Zero Degree Calorimetry at RHIC and the LHC

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The A&M group in BRHAMS is responsible for the maintenance and operation of the Zero Degree Calorimeters, ZDCs [1]. These have been very useful in measuring the total cross section and studying the electromagnetic excitation of nuclei [2]. We hope to extend these measurements to lower energies by studying data taken at $\sqrt{S_{nn}} = 17$ GeV.

Unfortunately for BRAHMS, the region over which the two ion beam collide is larger than originally planned. Collisions too far away from the focus of the spectrometers are not useful for offline analysis. During the 2001 running at RHIC the ZDCs were used to provide a level 0 vertex trigger by requiring the time signal from both calorimeters arrive at the electronics hut within a few nano seconds of each other. By only accepting triggers within 15cm of the nominal interaction point, the useful data rate of BRAHMS was almost doubled. This will be improved in the next run by forming the coincidence inside the interaction region and possibly adding faster tubes. Offline this measurement is refined by correcting for the "slewing effect" which causes the time measurement to depend upon the size of the signal. Fig. 1 shows the difference in the Z vertex measured by the mid-rapidity TPC and the ZDCs. A calibration code has been developed to produce final time and energy signals from the ZDCs and insert them into the BRAHMs database.

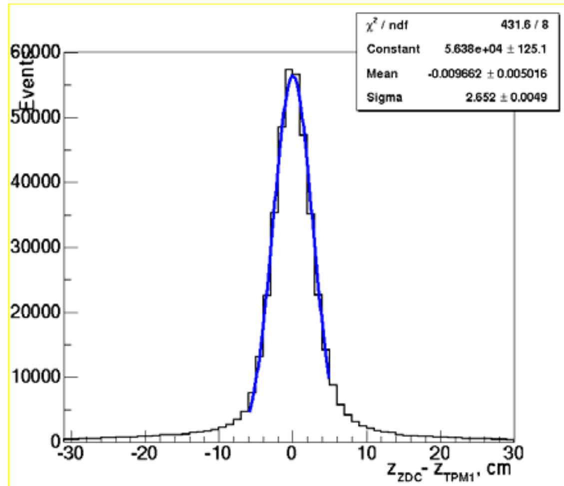

Figure 1: Difference in the Z coordinate of the interaction vertex as measured by the ZDCs using time differences and a TPC using tracking.

While RHIC remains the essential focus of current high energy nuclear physics preparations are well underway to accelerate protons $\sqrt{S_{nn}} = 14.0$ TeV and gold ions to $\sqrt{S_{nn}} =$ 5.6 TeV at the Large Hadron Collidor at CERN [3]. A proposal has been made for U.S. nuclear physicists to participate in the heavy ion program of the CMS experiment at the LHC [4]. Within CMS a small space exists at the point were the beam pipes diverge from the interaction region. We have proposed to insert a ZDC similar to the ones built for RHIC. Fig. 2 shows that such a device could achieve an energy resolution of 10-14%. This proposal is currently under review by the DOE.

References

[1] C. Adler *et al.,* Nucl. Instr. Meth. A **470**, 488 (2001).

[2] M. Chiu *et al.* accepted by Phys. Rev. Lett., http://xxx.lanl.gov/abs/nucl-ex/0109018.

[3] http://lhc.web.cern.ch/lhc/general/gen_info.htm.

[4] M. Ballintjn *et al., Heavy Ion Physics at the LHC with the Compact Muon Solenoid Detector*, http://yepes.rice.edu/cms/proposal.

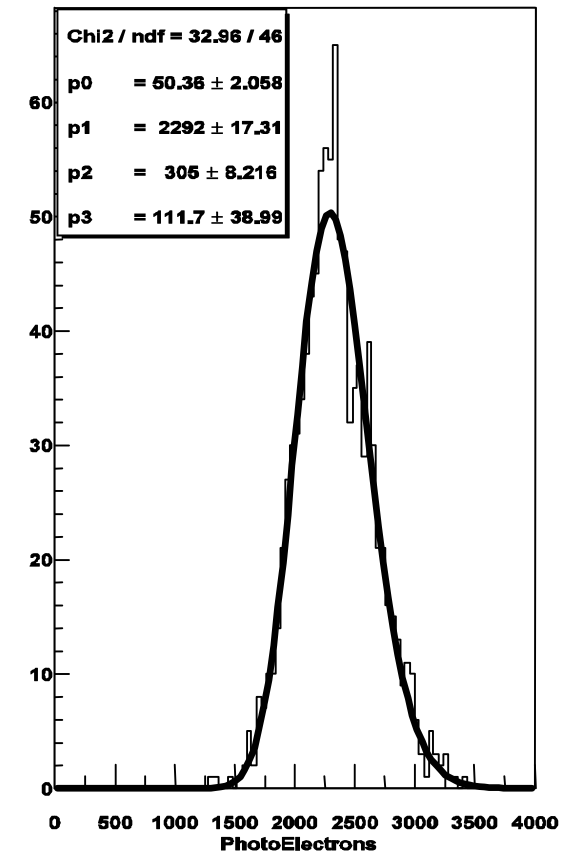

Figure 2: Monte Carlo simulation of the response of a ZDC with 15mm thick tungsten plates and quartz-quartz fibers to neutrons emitted by the Giant Dipole Resonance and a beam energy of 2.8 TeV/A.