



Electron irradiation of water ice samples in the laboratory - Implications for icy moons and comets

André Galli¹, Romain Cerubini¹, Antoine Pommerol¹, Peter Wurz¹, Audrey Vorburger¹, Martin Rubin¹, Apurva Oza¹, Marek Tulej¹, Nicolas Thomas¹, and Niels F.W. Ligterink²

¹University of Bern, Physics Institute, Space Research and Planetary Science, Bern, Switzerland (andre.galli@space.unibe.ch)

²Center for Space and Habitability, University of Bern, Bern, 3012, Switzerland

The surfaces of icy bodies in the solar system are continuously irradiated by charged particles from planetary magnetospheres or from the solar wind. This irradiation induces chemical reactions in the surface ice and also acts as an atmospheric release process. Remote observations, theoretical modelling, and laboratory experiments must be combined to understand this plasma-ice interaction. In this presentation, we concentrate on laboratory experiments with electron irradiation (energy range of 0.1 to 10 keV) of water ice. The samples include thin ice films on a microbalance as well as thick layers of porous ice, resembling regolith. The physical and optical properties of the latter make them realistic analogues for the surfaces of icy moons.

We measure the sputtering yield and monitor the irradiation-induced alterations in the ice samples with a dedicated new time-of-flight mass spectrometer.

Previous results obtained with an earlier quadrupole mass spectrometer (Galli et al. 2018, Planetary and Space Sciences) indicated that most water escaping the ice sample upon electron irradiation does so in the form of the radiolysis products H₂ and O₂. The freshly produced H₂ appeared to leave the porous water ice sample immediately whereas the O₂ escape slowly increased until reaching a steady-state ratio of 1:2 of O₂ to H₂. With the new mass spectrometer, we investigate the release and storage of radiolysis products at a higher temporal resolution and sensitivity for a variety of ice sample porosities and thicknesses. We pay special attention to less abundant radiolysis products such as H₂O₂ and to the O₂/H₂O ratio in the irradiated water ice layer.