

## CONTENTS

Preface .....	xi
Organizing Committee.....	xiii

### FUNDAMENTAL PROCESSES

<b>Study of Negative-Ion Transport Phenomena in a Plasma Source .....</b>	<b>3</b>
D. Riz and J. Paméla	
<b>The Effect of Cesium and Xenon Addition on Negative-Hydrogen</b>	
<b>Ion Production .....</b>	<b>16</b>
P. G. Steen and W. G. Graham	
<b>Variable Statistical Weights for Particle Species in PIC-MCC</b>	
<b>Simulations .....</b>	<b>26</b>
D. A. W. Hutchinson and M. M. Turner	
<b>Negative-Hydrogen Production at a Graphite Surface .....</b>	<b>36</b>
K. Tsumori, W. R. Koppers, R. M. A. Heeren, M. F. Kadodwala, A. W. Kleyn, and J. H. M. Beijersbergen	
<b>Enhanced Negative-Ion Formation via Electron Attachment</b>	
<b>to Electronically Excited States .....</b>	<b>44</b>
L. A. Pinnaduwage	
<b>The Role of High Rydberg States in the Generation of Negative Ions</b>	
<b>in Negative-Ion Discharges .....</b>	<b>61</b>
J. R. Hiskes	
<b>Mechanisms of H<sub>2</sub> Vibrational Excitation and H<sup>-</sup> Generation</b>	
<b>in a Low-Voltage Plasma-Beam Cesium-Hydrogen Discharge.....</b>	<b>76</b>
F. G. Baksht, V. G. Ivanov, A. A. Kostin, A. G. Nikitin, and S. M. Shkolnik	
<b>Equilibrium Modeling for a Medium-Sized H<sup>-</sup> Source .....</b>	<b>96</b>
D. A. Skinner, M. Bacal, and W. G. Graham	
<b>Recent Advances in H<sub>2</sub>/D<sub>2</sub> Plasma Kinetics .....</b>	<b>109</b>
C. Gorse, M. Capitelli, R. Celiberto, D. Iasillo, and S. Longo	
<b>Recombination Coefficient and Final State Vibrational Distribution</b>	
<b>for the Reaction: H+H<sub>ad</sub>+Cu(111)→H<sub>2</sub>(v)+Cu(111) .....</b>	<b>118</b>
G. D. Billing and M. Cacciatore	
<b>Investigation by Photodetachment and Probes of H<sup>-</sup>/D<sup>-</sup> Ion Sources</b>	
<b>with Cesium Seeding .....</b>	<b>127</b>
L. I. Elizarov, F. El Balghiti, and M. Bacal	
<b>Plasma Transfer Process in Hydrogen-Negative Ions Source Based</b>	
<b>on Reflective Discharge .....</b>	<b>142</b>
V. P. Goretsky, A. V. Ryabtsev, I. A. Soloshenko, A. F. Tarasenko, and A. I. Schedrin	
<b>The Possibility of VUV Lasing in a Volume H<sup>-</sup> Source .....</b>	<b>153</b>
D. A. Skinner	

<b>Generation of Hydrogen-Negative Ions in a Low-Voltage Cesium-Hydrogen Discharge in a Hollow Cathode</b>	162
F. G. Bakht and V. G. Ivanov	
<b>Electron Molecule Cross Sections Relevant to Negative-Ion Sources and Divertor Plasmas</b>	174
R. Celiberto, M. Capitelli, U. T. Lamanna, and R. K. Janev	
<b>Total Elastic, Diffusion, and Viscosity Cross Sections for Excited Atomic Hydrogen</b>	180
R. Celiberto, M. Di Foggia, U. Lamanna, and M. Capitelli	
<b>Numerical Study of Cesium Effects on Negative-Ion Production in Volume Sources</b>	187
O. Fukumasa and E. Niitani	
 <b>SOURCES</b>	
<b>Development of High-Current Hydrogen-Negative Ion Source for NBI in NIFS</b>	201
T. Kuroda, O. Kaneko, Y. Oka, M. Osakabe, Y. Takeiri, K. Tsumori, A. Ando, R. Akiyama, E. Asano, K. Kawamoto, T. Takanashi, and M. Hamabe	
<b>Development of Multi-ampere D<sup>-</sup> Source for Fusion Applications</b>	214
C. Jacquot, Y. Belchenko, J. Bucalossi, D. Riz, and R. Trainham	
<b>Noiseless, High-Current Density H<sup>-</sup> Beam from a Magnetron-Type Ion Source</b>	228
W. Wang, S. K. Guharay, M. Reiser, and V. Dudnikov	
<b>Practical Aspects of Surface Plasma Sources Operation</b>	237
V. G. Dudnikov	
<b>Study on the Energy Distribution of Ion Beams Extracted from the Sputter-Type Negative-Ion Source</b>	241
J. Ishikawa, H. Tsuji, T. Takatori, and Y. Gotoh	
<b>Development of Negative-Ion Sources for Fusion-Produced Alpha Particle Diagnostics</b>	252
M. Wada, M. Sasao, and A. Taniike	
<b>Evaluation of a Simple Method for Chopping Penning Surface-Plasma Source H<sup>-</sup> Beams (Abstract)</b>	260
H. V. Smith, Jr., P. Allison, J. D. Schneider, J. E. Stelzer, and R. R. Stevens, Jr.	
<b>Investigation of Two Negative-Hydrogen Ion Sources: Effect of the Volume</b>	261
A. M. Bruneteau, C. Courteille, R. Leroy, and M. Bacal	
<b>A New Plasma H<sup>-</sup> Ion Source</b>	272
P. A. Litvinov and I. S. Savchenko	
<b>A Comparison of the Plasma Characteristics of Two Multicusp Negative-Ion Sources</b>	281
W. G. Graham, P. G. Steen, C. Courteille, R. Leroy, and M. Bacal	

<b>Enhancement of H<sup>-</sup>/D<sup>-</sup> Volume Production in a Double-Plasma-Type Negative-Ion Source</b>	288
O. Fukumasa, H. Nishimura, and S. Sakiyama	
<b>Experimental Results on ITER-NBI Concept Source</b>	300
N. Miyamoto, H. Oguri, Y. Okumura, T. Inoue, Y. Fujiwara, K. Miyamoto, A. Nagase, Y. Ohara, and K. Watanabe	
 <b>ACCELERATION</b>	
<b>Beam Acceleration Test in Negative-Ion-Based NBI System for JT-60U</b>	309
K. Watanabe, N. Akino, M. Araki, N. Ebisawa, Y. Fujiwara, M. Hanada, A. Honda, T. Inoue, T. Itoh, M. Kawai, M. Kazawa, J. Koizumi, M. Kuriyama, K. Miyamoto, N. Miyamoto, K. Mogaki, A. Nagase, Y. Ohara, T. Ohga, Y. Okumura, H. Oohara, K. Ohshima, F. Satoh, S. Takahashi, T. Takenouchi, H. Usami, K. Usui, M. Yamamoto, and T. Yamazaki	
<b>Preliminary Results of the 1 MeV SINGAP D<sup>-</sup> Acceleration Experiment</b>	320
J. Pamela, J. Bucalossi, C. Desgranges, M. Fumelli, P. Massmann, and A. Simonin	
<b>Acceleration and Beam Optics of the Intense H<sup>-</sup> Ion Beam</b>	333
K. Tsumori, A. Ando, M. Hamabe, Y. Takeiri, O. Kaneko, Y. Oka, M. Osakabe, T. Kawamoto, E. Asano, R. Akiyama, and T. Kuroda	
<b>Space Charge Compensation and Collective Processes in the Intensive Beams of H<sup>-</sup> Ions</b>	345
I. A. Soloshenko	
<b>Negative-Ion Stripping in Beams</b>	365
C. Michaut and M. Bacal	
<b>High-Efficiency Trapping of Stray Electrons in Negative-Ion Accelerators</b>	378
A. Simonin	
<b>Measurement of Beam Halo in a 400 keV H<sup>-</sup> Ion Source</b>	390
K. Miyamoto, Y. Fujiwara, T. Inoue, N. Miyamoto, A. Nagase, Y. Ohara, Y. Okumura, and K. Watanabe	
<b>High-Energy Acceleration of H<sup>-</sup> Ion Beam at MeV Test Facility</b>	397
T. Inoue, Y. Fujiwara, K. Miyamoto, N. Miyamoto, A. Nagase, Y. Ohara, Y. Okumura, K. Watanabe, and K. Yokoyama	
<b>Influence of Collective Processes on Stationary State and Charge Compensation of Ion Beams</b>	406
Yu. A. Svistunov and S. Yu. Udovichenko	
 <b>DIAGNOSTICS</b>	
<b>Photodetachment Diagnostics of Plasma with High n<sub>-</sub>/n<sub>e</sub> Ratio</b>	421
F. El Balghiti, F. G. Bakht, and M. Bacal	

<b>Measurement of Negative-Ion Density Near the Plasma Grid by Photodetachment.....</b>	<b>436</b>
---	------------

M. Wada, M. Nishiura, and T. Kasuya

<b>A Time-of-Flight Spectrometer for Energy Analysis of Slow Heavy Ions and Neutrals.....</b>	<b>445</b>
---	------------

M. Döbeli and V. K. Liechtenstein

<b>Comparison of Negative-Ion Density Measurements by Probes and by Photodetachment (Abstract) .....</b>	<b>450</b>
--	------------

A. G. Nikitin, F. El Balghiti, and M. Bacal

## APPLICATIONS AND SYSTEMS

<b>Fabrication of Negative-Ion-Based Neutral-Beam Injector for Large Helical Devices .....</b>	<b>453</b>
--	------------

O. Kaneko, S. Murakami, Y. Oka, M. Osakabe, Y. Takeiri,  
K. Tsumori, R. Akiyama, E. Asano, T. Kawamoto, and T. Kuroda

<b>Status and Near Future of the H<sup>-</sup>(D<sup>-</sup>) Related R&amp;D at Kurchatov Institute .....</b>	<b>463</b>
--	------------

N. N. Semashko

<b>Current-Drive and Current-Profile Control on Tore Supra: A Possible Application for High-Energy Negative-Ion Based D<sup>0</sup> Injectors .....</b>	<b>479</b>
---	------------

V. Basiuk, P. Lotte, and J. Pamela

<b>Ion-Source Requirements for Pulsed-Spallation Neutron Sources .....</b>	<b>490</b>
--	------------

J. R. Alonso

<b>Design of the ITER Neutral-Beam Injectors .....</b>	<b>504</b>
--	------------

R. S. Hemsworth, J.-H. Feist, M. Hanada, B. Heinemann, T. Inoue,  
E. Küssel, V. Kulygin, A. Krylov, P. Lotte, K. Miyamoto, N. Miyamoto,  
D. Murdoch, A. Nagase, Y. Ohara, Y. Okumura, J. Paméla, A. Panasenkov,  
K. Shibata, M. Tanii, and M. Watson

<b>The ITER Neutral Injector Beamline Physics .....</b>	<b>518</b>
---	------------

M. Hanada, J. P. Lotte, R. S. Hemsworth, A. Krylov, and J. Pamela

<b>Application of Low-Energy Negative- and Positive-Ion Beams to Thin Film Formation.....</b>	<b>532</b>
---	------------

Y. Horino, N. Tsubouchi, B. Enders, K. Fujii, K. Yamashita, and M. Wada

<b>Plasma Neutralizer for H<sup>-</sup> Ions (Abstract) .....</b>	<b>544</b>
---	------------

V. A. Baturin and I. S. Savchenko

<b>H<sup>-</sup> Ion Neutralization on Carbon Foils (Abstract).....</b>	<b>545</b>
---	------------

V. A. Baturin and I. S. Savchenko

## POLARIZED SOURCES

<b>Improved Ionizer for Nuclear Polarized Negative-Ion Production (Abstract).....</b>	<b>549</b>
---	------------

V. G. Dudnikov

<b>High-Intensity Sources of Polarized Negative-Hydrogen Ions with Resonant Charge-Exchange Plasma Ionizer (Abstract).....</b>	<b>550</b>
--	------------

A. S. Belov, S. K. Esin, L. P. Netchaeva, Yu. V. Plokhinski,  
G. A. Vasil'ev, V. S. Klenov, A. V. Turbin, V. P. Yakushev,  
and V. G. Dudnikov

<b>Panel Discussion .....</b>	<b>551</b>
-------------------------------	------------

<b>Summary and Closing Remarks.....</b>	<b>575</b>
---	------------

J. R. Hiskes

<b>Appendix I: List of Participants.....</b>	<b>581</b>
--	------------

<b>Appendix II: List of Sessions .....</b>	<b>587</b>
--	------------

<b>Author Index.....</b>	<b>597</b>
--------------------------	------------