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Loss reduction techniques for synchrotron slow extraction and beam delivery: simulations and recent measurements at MedAustron

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Slow extraction using third integer resonance and a thin electrostatic septum is a common extraction scheme employed when a continous beam delivery is required downstream, such as in medical ion-therapy treatment or for fixed target physics experiments. Moreover, the beam often needs to be split in the transfer line after being extracted, if a simultaneous continuous spill is requested by more than one user. This is the case in the SPS North Area transfer line (TT20), where a Lambertson splitter septum is used. Both the extraction and the splitting processes are intrinsically lossy, as some particles inevitably impact with the septa blades or the aperture. In this contribution, loss reduction techniques are explored with the aim to reduce overall losses from the synchrotron to the user. Different slow extraction techniques, namely quadrupole sweep, betatron core and constant optics (COSE), are compared in simulations as well as through recently acquired data taken at the MedAustron ion beam cancer treatment facility in Wiener Neustadt, Austria.

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