Thesis: Master
Faculty: Physics
Type: (numerical-modelling/data analysis)
Title: Numerical investigations of SPIDER negative ion beam in support of Beam Emission Spectroscopy
Tutor RFX: Riccardo Agnello, Marco Barbisan, Roberto Pasqualotto
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Topic of thesis: emission spectroscopy/negative ion beams

The negative ion source SPIDER, located at Consorzio RFX (Padova, Italy) is the full-scale prototype of the source for the Heating Neutral Beam (HNB) Injector for the fusion reactor ITER. SPIDER's main goals are investigating the extracted negative ion beam and optimizing its performances in terms of current, homogeneity and extraction optics. Multiple diagnostics are routinely employed in SPIDER to measure the extracted negative ion beam. One of these techniques, the Beam Emission Spectroscopy (BES) relies on the analysis of the emission spectrum of beam particles interacting with the background gas. BES technique is employed to estimate the beam divergence, one of the crucial parameter for HNB optimization in terms of beam extraction optics and transport.

The goal of this thesis is to advance in the understanding of the physics of the extracted beam in SPIDER developing numerical models to simulate the spectra acquired by the diagnostic BES. These numerical tools are necessary for a thorough comprehension of collected data. The activities envisaged for this thesis include, on the one hand, the development or exploitation of existing beam optics numerical tools, and, on the other hand, the thorough analysis of BES experimental data collected during the last experimental campaigns. A special attention will be devoted to coupling dedicated numerical tools, from the process of negative ion extraction and acceleration, to the interpretation of beam diagnostics data. This step of gathering the multiple physical processes is required to improve the understanding of the overall SPIDER operation. Therefore, this approach will be based on the activity of comparing the outcome of multiple diagnostics.

Apart from the formative experience in working as a part of a large team, this work of thesis in intended to actively contribute in the advancement of the physics comprehension of full-scale negative ion sources for fusion.

Required skills: familiarity with Matlab and/or C++ and/or Python and/or IDL or similar.
Proposal date: 08 April 2022
Status:
Student: