

Performance analysis and application study of a laser enhancement cavity for photo-neutralization of Negative Ion Beams

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Abstract:

Photo-neutralization of negative ion beams is now regarded as a promising concept to enhance plasma heating system efficiency of negative ion based neutral beam injection in large fusion experiments. In this work we describe a photo-neutralization scheme currently under test at Consorzio RFX based on the trapping of the second harmonic of a Nd:YAG laser in a closed loop optical cavity. In this work the system performances are analyzed with respect to optical layout and optical losses, in order to identify an optimal configuration, as well as to validate a simple numerical model. The latter is developed to assess the photo-neutralization degree achievable once the system is applied to the NIO1 negative ion beam facility in Padova. In particular, the study defines the requirements of pumping laser energy and repetition rate. A parallel analysis, regarding the application of a resonating enhancement cavity to NIO1, is presented and a comparison between the two approaches is discussed.