Reply to comments by Anonymous Referee #3

On the manuscript Interactive comment on "**Design and Characterization of a new OFR: The Particle Formation Accelerator (PFA)** " by Xu and Collins., submitted to Atmospheric Measurement Techniques.

1. **I think in the Introduction part it is worth mentioning that the PFA is vertically oriented and the heating source is on the top, thus minimizing the convection and maintaining laminar flow profile, which is different from other oxidation flow reactors.**

Answer: Thanks for pointing this out. We added those details in the introduction.

2. **Section 2.1 is a little difficult to follow and it does take me a while to figure out the actual design. I think it needs to be rearranged with subsections, e.g., inlet, main tube, outlet, lamps, etc., to make it clearer.**

Answer: Please refer to the response to Anonymous Reviewer #1 general comment (1) for details of changes made to the manuscript structure.

3. **Line 121: based on the parabolic flow assumption and the dimension (2.1 cm ID of the cone and 7.8 cm ID of the tube), it is just about 14% flow that goes into the cone ideally. That 50% flow is extracted at the cone suggests that it is not the parabolic profile at the outlet. Maybe clarify this point here.**

Answer: Sorry for the mistake, we corrected this in the revised paper. The ID of the exiting cone should be 4 cm, with the result that the roughly 50:50 flow split does not result in significant deviation in gas streamlines at the exit.

4. **About the lamp: if I understand correctly, the lamp is exposed directly to the flow? Also, since Sections 2.6 & 3.2 presented the experimental measurement of light intensity as a function of the distance to the bottom, it is worth mentioning it in Section 2.1 at least or rearranging the two sections.**

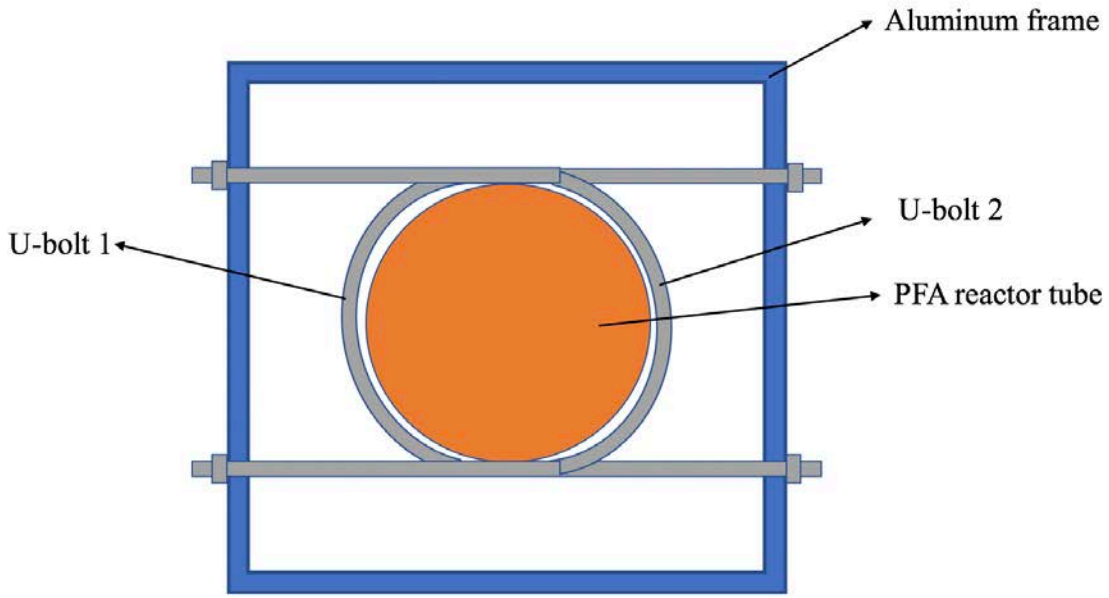
Answer: Yes, the lamp is exposed directly to the flow, but only the side flow after it is split from the sample flow. So there is no contact between the sample flow and the lamp surface. We added a sentence clarifying this in the revised paper.

5. **About the position of ePTFE: is it inside the PFA tube or outside the PFA tube but inside the layer of aluminized Mylar?**

Answer: The latter – outside the PFA tube but inside the layer of aluminized Mylar.

6. **Line 142: it is not very clear how the two U-bolts hold the tube inside the aluminum tube.**

Answer: Those two U-bolts are mounted through opposite sides of the square enclosure as shown in the top view sketch below.



7. **Line 148: is the temperature referring to the gas coming out of the PFA tube or that coming between the shell?**

Answer: We measured the temperature on the outside surface of the PFA tube during the laboratory experiments. The warmest point, which is close to the lamp, was stable at 23.6 C. We believe the sample flow temperature lies between that and room temperature because it only experiences a small amount time around the warm outlet.

8. **About the experimental setup: how is the gas getting through the tube, by pulling due to vacuum at the outlet or pushing at the inlet? For each case, there should be an excess flow (or open port), but Fig. 2 cannot tell. I guess it is pulled by the vacuum at the outlet?**

Answer: Yes, it's pulled by the vacuum pump at the outlet; we didn't control the inlet flow.

9. **About purge flow: does this flow determine the actual flow fraction that goes into the outlet cone?**

Answer: Yes, it does. We control the total flow to be 3 lpm. The sample through the center port was connected to an SMPS that had a fixed flow rate of 1.5 lpm. The side flow was extracted by a vacuum pump and was controlled to 1.5 lpm using a rotameter.

10. **About the charge effect on particle wall loss: does it have a preference on a specific polarity when there is a static charge on the surface?**

Answer: We did not evaluate this but expect that it would be comparable for positively and negatively charged particles for reasons similar to those described by McMurry and Rader (1985) for Teflon smog chambers.

11. **Line 221: how is the gas transmission efficiency determined by pulse injection? Does the concentration downstream refer to integrated concentration?**

Answer: The gas transmission efficiency was determined through steady state experiments in which the gas was continuously injected. We revised this sentence to make it clearer. Please see **Section 2.4** in the revised paper.

12. **Section 3.1: same as comment 3, how does the simulated velocity distribution look like at the outlet w/ and w/o purge flow?**

As noted in the response to comment 3, the exit port diameter stated in the original manuscript was incorrect. The velocity distribution is expected to be minimally perturbed in the exit region with the purge flow on.

13. **Figures 5 & 6 show that even with the high-reflective layer, the UV intensity at the inlet can be one-third of that at the outlet and the corresponding OH concentrations could be the same ratio. Thus there could exist a transition regime in the reactor that a compound reacts with O_3 and OH equally. Though it does not affect the OH exposure calculation, knowing the distributions of O_3 and OH along the tube will be helpful to analyze the competing reaction channels. If this point is out of the scope of this manuscript, it is worth mentioning that point though.**

Answer: Done. Please see **Section 2.5** in the revised paper.

14. **For the transmission efficiency of sticky vapor molecules, I am wondering if the transmission efficiency increases as the Teflon wall gets saturated after absorption/adsorption for a long time? The same question goes to Section 3.5, will the SOA yield increase after the experiment runs for a long time when the Teflon wall gets saturated with the sticky vapor molecules? For experiments with seeds, what is the timescale loss to the wall versus that to the particle surfaces?**

Answer: We didn't observe transmission efficiency increases with time. We conducted the experiments for at least 8 hours and each was repeated at least 3 times; no increase in transmission efficiency was evident. The same is true for the SOA yield results reported in Section 3.5. Again, we didn't observe any change over time or between repeat experiments. We have not yet estimated the relative timescales of vapor loss to the walls and to particle surfaces, in part because much of our initial effort involved variation of parameters that would produce a wide range in the resulting balance between the two.

15. **Equation 3: since RTD is the term used in the context, PDF may be replaced with RTD.**

Answer: We would like to keep this to be consistent with use in other OFR papers and the RTD comparison provided in the PAM wiki website.

16. **Line 324: what is the purpose of turning off the purge flow?**

Answer: It will always be on during normal operation. It was turned off only to provide a contrast that demonstrates its impact.

17. **Lines 351 and 360: it is worth noting here that the reactivities of OH and VOC are different.**

Answer: Thanks for the comment.

18. **Line 384: How is the ambient OHR determined?**

Answer: In response to Anonymous Reviewer #1 general comment (11), we removed the reference reporting OHR in the study region because it is likely not representative of present day conditions. No gas phase measurements were made during the tests and so we have no way of constraining the OHR.

19. **Figure 10: For experiments under the same condition, how are the different data points from since the flow reactor is usually running at a steady-state? If it is because of different injected VOC concentrations, it is better to mention that in the caption.**

Answer: Yes, the different data points were because the injected VOC concentrations were different. We clarified this in the caption of what is now **Figure 8** in the revised paper