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Expanding the CERN ion injector chain capabilities: new beam dynamics simulation tools for future ion species

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The present ion physics program in the CERN accelerator complex is mainly based on Pb ion beams. The ALICE3 detector upgrade proposal at the Large Hadron Collider (LHC) requests significantly higher integrated nucleon-nucleon luminosity compared to the present Pb beams, which can potentially be achieved with lighter ion species. These lighter ion species have also been requested by the fixed-target experiment NA61/SHINE in the CERN North Area (NA). To assess the performance capabilities of the CERN Ion Injector chain (consisting of Linac3, LEIR, PS and SPS) for light ions, for which there is little or no operational experience at CERN, beam-brightness and intensity limitations need to be studied. This contribution presents tracking simulation results for the PS and SPS, compared against recent experimental beam data for Pb in the Ion Injectors. These simulations include limiting beam-dynamics effects such as space charge and intra-beam scattering, and their impact on the intensity and emittance evolution is discussed. These simulation models are used to predict the optimal ion species for maximum performance out of the Ion Injector Chain.

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