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Atomic oxygen in the atmospheres of the terrestrial planets measured by THz spectroscopy

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Atomic oxygen is a key species in the upper atmospheres of the Earth, Venus and Mars. It is located in the mesosphere and lower thermosphere (MLT) at altitudes above about 80 km, and thus plays an important role for the chemistry and energy balance in the MLT region as well as for the deceleration of satellites in low-Earth orbit. The fine-structure transition of atomic oxygen at 4.7 THz has been measured in the atmospheres of the three planets with GREAT (German Receiver for Astronomy at THz Frequencies) on board of SOFIA, the Stratospheric Observatory for Infrared Astronomy [1, 2, 3, 4]. Recently, it has also been measured with OSAS-B (Oxygen Spectrometer for Atmospheric Science on a Balloon), which is a 4.7-THz heterodyne spectrometer developed by DLR [5]. Both spectrometers rely on a quantum-cascade laser as local oscillator and a superconducting hot electron bolometer mixer. In this presentation I will describe the design and performance of these spectrometers, present results about atomic oxygen in the atmospheres of Earth, Venus and Mars and discuss future perspectives regarding THz spectroscopy of atomic oxygen in the atmosphere of Earth.

[1] L. Rezac et al., “First detection of the 63 µm atomic oxygen line in the thermosphere of Mars with GREAT/SOFIA,” Astron. Astrophys., vol. 580, L10 (2015).

[2] H. Richter et al., “Direct measurements of atomic oxygen in the mesosphere and lower thermosphere using terahertz heterodyne spectroscopy,” Commun. Earth Environ., vol. 2, 19 (2021).

[3] H. Wiesemeyer et al., “First detection of the atomic ^{18}O isotope in the mesosphere and lower thermosphere of Earth,” Phys. Rev. Res., vol. 5, 013072 (2023).

[4] H.-W. Hübers et al., “Direct detection of atomic oxygen on the dayside and nightside of Venus,” Nature Comm., vol. 14, 6812 (2023)

[5] M. Wienold et al., “OSAS-B: A balloon-borne terahertz spectrometer for atomic oxygen in the upper atmosphere,” IEEE THz Science and Technol., vol. 14, 327 (2024).