**White Paper for *Frontiers of Plasma Science Panel***

Date of Submission: ***20 June 2015***

Indicate the primary area this white paper addresses by placing “P” in right column.
Indicate secondary area or areas by placing “S” in right column

“P”, “S”

| | |
|---|---|
| ☐ Plasma Atomic physics and the interface with chemistry and biology | P |
| ☐ Turbulence and transport | |
| ☐ Interactions of plasmas and waves | |
| ☐ Plasma self-organization | |
| ☐ Statistical mechanics of plasmas | S |

Indicate type of presentation desired at Town Hall Meeting.

“X”

Oral

Poster

Either Oral or Poster

Will not attend x

Title: Microphysics of the plasma-solid interface

Corresponding Author: Michael Bonitz

☐ Institution: Kiel University, Germany

☐ email: bonitz@theo-physik.uni-kiel.de

Co-Authors: Holger Kersten, Kiel University

- ***Describe the research frontier*** **and importance of the scientific challenge.**

Low-temperature plasmas in contact with solid surfaces are a field of very broad relevance but still lacking fundamental understanding. The present treatments in plasma physics approximate the solid interface in a very primitive way, whereas condensed matter people usually try to avoid plasmas at all. What is needed are theoretical (and simulation) and experimental efforts that allow for a microscopic understanding of the behavior of electrons and ions when crossing this interface.

- ***Describe the approach to advancing the frontier and indicate if new research tools or capabilities are required.***

An approach from the condensed matter side has recently been developed, e.g. [1,2] but is still in its infancy. A concerted effort of plasma physicists, condensed matter physicists but also colleagues from atomic and molecular physics and chemistry is required to move this field ahead. In particular, a combination of advanced nonequilibrium plasma physics (kinetic theory) and quantum kinetic approaches. on the condensed matter side. This will require not only cross-disciplinary research. From the experimental side new approaches are needed that utilize standard condensede matter experiments in the presence of a plasma.

- ***Describe the impact of this research on plasma science and related disciplines and any potential for societal benefit***.

A basic understanding of electronic, atomic and chemical processes at the plasma-solid interface is expected to have a big impact on existing technological applications of plasmas. The field should transfrom from a trial and error approach to real predictive capability. This will allow one to optimize existing applications, in particular, the selection of materials and plasma operation parameters. At the same time new applications are expected to emerge. Improved understanding in this field should also be beneficial for other branches of plasma physics - from high-temperature and fusion plasma-wall interaction to bio-medical interfaces.

## References (Maximum 1 page)

[1] F.X. Bronold, H. Fehske, R. L. Heinisch and J. Marbach, Contrib. Plasma Phys. 52, 856 (2012)

[2] F.X. Bronold, H. Deutsch, and H. Fehske.
The European Physical Journal D, Volume 54,.519-544 (2009)

**Figures (maximum 1 page)**