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Atmospheric Measurement Techniques Discussions

Interactive comment on "A laser-induced fluorescence instrument for aircraft measurements of sulfur dioxide in the upper troposphere and lower stratosphere" *by* Andrew W. Rollins et al.

Andrew W. Rollins et al.

andrew.rollins@noaa.gov

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We would like to thank the Referee for reviewing our paper, and for pointing to a number of points that could be clarified. In the following, we quote the Referee's individual points in bold, followed by our responses in plain text.

Pg 4 lines 4-11: This paragraph seems like an odd fit here, maybe better in background

Agreed. We have moved this text to near the end of the Background section (P2 L33 – P3 L7).

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Discussion paper

Fig 4: Figure is a bit difficult to interpret as the lines are difficult to see in the picture. Recommend replacing photo with a schematic for greater legibility.

We have replaced the photo with a schematic as suggested.

Page 7 line 6-9: Authors do not describe the method through which they use the reference cell.

At this point we use it as a check on the fluorescence signal observed during spectral laser scans. We have added text here (P7 L7-10) to describe this.

Page 7 line 9: I could not find from what trigger is the 20 ns gate measured?

The timing between laser shot and photon counting gates is controlled by one computer. This is now explained in the text (P7 L14-17).

Page 7 line 18: Why use quenching by argon? Was air not available? How does that affect the calculated lifetime?

We were unable to find the quenching rate coefficient for air in the literature. As we noted before, our observed lifetime is somewhat shorter than would be expected for argon. We have added a comment here (P7 L26-27) to suggest that the difference may be due to the difference between argon and air as quenchers.

Page 7 line 19: This is the first mention of laser pulse duration. This is controlled by the DFB pulse? Is there a difference in pulse duration between the DFB pulse and the pulse leaving the amplifier?

We had mentioned that the seed laser is pulsed with 2 ns current pulses (P5 L4), and that the amplified pulses have 2 ns pulse duration in Section 2.2 (P6 L4). We have now added text in Section 2.2 (P5 L5) to also clarify that the seed laser output pulse is 2 ns. Our measurements do not suggest a significant difference in the temporal profile between seed and amplified pulses.

Page 8 line 26: What form do the light baffles in the cell take? A pinhole? This

would seem to result in significant dead volume, or at least slow volume, even with flow moving through from either end.

The holes in the baffles are 3 mm (now mentioned in the text P6 L33). This does not present a significant flow restriction for the flow conditions in our system. As indicated in Figure 8 and discussed in the text, we have no evidence that a dead or poorly swept volume affects our measurements.

Page 9 line 3: What error in SO2 concentration does a 0.3 hPa error correspond to? Have the authors performed pressure sensitivity testing?

We did test the pressure dependence of the signal and it is nearly linear in the pressure range that the instrument has been operated. A sentence has been added here (P9 L17-19) to address this question.

Page 10 line 17-28: While the assumption that H2O quenching is negligible is likely a valid one, this would be more convincingly asserted by a brief sensitivity analysis with this instrument. Have the authors performed such a test?

Due to the comments of both reviewers we now report the results of a precise test of the sensitivity of the fluorescence quantum yield due to quenching by water vapor. We can detect no significant reduction in signal at increased water vapor mixing ratios. Text has been added on p11 L13-15 to reflect this.

Figure 13:x SO2 data also 10 s average?

Yes. We have changed the figure caption to state this.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-155, 2016.

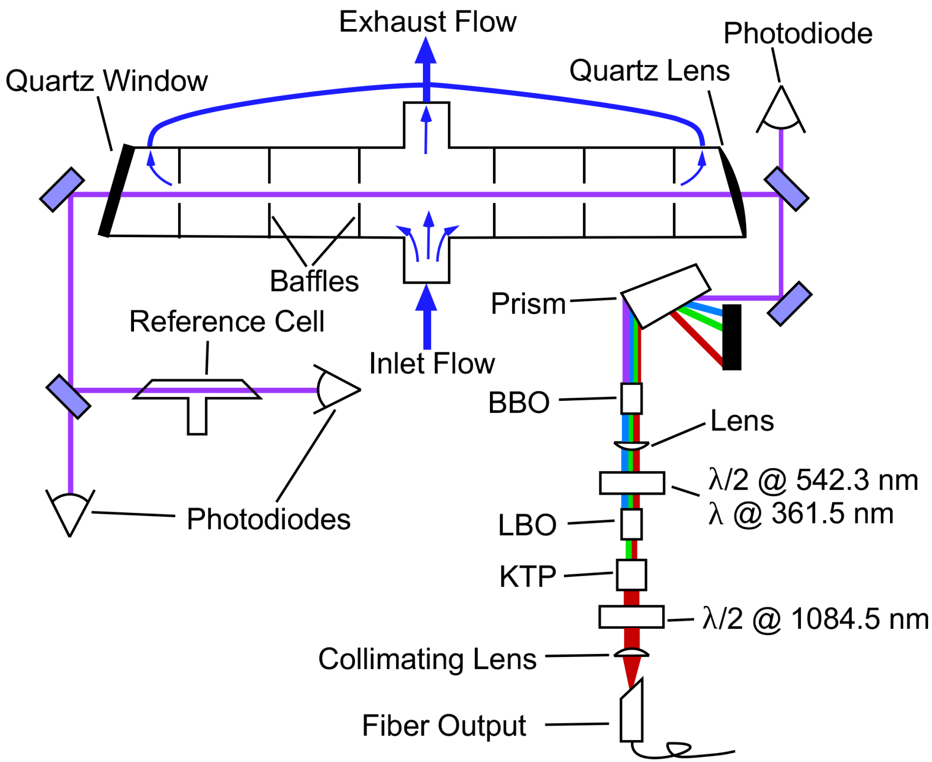

Fig. 1. New Figure 4: Schematic of the free space beam.