

# DENNIS P BOYLE

Princeton Plasma Physics Laboratory  
PO Box 451  
Princeton, NJ 08543-0451  
[dboyle@pppl.gov](mailto:dboyle@pppl.gov)  
(862) 216-1336

[orcid.org/0000-0001-8091-8169](https://orcid.org/0000-0001-8091-8169)  
[publons.com/researcher/1240644/](https://publons.com/researcher/1240644/)  
[researchgate.net/profile/Dennis\\_Boyle](https://researchgate.net/profile/Dennis_Boyle)  
[mendeley.com/profiles/dennis-boyle](https://mendeley.com/profiles/dennis-boyle)  
[scholar.google.com/citations?user=9DlT3ToAAAAJ](https://scholar.google.com/citations?user=9DlT3ToAAAAJ)

## Education

### Princeton University

PhD in Astrophysical Sciences, Program in Plasma Physics 2016  
*Measurements of impurity concentrations and transport in the Lithium Tokamak Experiment*

MA in Astrophysical Sciences, Program in Plasma Physics 2010

### Columbia University School of Engineering and Applied Science

BS in Applied Physics, *magna cum laude* 2008

## Research

**Lithium Tokamak Experiment- $\beta$**  – Associate Research Physicist 2016 - Present

Supervisor: R Majeski Princeton Plasma Physics Laboratory

*Confinement studies of neutral beam-heated and fueled plasmas with low-recycling walls*

- Led or supported majority of activities to complete upgrade and DOE notable outcome
  - Closely involved with nearly every subsystem of the experiment
  - Designed, improved, coordinated, implemented, maintained, operated, and/or analyzed majority of machine, diagnostic, and experimental systems
- Led plasma operations, vacuum conditioning, pump down, and numerous preparations
  - Exceeded LTX machine and plasma performance
  - Developed and optimized discharges for NBI testing, beam fueling study, lithium operations, wall retention measurements, and high field operation
  - Implemented hot bake with higher-power neon glow discharge cleaning
  - Achieved high vacuum and high plasma performance before lithium conditioning
  - Coordinated, performed, supported majority of vacuum component reinstallation
  - Performed tests of shell motion, leading to reinforcement of shell supports
  - Improved remote monitoring and recording of coils and machine
- Completed Thomson scattering camera, spectrometer, viewing optics, and laser upgrades
  - Improved, aligned, and calibrated views and spectrometer
  - Collaborated with laser recommissioning, beam dump upgrade, and realignment
- Improved plasma startup capabilities with shot programming, ECRH port, and filament
  - Enhanced coil control software, reconstructed old coil currents despite different configurations, optimized to achieve reliable breakdown without ECRH startup
- Collaborated with CHERS and NBI design, installation, alignment, calibrations, software
  - Supported TRANSP/NUBEAM simulations, enabled storage/analysis of NBI data
- Worked to accomplish project's scientific mission and team members' individual goals
  - Supported colleagues and collaborators with equipment, data, planning, analysis
  - Co-authored papers, presentations, and invited talks
  - Provided coordination, training, expertise, and help to colleagues, collaborators, technicians, software engineers, students, and new personnel
  - Wrote, revised, implemented, taught, learned, and executed PPPL procedures

**Lithium Tokamak Experiment** – Doctoral Candidate 2011 – 2016

Advisor: R Kaita

Princeton Plasma Physics Laboratory

*Experimental study of the effects of lithium-coated walls on transport in a tokamak using doppler, survey, and Thomson scattering spectroscopy*

- First observation of flat temperature profiles with hot edge in low-recycling regime
- First ever successful operation of a tokamak fully surrounded by liquid lithium
- Operated and optimized tokamak; installed, maintained, and operated subsystems
  - Vacuum, electrical, high pressure gas/liquid, cryogenic, lithium, diagnostics, data
  - Installed, calibrated, automated, & operated multiple visible/EUV spectrometers
  - Designed and implemented upgrade to visible spectroscopy collection optics
  - Re-aligned, re-calibrated, and improved Thomson scattering system
- Results showed low to modest core impurity levels with solid and liquid lithium coatings
  - Analysis in IDL and Python; TRANSP, NCLASS, and MIST for transport analysis

**National Spherical Torus Experiment** – Graduate Student Researcher 2010 – 2012

Advisor: R Maingi

Princeton Plasma Physics Laboratory

*Investigation of the relationships between suppression of edge instabilities, evolution of edge plasma profiles, and lithium wall coatings using profile and edge stability analysis tools*

- Analyzed dataset with General Atomics pyTools, kinetic EFITs, IDL, MDSplus, and PEST
- Yielded better understanding of how lithium suppresses instabilities

**Levitated Dipole Experiment** – DOE FES Graduate Fellow 2009

Advisor: ME Mauel

MIT Plasma Science and Fusion Center

*Analysis of vessel eddy currents using a “Copper Plasma” to improve magnetic diagnostics*

- Designed, constructed, and operated in-vessel copper coils to simulate plasma
- Analyzed magnetic data in IDL and Mathematica, improved calibration of sensors

**Lithium Tokamak Experiment** – Graduate Student Researcher 2008

Advisors: R Kaita and R Majeski

Princeton Plasma Physics Laboratory

*Assembly of tokamak and installation of magnetic and spectroscopic diagnostics*

**Electrostatic Dust Detector** – National Undergraduate Fellow 2007

Advisor: CH Skinner

Princeton Plasma Physics Laboratory

*Optimization and characterization of electrostatic dust detectors for use in fusion devices*

**Columbia Non-Neutral Torus** – Undergraduate Student Researcher 2005 – 2008

Advisor: TS Pedersen

Columbia University

*Design, machining, construction, and calibration of circuitry, probes, et cetera for diagnostics*

- Transitioned circuit design and construction to printed circuit boards
- Automated calibration of circuits using Labview

## ***Publications (first-author)***

- [1] DP Boyle et al *Impurity concentrations and transport in LTX plasmas fully surrounded by liquified lithium surfaces* **Fusion Engineering and Design** (to be submitted)
- [2] DP Boyle et al *Observation of flat electron temperature profiles in the Lithium Tokamak Experiment* **Physical Review Letters** 119 (2017) 015001

- [3] DP Boyle et al *Varying the pre-discharge lithium wall coatings to alter the characteristics of the ELM-free H-mode pedestal in NSTX* **Journal of Nuclear Materials** 438 (2013) S979–S982
- [4] DP Boyle et al *The relationships between edge localized modes suppression, pedestal profiles and lithium wall coatings in NSTX* **Plasma Physics and Controlled Fusion** 53 (2011) 105011
- [5] DP Boyle et al *Electrostatic dust detector for fusion devices with improved sensitivity* **Journal of Nuclear Materials** 390–391 (2009) 1086–1089

### ***Publications (co-author)***

- [6] DB Elliott et al *Initial results from the newly upgraded LTX- $\beta$*  **IEEE Transactions on Plasma Science** (to be submitted) : P2-57 / 242
- [7] A Maan et al *Plasma Facing Component Characterization and Correlation with Scrape-off Layer Conditions in Low-recycling Lithium Tokamak Experiment- $\beta$  Plasmas* **IEEE Transactions on Plasma Science** (to be submitted) P1-05 / 252
- [8] A Maan et al *A simple vacuum suitcase for plasma facing component characterization in fusion devices* **Review of Scientific Instruments** (to be submitted)
- [9] R Majeski et al *The LTX- $\beta$  Research Program and First Results* **27<sup>th</sup> IAEA Fusion Energy Conference** (2018) EX/P8-29
- [10] DB Elliott et al *The charge exchange recombination spectroscopy diagnostic on the upgraded Lithium Tokamak eXperiment (LTX- $\beta$ )* **Review of Scientific Instruments** 89 (2018) 10D118
- [11] R Majeski et al *Compatibility of lithium plasma-facing surfaces with high edge temperatures in the Lithium Tokamak Experiment* **Physics of Plasmas** 24 (2017) 056110
- [12] C Hansen, DP Boyle, JC Schmitt, & R Majeski *Equilibrium reconstruction with 3D eddy currents in the Lithium Tokamak eXperiment* **Physics of Plasmas** 24 (2017) 042513
- [13] R Kaita et al *Hydrogen retention in lithium on metallic walls from “in vacuo” analysis in LTX and implications for high-Z plasma-facing components in NSTX-U* **Fusion Engineering and Design** 117 (2017) 135–139
- [14] S Kubota et al *A frequency-modulated continuous-wave reflectometer for the Lithium Tokamak Experiment* **Review of Scientific Instruments** 88 (2017) 053502
- [15] R Majeski et al *Observation of an Isothermal Electron Temperature Profile with Low Recycling Lithium Walls in LTX* **26<sup>th</sup> IAEA Fusion Energy Conference** (2016) EX/P3-34
- [16] JC Schmitt et al *High performance discharges in the Lithium Tokamak eXperiment with liquid lithium walls* **Physics of Plasmas** 22 (2015) 056112
- [17] M Lucia et al *Dependence of LTX plasma performance on surface conditions as determined by in situ analysis of plasma facing components* **Journal of Nuclear Materials** 463 (2015) 907

- [18] K Tritz et al *VUV/XUV measurements of impurity emission in plasmas with liquid lithium surfaces on LTX* **Plasma Physics and Controlled Fusion** 56 (2014) 125014
- [19] K Widmann et al *High-resolution grazing-incidence spectrometer for temperature measurements of low-Z ions emitting in the 100-300 Å spectral band* **Review of Scientific Instruments** 85 (2014) 11D630
- [20] R Majeski et al *Particle control and plasma performance in the Lithium Tokamak eXperiment* **Physics of Plasmas** 20 (2013) 056103
- [21] R Maingi et al *The nearly continuous improvement of discharge characteristics and edge stability with increasing lithium coatings in NSTX* **24<sup>th</sup> IAEA Fusion Energy Conference** (2012) EX/11-2
- [22] R Majeski et al *Results from LTX with Lithium-Coated Walls* **24<sup>th</sup> IAEA Fusion Energy Conference** (2012) ICC/P5-01
- [23] R Maingi, DP Boyle, JM Canik, SM Kaye, CH Skinner, et al, *The effect of progressively increasing lithium coatings on plasma discharge characteristics, transport, edge profiles, and ELM stability in NSTX* **Nuclear Fusion** 52 (2012) 083001
- [24] TK Gray et al *Spectral emission measurements of lithium on the lithium tokamak experiment* **Review of Scientific Instruments** 83 (2012) 10D537
- [25] R Maingi, SM Kaye, CH Skinner, DP Boyle, JM Canik, et al *Continuous Improvement of H-Mode Discharge Performance with Progressively Increasing Lithium Coatings in the National Spherical Torus Experiment* **Physical Review Letters** 107 (2011) 145004
- [26] R Maingi et al *Modification of Edge Profiles , Edge Transport , and ELM Stability with Lithium in NSTX* **23<sup>rd</sup> IAEA Fusion Energy Conference** (2010) EX/D2-2

### ***Publications (contributing author)***

- [27] X Zhang et al *Design and calibration of a retarding field energy analyzer for the LTX-β scrape off layer and modeling of electrostatic potential in a collisionless SOL* **Nuclear Materials and Energy** 19 (2019) 250–254
- [28] S Kubota et al *Millimeter-wave interferometry and far-forward scattering for density fluctuation measurements on LTX-β* **Review of Scientific Instruments** 89 (2018) 10H114
- [29] PE Hughes et al *Magnetic perturbation diagnostics in the high-temperature lithiated environment of LTX-β* **Review of Scientific Instruments** 89 (2018) 10J104
- [30] R Maingi et al *Effect of progressively increasing lithium conditioning on edge transport and stability in high triangularity NSTX H-modes* **Fusion Engineering and Design** 117 (2017) 150–156
- [31] JK Lepson et al *Responsivity calibration of the LoWEUS spectrometer* **Review of Scientific Instruments** 87 (2016) 11D614

- [32] R Maingi et al *Comparison of helium glow and lithium evaporation wall conditioning techniques in achieving high performance H-mode discharges in NSTX* **26<sup>th</sup> IAEA Fusion Energy Conference** (2016) EX/P4-38
- [33] SM Kaye et al *An overview of recent physics results from NSTX* **Nuclear Fusion** 55 (2015) 104002
- [34] R Maingi et al *Dependence of recycling and edge profiles on lithium evaporation in high triangularity high performance NSTX H-mode discharges* **Journal of Nuclear Materials** 463 (2015) 1134
- [35] M Lucia et al *Development progress of the Materials Analysis and Particle Probe* **Review of Scientific Instruments** 85 (2014) 11D835
- [36] SA Sabbagh et al *Overview of physics results from the conclusive operation of the National Spherical Torus Experiment* **Nuclear Fusion** 53 (2013) 104007
- [37] JC Schmitt et al *Results and future plans of the Lithium Tokamak eXperiment (LTX)* **Journal of Nuclear Materials** 438 (2013) S1096–S1099
- [38] A Diallo et al *Progress in characterization of the pedestal stability and turbulence during the edge-localized-mode cycle on NSTX* **Nuclear Fusion** 53 (2013) 093026
- [39] RJ Groebner et al *Improved understanding of physics processes in pedestal structure leading to improved predictive capability for ITER* **Nuclear Fusion** 53 (2013) 093024
- [40] Robert Kaita et al *Experiments with liquid metal walls: Status of the lithium tokamak experiment* **Fusion Engineering and Design** 85 (2010) 874-881
- [41] QR Marksteiner et al *Studies of a Parallel Force Balance Breaking Instability in a Stellarator* **AIP Conference Proceedings** 63 (2009) 63-68

### ***Presentations (invited)***

- [1] *Analysis of low recycling discharges with improved confinement and a hot edge in the Lithium Tokamak Experiment* **Exploratory Topics in Plasma and Fusion Research** 2017

### ***Presentations (first-author)***

- [2] *Impurity concentrations and transport in LTX plasmas fully surrounded by liquified lithium surfaces* **60<sup>th</sup> APS DPP** 2018
- [3] *Enhanced plasma and surface capabilities with beam fueling and heating in the Lithium Tokamak Experiment-Beta (LTX- $\beta$ )* **23<sup>rd</sup> Plasma Surface Interactions** 2018
- [4] *Overview of Upgrades to the Lithium Tokamak Experiment, LTX- $\beta$*  **59<sup>th</sup> APS DPP** 2017
- [5] *Measurements of impurity concentrations and transport in the Lithium Tokamak Experiment* **58<sup>th</sup> APS DPP** 2016

- [6] *Measurements of impurity concentrations and transport in the Lithium Tokamak Experiment* **22<sup>nd</sup> Plasma Surface Interactions** 2016
- [7] *Low impurity concentrations and enhanced confinement in the Lithium Tokamak Experiment (LTX)* **57<sup>th</sup> APS DPP** 2015
- [8] *Impurities in the Lithium Tokamak Experiment* **56<sup>th</sup> APS DPP** 2014
- [9] *Measuring the Effects of Lithium Wall-coatings on Impurities in LTX* **Exploratory Topics in Plasma and Fusion Research** 2014
- [10] *Effects of lithium wall-coatings on impurity ions in the Lithium Tokamak Experiment (LTX)* **41<sup>st</sup> IEEE International Conference on Plasma Science** 2014
- [11] *Improved doppler spectroscopy measurements on LTX* **55<sup>th</sup> APS DPP** 2013
- [12] *Passive CHERS measurements in the Lithium Tokamak Experiment (LTX)* **54<sup>th</sup> APS DPP** 2012
- [13] *Varying the pre-discharge lithium wall coatings to alter the characteristics of the ELM-free H-mode pedestal in NSTX* **20<sup>th</sup> Plasma Surface Interactions** 2012
- [14] *Evolution of ELM-free pedestal structure with lithium wall coatings in NSTX* **U.S. Transport Taskforce Workshop** 2012
- [15] *The relationships between ELM suppression, pedestal profiles, and lithium wall coatings in NSTX* **53<sup>rd</sup> APS DPP** 2011
- [16] *Edge profile and stability analysis as ELMs disappear with increasing lithium wall coatings in NSTX* **52<sup>nd</sup> APS DPP** 2010
- [17] *Eddy Currents and Magnetic Reconstruction in LDX* **51<sup>st</sup> APS DPP** 2009
- [18] *Electrostatic dust detector with improved sensitivity* **49<sup>th</sup> APS DPP** 2007

## ***Awards & Honors***

Publons Peer Review Award Top 1% in Physics	2018
U.S. Delegate to 60 <sup>th</sup> Meeting of Nobel Laureates and Young Researchers in Lindau	2010
U.S. Department of Energy Fusion Energy Sciences Fellowship	2008 – 2011
Faculty Award, Department of Applied Physics, Columbia University	2008
National Undergraduate Fellowship in Plasma & Fusion Energy Science	2007
Dean's List, Columbia University	2004 – 2008

## ***Teaching***

<b>Preliminary Exam Review Course</b> – Princeton University	2009
Led twice weekly review for plasma graduate students preparing for Physics Preliminary Exam	
<b>NUF/SULI homework sessions</b> – Princeton Plasma Physics Laboratory	2010 – 2017
Reviewed plasma physics problem sets with small groups of undergraduates	



## ***Outreach Activities***

U.S. Department of Energy National Science Bowl	2009 – Present
American Physical Society Plasma Sciences Expo	2009 – Present
Demonstrations at local events with PPPL Science Education	2010 – Present
LTX Visitor and Safety Tours	2011 – Present
“Fusion Day” outreach to United States Congress	2013, 2015

## ***References***

Richard Majeski	<a href="mailto:rmajeski@pppl.gov">rmajeski@pppl.gov</a>
Ronald Bell	<a href="mailto:rbell@pppl.gov">rbell@pppl.gov</a>
Rajesh Maingi	<a href="mailto:rmaingi@pppl.gov">rmaingi@pppl.gov</a>
Robert Kaita	<a href="mailto:kaita@pppl.gov">kaita@pppl.gov</a>
Vlad Soukhanovskii	<a href="mailto:soukhanovskii2@llnl.gov">soukhanovskii2@llnl.gov</a>
Charles Skinner	<a href="mailto:cskinner@pppl.gov">cskinner@pppl.gov</a>
Filippo Scotti	<a href="mailto:scotti@llnl.gov">scotti@llnl.gov</a>
Thomas Pedersen	<a href="mailto:thomas.sunn.pedersen@ipp.mpg.de">thomas.sunn.pedersen@ipp.mpg.de</a>
Mike Mauel	<a href="mailto:mauel@columbia.edu">mauel@columbia.edu</a>