Efficiency Studies for the new Muon Telescope Detector at STAR

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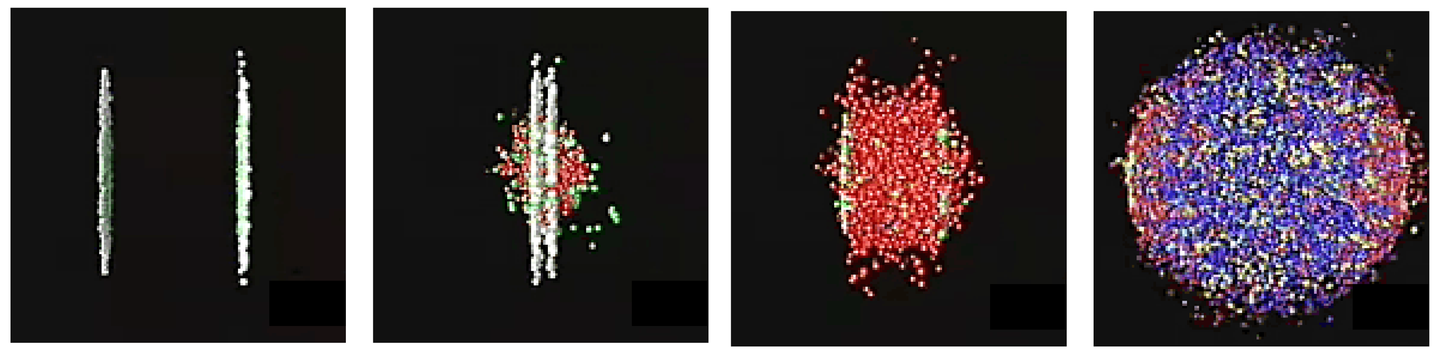
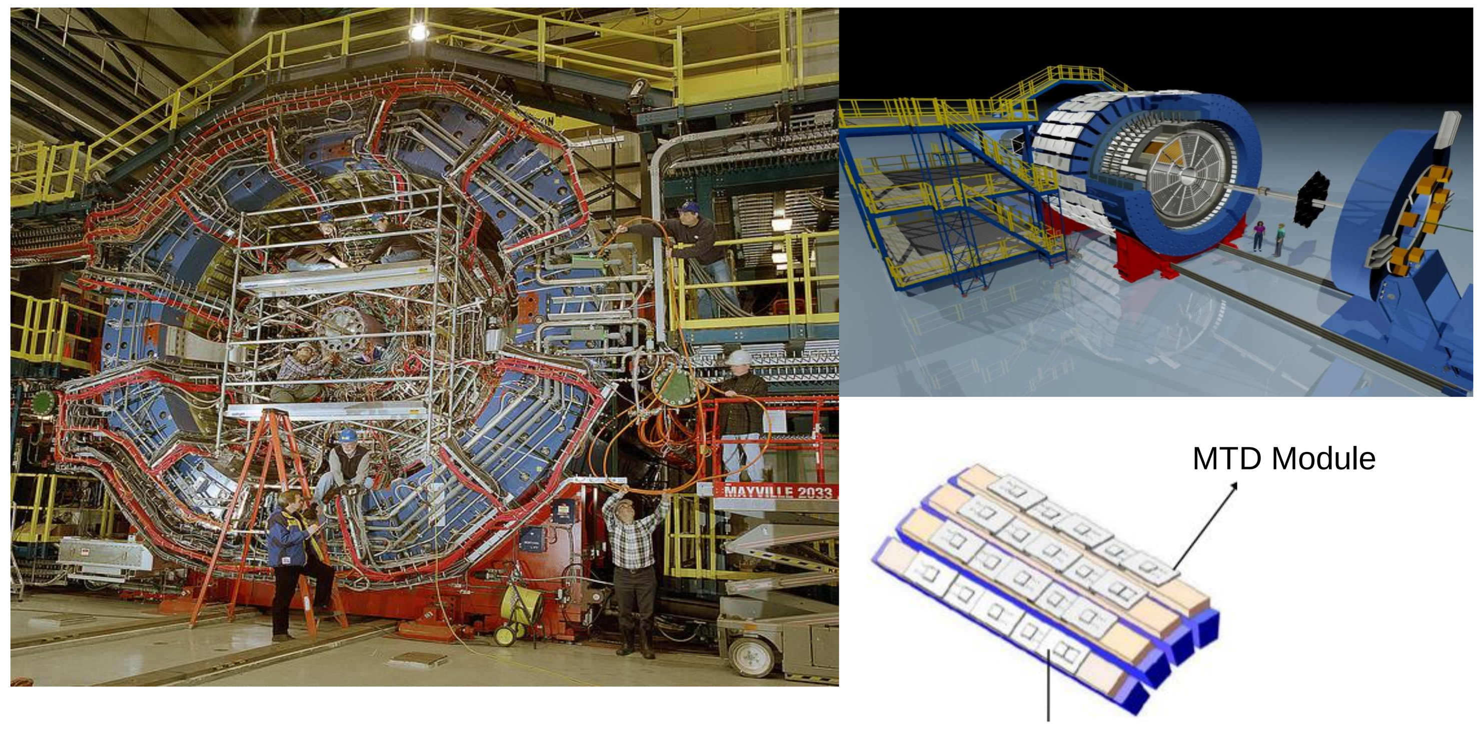
Abstract

The Muon Telescope Detector (MTD) is a new detector subsystem in STAR at the Relativistic Heavy Ion Collider (RHIC). The MTD will contribute to studies of the matter being created in heavy-ion collisions by allowing measurements of the J/Psi meson and the different Upsilon states over a broad transverse momentum range via the reconstruction of their di-muon decays. Simulations to estimate the efficiency of the MTD for detecting muons were performed. The results of these simulations will be presented.

Relativistic Heavy Ion Collisions and STAR



At Brookhaven National Laboratory the Relativistic Heavy Ion Collider (RHIC) is the first collider in the world capable of colliding heavy ions near the speed of light. This type of collision produces enough energy to *melt* the protons and neutrons. This deconfined state of matter called quark gluon plasma (QGP) is believed to have existed at the very beginning of the universe after the big bang. The primary goal of the STAR experiment is to study the formation and characteristics of QGP.



The STAR Detector at the Relativistic Heavy Ion Collider at Brookhaven National Lab.

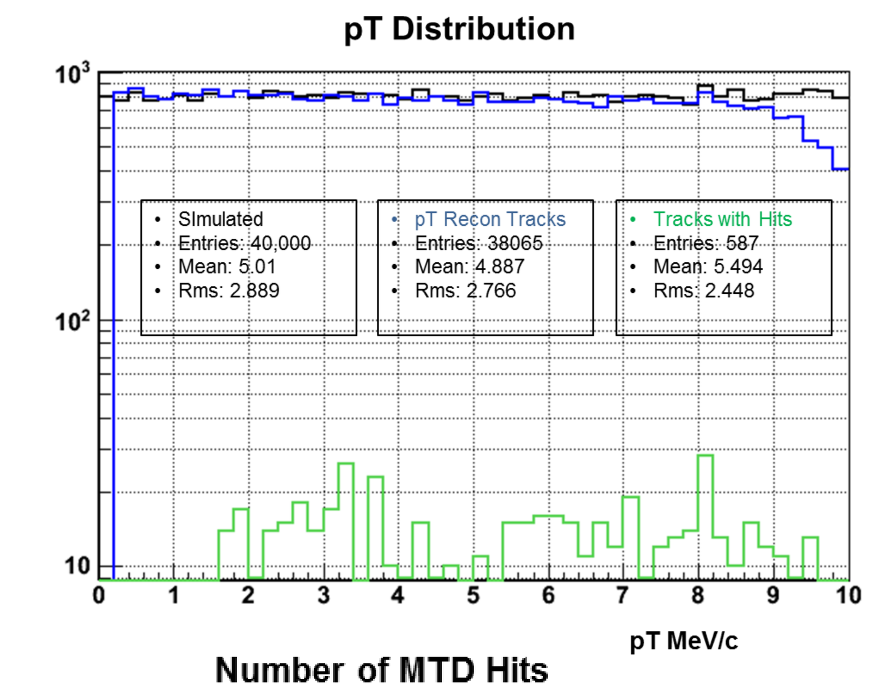
Relativistic Heavy Ion Collisions and the Muon Telescope Detector

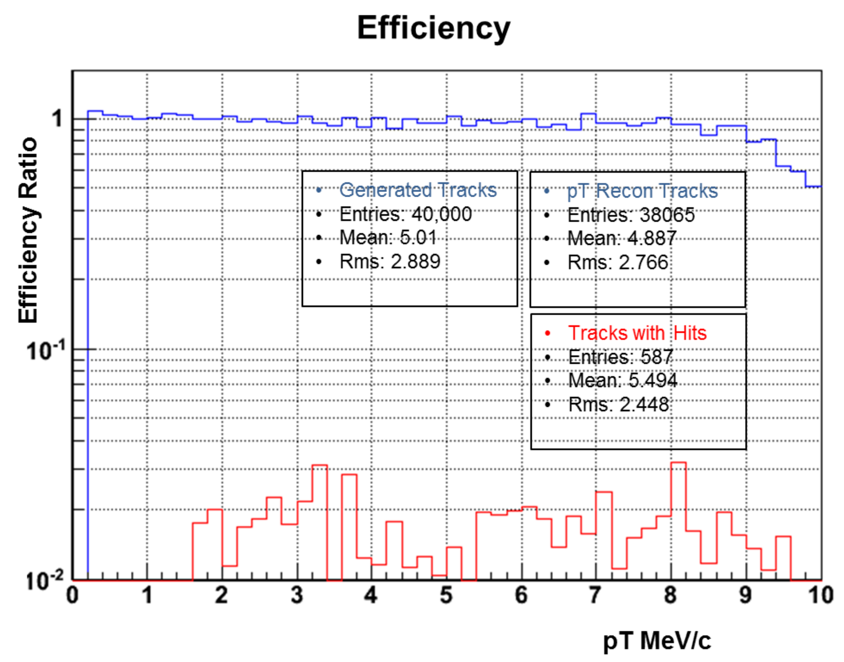
A new detector built for the STAR experiment is the Muon Telescope Detector (MTD). The MTD will allow for the detection of di-muon pairs from QGP thermal radiation, quarkonia, light vector mesons, resonances in QGP, and Drell-Yan production, as well as single muons from the semi-leptonic decays of heavy flavor hadrons. The MTD is located outside the time projection chamber (TPC) and the barrel-electromagnetic calorimeter (BEMC). The steel from the magnet serves as an absorber for particles other than muons, resulting in mostly muons reaching the MTD.

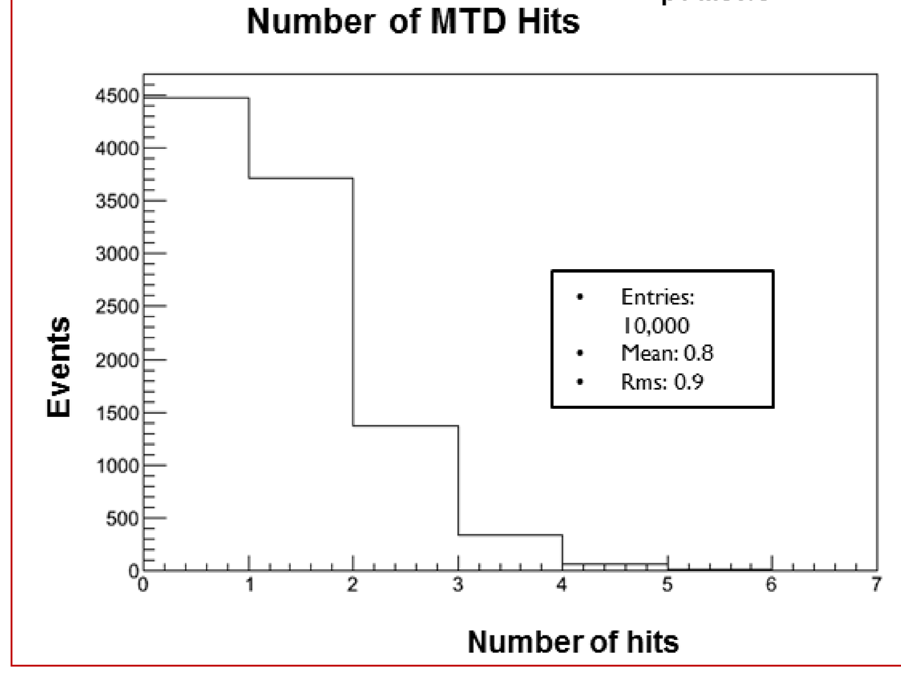
Method

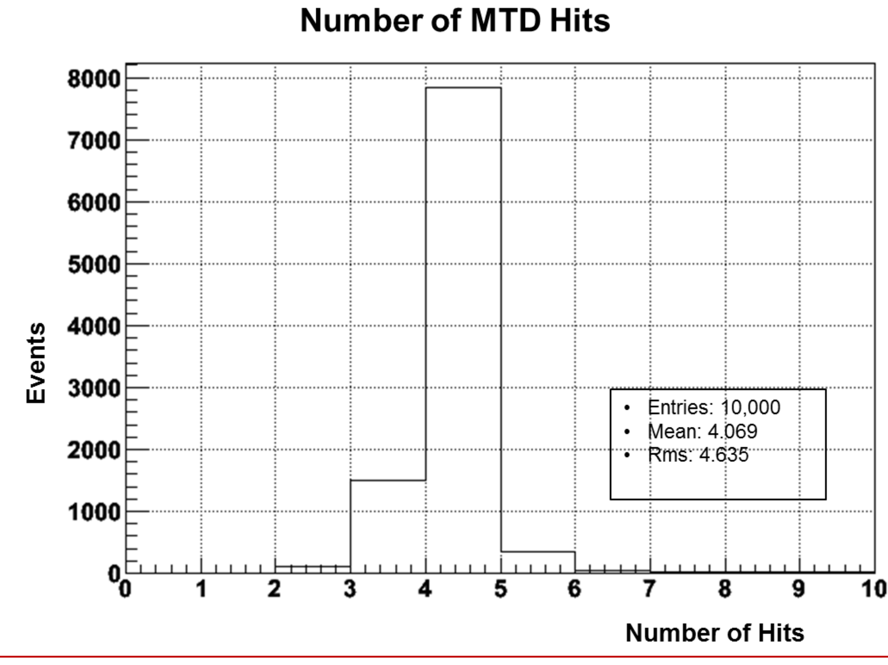
- The goal of this project is to determine the efficiency of the MTD.
- A single particle generator was used to simulate 4 muons per event.
- $p_T < 10$ GeV/c and $|\eta| < 0.8$
- 10,000 events were simulated and processed through the STAR data reconstruction chain producing tracks in the TPC and hits in the MTD.

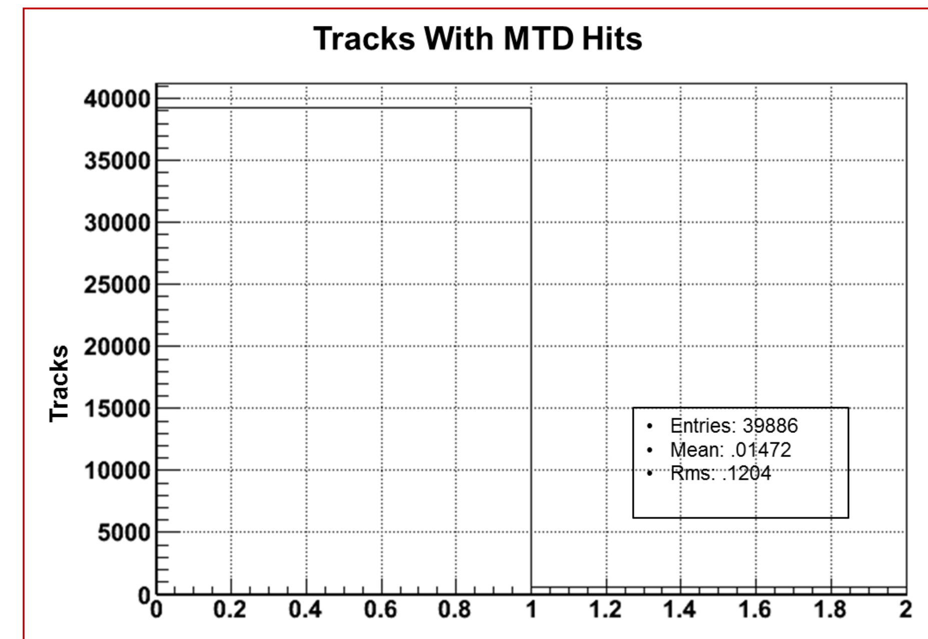
Results



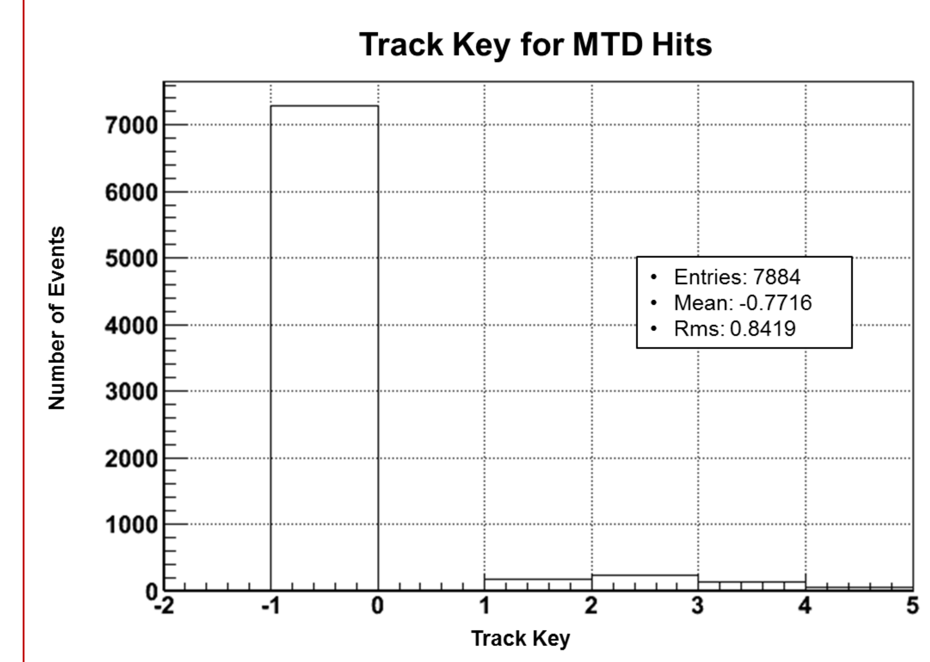








This histogram shows whether or not a track has a matching MTD hit with zero denoting no matched hit and one denoting a match. **From this figure we find only 1.5% of the tracks were matched to an MTD hit.**



Alternatively, we can look at the number of hits with a matching track. The track key is the ID of the track to which the MTD hit was matched where -1 denotes no match was found**. Although, ~8,000 hits were found (20% of the number of generated muons), 93% of the hits had no matching track**.

Conclusion

The efficiency of the MTD was determined to be 1.5%. This value is much lower than the expected value. The results show that there are more MTD hits detected than there are tracks matched to MTD hits. This points to a problem in the matching of tracks to MTD hits.

BROOKHAVEN NATIONAL LABORATORY

"The Physics of RHIC" *www.bnl.gov/rhic.physics.asp*
L. Ruan "The Overview of Muon Telescope Detector project: physics and current status"

Aknowledgements
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