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Dynamical evolution of sodium anisotropies in the exosphere of Mercury

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The exosphere of Mercury is a tenuous collisionless cloud of gas still poorly known. In fact, it is the result of the diverse interactions between many systems, which are: the surface, the interplanetary medium (Solar wind, photons and meteoroids), the planetary and the interplanetary magnetic fields. Many ground-based observations allowed the detection of intense and variable sodium emissions at global and local spatial scales, the latter being mostly concentrated in the mid-to-high latitude regions. These regions are indeed the preferred location of solar wind precipitation on the surface of the planet.

In the present work, by using high resolution Na observations obtained at the Canary Islands with the THEMIS solar telescope, we analyze the variability of the sodium exosphere on time-scale of 1 hour and investigate the possible mechanisms that could explain the exospheric sodium emission distribution and its dynamics. A new procedure of analysis is applied to make the data fully comparable among each other and allow a proper analysis of the peak evolution. Our interpretation relates the observed sodium asymmetries to the combined effects of plasma and photons impacts onto the Mercury's surface and of sodium diffusion through the upper layer of the surface. Simulations of the exosphere generation and of the possible coupling between IMF and planetary magnetosphere suggest that observations could be interpreted as the effects of a combination of both the magnetic reconnection regimes of pulsed and quasi-steady reconnection. In addition to this, a progressive broadening of the peak regions together with an increase of the equatorial region seem to corroborate the role of photon stimulated desorption, in association with the subsequent ion sputtering and with global sodium migration around Mercury, as the causes of the observed Na peak regions evolution.