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# Note on Triggers in Collider Experiments with Heavy Ions

1) A trivial criterion for event selection in ultrarelativistic heavy ion collisions is centrality. Such a trigger can be de-rived from the forward energy or the multiplicity of the pro-duced (charged) particles (at midrapidity). At RHIC and LHC such a selection will result in a trigger rate of 100 events/s.This is to be compared to current storage media technology which limits the recording rate to 1 event/s.

2) It is conceivable and straight forward in principle to devisea trigger on jets by means of a calorimeter or online track recognition of fast i.e. straight tracks in a tracking devicee.g. a TPC. Such a trigger will be uncontroversial, if the jet signature is well defined and any background is small and well understood.

3) Any other, more sophisticated, trigger scheme is based on speculations about possible signals from 'interesting events' rather than concrete quantitative predictions from theory. Such triggers require careful study of signifcance and bias and therefore high statistics data samples. In fact a neccesarycondition for the understanding of the trigger is the knowledge of the distribution of the trigger observable for the full event sample. The standard scheme of having a minimum bias run in order to learn about the features of various trigger modes is not sufficient for triggers selecting rare events, because the number of events from a minimum bias run fulfilling the trigger criteria is by definition (too) small. On the other hand, in such trigger studies the full event information is not really needed. Only the information which enters into the trigger decision has to be recorded.

4) Based on the considerations of 3) I propose to change the standard data acquisition scheme in such a way as to allow only parts of the events to be recorded. In fact some information of each (central) event should be recorded. As a minimum all variables in which the trigger cut is applied should be stored in a histogram. For example: if a trigger selects some exotic ratio of charged particles to E.M.-energy, the full distribution of that ratio should be available after the run. A more complete and com- prehensive strategy is to preserve all raw data

needed for the trigger decision. Raw data means here the information recorded by the detectors. In the example above, this comprises the data from the (charged) particle multiplicity detector and from the E.M.-calorimeter. Rare triggers require a very good understanding of detector response, simply because the malfunctioning of a detector may be more probable than the occurrence of the real rare event. Offline analysis of the trigger procedures on large numbers of events are therefore mandatory.

5) Sophisticated 3rd level triggers could, in the spirit of what was said in 4), be considered as event filters: an event, which is presented to the 3rd level trigger processor, will be written to tape in its entirety only if it fulfils the trigger condition; if not, only the information used in the 3rd level trigger will be recorded (e.g. the outer sectors of the TPC). Both actions constitute a filter process: in the first action the filter selects (complete) events, in the second parts of the events are fitered out for recording on the storage device.

In the presented scheme the volume of data per event recorded will vary significantly, but the total amount of bytes written to tape per run will be the same and given by the writing speed. The number of complete events will be reduced in favor of trigger information from the complete ensemble of events.