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# A sensitive search for methane in the atmosphere of Mars using heterodyne spectroscopy at 7.8 µm wavelength

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## Abstract

The detection of methane ($CH_4$) in the Martian atmosphere has been claimed by various groups since 2003 [1,2,3]. Mumma et al. [3] found strong variation of methane with season, latitude and longitude at a mixing ratio of up to 40 ppb in late Northern summer. However, in recent years no detections of methane were reported and doubts on the validity of the earlier results have been raised [4].

Ultra-high resolution spectroscopy at infrared wavelength has proven to be a powerful tool to study planetary atmospheres as many physical parameters of such atmospheres like pressure, temperature, composition or dynamics can be studied. A spectral resolution of better than $10^6$ allows to fully resolve profiles of single molecular features. This is a strong advantage as the analysis of low resolution data in general requires more information about the state of the studied atmospheres which has to be provided from additional observations or models. High-resolution heterodyne spectroscopy at the strong methane band at 7.8 µm can provide further independent prove of the existence and more detailed data on the abundance and distribution of methane in the atmosphere of Mars andcan lead to new insights to the vertical mixing ratio profile.

## 1. Instrumentation:

A spectral resolution of better than $10^6$ at infrared wavelength can only be achieved by heterodyne techniques. Only two instruments worldwide are using this method for astronomical observations: THIS (Tuneable Heterodyne Infrared Spectrometer) and NASA GSFC's HIPWAC (Heterodyne Instrument for Planetary Winds And Composition). The latter has recently be upgraded to allow use of tuneable quantum-cascade lasers (QCLs) as local oscillators (LOs) allowing to target the 7.8 µm wavelength region.

## 2. Observations:

HIPWAC has been set up for observations of methane at the NASA IRTF facility on Mauna Kea Hawaii from May 22nd to 24th 2012. The high Earth-Mars radial velocity at that time of ~14 km/s and the high altitude of 4200 m allowed us peak through the methane features in the telluric atmosphere. A detection limit of ~10 ppb of methane in the martian atmosphere was estimated for an integration time of 4-8 hrs depending on atmospheric transmission on the targeted methane feature at 1282.62 $cm^{-1}$.

Unfortunately, two of the three observing nights were lost to weather as hurricane strength winds prohibited us from observing. The final night on May 24th was however successful. We will present a first analysis of the acquired data.

## References

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