

PhD project

Title: Studies of beam dynamics limitations across the ion injector complex at CERN

In the present CERN Long Term Accelerator Schedule, heavy-ion operation ends with Run 4. However, there are presently studies ongoing on how to extend the ion program to Run 5 and beyond. The main interest would be to operate with significantly higher luminosity as compared to the Pb ion beams operated so far, which could potentially be achieved with lighter ion species. To achieve the requested increase in luminosity the ion injector chain consisting of Linac3, LEIR, PS and SPS will need to provide significantly higher beam intensities as compared to the Pb ion beams. So far the operational experience with light ion beams in the injector chain is very limited and the beam dynamics limitations for these beams are not well known, and therefore it is difficult to make predictions on the intensity reach of the injector complex.

The goal for this PhD project is to establish the performance limitations from incoherent effects such as Intra Beam Scattering (IBS) and space charge (SC) across the ion injector chain. In particular, the aim is to develop a simulation model for each machine that is benchmarked with the observations with Pb-ion beams already available in the complex. In a second step, the candidate will perform experimental studies with the O-beams, which will be produced for a test run in the LHC in 2023. Based on these two ion species, a generalized scaling of IBS and SC limitations will be established. Finally, this model will be used to optimize the performance of the ion injector chain by finding the best isotopes or charge state at LEIR injection, defining the optimum number of bunch splitting in the PS, and possibly also by using a stripper in the LEIR to PS transfer line.

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