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## **RF Positive Ion Source with Solenoidal Magnetic Field**

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A positive ion source with RF discharge in solenoidal magnetic field is described. In this paper we present an overview of the positive ions production in saddle antenna (helicon discharge) radio frequency (SA RF) ion sources. An efficiency of H<sup>+</sup> ion production in recently developed RF sources with solenoidal antennas was improved to 1.5-2 mA/kW. About 60 kW of RF power is typically needed for 50 mA beam current production from a 7 mm emission aperture. This efficiency is relative low because in the RF discharge with solenoidal antenna, the plasma is generated near the coil and diffuses to the axis creating a nearly uniform plasma density distribution in all cross sections of the discharge chamber, when the plasma flow is necessary only near an emission aperture. The efficiency of the extracted ion generation was improved significantly with using of the saddle antenna. In the RF discharge with the saddle antenna the plasma is generated near the axis and the magnetic field suppresses the plasma diffusion from the axis, creating a peaked plasma density distribution on the emission aperture. With the SA the efficiency of positive ion generation in the plasma has been improved up to 200 mA/cm<sup>2</sup> per kW of RF power at 13.56 MHz. Continuous wave (CW) operation of the RF source has been tested on the small test stand. The general design of the CW RF source is based on the pulsed version. Compact design of ion source is presented. Some modifications were made to improve the cooling and simplifying design. Features of SA RF discharges and ions generation will be discussed.

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