A Monte Carlo feasibility study of the CBM event reconstruction at high interaction rates based on time information. *

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A Monte-Carlo simulation was performed in order to study the feasibility of event reconstruction at high interaction rates based on the timing information provided by the Silicon Tracking System (STS). A parameter which could be used for event separation is the reconstructed interaction time $T_0$. In our study, the resolution of the reconstructed $T_0$ is determined mostly by the time resolution of the STS which is in the order of 5 ns. We will study the separation of events in time-base simulations using a cut in $\Delta T_0$ for a reaction rate of $10^7$/s. We have to take into account two different situations: if $\Delta T_0$ of two different interactions is smaller than the $\Delta T_0$ cut value, there is the possibility to combine reconstructed tracks of particles from two different interactions in one event; If the $T_0$ reconstruction resolution is greater than $\Delta T_0$ cut value, there is the possibility to divide the reconstructed tracks of particles from the same interaction in two different events. In Figure 1 the relative numbers of combined and divided events are presented as function of the $\Delta T_0$ cut value, the assumed $T_0$ resolution is 5 ns. It can be seen that with a $\Delta T_0$ cut value of 5 ns for example the number of divided events (red squares) is about 15%, and the number of combined events (black circles) is about 6%. With increasing $\Delta T_0$ cut value the number of divided events decreases dramatically, but the number of combined events increases up to 20% for a $\Delta T_0$ cut value of 20 ns. It is clear, that for event separation at interaction rates as high as $10^7$/s an additional cut variable is needed.

The separation of different events can be improved by using the information on the different positions of the primary vertices in addition to the reconstructed $T_0$ values. For the simulation we assume a Gaussian distribution of the beam particles at the target (i.e. of the primary vertices) with a FWHM of 1 cm. In figure 2 the distribution of the primary vertices in horizontal (upper plot) and vertical position (lower plot) is shown as function of time. The height and the length of the symbols correspond to a vertex resolution of 100 µm and a reconstruction resolution of 20 ns, respectively. It can be seen that the events are clearly separated in space and time for an interaction rate of $10^7$/s. Taking into account the position information of the primary vertex it is possible to reduce the number of combined events by up to 2 orders of magnitude.

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Figure 1: Number of combined (black circles) and divided (red squares) events as a function of the $\Delta T_0$ cut value for a resolution of the reconstructed interaction time of 5 ns.

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Figure 2: Primary vertex distribution in horizontal (upper plot) and vertical (lower plot) direction for a Gaussian distribution of the beam particles with FWHM = 1 cm for an interaction rate of $10^7$/s as function of time. The symbol size corresponds to a vertex resolution of 100 µm, and a resolution of the interaction time of 20 ns.