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Identification of OSSO as a Near-UV Absorber in the Venusian Atmosphere

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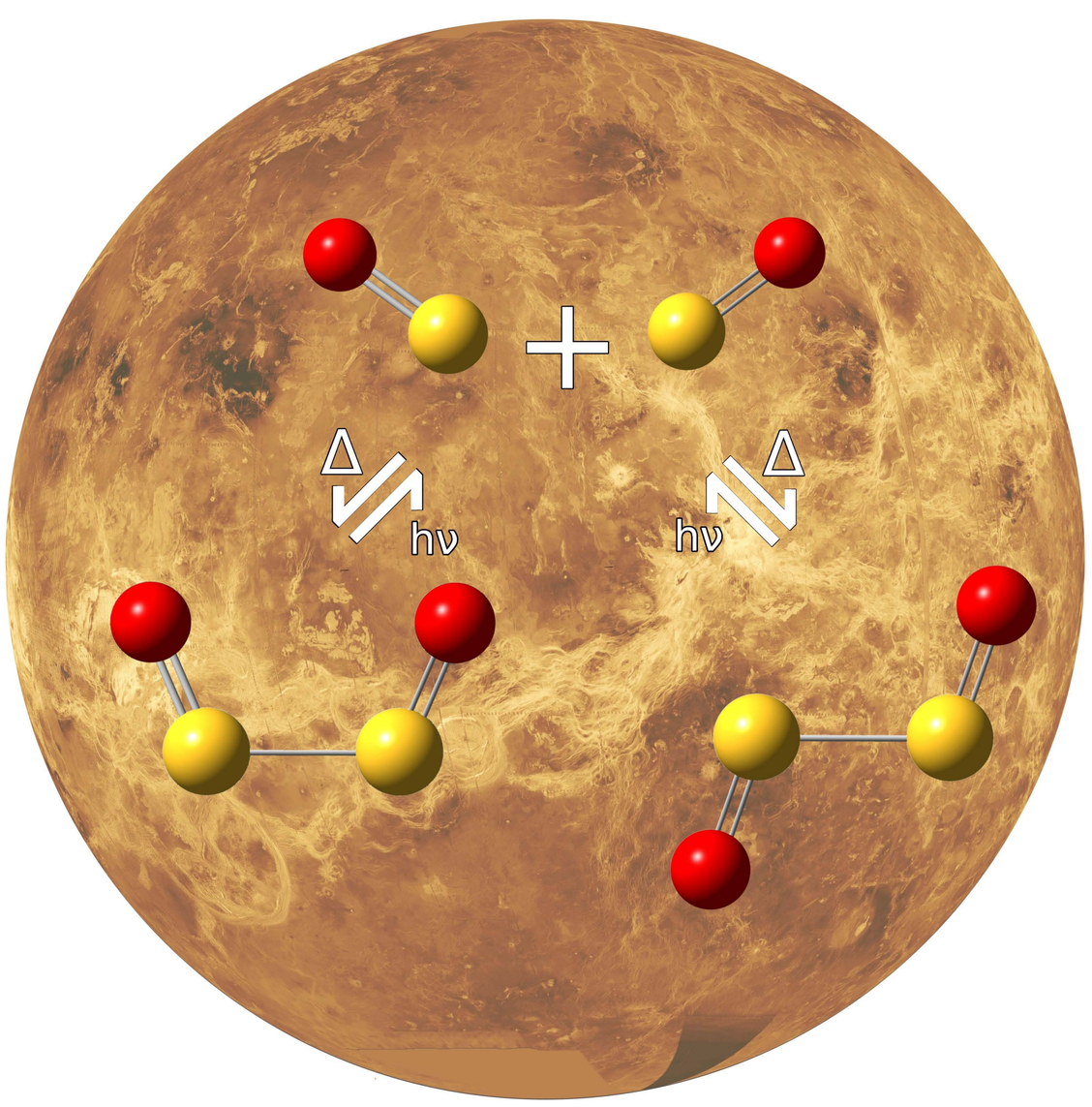
Prediction of OSSO on Venus

The two OSSO isomers, *cis*- and *trans*-OSSO are predicted to exist in significant amounts in the top cloud layer and mesosphere of Venus. This is based on a high level computational study of sulfur monoxide (SO) and all identified S_2O_2 isomers, which suggests that *cis*- and *trans*-OSSO are formed *via* a barrierless $^3SO+^3SO$ reaction. The two OSSO isomers are predicted to be similar in concentration ^3SO which is the second most abundant sulfur oxide on Venus, only surpassed by SO_2.

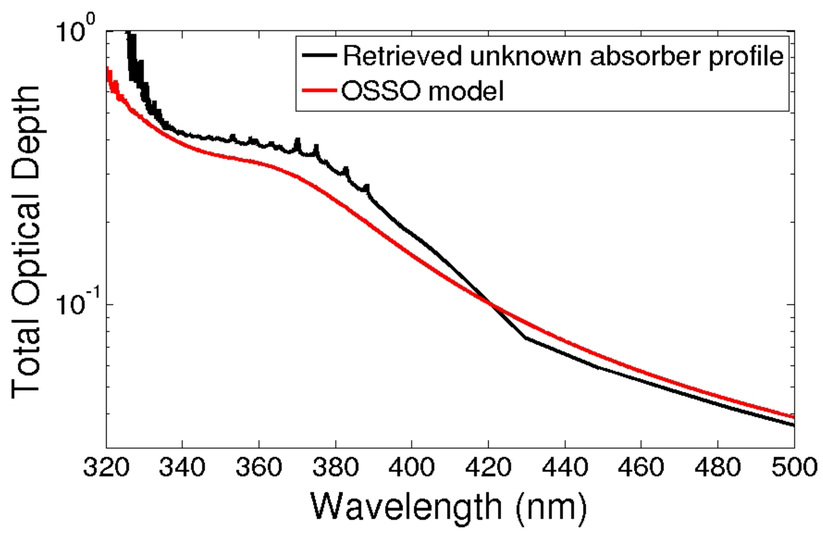
OSSO is a near-UV absorber

With the CC3/aug-cc-pV(T+d)Z method, we calculate that both *cis*- and *trans*-OSSO absorb in the near-UV range. We find it is a $\pi \rightarrow \pi^*$ transition along the S-S bond responsible for the absorption. By probing the excited state of the two OSSO isomers with a multireference method, we find that they most likely dissociate upon absorption of a near-UV photon to form two SO molecules.



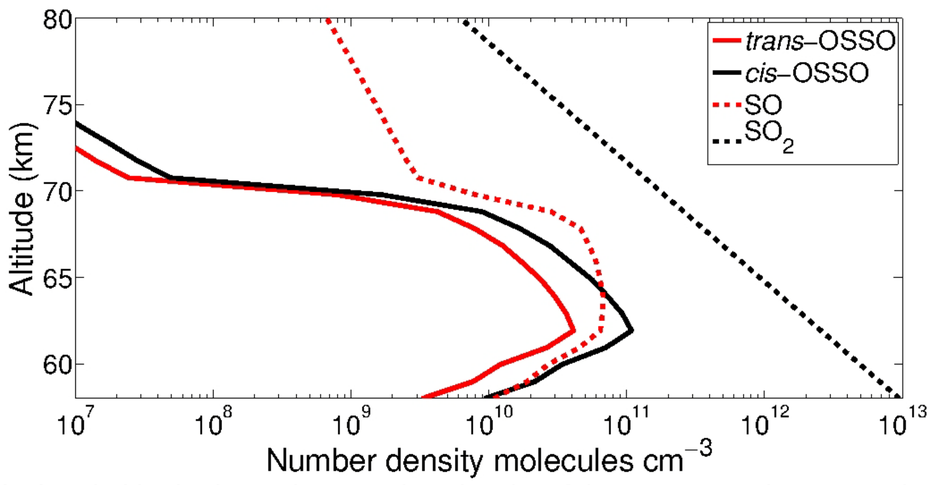
The unidentified near-UV absorber on Venus

Since the first UV spectra of Venus were recorded, a heterogeneous near-UV (320-400 nm) absorption phenomenon has been identified. The absorption occurs predominantly in the upper cloud deck on Venus (50-70 km altitude) and is correlated to SO_2. The absorption cannot be explained by a single absorber and the UV dark features attributed to the absorber has a lifetime much shorter than aerosols. We find that OSSO can account for the near-UV absorption on Venus, as it fits all the properties of the unidentified near-UV absorber.

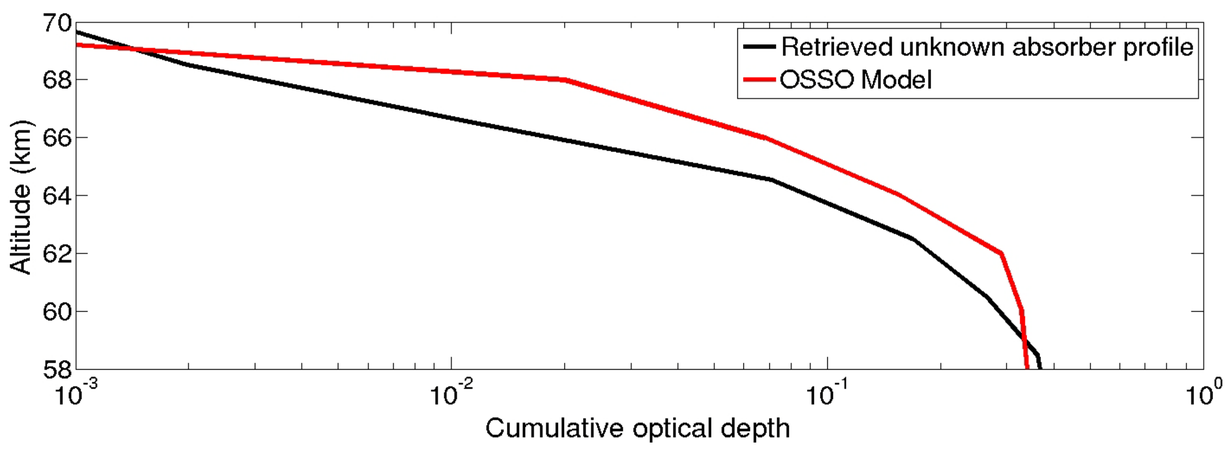


Total optical depth computed for the unknown absorber according to Haus *et al. 2016* in black and for the two OSSO isomers in red on Venus. Both profiles include the contribution from SO_2 which is significant at 320 nm, but provides a negligible contribution at longer wavelengths.

Altitude dependent OSSO profiles



Calculated altitude dependent number density of the two OSSO isomers using our 1-D model. SO and SO_2 numbers from Venus satellite measurements.



Cumulative optical depth through the top cloud layer of Venus for the Haus *et al. 2016* retrieved unknown UV absorber compared to our OSSO model.

References

B. N. Frandsen, P. O. Wennberg, and H. G. Kjaergaard, Accepted.*Geophys. Res. Lett. (2016)*
R. Haus *et al. (2016) Icarus, 272, 178-205.*