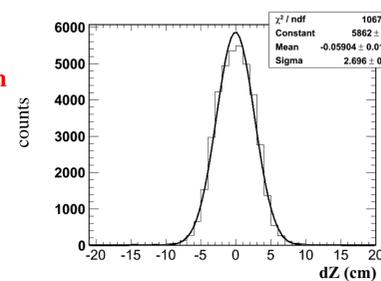


e- $\mu$  event

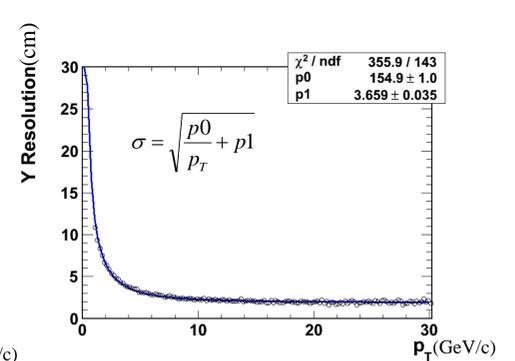


$\mu$ - $\mu$  event

### Spatial resolution ( $p_T > 10 \text{ GeV}/c$ )



Intrinsic resolution: 2.6 cm



Intrinsic resolution: 1.9 cm

### Summary:

- 10% of full system was installed in STAR for Run-12 and took data.
- MTD trigger system worked well with the STAR trigger system.
- Intrinsic resolution based on cosmic-ray data: 2.6cm along the strip  
1.9cm perpendicular to the strip

### Future:

- Time resolution will be obtained from Run-12 cosmic-ray data.
- More than half the full system will be installed for Run-13.
- More statistics for physics analysis in Run-13.

