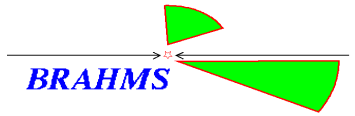


Triggers for pp and dA

F.Videbaek

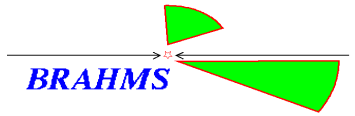
Brahms Coll meeting Dec. 2002

Much of the following material has already been shown at several meeting as well as postings to the mailings lists.

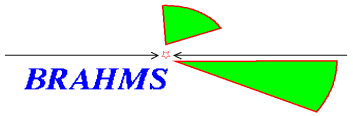
Since all of the FY03 running will be with dA and pp the system should be setup initially to deal with this.The structure of these slides are

- Issues and why dA and pp triggers has to be improved over past experience.
  - Level 0 and min bias determination
  - Spectrometer triggers (and timing) discussed by Dana.
  - Vertex determination.
  - Electronics..

January 2002 pp running



- The tracks per pp (and dA) event is low so it is/was essential to deploy spectrometer triggers. The interaction rate was ~20-40K/sec.The max nominal luminosity is ~400K
- The Min bias trigger was formed using the INEL counters with a left+right coincidence (additional information in back)
- For MRS two special counters was build. A front start counter TMRSF as well as a 5 slat 80 cm long counters placed behind the TOFW. The trigger was formed as INEL*TMRSF*BACK*RC (RC being the rhic clock)
- For FS one counter was build TD1 (3 slats in front of D1) was defined by From both H1 and H2 we formed in the FEH using NIM electronics an or of up/down discriminator signals. For data-taking exclusively the following was used INEL*TD1*H1, but a FS trigger INEL*TD1*H1*H2 was commissioned and a trigger bit set for part of the run.
- The trigger were effective in selecting events with tracks. Under most (but not all beam conditions) there were ~.4-.6 track per FS trigger and in MRS ~.3 per trigger. The factor is dependent on the angle settings.
- The in-efficiency of the trigger I.e. how often was a good track missed is not studied in detail but from online it was concluded to be > 90%.Most of this presumably comes mainly from the inefficiency also seen in regular FS analysis of H1,H2.

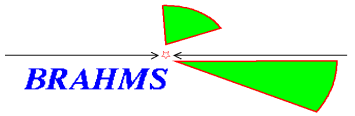


Issues for dA and pp running

The running of dA and pp raises several issues. For each of the species one needs to have

- Level 0 (luminosity, min bias) trigger systems. Requirements are high efficiency, and needs timing at ~1 nsec level.
- Vertex determination for most events, 4 cm requirement s deal (8-9 as from INEL may not be sufficient with the 200MHz re-bunched beam)
- Spectrometer system needs trigger counters for track selection.
  - The pp setup used last year for MRS will not work for dA.

- Centrality selection in d-Au.
  - Select on charged particles using existing Tile array + left BB.
  - Should we add additional coverage? In array and/or outside?
- Beam expectations
  - dA: 56 bunches beta*=2; .9mrad angle for both beams;I.e 0.06 degree thus neglible in terms of y-pt. L<av>~1.6.10**28; ie.interaction rate of (2.2b) => 40K/sec.
  - Pp 112 bunches beta*=2 ; L<av> 10.10**30 => interaction rate of 400K/sec



Spectrometer triggers

- This is the almost easiest part of the trigger issue. See also Dana's presentation

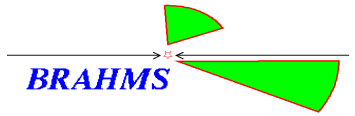
FS

- The evaluation is that even at 3 deg the TD1 front triggers will have a small double hit probability (3 segments). The expected dN/deta in the forward region is ~2*pp in dA.
- The timing of TD1 is satisfactory, and the combination with H1,H2 worked well in pp . There is no reason this should not be the case for dA too. The electronics is already setup in FEH, though one could use the VME modules described below to simplify setup.

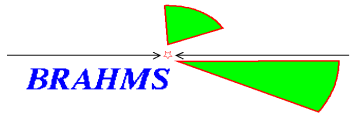
MRS

- Solution: Use the TOFW-panel hits to generate part of the trigger. This will be done on the platform, feeding one output from the discriminators to a NIM/ECL converters (housed in a CAMAC crate) and then into VME modules that performs a parallel AND between up/down hits and a final Or. The final production is in place and will be done in ~ 1 week.
- The insertion time is as good as the equivalent NIM circuits. (RAS,DB)

Spectrometer Triggers continued



- A front start & trigger counters has to be segmented to handle dA.
- The present design is to have a slats ~ 3 cm tall 5 cm wide and 1 cm thick with a single PMT tube on each. There will be 6 slats with Tubes + 5 cm light guide alternating up/down. This arrangement will be right in front of TPM1 but placed on its own stand. Track projections to correct for transition time within the scintillation material for offline analysis.
- Online the trigger logic (a simple Or) will be made in FEH.
- This detector is alomost complete and ready for installation
- Thus the final MRS track trigger will be made from an AND of this TMRF trigger (or whatever name it will have) and the grand or from the TOFW panels.



Min Bias counters

The INEL counter system (from pp2pp) has as designed a high efficiency for detecting min bias non single diffractive (NSD) pp events (~95%).

Two issues

1. The timing difference between station 1 in left+right is only 5 nsec, so it is difficult to discriminate between halo events hitting first Left then right from collision events that took place with the +-78 cm between the detectors.
2. Part of the station 1 (and 2) in the right hand side sits in the path of particles towards the FS, and should preferably be removed. This will lower the efficiency somewhat by another 10% for pp

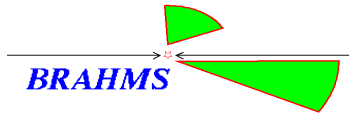
For dA the efficiency is quite high using these counters (see later plots), although it has yet to be studied how the eff it is for more peripheral dA (which most be like 2*pp in right array.)

In terms of overall efficiency for making both Level 0 , as well as for luminosity measurements these counters are satisfactory. The real issue is how to improve the timing information such a ‘vertex’ can be reconstructed with a good sigma (~5 cm).

Possible solutions could be

- Add another tubes to each module of the INEL + ADC information
- Replace some of the station with large solid angle scint. Slats with multiple tubes for readout.

See some of the possibilities discussed by Hiro.



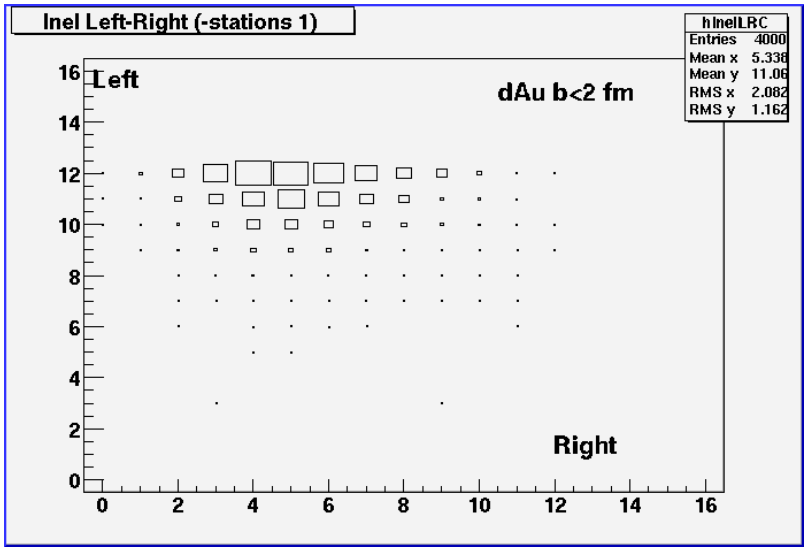
Vertex information

It is important to have event by event vertex information for the following purposes

1. Acceptance depends on vertex position – typically done in 5 cm bins. The MRS track do point to this accuracy to the beam line, but the FS tracks NOT in particular at the more forward angles.
2. The position of tracks are compared to the event vertex and used to reject background tracks.
3. The vertex is used to count min bias (or centrality selected) events within each vertex.

- The resolution of ~8-9 cm was obtained from the INEL. Such resolution is probably ok for normalization purposes, but is not so good for rejection of FS and MRS tracks (I.e. we will get a larger background contribution to tracking). Too with the expected 200 MHz re bunching of the beam the vertex distribution becomes narrower with faster falloff; thus increasing the requirement for
- For dA the left array (beam-beam) should have a reasonable probability to give information for all data. This may be used to impose constraint on track selection.

Efficiency for d-Au



For central d-au the combination of Inelastic station 2-3 (each side) is very efficient for central d-Au. See upper slide.

For min bias an overall efficiency is about 90% - slide still to come.

The efficiency for present Beam-Beam counters is about ~49%; It can be increased to ~58% by adding a Pb-converter (1 cm) on the front of each rube. The real problem is that even this has an centrality dependent efficiency which as best is ~80%. The next slide shows this.

Centrality

It seems that a combination of the Tile ADC (I.e. multiplicity in –1<e<2 and Left BB may do reasonable well for centrality selection.

Adjacent plots illustrate the features