

Review of manuscript

## **LIDAR technology for Measuring trace gases on Mars and Earth**

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The manuscript describes a study aiming at evaluating the potential of trace gas measurements in the atmospheres of both Earth and Mars with lidar. The focus is on the greenhouse gases CO<sub>2</sub> and CH<sub>4</sub>. My impression is that this project is clearly behind what would be needed for characterizing lidar missions. Instead (see abstract), calculations are stressed to support the claim of unprecedented accuracy. For instance for CO<sub>2</sub> it is well known that the lidar approach, at this time, does not fulfill the requirements.

### Introduction

A lot of information is given on both species, but the true requirements are missing. For instance, the variability of CO<sub>2</sub> in the atmosphere of our planet is known to be extremely low. This makes the job of identifying sources and sinks rather demanding. For the reader this kind of information would be necessary. For a well-mixed gas no lidar measurements are necessary since a simpler approach will be adequate. There is no description how the measurements would look.

Rest of the paper:

P. 4679, line 7: A reference for these numbers is missing

P. 4679, line 8: 0.03 cm<sup>-1</sup> is not "very high resolution".

P. 4679, line 9: minimum atmospheric width?

P. 4679, line 10: "and therefore sensitivity" is unclear.

P. 4679, line 15-16, throughout paper (also figures): Use "transmittance" and "absorbance"; "transmission" and "absorption" are processes!

P. 4679, line 21: better; "within a few hundred".

P. 4680, line 7: better: "and idler emission is generated"

P. 4681, line 14: For a demonstration for a space mission this does not look sufficient and clearly below the state of the art (much stronger narrow-band pump lasers exist).

P. 4683, lines 5-7: This should be demonstrated here! Anything else is nothing particularly new.

Sec. 4.2., first paragraph: What is the difference in absorption cross section? There are also other advantages at the shorter wavelength (higher lidar signal, more sensitive detectors)

The number of Figures is excessive.

Will the measurements on Mars be made with an open cell? There is no description what is be planned.

In summary, there are too many deficiencies that I can recommend publication.