

Managed by Fermi Research Alliance, LLC for the U.S. Department of Energy Office of Science

## **Highly Efficient Sources of Negative Hydrogen Ions**

# **Cooperative Research and Development Agreement Final Report**

CRADA Number: FRA-2011-0006

Fermilab Technical Contact: Dan Bollinger

Summary Report 6 January 2020

Fermi National Accelerator Laboratory / Kirk and Pine Street / P.O. Box 500 / Batavia, IL 60510 / 630.840.3000 / www.fnal.gov / fermilab@fnal.gov Managed by Fermi Research Alliance, LLC for the U.S. Department of Energy Office of Science Fermi Research Alliance, LLC under Contract No. DE-AC02-07CH11359 with the U.S. Department of Energy, Office of Science, Office of High Energy Physics.

#### NOTICE

This report was prepared as an account of work sponsored by an agency of the United States government. Neither the United States government nor any agency thereof, nor any of 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. Reference herein to any specific commercial product, process, or service by 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. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States government or any agency thereof.

Available electronically at http://www.osti.gov/bridge

Available for a processing fee to U.S. Department of Energy and its contractors, in paper, from: U.S. Department of Energy Office of Scientific and Technical Information P.O. Box 62 Oak Ridge, TN 37831-0062 phone: 865.576.8401 fax: 865.576.5728 email: mailto:reports@adonis.osti.gov

Available for sale to the public, in paper, from: U.S. Department of Commerce National Technical Information Service 5285 Port Royal Road Springfield, VA 22161 phone: 800.553.6847 fax: 703.605.6900 email: orders@ntis.fedworld.gov

online ordering: http://www.ntis.gov/ordering.htm

In accordance with Requirements set forth in Article XI.A(3) of the CRADA document, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

CRADA number:	FRA-2011-0006
CRADA Title:	Highly Efficient Sources of Negative Hydrogen Ions
Parties to the Agreement:	MUONS, Inc and Fermi Research Alliance, LLC

### Abstract of CRADA work:

Fermilab will provide technical expertise to help Muons, Inc. develop novel modifications of Hsource designs which will satisfy the performance requirements of Project X at Fermilab. The new source will be an advanced version of a Penning DT SPS (Dudnikov-Type Penning Surface Plasma Source) with a high efficiency, deliver up to 15 mA average current with improved electrode cooling. Supported in part by DOE STTR grant DE-SC0006267.

### **Summary of Research Results:**

Factors limiting the operating lifetime of Compact Surface Plasma Sources (CSPS) were analyzed and possible treatments for lifetime enhancement considered. Noiseless discharges with lower gas and cesium densities were produced in experiments with modified discharge cells. With these discharge cells it is possible to increase the emission aperture and extract the same beam with a lower discharge current and with correspondingly increased source lifetime.

#### **Related Reports, Publications, and Presentations:**

Dudnikov, Vadim, and Bollinger, Daniel. Highly Efficient Sources of Negative Hydrogen Ions. United States: N. p., 2013.Web.

IPAC'10, Kyoto, Japan, Dudnikov, Vadim and Johnson, Rolland P. High Brightness H- Surface Plasma Sources (THPEC072).

Dudnikov, V, Bollinger, D, and Lawrie, S. Lifetime of Highly Efficient H- Ion Sources. 2013. Web. (FERMILAB-CONF-12-248-AD)

### Subject Inventions listing:

None

**Report Date:** 6 January 2020

Technical Contact at Fermilab: Dan Bollinger

This document contains NO confidential, protectable or proprietary information.