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A review of the NIFS negative-ion based NBI driven with Filament-Arc (FA) discharge

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Negative ion based NBI (n-NBI) system for the Large Helical Device (LHD) had developed at NIFS since 1987 and started the injection since 1998. Filament-Arc (FA) discharge was applied for the n-NBI system as the first-generation negative ion source. Three beamlines (BL) of the n-NBI system are installed to the LHD and the design values of injection power, beam energy, pulse duration, injection interval and beamlet divergence are 5 MW/BL, 180 keV, 10 sec, 3 min. and less than 5 mrad, respectively.
Long-pulse injection was carried out using one of the n-NBI BL and the pulse-duration of 128 sec. was achieved. In the high-power injection, the maximum injection power of 16 MW was obtained in simultaneous injection with three n-NBI BLs. To obtain more stable beam injection and to prepare the deuterium beam injection, physics based diagnostic experiments has been established at the NIFS NB Test Stand (NIFS NBTS). The diagnostic system is available to measure with some diagnostic devices at the same time and some of the phenomena of the caesium (Cs)-seeded hydrogen and deuterium plasmas and beamlet characteristics were revealed.
In this tutorial, characteristics of the plasmas in the FA negative ion sources and those of beams accelerated from the sources are presented based on the results of development, injection and diagnostic experiments.

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