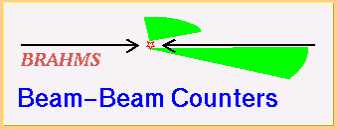


BRAHMS Beam-Beam Counters in First Collisions at RHIC

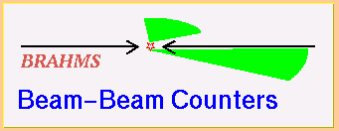
Yury Blyakhman, Burton Budick

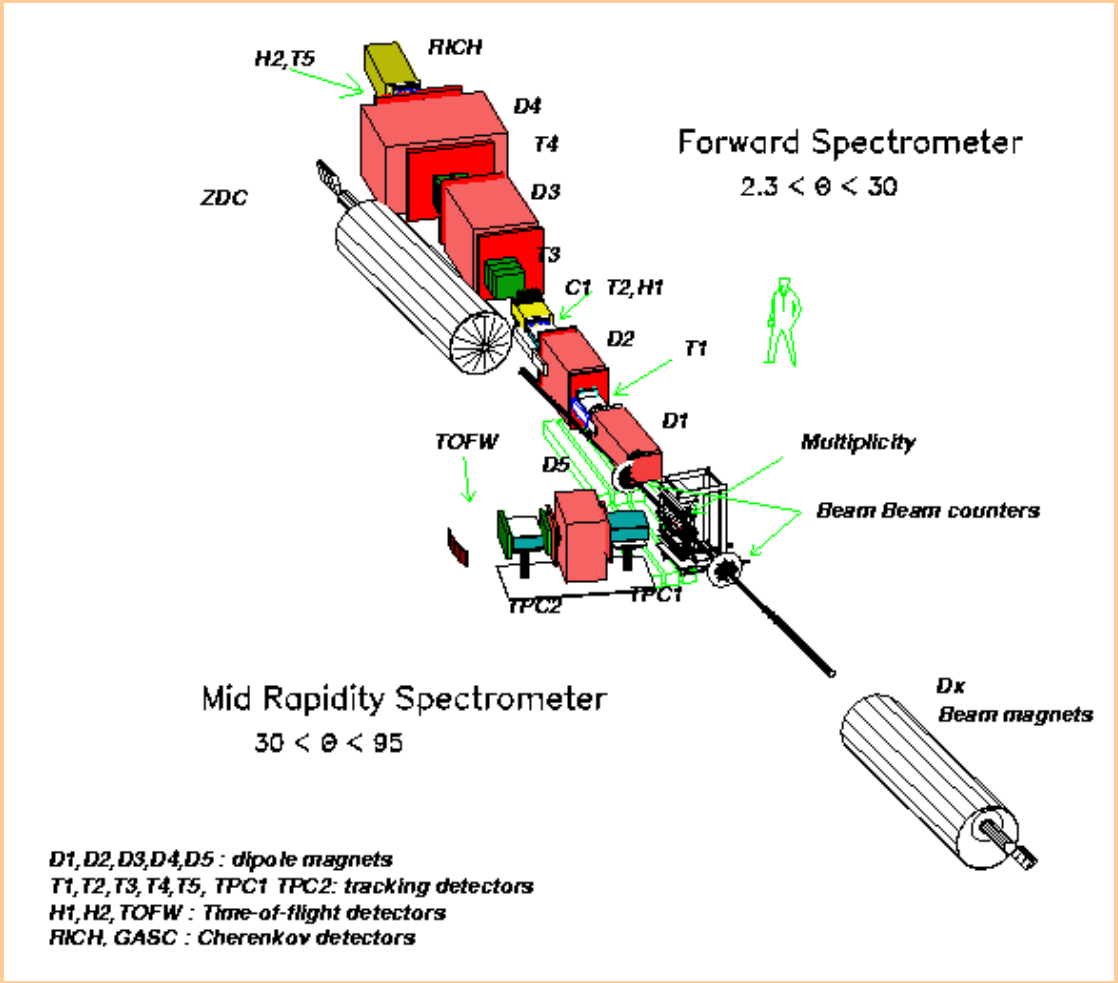
New York University, Physics Department

BRAHMS Collaboration

October 2000

Broad RAnge Hadron Magnetic Spectrometer
BRAHMS :



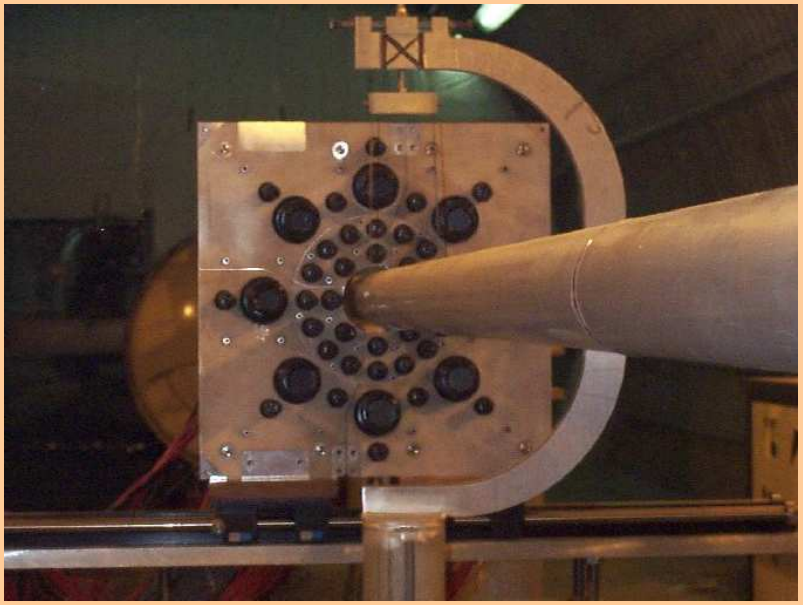


Beam-Beam Counters:

- Characterize collisions from a global perspective.
- Provide Level0 trigger.
- Permit a rapid estimate of a collision point (±20*mm*).
- Get Charged multiplicity values at wide range of η.

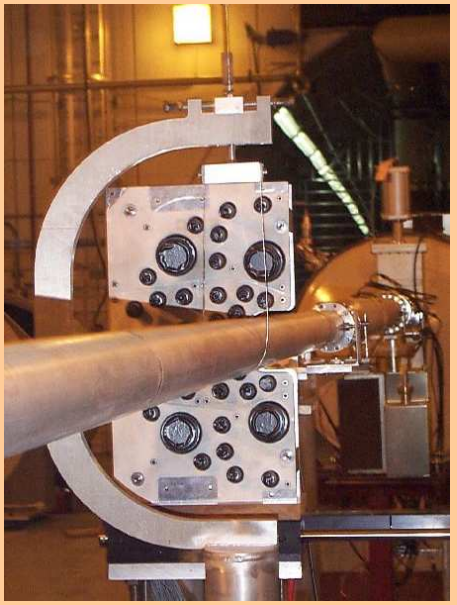
Figure 1: **A perspective view of BRAHMS detector system.**

Left Array



- Located 220cm form the vertex
- 2 types of Cherenkov radiators, glued to the photomultiplier tube
- Diameters:19mm and 51mm
- Radiators: 30mm and 40mm

Right Array



Right Array geometry is restricted by the magnet D1 :

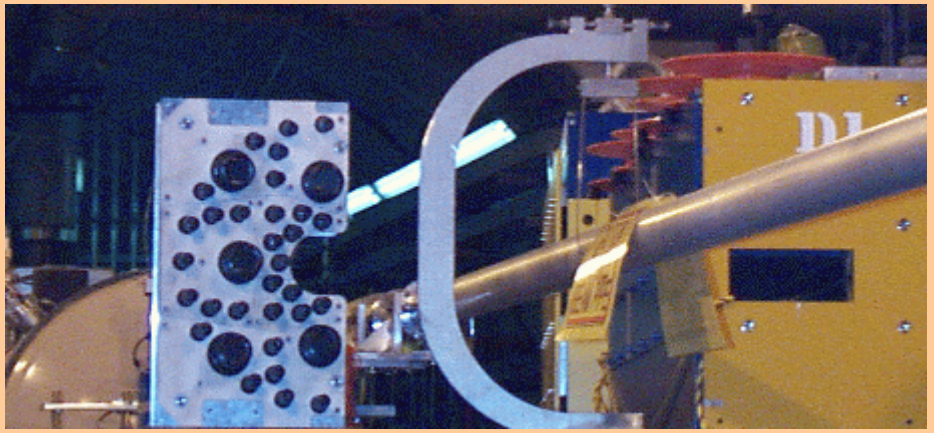
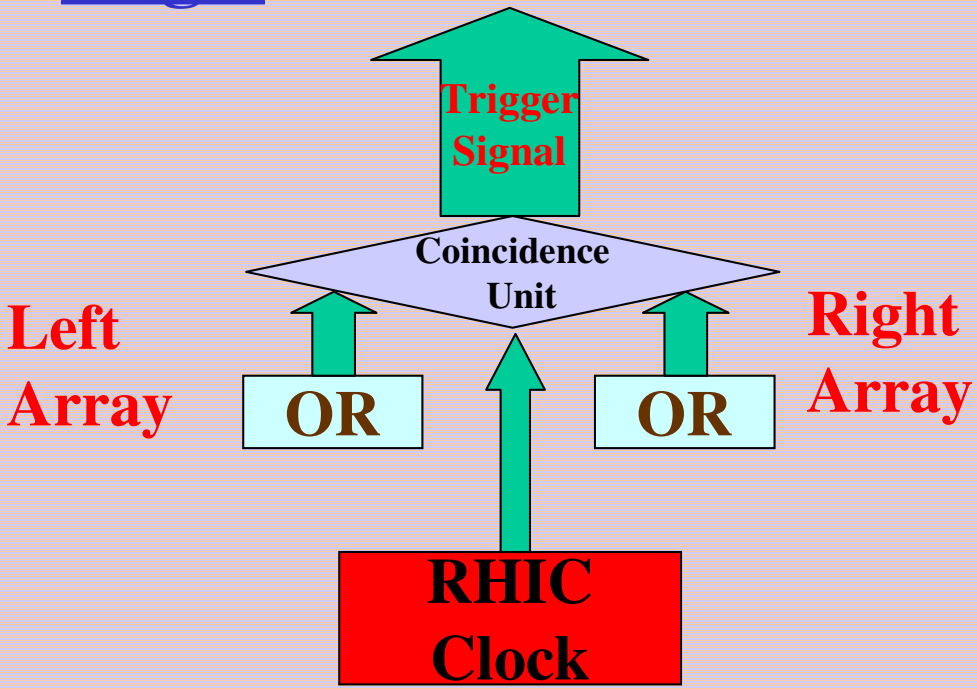


Figure 2: **Actual view of the Beam-Beam Counters.**

Logic



Number of hits, triggering the "OR" unit and Gate Width in the Coincidence Unit are defined by the kind of events we want to detect.

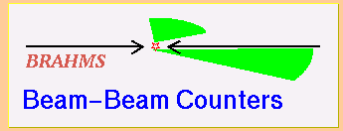
Conditions:

- β=1 Particles;
- 50 *psec* Tube Resolution

Figure 3: **Beam-Beam Counters Logic and Outline**

Beam-Beam Triggers by the coincidence of fine-timed Big Tubes:

- **Any 2 Tubes in each array within a *5nsec* Gate;**
- **Any 3 Tubes in each array within a *14nsec* Gate;**
- **2 perfectly timed Tubes in each array within a *5nsec* Gate.**



First Collisions at BRAHMS were detected by ZDC's and Beam-Beam Counters :

$$(t_{BB_L} - t_{BB_R}) = 0$$

and

$$(t_{ZDC_L} - t_{ZDC_R}) = 0$$

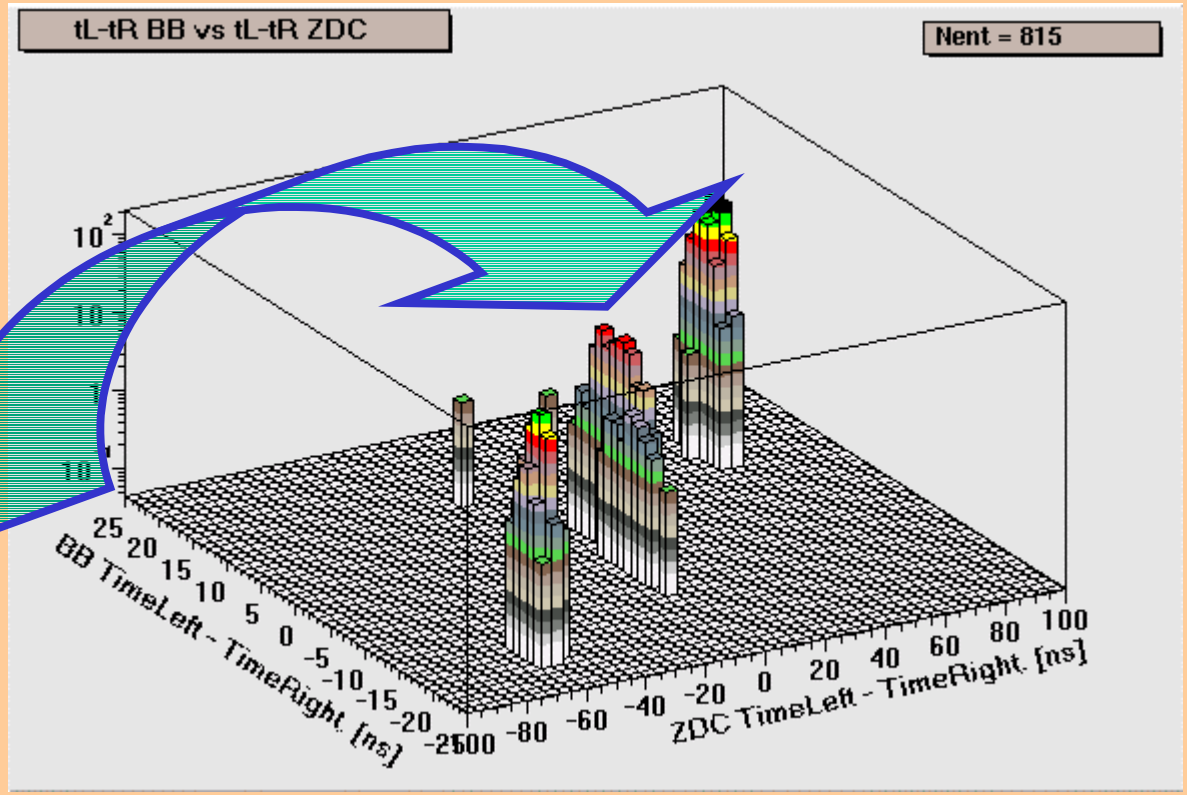
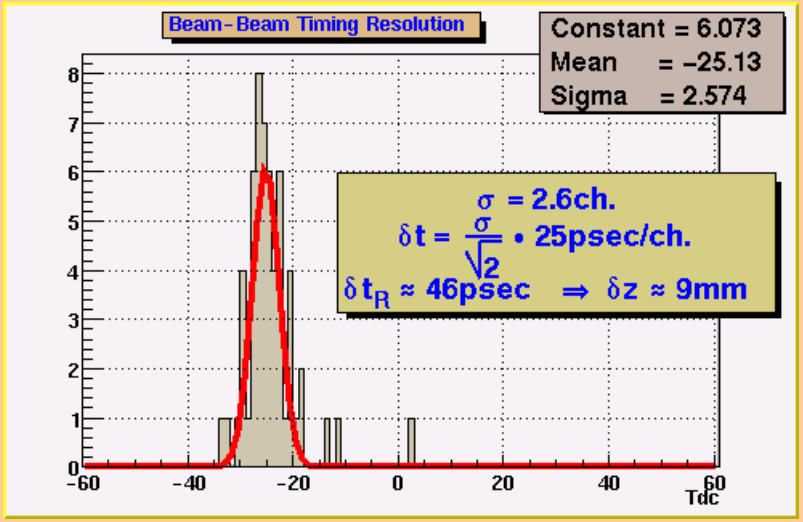
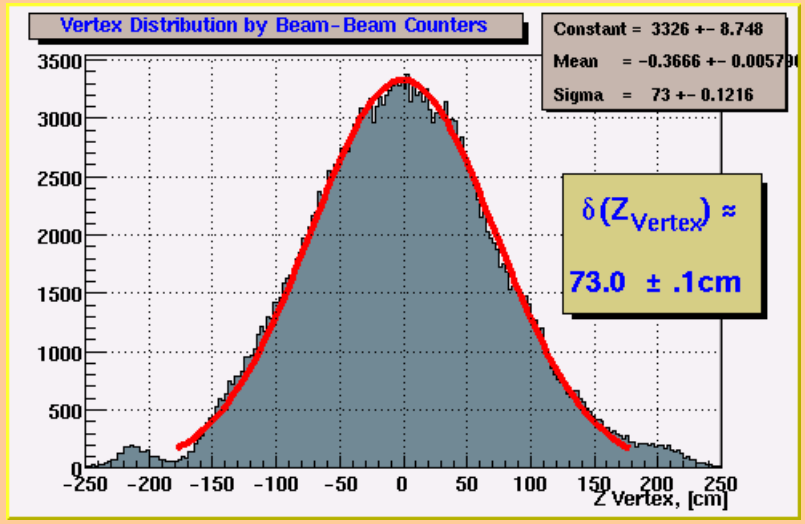
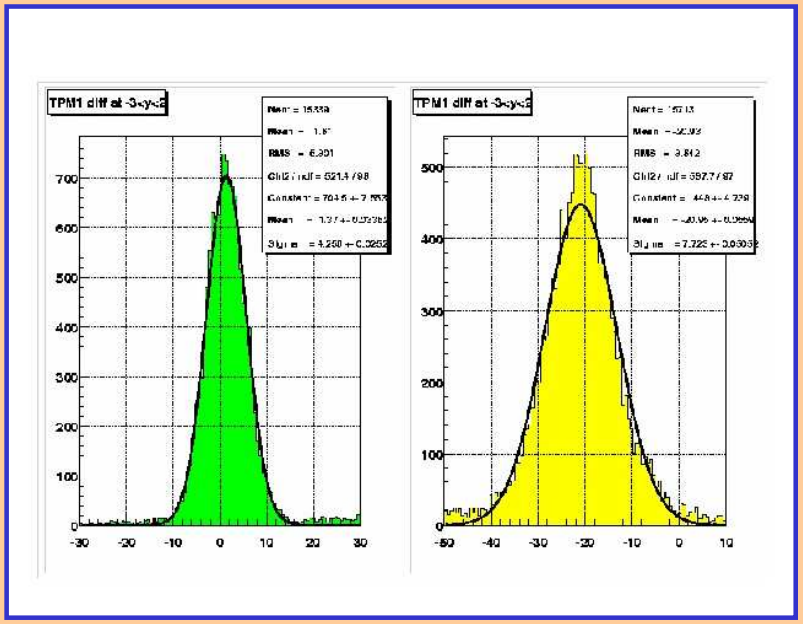


Figure 4: **Beam-Beam Trigger.**

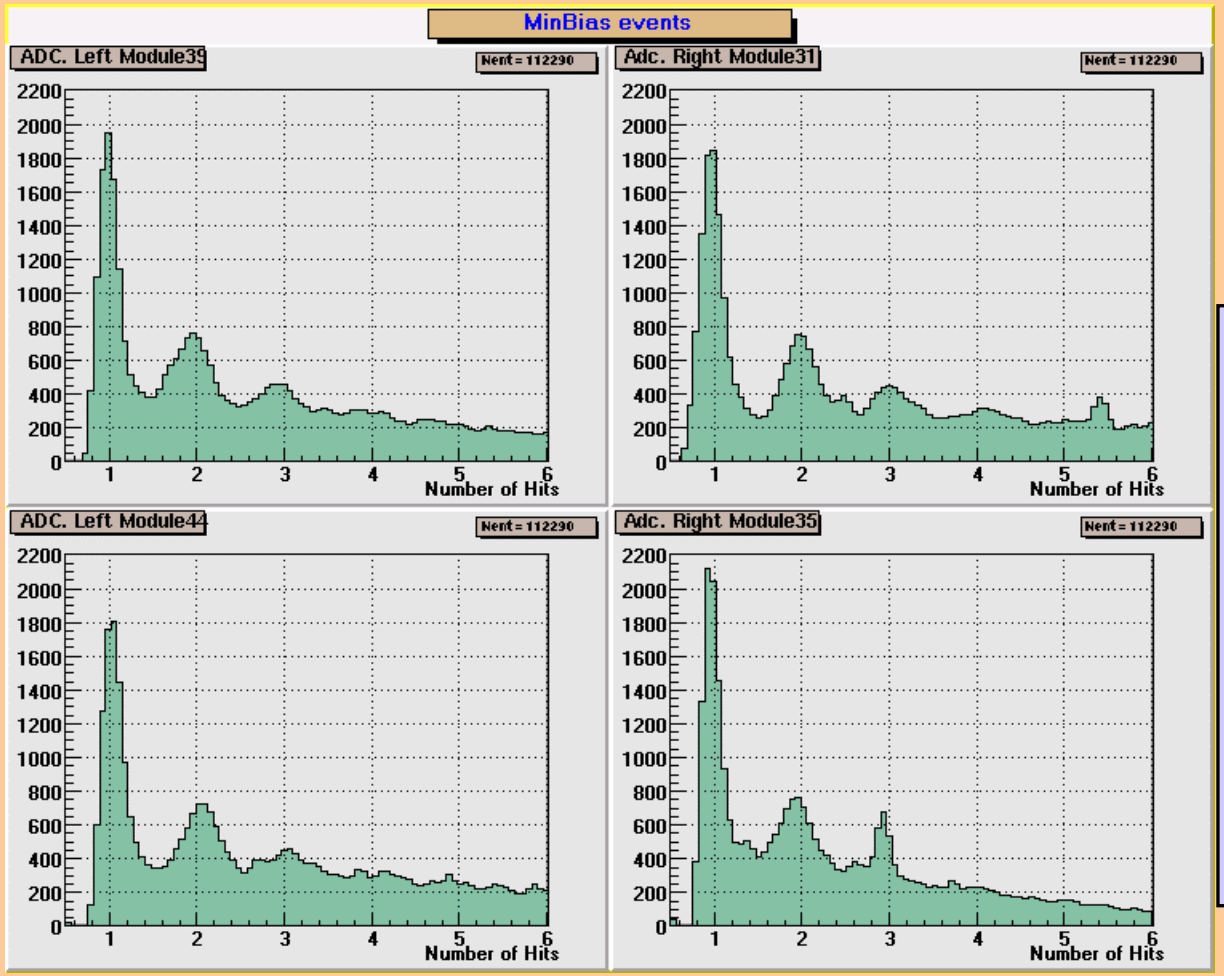


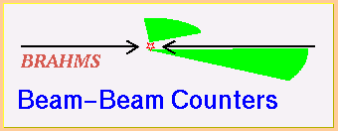




By using vertex, defined by the TPC, Beam-Beam *z*-resolution was defined with a precision of $\delta z = \pm 4.2cm$

Figure 5: **Beam-Beam Timing and Vertex Definition.**





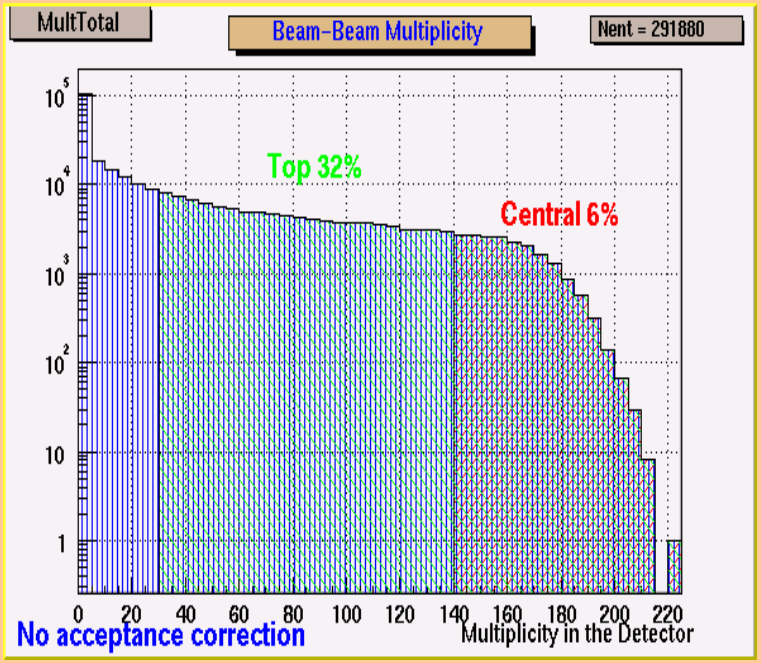
"Good Collision Events" conditions:

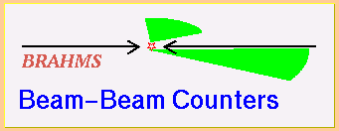
1. **Two Big Beam-Beam Counters Tubes coincidence within a narrow gate;**

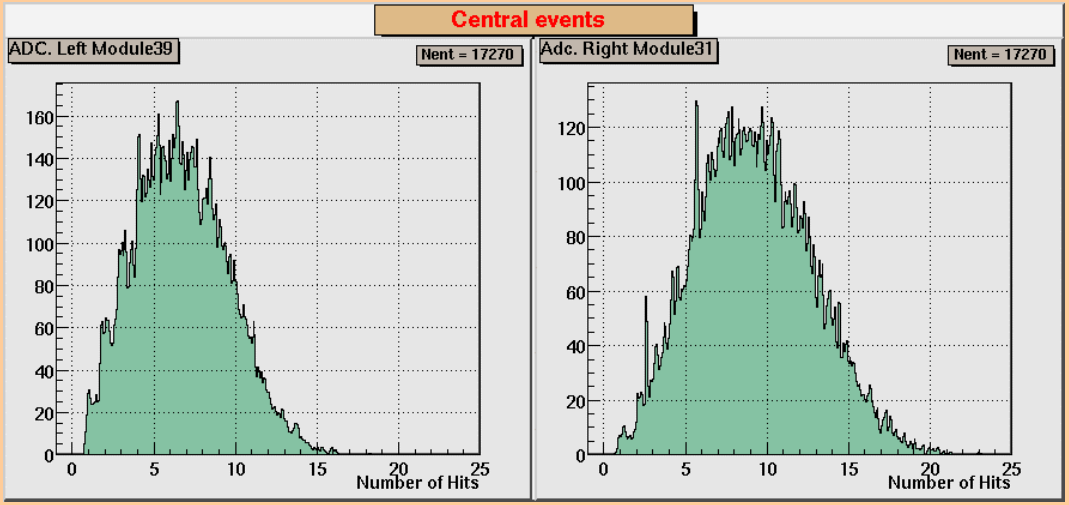
2. **ZDC Trigger, to include most peripheral collisions;**

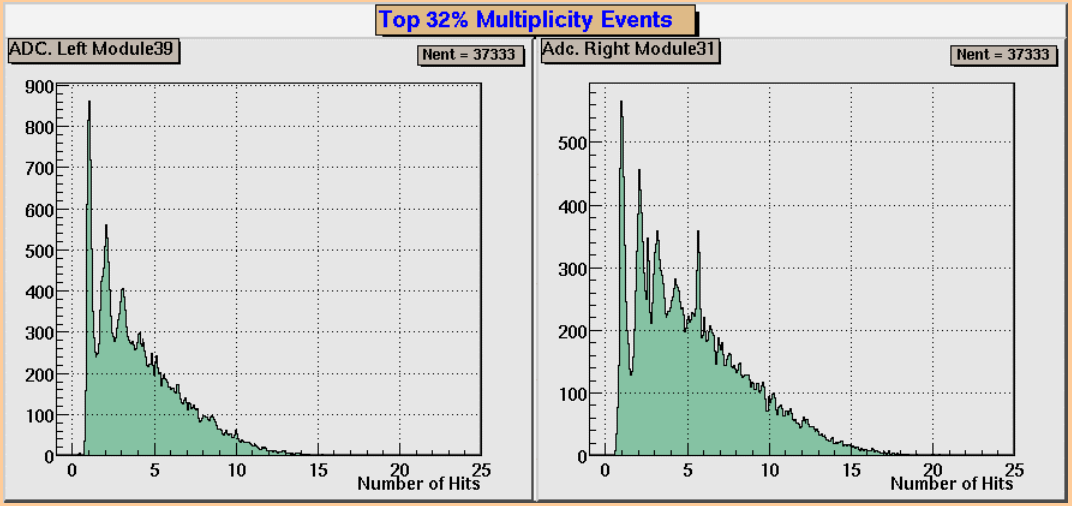
3. **Collision vertex location to be within 45*cm* of the physical vertex to ensure proper Beam-Beam acceptance, since they are pointing to the physical center of the detector.**

Figure 6: **Minimum Bias Events.**





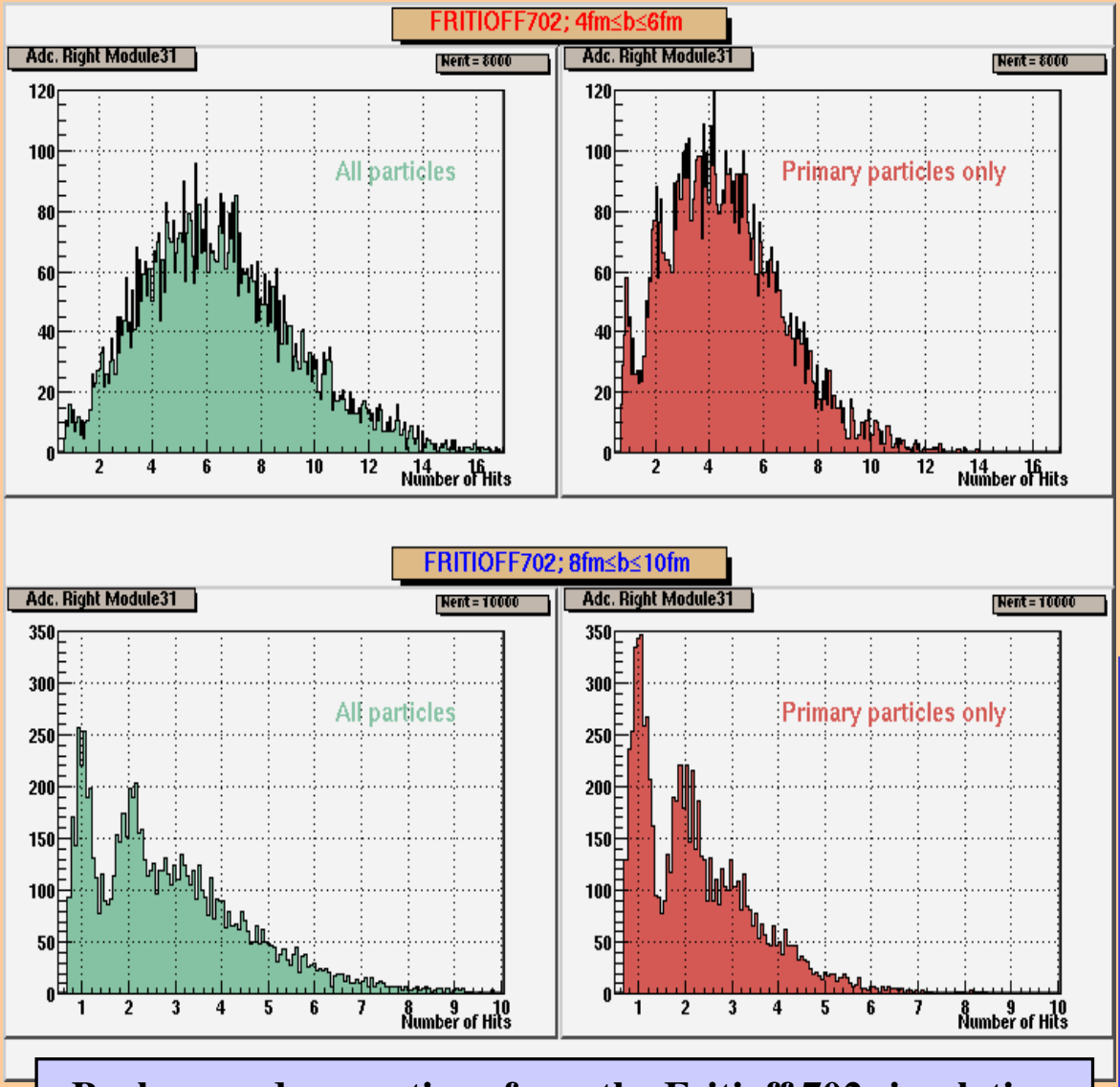


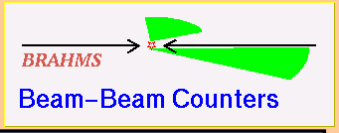


Multiplicity =

$$\frac{\text{Adc Value} - \text{Pedestal}}{\text{Pulse Height of 1Hit}}$$

Figure 7: **Multiplicity and Centrality.**





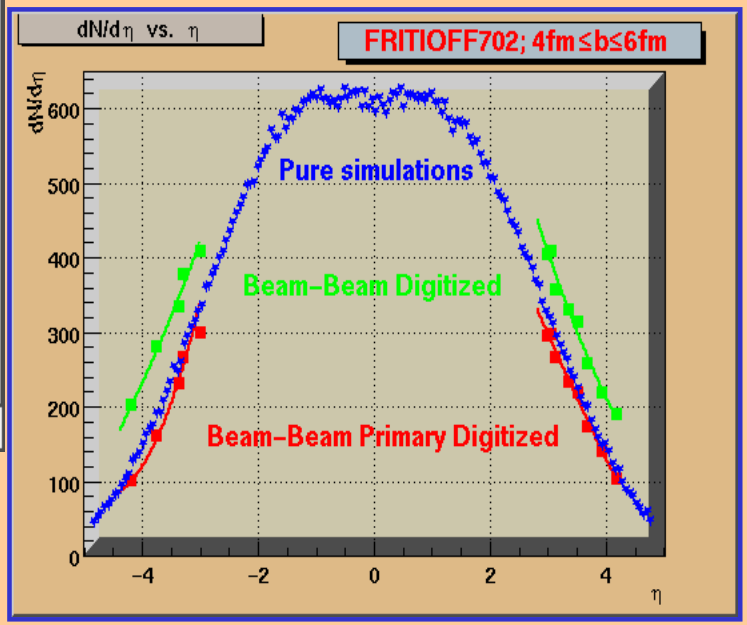
Beam-Beam Geometry

η Coverage:

$3.00 \leq |\eta| \leq 4.20$

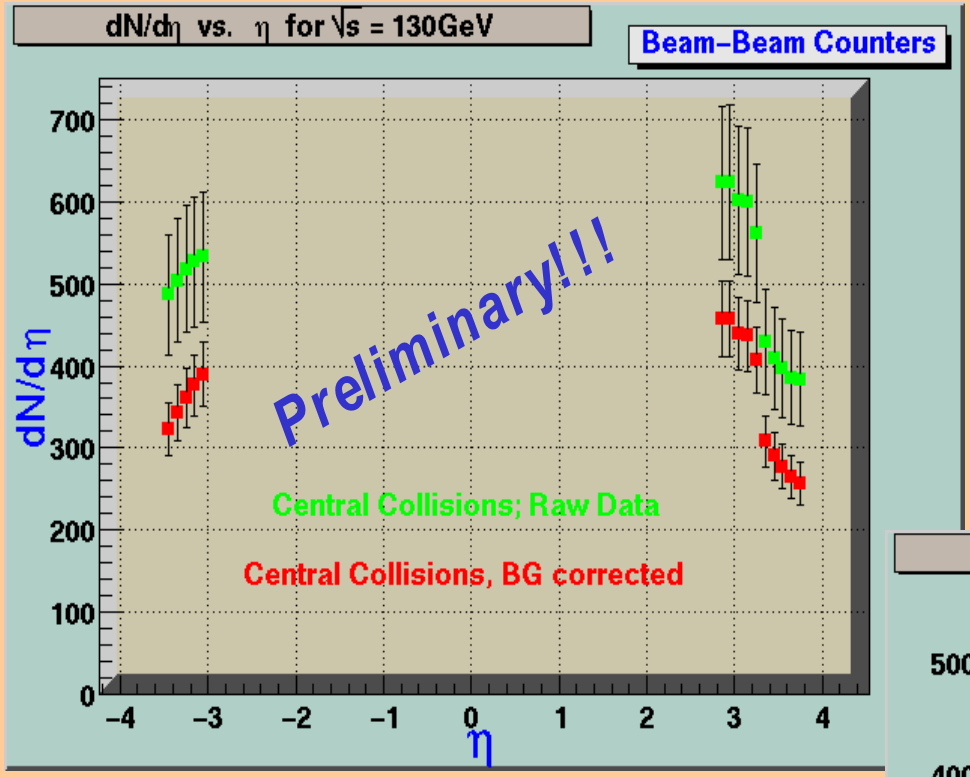
Background Correction:

Extracted as a fraction of two functions :

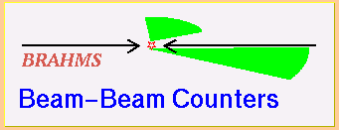


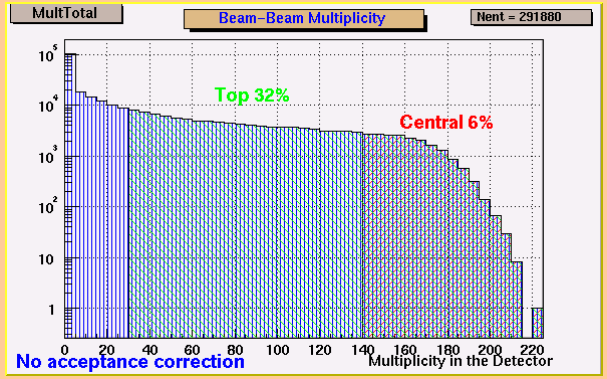
Background corrections from the Fritioff 702 simulation and from the rough estimations for real data was different by less than 5%

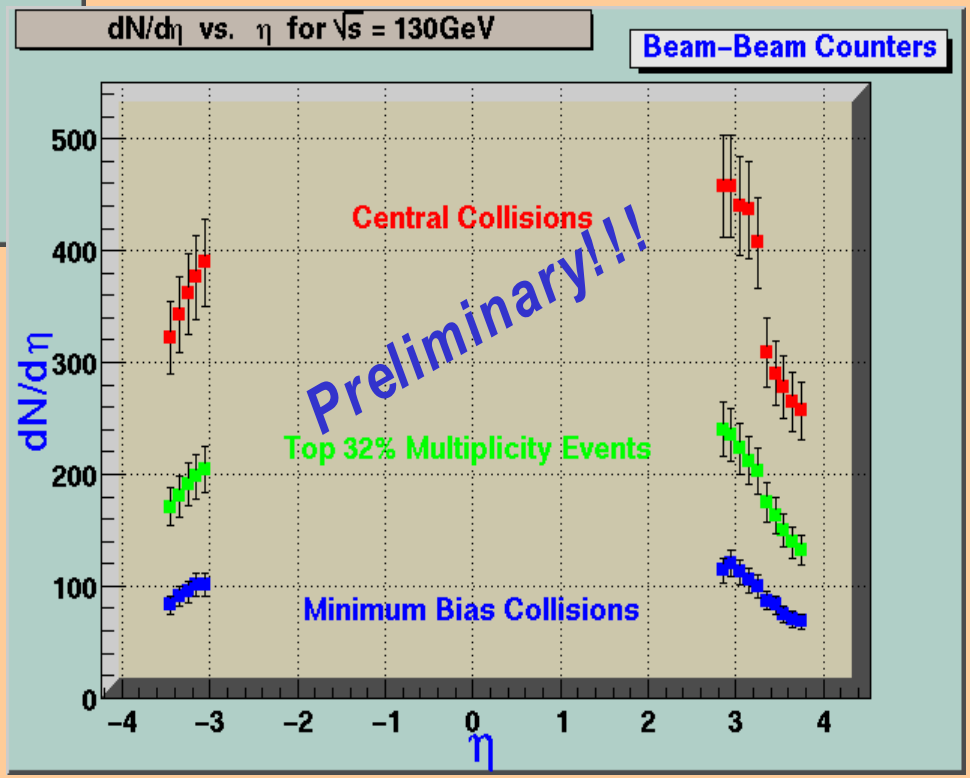
Figure 8: **GEANT Estimations.**



$|Z_{vertex}| \leq 45cm$



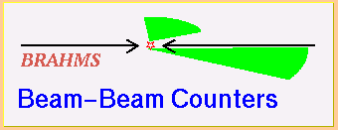




dN/dη calculated :

- on Event-per-Event basis;
- Using Vertex defined by Beam-Beam Counters (precision of 4.2cm introduced less than 2% difference);
- Using only Big Tubes (for now)
- $\delta(\eta) = .05$;
- $\delta(dN/d\eta)_{Stat} \leq 5\%$;
- $\delta(dN/d\eta)_{System.} \leq 10\%$
- $\delta(dN/d\eta)_{System.\ from\ the\ BG\ Correction} \leq 15\%$

Figure 9: **Real Data Analysis.**



Conclusion and Present Status:

Commissioning and Data Run of Summer'2000 demonstrates, that Beam-Beam Counters show a great performance in serving as a Level0 trigger for BRAHMS:

- **Serve as a start for BRAHMS detectors;**
- **Identify collisions for RHIC;**
- **Provide information on $dN/d\eta$ values for large η.**