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RF-driven negative ion sources for fusion

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The tutorial gives insights in the need, challenges and ongoing R&D of powerful and large RF-driven ion sources for extracting the required current of negative hydrogen ions (H- and D-) for fusion:
The neutral beam injection systems for the international fusion experiment ITER (www.iter.org) are based on large negative hydrogen ion sources that have to operate at very ambitious parameters. The large RF-driven negative ion sources (1 MHz, 800 kW, to illuminate a source area of 1.9 x 1 m2) have to deliver an accelerated current up to 46 A negative hydrogen ions (40 A for D- ,46 A for H-) extracted from 1280 apertures stable for one hour. The co-extracted electron current has to be kept below the extracted ion current to avoid damages of the grid system. At the source pressure of 0.3 Pa or below the negative ions have to be produced at a low work function surface for which cesium is evaporated into the source. In order to fulfill all these requirements an R&D program has been launched several years ago. The challenges, however, are enormous; among them the control of the cesium dynamics in the source that determines the reliability of the source performance, the amount of co-extracted electrons which limits the extractable negative ion current, and the size scaling of the source towards the ITER source size.

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