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High-resolution THz spectroscopy of the mesosphere and lower thermosphere of the Earth

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The mesosphere and lower thermosphere (MLT) at altitudes from about 100 km to 250 km is are largely unexplored. Atomic oxygen is a key species in in this part of the atmosphere. It plays an important role for the chemistry and energy balance in the MLT region as well as for the deceleration of satellites and space debris in Low Earth Orbit (LEO). In particular because of the latter one there is an increasing interest in this part of the atmosphere. However, measurements of atomic oxygen are scarce, despite that is the most abundant species above about 150 km. The fine-structure transitions of atomic oxygen at 2.1 and 4.7 THz are particularly well suited for the observation of atomic oxygen [1, 2, 3]. The radiance of these transitions provides information about the number density, the linewidth provides information about the temperature, and the Doppler shift and line profile provide information about wind speed in the MLT.

Recently, atomic oxygen in the MLT has been measured with OSAS-B (Oxygen Spectrometer for Atmospheric Science on a Balloon), which is dual frequency, balloon-borne THz heterodyne spectrometer developed by DLR [3]. The spectrometer is optimized for measuring the 2.1-THz transition and the 4.7-THz transition of atomic oxygen. Both frequency bands rely on a superconducting hot electron bolometer mixer. At 2.1 THz the local oscillator is an amplifier-multiplier chain while at 4.7 THz it is a quantum-cascade laser. The design and performance of the OSAS-B dual frequency heterodyne spectrometer as well as results from measurement campaigns with OSAS-B flying on a stratospheric balloon at altitudes above 30 km will be presented. Finally, perspectives towards a satellite mission with a THz spectrometer for atomic oxygen will be discussed [4, 5].

REFERENCES

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