Intergration of the ZDC into Brahms
Summary of Meeting Held at BNL 13 May 98

Michael Murray

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Abstract

Present: D. Beavis, C. Chasman, R. Debbe, M. Justice, J.H. Lee, M. Murray, J. Olness and F. Videbaek

The following list is based on the agenda prepared by Flemming.

Mechanical The ZDCs will be positioned outside the reach of the crane. However since each module weighs of order 100lb it should be straightforward for two people to position them behind the DX magnet.

It is important that the stand for the calorimeter not interfere with the forward spectrometer of BRAHMS. Bill Christie has agreed to get something sketched based on the drawings supplied by Dan Weiss. Dana will work with Bill to ensure there is no interference. The stand does not need to be movable in the vertical direction since we can simply adjust the height of the calorimeters with shims, once the height of the RHIC beam is known precisely.

Since space between the beam pipes will be limited it will be difficult to misalign the calorimeters by more than a few mm. Tests at CERN showed that moving the beam 1cm from the center of the ZDCs has little effect on performance, see Fig 5 of [2]. However they should be surveyed to within a few mm so that we can do accurate acceptance calculations with the Monte Carlo. Ramiro gave me one of BNL's standard survey points. I have sent this to Frankfurt so that it can be integrated in the design.

Signals There was a lot of discussion about the large dynamic range required of the ZDCs. NA49 measured a 7TeV in neuton energy for semi-peripheral PbPb collisions at 158GeV/A. Thus at RHIC we should expect to see up to 4.4TeV (44 neutrons) for such collisions. Note that this is the maximum *mean* energy that would occur at a given impact parameter). Of course not all the energy be deposited in one module. Figure 1 on page 2 shows the average and RMS energy per module in the prototype tungsten ZDC for 100GeV protons. Although the maximum is in module 1 the fluctuations are large, showing that we will need to sum outputs from all the modules. Figure 2 on page 5 the

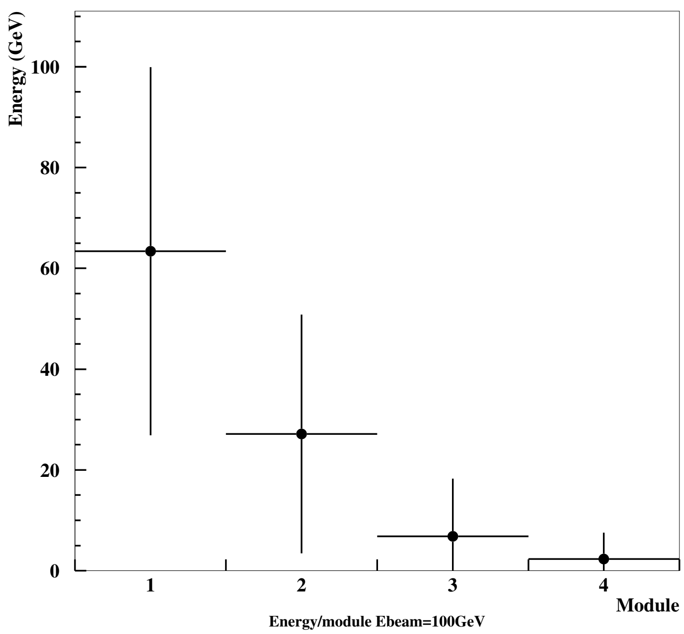

Figure 1: The average and RMS energy per module in the prototype tungsten ZDC for 100GeV protons

distribution of energy in module 1 for "super events" created out of 50 proton events. From this plot we can conclude that we should see less than 4TeV in 1 module.

We would also like to get good timing when measuring 1 neutron which will produce 100GeV in the calorimeter. Too get good timing we would like to set the discriminator a factor of 3 below this, say 30GeV. Thus we require the phototubes to be linear over a dynamic range of at least 130. Chalis suggested that we use two tubes per module, at least for the middle tube which sees the most signal. However this is quite difficult to realise in practice unless we make a simple left/right split of the ribbons. If put a discriminator with a 10mv threshold next to the calorimeter and send 3/4 of the signal to the discriminator and 1/3 to the electronics hut then 10mv on the discriminator corresponds to 13.3mv on the tube. The maximum output of the tube should then be 130*13.3mv or 1.7V. This seems just about managable.

HV Controls Overall it seems the best that the HV modules sit in a VME crate (supplied by RHIC controls group) siutuated in the fast electronics hut. They can have control during commisioning periods, while the experiment at all other times. The expriment determines the HV settings. The VME crate will be linked to the eithernet and the RHIC clock via an optical links.

Trigger It would be useful if the ZDCs were available for the first level trigger. The initial timing signal T0 is formed 250ns after an interaction while the level 0 trigger is formed at $t = 320ns$. Dana has estimated that if we run the ZDC cables to the pivot point and them bring them out with the rest of the cables they would need to 41m long. Using RG58 cable with a transmission speed of v=.67c would get the signals to the fast electronics hut at t = 327ns. We could save 32ns if we use cable with v=.78c. Pulling the cable diagonally across the floor save 8m or 34ns. Giving us 60ns to do logic.

Cable Dana would prefer if BRAHMS were responsible for laying the high voltage cables, rather than having Ted Robinson of RHIC do it. It seems best to use fast cables, v=.78c.It would be helpful if the cables from the ZDC closest to the electronics hut could be a few meters shorter than the other side and this would simplify the generation of the NIM logic.

Readout To readout the ZDCS in BRAHMS requires only 6 ADC (12 bit) and 6 TDC channels It seems simplest to do this in CAMAC, although FASTBUS could be used if we wish.

Scalers The ZDCs would require about BRAHMS 10 scalers to be read out every minute or so as well as having some read out on an event by event basis. It would also be useful is some other detector could be used to measure the interaction rate on a timescale of order 1 minute.

Random triggers Random triggers would allow us to look for pileup effects that might occur at high beam rate.

Monte Carlo Currently there are several different Monte Carlos being used by the QCAL group. The best points of all of these need to be combined. Ideally it would be possible to share most of this between the four RHIC experiments. Edmundo Carcia has sent me his version of the DX geometry which he got from Bill Christie. This needs to be updated now that the drawings for the DX magnet have been completed. Edmundo has given me his fragment coalescence routines as well as some routines that allow GEANT to handle ions. Clemens Alder is working on simulating the test beam results. He will use the photon production routines that I got from CMS. Flemming has written a set of specifications for putting a new detector into GBRAHMS. Edmundo suggested that everyone who is working on ZDC Monte Carlos should get together to share the effort. I will try to arrange a meeting on this for June at BNL.

Analysis modules. Currently no such module exists for the ZDCs. After we can produce Monte Carlo ZDC "data" I will work on writing such a module.

References

[1] M. Murray, "Zero Degree Calorimetry for Brahms" www.rhic.bnl.gov/export1/brahms/WWW/private/notes.html

[2] QCAL Group, "Zero Degree Calorimeters for RHIC" www.rhic.bnl.gov/html/ZDC.html

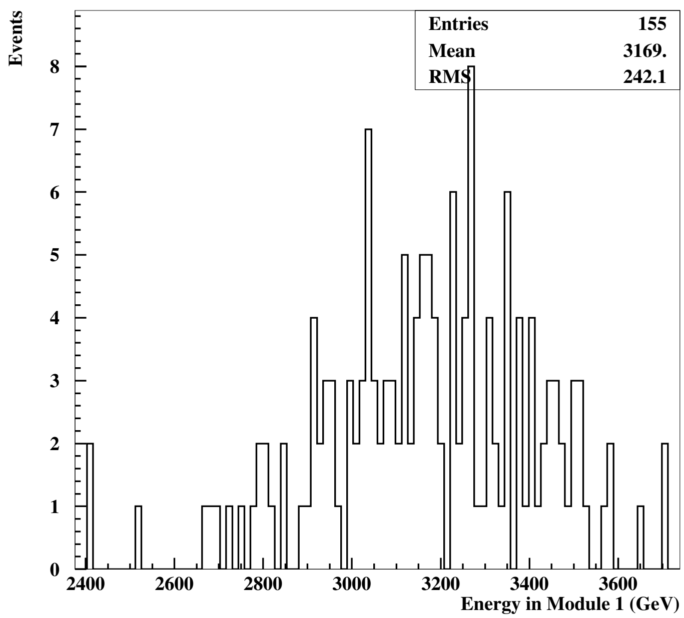

Figure 2: The distribution of energy in module 1 for "super events" created out of 50 proton events