A Study of High-p_T/High-Mass Dielectron Production Through Trigger Combination in 200 GeV Au+Au Collisions at STAR

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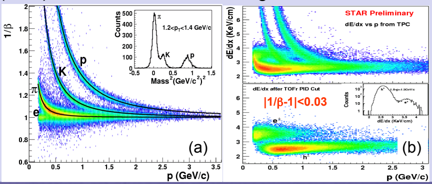
Abstract

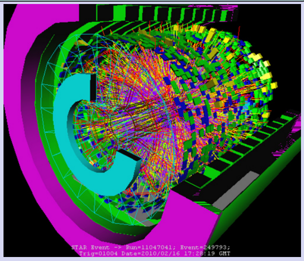
To observe the dilepton production at high p_T, it is necessary to utilize the data from the high-p_T triggers in conjunction with the minimum-bias trigger. These dielectron measurements are made using data from the STAR Time Projection Chamber, Time of Flight, and the Barrel Electromagnetic Calorimeter at midrapidity. In this poster, we present the first trigger-combination study on the dielectron production in 200 GeV Au+Au collisions recorded by the STAR detector in 2010 using a combination of the minimum-bias trigger and three high-p_T triggers with different energy thresholds in the BEMC. Because the mass spectrum from each high-p_T trigger is biased, we apply an effective weight to each dielectron pair based on the trigger threshold and scale factor. Finally, we combine the results from all four triggers. The analysis details and associated mass spectra will be discussed.

RHIC and STAR

Aerial view of the RHIC facility

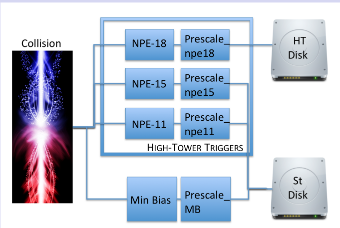
The Solenoidal Tracker at RHIC (STAR) is located at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory. RHIC and STAR's primary purpose is to investigate the properties of the strongly-interacting QGP. STAR contains many independent detectors, but this investigation uses primarily the Time of Flight (TOF), Time-Projection Chamber (TPC) and the Barrel Electromagnetic Calorimeter (BEMC). Together, these three detectors allow us to obtain very accurate electron identification, from which we extract dilepton information. Seen to the right are the particle spectra from the TOF (a) and the TPC (b).





Event Display at STAR from Run 10

High-p_T Triggers at STAR



Triggers are an integral part of any experimental setup at a collider. In essence, users select which physics events are most interesting by setting up triggers to target those specific events. From there, the users can discard the rest to save disk space. However, these selections could create bias, which must be accounted for. This study attempts to incorporate events that could satisfy the "high-p_T" triggers, which require a certain energy threshold in any of the BEMC towers to pass. There exist three high-p_T triggers at STAR: NPE-11 (E_T > 2.6 GeV), NPE-15 (E_T > 3.6 GeV) and NPE-18 (E_T > 4.3 GeV), *all stemming from the original minimum bias sample*. Each of these triggers has an independent prescale factor, used to regulate the amount of data that users read to disk. As we move toward higher p_T in our data sample, the high-p_T trigger statistics start to dominate and our spectrum becomes biased toward higher-p_T events. In addition, the high-p_T triggers often have lower prescale values so higher energy events exist in disproportionate numbers on the disk. For this reason, we must "unprescale" the data to recover the original effective minimum bias spectrum before prescale. In this manner, we obtain an unbiased spectrum.

Trigger Combination Method

To properly combine the triggers, we must separate the data into four independent energy (ADC) blocks, based on the four triggers contained in the study. These four sections are then simply added together to produce the foreground. The scale factor is an effective prescale factor using the overlap of the four triggers.

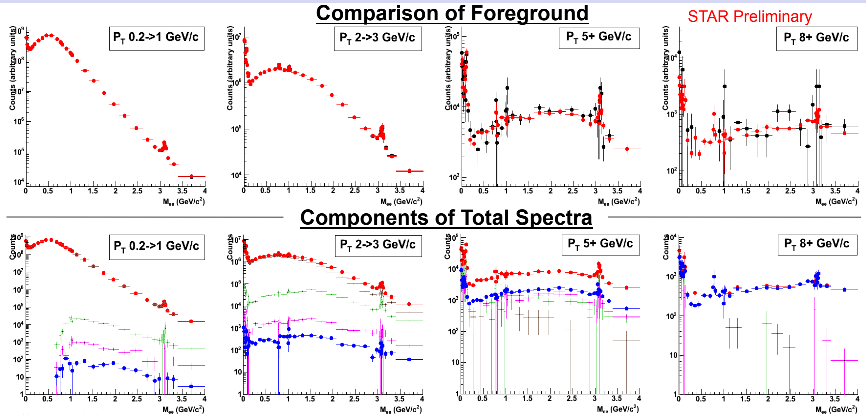
	Collection 1 +	Collection 2 +	Collection 3 +	Collection 4
Trigger	MB	MB || NPE11	MB || NPE11 || NPE15	MB || NPE11 || NPE15 || NPE18
Energy Threshold	ADC < 11	11<= ADC< 15	15 <= ADC < 18	ADC >= 18
Scale Factor	x MB pscl	x combination (MB,NPE11) pscl	x combination (MB,NPE11, NPE15) pscl	x combination (MB,NPE11,NPE15, NPE18) pscl

Results and Conclusions

4.52E+9 equivalent Min Bias events

Trigger Comb. FG (unlike-sign pairs)
Prescale-Corr. Min Bias (unlike-sign)

Below is the foreground & collection spectra for four p_T bins



All Collections, Collection 1, Collection 2, Collection 3, Collection 4

Minimum-bias data has plenty of statistics in the lower p_T regime, but in the intermediate / high p_T and mass ranges, we quickly run out of statistics. By incorporating the high-p_T triggers, we can see (especially for p_T > 5 GeV/c) we still have enough statistics to obtain a relatively smooth foreground.

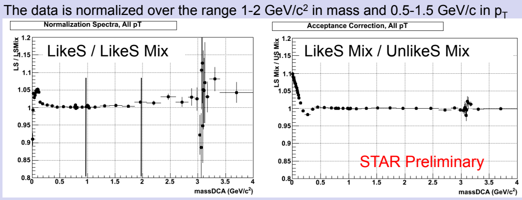
Future Work

Our next step is to obtain the resulting signal from our foreground. Correlations exist in the high-p_T foreground such that obtaining a true signal is a non-trivial matter. Further study into these correlations is needed.

We plan to use **Event Mixing** for the combinatorial background subtraction in the region above 1 GeV/c^2. By mixing uncorrelated **minimum bias events only**, we obtain a pure statistical background, which then is normalized to the foreground.

Great care will be taken to ensure the mixed events are uncorrelated. We plan to do this by only mixing minimum bias data and then, only within finite centrality, z-vertex and magnetic field orientation bins.

The data is normalized over the range 1-2 GeV/c^2 in mass and 0.5-1.5 GeV/c in p_T



Once a signal is obtained, it will be corrected for the detector efficiency of dielectron pairs.