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Continuous pulse advances in the negative ion source NIO1

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Consorzio RFX and INFN-LNL have designed, built and operated the compact radiofrequency negative ion source NIO1 (Negative Ion Optimization phase 1) with the aim of studying the production and acceleration of H⁻ ions. In particular, NIO1 was designed to keep plasma generation and beam extraction continuously active for several hours. Since 2020 the production of negative ions at the plasma grid (the first grid of the acceleration system) is enhanced by a Cs layer, deposited on its surface by means of active Cs evaporation in the source volume. For the negative ion sources applied to neutral beam injectors for fusion, keeping the beam current and the fraction of co-extracted electrons stable for times of at least 1 h is essential. Optimal conditions must also take into account the redistribution of caesium among the plasma box surfaces due to the action of the plasma.

The paper presents the latest results of the NIO1 source, in terms of beam performances during continuous (6÷7 h) plasma pulses. The effect of the plasma grid temperature on the production of negative ions is studied. Moreover, the conditions of the source are discussed also in terms of Cs density circulating in the volume as measured by the laser absorption spectroscopy diagnostic, and of basic plasma properties thanks to the measurements of emission spectroscopy.

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