Monte Carlo Modelling of Neutral Hydrogen in the Exosphere of Mercury

M. S. Wedlund¹, F. Leblanc¹, J-Y. Chaufray², and R. Modolo¹

¹ LATMOS/IPSL, CNRS, Université Versailles Saint Quentin en Yvelines, France
² LMD/IPSL, Université Pierre et Marie Curie, France

Following current and future space missions such as Messenger and BepiColombo, the study of the exosphere of Mercury has become of major interest. The spatial and temporal structures of exospheric hydrogen, as well as its thermal distribution, have never been fully addressed while observational data are now available. This paper presents a neutral hydrogen 3D Monte Carlo model applicable to the surface-bounded exosphere of Mercury.

At each time step, test particles are created on Mercury's surface and are ejected depending on the initial random energy assuming a Maxwellian distribution, following ballistic trajectories until re-impacting the surface or escaping Mercury. The model includes Mercury's gravity field, the solar radiation pressure, thermalisation and ionisation parameters.

A comparison of the simulation results with hydrogen data from both Mariner 10 and Messenger will be performed as a validation of the model.

The model predicts hydrogen escaping rates as well as the exospheric signatures of possible source regions. A sensitivity study to solar wind conditions is conducted and shows how hydrogen densities and temperatures evolve with respect to it.