

Geosci. Instrum. Method. Data Syst. Discuss., referee comment RC1
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Comment on gi-2022-7

Laila Andersson (Referee)

Referee comment on "Laboratory measurements of the performances of the Sweeping Langmuir Probe instrument aboard the PICASSO CubeSat" by Sylvain Ranvier and Jean-Pierre Lebreton, Geosci. Instrum. Method. Data Syst. Discuss., <https://doi.org/10.5194/gi-2022-7-RC1>, 2022

Dear Sylvain Ranvier and Jean-Pierre Leberton

Great paper and I have some suggestions for improvement.

On page 1 lines 12-14 and page 15 lines 288-290: From the IV-curve of a LP-instrument the electron density and temperature is a derived quantity with some uncertainty. The paper present a selected sweep methodology to optimize the telemetry volume over downlinking a full IV-sweep. In the discussion about the approach the manuscript do quantify the impact of having a limited number of data points in the IV-curve on the resulting uncertainty. Can change in the uncertainty of electron density and temperature be quantified?

On page 3 the methodology of data sampling is discussed. In the paper the notation 'inflection point' is stated but that notation is not clearly explain. This important because the MAVEN LPW instrument used a similar approach and it would be good to highlight the similarities/differences. On MAVEN at low altitudes (sweep potential +-5 V) we use a look-up table for the sweep steps (large step sized on the start and stop and small step sizes in the center similar to the PICASSO approach). This sweep is then centered on the location where the previous measured current changed sign plus an offset. The offset allows any current offset to be taken into consideration and center the smallest voltage step sizes in the region where the electron temperature is extracted, i.e. the smallest steps is not necessarily where the measured current change sign. The centering of the look-up table is only allowed to slowly change from sweep to sweep (a time constant is set in the instrument of how 'slow' this change is selected to be). In the paper it is not clear if the PICASSO approach take into account any instrument current offsets or how fast the instrument respond to large changes from one sweep to another. This last topic is an important point when looking at Figure 13.

On page 3 the stepping speed at up to 10 kHz is discussed. There has been a recent paper analyzing the sweep speed. They analyzed 10 kHz (and higher), you might want to reflect over their numerical result with your observational result.

M. Kjølberbakken, W. J. Miloch, Ø. G. Martinsen, O. Pabst and K. Røed, "Numerical Study of Non-Linear Effects for a Swept Bias Langmuir Probe," in *IEEE Transactions on Plasma Science*, vol. 50, no. 5, pp. 1237-1245, May 2022, doi: 10.1109/TPS.2022.3164220.

On page 5 discussing the temperature of the probe. Is the 200 oC and measured temperature or a simulated thermal estimate? I assume the temperature is for the metal rod, not the electronics such as the preamps.

Page 8. Very nice simulations capturing the problem with high density region and small SC. I might have missed it was the simulation in flowing plasma? For MAVEN LPW we did also simulations of the local plasma, I would recommend you to read that paper and comment on similarity/differences. In that paper the potential influence from the SC was not the main issue but the wake due to the probe itself.

Ergun, R. E., Andersson, L. A., Fowler, C. M., & Thaller, S. A. (2021). Kinetic modeling of Langmuir probes in space and application to the MAVEN Langmuir probe and waves instrument. *Journal of Geophysical Research: Space Physics*, 126, e2020JA028956. <https://doi.org/10.1029/2020JA028956>

Page 13 discussing the result of Figure 14 (and Figure 15). Could the authors add a few sentences how this would change for space instrument. In space the instrument often is just continuously on so this increase might not be ever observed. The paragraphs fell a slightly short with taking the result from the laboratory and spell out how it would be observed in space.

Page 12-14 about the contamination: Gold is fairly robust material and is unlikely to be effected by atomic oxygen. But for the readers understanding, it could be good to point out that atomic oxygen could change the behavior in similar way as the contamination issues. Joseph Samaniego did some laboratory experiments and that effort could be help the discussion in this paper. This is one of the papers:

Samaniego, J. I., Wang, X., Andersson, L., Malaspina, D., Ergun, R. E., & Horányi, M. (2018). Investigation of coatings for Langmuir probes in an oxygen-rich space environment. *Journal of Geophysical Research: Space Physics*, 123, 6054– 6064. <https://doi.org/10.1029/2018JA025563>

Great work,

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