

# Lawrence Berkeley National Laboratory

## Recent Work

**Title**

A SELF-EXTRACTION NEGATIVE ION SOURCE

**Permalink**

<https://escholarship.org/uc/item/5f41z1mr>

**Author**

Leung, K.N.

**Publication Date**

1979-03-02

00:00300771

Uc-20

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

LBL-8672  
Abstract

A SELF-EXTRACTION NEGATIVE ION SOURCE

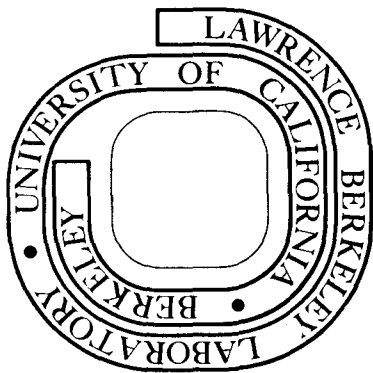
K. N. Leung and K. W. Ehlers

IA  
RCO  
OSTI  
COL

January 1979

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

**For Reference**  
Not to be taken from this room



LEGAL NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

## **DISCLAIMER**

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

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<sup>+</sup> or D<sup>+</sup> 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<sup>-</sup> or D<sup>-</sup> ion beams. There are different approaches for the production of negative ions. The device described here is a cylindrical multi-line-cusp plasma source\* (20 cm in diameter and 23 cm long) with 10 columns of samarium cobalt magnets ( $B_{\text{max}} \approx 4\text{kG}$ ) 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 ( $\sim 300\text{ V}$ ) with respect to the plasma, positive ions are accelerated across the sheath to the converter. H<sup>-</sup> 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<sup>-</sup> 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<sup>-</sup> ions. Cesium and later, other materials to reduce the work function, can be added to the converter surface to enhance the yield of H<sup>-</sup>. The self-extracted H<sup>-</sup> ions have been observed by a mass spectrometer. They can also be measured by a plane Langmuir probe. Detailed measurement of the H<sup>-</sup> 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

- ( ) Prefer oral session
- (x) Prefer poster session
- ( ) No preference
- ( ) Special requests for placement of this abstract

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

- Submitted by:

Ka-Ngo Leung

(signature)

*Ka-Ngo Leung*  
(same name typewritten)

Lawrence Berkeley Laboratory  
(full address)

Berkeley, Ca. 94720

U. S. A.

- I am member of the Committee on Plasma Science and Applications:

( ) yes (x) no

This report was done with support from the Department of Energy. Any conclusions or opinions expressed in this report represent solely those of the author(s) and not necessarily those of The Regents of the University of California, the Lawrence Berkeley Laboratory or the Department of Energy.

TECHNICAL INFORMATION DEPARTMENT  
LAWRENCE BERKELEY LABORATORY  
UNIVERSITY OF CALIFORNIA  
BERKELEY, CALIFORNIA 94720