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Modelling of the solar wind interaction with the Moon at macro and micro scales

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Recent Lunar missions have shown that the solar wind interaction with the Moon is complex and scientifically more interesting than anticipated before, as shown by new in situ plasma, neutral atom and magnetic field observations. Especially, an unexpectedly high fraction of the incident solar wind protons is reflected from the surface, and even larger fraction by the Lunar magnetic anomalies. This effect has been observed both by measuring deviated solar wind flow near the magnetic anomalies and by observing decreased flux of energetic neutral hydrogen atoms, ENAs, from the surface region of strong magnetic anomalies. These ”macro scale” processes affect the properties of plasma near the Lunar surface. Consequently, also physical processes at ”micro scales” within the Debye sheath layer, where the electric potential of the surface and near surface region are controlled by photoelectrons and solar wind particles, are affected.

In this work we introduce two numerical kinetic simulation models developed to study the solar wind interaction with the Moon: (1) a hybrid model (HYB-Moon) to study macro scale processes and (2) a full kinetic PIC model to study micro scale processes. Both models are part of the HYB planetary plasma modelling platform developed at the Finnish Meteorological Institute. In the hybrid model ions are modelled as particles while electrons form a charge neutralizing massless fluid. In the Particle–in-cell (PIC) simulation both ions and electrons are modelled as particles. In the presentation we show preliminary results based on these models.