THIRD INTERNATIONAL SYMPOSIUM ON NEGATIVE IONS, BEAMS AND SOURCES (NIBS 2012)

Jyväskylä, Finland 3 – 7 September 2012

EDITORS
Olli Tarvainen
Taneli Kalvas
University of Jyväskylä, Jyväskylä, Finland

All papers have been peer reviewed.

SPONSORING ORGANIZATIONS
Dehnel - Particle Accelerator Components and Engineering, Inc.
Federation of Finnish Learned Societies
City of Jyväskylä
University of Jyväskylä

Melville, New York, 2013
AIP CONFERENCE PROCEEDINGS 1515
## Table of Contents

Preface - Third International Symposium on Negative Ions, Beams and Sources  
Olli Tarvainen  
1

**FUNDAMENTAL PROCESSES AND MODELING**

Plasma grid shape and size effects on the extraction of negative ions  
F. Taccogna, P. Minelli, M. Capitelli, S. Longo, and R. Schneider  
3

Modeling the particle transport and ion production in a RF driven negative hydrogen ion source for ITER NBI  
D. Wünderlich, P. McNeely, L. Schiesko, U. Fantz, P. Franzen, and NNBI-Team  
12

Study of negative hydrogen ion beam optics using the 2D PIC method  
K. Miyamoto, S. Okuda, A. Hatayama, M. Hanada, and A. Kojima  
22

Numerical modeling of the Linac4 negative ion source extraction region by 3D PIC-MCC code ONIX  
31

Negative ion production by plasma-surface interaction in caesiated negative ion sources  
M. Bacal and M. Wada  
41

The response of surface negative ion yield and virtual cathode formation to the effective work function of caesium  
D. B. King, A. J. T. Holmes, R. McAdams, and E. Surrey  
49

Effects due to adsorbed atoms upon angular and energy distributions of surface produced negative hydrogen ions  
M. Wada, M. Bacal, T. Kasuya, S. Kato, T. Kenmotsu, and M. Sasao  
59
VUV-diagnostics of a filament-driven arc discharge H⁻ ion source
J. Komppula, O. Tarvainen, S. Lätti, T. Kalvas, H. Koivisto, V. Toivanen, and P. Myllyperkiö 66

Analysis of the double-ion plasma in the extraction region in hydrogen negative ion sources
T. Fukuyama, S. Okuda, A. Fukano, K. Tsumori, H. Nakano, and A. Hatayama 74

Estimation of sputtering damages on a magnetron H⁻ ion source induced by Cs⁺ and H⁺ ions
H. Pereira, J. Lettry, J. Alessi, and T. Kalvas 81

Neutral resonant ionization in the high-intensity cesium sputter source
John S. Vogel 89

Small-radius planar-coil driven inductive discharge as a source of negative hydrogen ions
Tsvetelina V. Paunska, Antonia P. Shivarova, Khristo Ts. Tarnev, and Dimitar T. Todorov 99

Study of plasma meniscus formation and beam halo in negative hydrogen ion sources

Operation and thermal modeling of the ISIS H⁻ source from 50 to 2 Hz repetition rates
H. Pereira, D. Faircloth, and J. Lettry 114

Distribution of the background gas in the MITICA accelerator
E. Sartori, S. Dal Bello, G. Serianni, and P. Sonato 121

ION SOURCES FOR FUSION

Commissioning of the negative ion testbed ELISE
W. Kraus, U. Fantz, P. Franzen, M. Fröschle, B. Heinemann, C. Martens, R. Riedl, and D. Wünderlich 129

Development of intense hydrogen-negative-ion source for neutral beam injectors at NIFS
Polar distribution of ions and electrons in extraction region of a large-scaled caesium seeded ion source

Construction of a versatile negative ion source and related developments

Multiaperture negative ion source

Analysis of electron temperature distribution by Kinetic modeling of electron energy distribution function in JAEA 10 ampere negative ion source

A comparison of hydrogen and deuterium plasmas in the IPP prototype ion source for fusion
U. Fantz, L. Schiesko, D. Wünderlich, and NNBI Team

Development of a negative ion-based neutral beam injector in Novosibirsk

Proposal of actively heated, long stem based Cs delivery system for diagnostic neutral beam source in ITER

Flexible magnetic design of the MITICA plasma source and accelerator
G. Chitarin, N. Marconato, P. Agostinetti, G. Serianni, and P. Sonato
Compensations of beamlet deflections for 1 MeV accelerator of ITER NBI

H⁻ density profile and response to applied bias and extraction voltages in H⁻ source

Cesium dynamics and H⁻ density in the extended boundary layer of negative hydrogen ion sources for fusion
C. Wimmer, U. Fantz, and NNBI-Team 246

Influence of cesium on the plasma parameters in front of the plasma grid in sources for negative hydrogen ions
R. Friedl and U. Fantz 255

Characteristics of volume produced negative hydrogen ions in a field-effect-transistor based ion source
N. Tanaka, T. Funaoi, K. Oikawa, Y. Saito, H. Nakano, and A. Ando 263

Diagnostics of a negative hydrogen ion source based on a planar-coil inductively-driven discharge
Stiliyan St. Lishev, Antonia P. Shivarova, Dimitar I. Iordanov, Dimitar T. Todorov, and Angel P. Demerdzhiev 270

Investigation of Helicon discharges as RF coupling concept of negative hydrogen ion sources
S. Briefi and U. Fantz 278

Conceptual design of data acquisition and control system for two Rf driver based negative ion source for fusion R&D

ION SOURCES FOR ACCELERATORS
Recent performance of the SNS H⁻ source for 1-MW neutron production
Martin P. Stockli, B. X. Han, S. N. Murray, T. R. Pennisi, M. Santana, and R. F. Welton 292
H⁻ ion sources for CERN's Linac4
J. Lettry, D. Aguglia, Y. Coutron, E. Chaudet, A. Dallocchio,
J. Gil Flores, J. Hansen, E. Mahner, S. Mathot, S. Mattei, O. Midttun,
P. Moyret, D. Nisbet, M. O'Neil, M. Paoluzzi, C. Pasquino, H. Pereira,
J. Sanchez Arias, C. Schmitzer, R. Scrivens, and D. Steyaert 302

H⁻ ion source development for the FNAL 750keV injector upgrade
D. S. Bollinger 312

Negative ion source development at the cooler synchrotron COSY/Jülich
O. Felden, R. Gebel, R. Maier, and D. Prasuhn 321

Over 60mA RF-driven H⁻ ion source for the J-PARC
A. Ueno, Y. Namekawa, S. Yamazaki, K. Ohkoshi, I. Koizumi,
K. Ikegami, A. Takagi, and H. Oguri 331

Developing reliable internal antennas and standardizing performance of
H⁻ RF ion sources
R. F. Welton, V. G. Dudnikov, B. X. Han, S. N. Murray, T. R. Pennisi,
R. T. Roseberry, M. Santana, and M. P. Stockli 341

Recent negative ion source activity at JYFL
T. Kalvas, O. Tarvainen, J. Komppula, M. Laitinen, T. Sajavaara,
H. Koivisto, A. Jokinen, and M. P. Dehnel 349

Developing the RAL front end test stand source to deliver a 60 mA,
50 Hz, 2 ms H⁻ beam
Dan Faircloth, Scott Lawrie, Alan Letchford, Christoph Gabor,
Mike Perkins, Mark Whitehead, Trevor Wood, Olli Tarvainen,
Jani Komppula, Taneli Kalvas, Vadim Dudnikov, Hugo Pereira,
Zunbeltz Izaola, and John Simkin 359

Potential for improving of the compact surface plasma sources
V. Dudnikov, D. Bollinger, D. Faircloth, and S. Lawrie 369

Operation status of the J-PARC negative hydrogen-ion source
H. Oguri, K. Ikegami, K. Ohkoshi, I. Koizumi, Y. Namekawa, A. Ueno,
A. Takagi, and S. Yamazaki 379

RF plasma modeling of the Linac4 H⁻ ion source
S. Mattei, M. Ohita, A. Hatayama, J. Lettry, Y. Kawamura, M. Yasumoto,
and C. Schmitzer 386
Optimization of magnetic field structure of a compact 14 GHz ECR ion source

Vacuum simulation and characterization for the Linac4 H source
C. Pasquino, P. Chiggiato, A. Michet, J. Hansen, and J. Lettry 401

Perfectly matched pulsed 2MHz RF network and CW 30MHz RF matching network for the J-PARC RF-driven H ion source
A. Ueno, Y. Namekawa, S. Yamazaki, K. Ohkoshi, I. Koizumi, K. Ikegami, A. Takagi, and H. Oguri 409

Emittance measurements of the J-PARC RF-driven H ion source
A. Ueno, Y. Namekawa, S. Yamazaki, K. Ohkoshi, I. Koizumi, K. Ikegami, A. Takagi, and H. Oguri 417

Gas injection and fast pressure-rise measurements for the Linac4 H source

Beam enhancement by axial magnetic field optimization of the J-PARC RF-driven H ion source
S. Yamazaki, A. Ueno, Y. Namekawa, K. Ohkoshi, I. Koizumi, K. Ikegami, A. Takagi, and H. Oguri 433

Design study of a test vessel to investigate the ISIS H Penning ion source plasma
Scott R. Lawrie and Daniel C. Faircloth 440

Upgrade of CW negative hydrogen ion source

Improving efficiency of plasma generation in H ion source with saddle antenna
V. Dudnikov, R. Johnson, S. Murrey, T. Pinnisi, C. Piller, M. Santana, M. Stockli, R. Welton, and C. Johnson 456
BEAM FORMATION AND LOW ENERGY TRANSPORT

Injection optics for fast mass switching for accelerator mass spectrometry

Emittance characterization of the spallation neutron source H⁻ injector

A magnetized Einzel lens electron dump for the Linac4 H⁻ ion source
Ø. Midttun, T. Kalvas, M. Kronberger, J. Lettry, H. Pereira, and R. Scrivens 481

Metal negative ion production by an RF sputter self-extraction ion source
N. Yamada, T. Kasuya, T. Kenmotsu, M. R. Vasquez Jr., and M. Wada 491

Heat load estimation in the duct and blanket module region of the HNB during various operating scenarios of the ITER machine

Tube entrance lens focus control

BEAM ACCELERATION AND NEUTRALIZATION

Status of physics design of the HNB accelerator for ITER

Benchmark of the SLACCAD code against data from the MANITU testbed at IPP
P. Agostinetti, G. Chitarin, P. Franzen, B. Ruf, G. Serianni, and P. Veltri 522

The beam driven plasma neutralizer
E. Surrey and A. Holmes 532

Spatial characterization of the space charge compensation of negative ion beams
P. Veltri, M. Cavenago, and G. Serianni 541
BEAMLINES AND FACILITIES

Status of PRIMA, the test facility for ITER neutral beam injectors
P. Sonato, V. Antoni, M. Bigi, G. Chitarin, A. Luchetta, D. Marcuzzi, R. Pasqualotto, N. Pomaro, G. Serianni, V. Toigo, P. Zaccaria, and ITER International Team 549

Advanced energy recovery concepts for negative ion beamlines in fusion power plants
R. McAdams, A. J. T. Holmes, M. Porton, A. Benn, E. Surrey, and T. T. C. Jones 559

Preliminary results from the Small Negative Ion Facility (SNIF) at CCFE
J. Zacks, R. McAdams, J. Booth, K. Flinders, A. J. T. Holmes, M. Simmonds, B. Stevens, P. Stevenson, E. Surrey, S. Warder, A. Whitehead, and D. Young 569

Thermal simulations of STRIKE tiles for the assessment of the CFC prototypes and of the configuration for SPIDER

Upgrade of the ITUR extraction system at ESS-Bilbao
Zunbeltz Izaola, Aitor Zugazaga, Jorge Feuchtwanger, David Fernández-Cañoto, Ibon Bustinduy, Juan Luis Munoz, Dan Faircloth, and Scott R. Lawrie 587

WORKSHOP ON PERFORMANCE VARIATIONS IN H- ION SOURCES

Workshop on performance variations in H⁻ ion sources 2012: PV H⁻ 12

Author Index 599