

# ***Interactive comment on “GreenHouse gas Observations of the Stratosphere and Troposphere (GHOST): an airborne shortwave infrared spectrometer for remote sensing of greenhouse gases” by Neil Humpage et al.***

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The authors would like to thank Anonymous Referee #2 for their constructive and helpful feedback on the AMT Discussion Paper ‘GreenHouse gas Observations of the Stratosphere and Troposphere (GHOST): an airborne shortwave infrared spectrometer for remote sensing greenhouse gases’ by Humpage et al. Here, we address each of the referee’s comments in turn and outline how we have used them to improve the manuscript.

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'The GHOST instrument is introduced in a descriptive way. A more architectural description would be preferred to help the reader better understand the layout and working of the instrument.'

- We have added a block diagram (Fig. 1) to the manuscript to provide an architectural overview of how the three components of GHOST work together.

'A more detailed description of the optical layout supported by block diagrams or schematic of the optical path would largely improve the scientific value.'

- We have added schematic diagrams of the optical path inside the TAM (Fig. 2) and the spectrometer (Fig. 3) to clarify the concept behind the optical design.

'A discussion of choices/trade-offs in the optical design and a description of the specifications and tolerances of the optical components is lacking.'

- We have added some discussion of the specifications and tolerances in the optical design of the TAM (Sect. 2.2 of the manuscript) and the Spectrometer Module (Sect. 2.3) to address this comment.

'Some minor point to be considered; the detector performance is characterized at 80 K but operated at a higher temperature, please discuss if the difference has an impact on the performance;'

- We have added the following text to the manuscript in Sect. 3.2 to address this point:  
'The measured dark current values are higher than the 0.25 counts/s that would be achieved if the detector were operated at liquid nitrogen temperature (80 K). However we consider it more advantageous to keep the detector slightly warmer but at a stable temperature (and known dark current, which can then be subtracted more easily), than to minimize the dark current at the expense of temperature stability.'

'The instrument employs two bands 2. A comparison of simultaneous measurements for the two bands could give insight in the instrument performance; The horizontal scale for bands 2A and 2B in figure 16 is different. Identical scales would be beneficial for

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comparison.’

- We have updated the original Figure 16 (Fig. 4 here) such that both the wavelength and the spectral radiance scales for Bands 2A and 2B are now identical. Whilst the spectral performance is different as expected (because of the different spectral sampling and resolution achieved for each band), it is worth noting that the radiometric calibration (as projected onto the spectral radiance scale) produces different results for the two bands. A possible explanation for this is that straylight, which is not accounted for here, affects the two bands differently. We are currently investigating the effects of straylight using new laboratory measurements taken since this work was submitted for publication, and have updated the text in the manuscript (Section 6) to refer to this and link it to the updated figure.

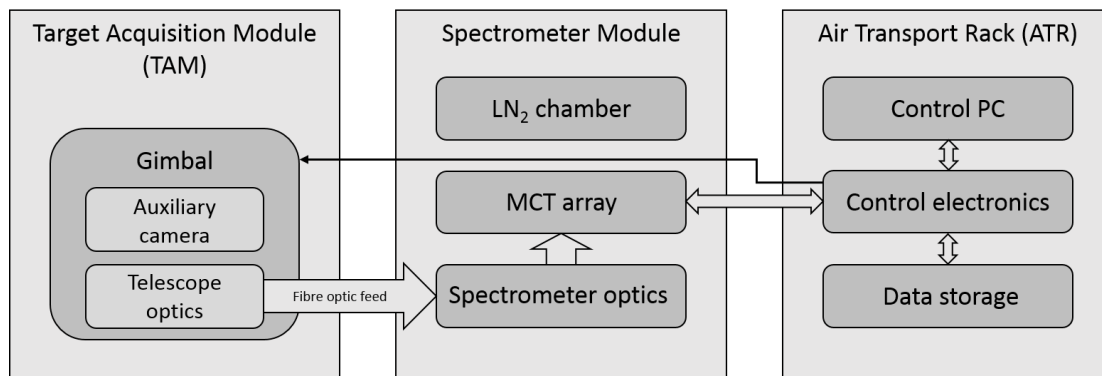
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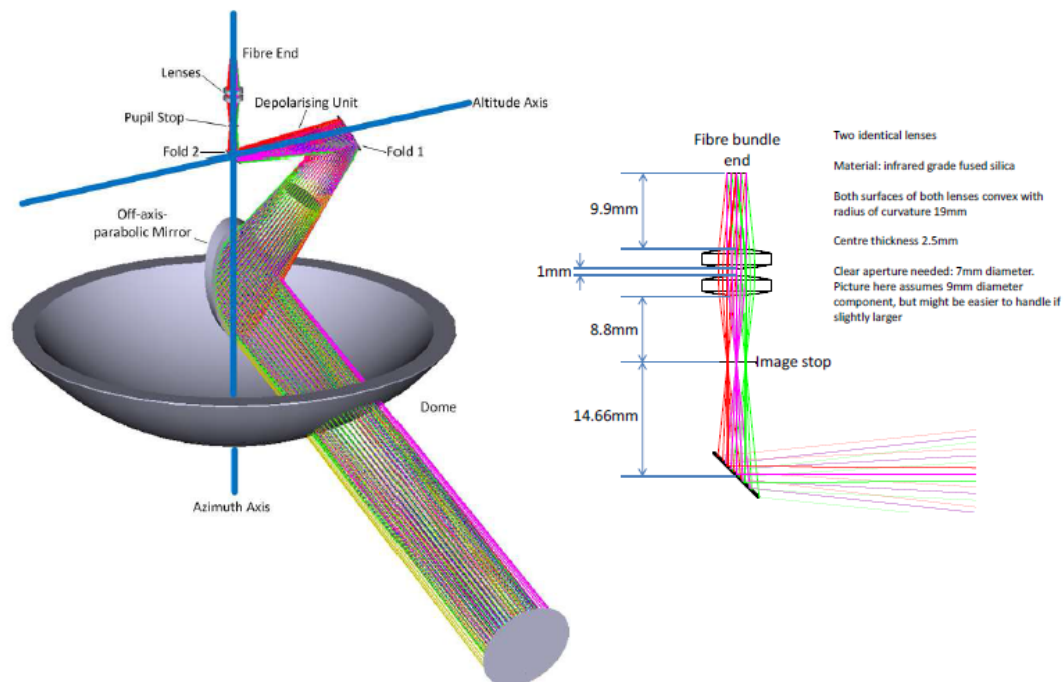
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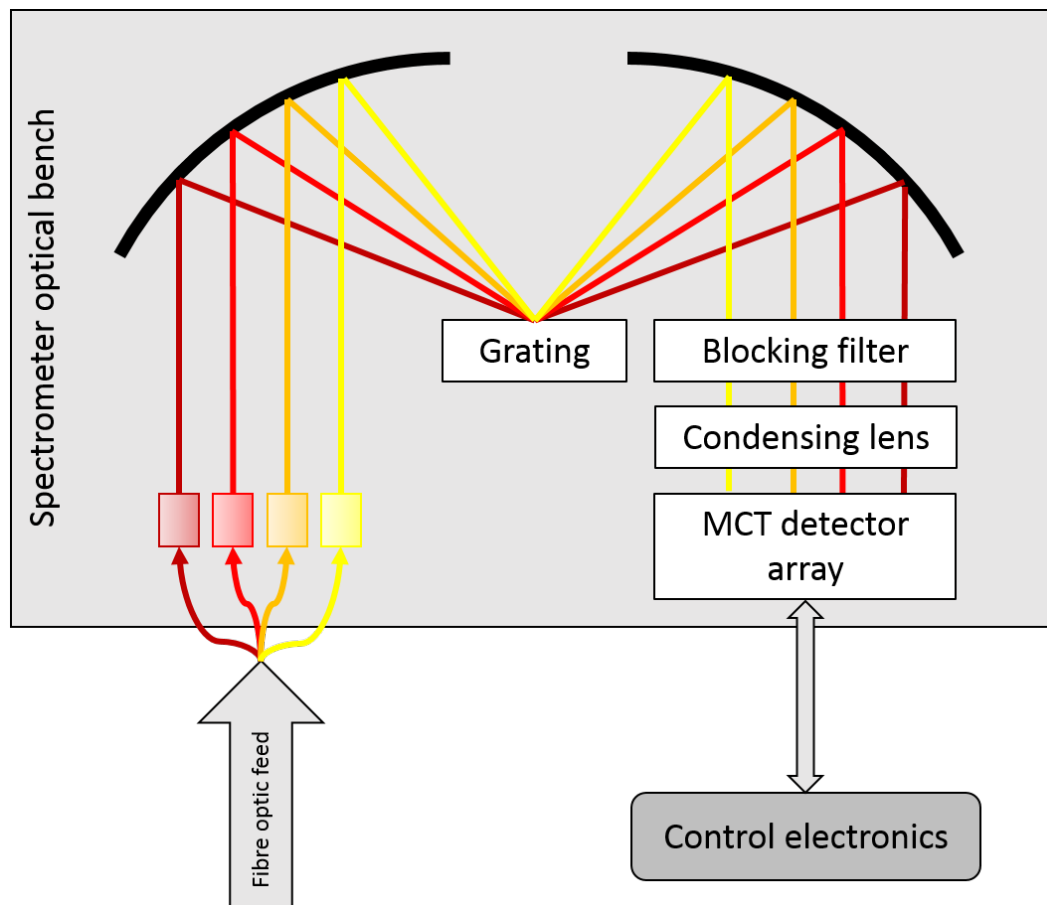
**Fig. 1.** Block diagram showing the three main components of the GHOST instrument and how they interact with one another.

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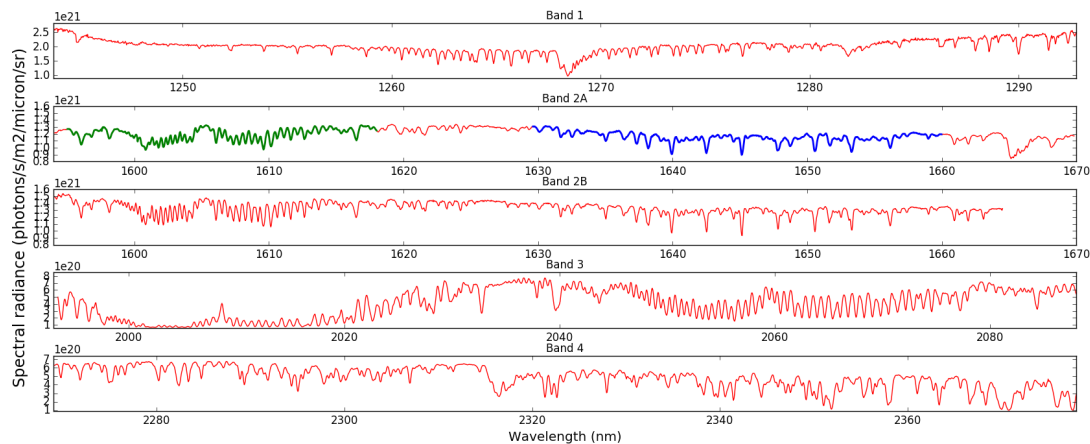


**Fig. 2.** Optical path diagram showing how the optical components of the TAM direct the observed light into the fibre bundle.

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**Fig. 3.** Block diagram showing a simple overview of the GHOST spectrometer optical layout.



**Fig. 4.** Example sun-glint radiance spectra measured by GHOST during the 10th March 2015 Global Hawk flight, now with matching scales for Bands 2A and 2B.

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