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Investigations of transit times for tune scan slow extraction at SIS18 GSI

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The temporary quality of the slowly extracted beams from a synchrotron on the 100 microseconds time scale is crucial for fixed-target experiments and hadron therapy. The spill micro structure is caused by power supply ripples that act on the ring quadrupoles. To reveal the beam dynamics of the slowly extracted beams, the transit time is investigated theoretically and experimentally. It is a crucial physics quantity which relates the beam dynamics inside the synchrotron with the temporal structure of the extracted beam. The investigation was performed at SIS18 at GSI, where tune scan slow extraction is routinely performed. In simulation, different approaches for the transit time determination were proposed and executed with particle tracking tools Xsuite. Experimentally, spills with sinusoidal tune excitations were evaluated, and the results show that the variation of transit time and spread during extraction is related to emittance reduction during the extraction process. Spill quality improvements described by the duty factor increases for smaller emittances had been shown in previous papers and will shortly be repeated here. To achieve a better insight into the beam dynamics an experimental test of quasi-step-type excitations of a fast quadrupole field was performed experimentally. The results and conclusions will be presented.

Primary author: YANG, Jiangyan (DUMMY (unkown institute)(DUMMY))

Co-authors: FORCK, Peter (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI)); SINGH, Rahul (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI)); SORGE, Stefan (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Presenter: YANG, Jiangyan (DUMMY (unkown institute)(DUMMY))

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