A reaction detector for CBM

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A detector placed around the target outside of the CBM acceptance (θ >25 deg) and registering reaction products of AuAu @ 10 AGeV and pC @ 30 GeV reactions was simulated. Equipped with a simple signal summing-up and threshold electronics such a reaction detector (RD) can distinquish between central, minimum bias and empty reactions in case of Au+Au and can deliver a "time zero" signal for TOF measurement even for p+C reactions.

Details of the simulation

A detector in form of a ring consisting of eight trapezoidal tails installed side by side (as depicted in Fig.1) covering polar angle of 30 to 60 deg and full azimuthal angle was investigated in the framework of the FAIR-ROOT [1] simulation system using Geant3 transport engine. Sensor material of 2 mm thickness and density of silicon has been assumed for the flat dies installed at 60 mm distance from the target center (0.25 Au or 1 mm C). This thickness corresponds to either ceramic RPC or to a MCP sensors - both posessing excellent timing properties and certain energy resolution. Standard URQMD AuAu @ 10 AGeV minimum bias and central events as well as pC @ 30 GeV have been used as input. FAIR-ROOT intrinsic "FairIonGenerator" method has been used to simulate "empty events" e.g. passage of heavy ion through the target material without any nuclear interaction, thus producing only delta electrons.

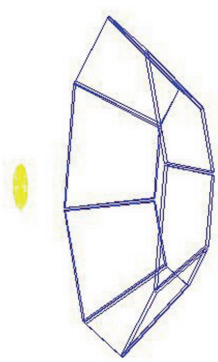

Figure 1: Reaction detector: ring of eight trapezoidal segments around the target (beam direction horizontally).

Simulations results

The sum of energy loss signals of all products from a nuclear collision in the reaction detector differs significantly for minimum bias or central events and "empty events" as presented in Fig.2. The lowest energy losses (below 10 MeV) and lowest multiplicities (8±2.5) are registered mainly for "empty events". Minimum bias events are characterized by the sum of energy loss in the reaction detector in the range up to 50 MeV. The highest energy loss (and at the same time highest particle multiplicity) is observed for central events. A simple threshold at 10 MeV of total energy loss per event would deliver a clear signature for nuclear reaction events (about 10 % of min bias events would be lost).

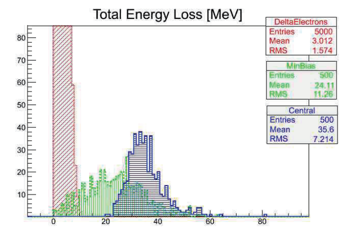

Figure 2: Total energy loss for central (hatched horizontally), minimum bias (hatched vertically) and empty events (inclined hatching).

Timing properties

The total energy loss signal can be used not only for nuclear reaction tagging but also as a "time zero" for TOF measurement. Due to the RD axial symmetry around the target the time spread of arriving particles is very narrow: RMS=10 ps. For 30 GeV protons on carbon target a similar time resolution is achieved as shown in Fig.3.

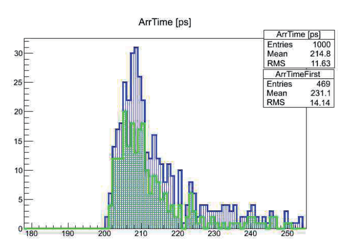

Figure 3: Time resolution for 30 GeV protons on carbon target. An additional requirement of at least a double hit in RD reduces the efficiency to 50%.

References

[1] http://fairroot.gsi.de/