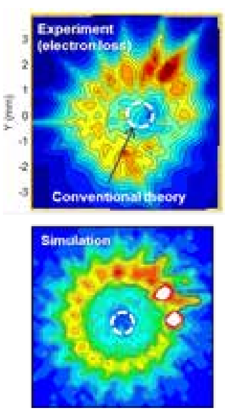
THE WILLIAM E. BOEING DEPARTMENT OF
AERONAUTICS & ASTRONAUTICS

... welcomes ...

RICHARD WIRZ

UCLA

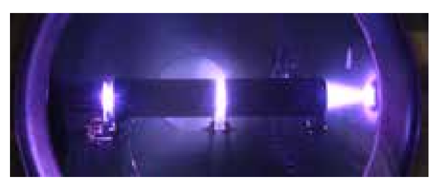
Miniature-Scale Plasma Confinement for Space Electric Propulsion



Miniature spacecraft have become an important part of the future of space science and exploration. Many of these missions require high-efficiency miniature electric propulsion to provide in-space maneuvers and station keeping. This talk will first discuss some of the miniature electric propulsion technologies developed at UCLA's Plasma & Space Propulsion Laboratory, including the world's first miniature noble gas ion thruster (MiXI: Miniature Xenon Ion) and the world's first "immortal" miniature Hall thruster that incorporates magnetic shielding (MaSMi: Magnetically Shielded Miniature). Missions for these thrusters include formation flying and micro- and nano-satellite exploration missions to the Moon and nearby asteroids.

With regards to MiXI, we have recently developed a new approach to miniature cusped discharge design that overcomes traditional scaling limitations. Our approach results in performance improvements of nearly 20%, thus rivaling the performance of full-scale thrusters. This accomplishment was the culmination of a multi-year effort combining experiments, simulations, and theoretical analyses. Through this effort, we were able to show that plasma cusp confinement at the micro-scale does not follow conventional theory for hybrid loss width (i.e., traditionally assumed to be the geometric mean for ion and electron gyro radii, $r_{hybrid} \propto \sqrt{r_i r_e}$). In contrast, our analyses show dramatically different loss behavior for miniature-scale plasma discharges, which exhibit complex ridge shapes for the collection area. This behavior can be explained by careful consideration of the upstream magnetic field and the related electron drift that results in both electron and plasma loss.

The talk will also cover our first-ever efforts related towards: (1) canonical experiments of ion-neutral interactions in thruster plumes, (2) measurements and simulations of the secondary electron interaction at plasma-facing surfaces, (3) and plasma-material interactions for featured surfaces. In our lab, we have developed the Plasma-Material Interactions ("Pi") Facility, which uses an axially magnetized cylindrical plasma discharge to deliver a wide range of plasma conditions to a material target. The Pi Facility has made significant discoveries through its use of a wide range of non-intrusive and in situ diagnostics, including a long distance optical microscope for examining in-situ plasma-surface interactions.



Time permitting, at the end of the talk, Prof. Wirz will give a brief overview of his Energy Innovation Laboratory's efforts in large-scale energy storage and advanced wind turbine blade design.

WILLIAM E. BOEING
DEPARTMENT OF AERONAUTICS & ASTRONAUTICS
UNIVERSITY *of* WASHINGTON

Monday, February 6, 2017 @ 4:00pm
Guggenheim Rm. 218 | UW Seattle

Visitor RSVP: contact@aa.washington.edu

THE WILLIAM E. BOEING DEPARTMENT OF
AERONAUTICS & ASTRONAUTICS

... Distinguished Guest Speaker ...

RICHARD WIRZ
UCLA

Professor
Mechanical & Aerospace Engineering

Prof. Richard Wirz is an Associate Professor in UCLA's Department of Mechanical and Aerospace Engineering, and holds a joint appointment at the NASA/JPL Electric Propulsion Group. He received his Ph.D. and M.S. degrees from Caltech and two engineering B.S. degrees from Virginia Tech. He is the Director of the UCLA Plasma & Space Propulsion Laboratory and the UCLA Energy Innovation Laboratory (www.WirzResearchGroup.com). His plasma lab investigates several topics related to electric propulsion and micropropulsion, including: low-temperature plasma discharges, plasma-material interactions, mission analysis, and spacecraft plasma interactions. His energy lab investigates large-scale energy challenges in both wind and solar.

Suggested Reading:

1. Patino M.I., Raitses Y., Wirz R.E., "Secondary electron emission from plasma-generated nanostructured tungsten fuzz," Applied Physics Letters, 109, 201602 (2016); doi: 10.1063/1.4967830
2. Dankongkakul B., Araki S. J., Wirz R.E., "Magnetic field structure influence on primary electron cusp losses for micro-scale discharges," Physics of Plasmas (featured on cover), 21, 043506 (2014); doi: 10.1063/1.4871724
3. Conversano R., Goebel D.M., Hofer R.R., Matlock T.S., Wirz R.E., "Development and Initial Testing of a Magnetically Shielded Miniature Hall Thruster", Plasma Science, IEEE Transactions on, PP, 99 (2014) doi: 10.1109/TPS.2014.2321107
4. Matlock T.S., Goebel D.M., Conversano R., Wirz R.E., "A dc plasma source for plasma–material interaction experiments," Plasma Sources Sci. Technol. 23 (2014) 025014 (11pp)
5. www.WirzResearchGroup.com

The William E. Boeing Chair's Distinguished Seminar Series brings scholars of national and international reputation who have made an impact in the field of aerospace engineering and beyond. This seminar series will cover a diversity of topics of current interest to those in academia, industry and the general public. It is our hope that these monthly seminars will encourage an exchange of ideas and bring aerospace engineering and science to the forefront.

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