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Self-extraction negative ion source — Source link

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Published on: 01 Jun 1982 - Review of Scientific Instruments (American Institute of PhysicsAIP)

Topics: Ion gun, Ion beam, Ion beam deposition, Faraday cup and Beam (structure)

Title
A SELF-EXTRACTION NEGATIVE ION SOURCE

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Publication Date
1979-03-02

To be presented at the 1979 IEEE International Conference on Plasma Science, Montreal, Canada, June 4-6, 1979

LBL-8672
Abstract

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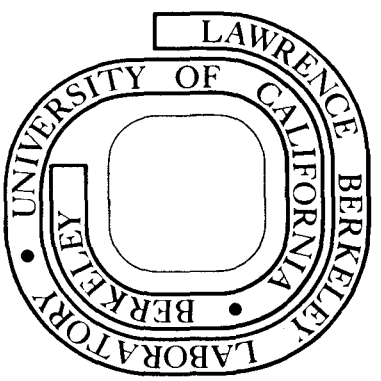
January 1979

Prepared for the U. S. Department of Energy
under Contract W-7405-ENG-48



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1979 IEEE INTERNATIONAL CONFERENCE ON PLASMA SCIENCE
June 4-6, 1979

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LBL-8672

A Self-extraction Negative Ion Source*. K.N. LEUNG, and K.W. EHLERS, Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720--In order to heat plasmas in the next generation fusion devices to thermonuclear temperature, high-power neutral beams are required. The neutralization efficiency for positive hydrogen or deuterium ion beams at energies greater than 150 keV is low. On the other hand, H^- or D^- ions have high stripping efficiency (> 60%) for beam energy greater than 150 keV. Thus an alternative procedure is the production of neutral beams from H^- or D^- ion beams. There are different approaches for the production of negative ions.[1] The device described here is a cylindrical multi-line-cusp plasma source[2] (20 cm in diameter and 23 cm long) with 10 columns of samarium cobalt magnets ($B_{max} \cong 4$kG) installed externally around the chamber wall. A movable, water-cooled, concave copper converter (6 cm by 10 cm) is inserted into the hydrogen plasma produced by a dc discharge. By biasing the converter negatively (~ 300 V) with respect to the plasma, positive ions are accelerated across the sheath to the converter. H^- ions formed on the converter surface will accelerate radially across the sheath and will be "self-focused" at the exit aperture of the source which is located in between two line-cusps. Therefore, no additional electric field is required to extract the H^- in this scheme. The dipole-fields of the permanent magnets will confine the high energy electrons and the plasma, but produce little effect on the trajectory of the H^- ions. Cesium and later, other materials to reduce the work function, can be added to the converter surface to enhance the yield of H^-. The self-extracted H^- ions have been observed by a mass spectrometer. They can also be measured by a plane Langmuir probe. Detailed measurement of the H^- ion current density and gas efficiency will be presented.

1. E. B. Hooper, Jr. "Negative Ion Based Neutral Systems," Proc. Fifth Conf. Use of Small Accelerators in Research and Industrial Applications, Denton, Texas, Nov. 6-8, 1978.

2. K. N. Leung, T. K. Samec, and A. Lamm, Phys. Lett. 51A, 490, (1975).

*This work is supported by the U.S. Department of Energy, Office of Fusion Energy under contract No. W-7405-ENG-48.

. Subject category number:
5 - Neutral Beams for Fusion Research

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Please place this paper and the paper on " The Berkeley Multi-line-cusp Ion Source" together

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