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Ar non-thermal component as seen by MAVEN after 4 years of observations?

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Abstract

The dissociative recombination of O_2^+ in Mars' ionosphere is thought to be today major channel of Mars' neutral atomic oxygen escape to space (1). In (2), we showed that the exospheric Ar can be measured by NGIMS/MAVEN up to 1200 km in altitude, highlighting the dichotomy of this exospheric population and the existence of a significant non-thermal component. Its main origin was shown to be the collisional interaction between the atmospheric Ar and the products of the dissociative recombination of the O_2^+ ions. We here present the whole set of NGIMS measurements of the atmospheric and exospheric Ar obtained so far.

Observations

We here analyzed NGIMS measurements of the Ar density performed from 04/15/2015 to 12/31/2017, between 150 and 500 km in altitude with nominal cadence (4037 inbound profiles).
Since april 2018, high cadence (100 times higher rate) observations have been performed (106 inbound profiles) with, since july 2018, regular measurements from 1200 to 300 km in altitude (35 inbound profiles).
A clear dichotomy of the profiles is seen above and below 350 km with scale height of 21 ± 3 km and 24 ± 4 km below 270 km in altitude and of 159 ± 24 km and 441 ± 84 km above 350 km.
High cadence campaigns allowed to get density above 500 km with S/N >> 1 and scale height with much better accuracy.
From the 7 campaigns of high altitude and cadence measurements (each of 5 consecutive inbounds), 4 successfully measured the Ar density above 350 km. For the 3 others, the density above 350 km was <8 cm^{-3} and could not be extracted from the background noise.

The measured densities above 350 km appear generally stable during 5 consecutive orbits but a campaign during which variation from one orbit to the following one by more than a factor 5 was observed. No significant variation in the plasma environment and of the solar radiation flux could be associated with such a variation.

Conclusions

NGIMS Ar measurements at high altitude and cadence reveal a relatively coherent spatial organization of Mars exospheric Ar. However, deep night Ar measurements need to be further performed to improve the S/N as well as new measurements at high latitude to explore the origins of the short time variability observed during one campaign.

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References

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