Mercury Exosphere, Global Circulation Model of its Sodium Component

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Our understanding of Mercury's sodium exosphere improved considerably in the last 5 years thanks to new observations and to the publication of a summary of the large set of ground based observations. This suggests that Mercury's sodium exosphere is partly driven by a global day to night side migration of the volatiles. One of the key questions remaining is the nature of the prevailing sodium ejection mechanisms. Because of the numerous uncertain parameters for each ejection mechanisms, solving this problem has been difficult as indicated by the numerous papers over the last 15 years with very different conclusions. In addition, the variation of the size and of the spatial distribution of the surface reservoir varies with distance from the sun affecting the importance of each ejection mechanism on Mercury's orbital position

We here present the results of a large number of simulations [1] of the sodium exosphere compared with the measured annual cycle of Mercury sodium emission brightness. These measurements were obtained from the published data by [2] as well as from our own data obtained during the last two years using THEMIS solar telescope. These data show that: the annual cycle of the emission brightness is roughly the same from one year to another, there are significant discrepancies between what would be observed if the exospheric content were constant, and that the annual cycle of Mercury's sodium exosphere strongly depends on its orbit, that is, there are seasons in Mercury's exosphere.

Based on these comparisons we derived the principal signatures for each ejection mechanism during a Mercury year and show that none of the ejection mechanisms dominates over the whole year. But, particular features of the annual cycle of the sodium intensity appear to be induced by one, temporarily dominant, ejection mechanism. For our best case, Mercury's exosphere content varies from ~$1.6\pm0.1\times10^{28}$ Na atoms at TAA=140° and 70° respectively to ~$4.5\pm0.3\times10^{28}$ Na atoms at TAA=180° and 0°. In addition, Mercury's exospheric surface reservoir contains from 1.0×10^{31} Na atoms at TAA=300° to 1.1×10^{31} Na atoms at TAA=170° with up to three times more sodium atoms trapped in Mercury's nightside than in its dayside surface.

References

[1] Leblanc F., and Johnson R.E., *Icarus*, **164**, 261-281 (2003).

[2] Leblanc F. and R. E. Johnson, *Icarus*, Submitted, (2010).