

Interactive comment on “Evidence of a significant rotational non-LTE effect in the CO₂ 4.3 μm PFS-MEX limb spectra” by Alexander A. Kutepov et al.

Anonymous Referee #1

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The paper "Evidence of a significant rotational non-LTE effect in the CO₂ 4.3 μm PFS-MEX limb spectra" by Kutepov et al. explains and verifies the physical details of the formation the 4.3 μm emission feature of CO₂ observed in limb-sounding spectra of planetary atmospheres. Given this feature can be used to estimate the atmospheric temperature and density structure, a deep understanding of the physical mechanisms leading to the shape of this emission is needed. By showing that a consistent non-LTE treatment of the molecular transitions involved in the formation of this emission feature improves the match between modeled and observed spectra substantially, this work contributes important information that is useful to the community and warrants publication. Overall the paper is well written and concise, some paragraphs detailed below

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require a bit of language polishing. In the introduction a sketch of the molecular level structure with the relevant transitions might be helpful to guide the reader. I recommend this manuscript for publication in AMT with some minor comments addressed:

Abstract, l2: 150km: tangent altitude? - please specify what this distance refers to.

Abstract, l3: "Martian atmosphere" - for clarification

p1, last par/p2: It would be helpful to show a (possibly simplified) sketch of the molecular level structure that involves the transitions discussed here.

p3, l24: an "a" is missing before "series"

p3, l26: "the" Martian atmosphere...

p4, l17: why was the altitude of 100km chosen for this comparison while the data discussed before refers to 115km? It would be more consistent to show this for the situation discussed before.

p4, l28: split infinitive "significantly better reproduces..." -> "reproduces ... significantly better compared to..."

p4, sec 3.1: While the model does a very good job reproducing the observed feature, it seems that the ratio of the peaks is slightly shifted toward the left peak compared to the observed spectrum. Is there an obvious explanation for this (admittedly small) discrepancy? What is the estimated uncertainty in the modeled spectrum (e.g., arising from input data) also with respect to the absolute values of the derived radiances?

p5, fig 1: assuming the figure will be smaller in the final layout if might be good to choose a different color or line width for the yellow line.

p6, fig 2: typo in the x-axis label in the right panel see previous comment above: why is an altitude of 100km chosen here?

p6, l2: ... "the" first of these...

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p6/p7: The last paragraph of sec 3.2 requires some language improvements, especially with regard to missing articles and word order. Maybe some of the long sentences could be split.

p7, l20: ...does "an" excellent job...

p7, l28: "...need of significant additional study..." - please rephrase this sentence to clarify.

p8, l7: ...influence "the" main results...

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