Responses to review comments:

We sincerely appreciate the reviewer's careful review and constructive comments. Our response to each comment is listed in the following in red. For convenience of reading, we repeat each comment in front of our response. Note that only future revision plans are mentioned because we are yet to be invited to revise the manuscript by the editor.

This work from Nishiyama and co-authors describes an in-flight calibration campaign of the Ganymede Laser Altimeter aboard JUICE. The team used reflected sunlight from the Earth and the temporal and spatial magnitude of the signal on the GALA receiver APD to assess the pointing of the GALA receiver itself. They conclude that based on comparisons with JUICE telemetry, there is a large (700 microrad) between the pre-flight and in-flight pointing of the GALA receiver. This has tremendous consequences for the use of GALA during the JUICE mission, as the GALA receiver FOV is only 550 microrad, thus if the receiver pointing is independent of the transmitter (unlikely) the transmitted beam could be completely outside the receiver FOV, rendering the instrument unable to range or provide active reflectance measurements. In general, the paper is very well written and the figures and analytical methods are of high quality. However, there are two main issues I see with this work at present. First, the (unavoidable for this observation) paucity of telemetry data, especially at the key time period related to the onset and falloff of the passive radiometry signal make the analysis wholly reliant on potentially larger errors in the assumed pointing of the spacecraft. The magnitude of the differences between the three interpolation methods (timing delays) are of the order of the overall pointing offset, and the expected temporal behavior for a fixed offset (positive or negative delay in both onset and falloff) is not observed using any of the three methods. The other part of the analysis rests on the structure in the passive data during Earth viewing and the magnitude of the signal during that period. The authors use very small signal variations (0.1 mV change on a 3.1 mV signal) to describe an optimal offset in pointing. This ~3% level of change is smaller than the residuals between the best fits and the data, the change in the ratio of the JANUS and GALA radiometry due to terrain type, and the change in responsivity due to detector temperature effects. This makes both of their lines of argument (temporal onset and falloff, and quantitative signal strength and correlation) suspect. I wholeheartedly agree that there is a strong need for a better round of calibration with high-rate telemetry at other targets, but this paper does not provide strong evidence for the unexplainable 700 urad offset they conclude is present.

Response: We are grateful for the reviewer's concise summary and thoughtful comments. See our detailed responses below.

Specific comments are below:

Line 22: Paper under review shouldn't be cited here, especially a self-citation.

Response: This paper will be kept cited because the paper is already published in The Planetary Science Journal (https://iopscience.iop.org/article/10.3847/PSJ/ae447c).

Section 2.1: A mechanical description of the GALA instrument would be useful to assess how this offset could have occurred and if it would affect the transmitter and receiver together.

Response: Thank you for the suggestion. We will add a short paragraph to summarize basic mechanical information of GALA.

Section 2.1: Table 1 should be moved much further up, or at least the FOV radius of GALA should be mentioned in this section since it is relevant to Figure 1.

Response: Following the comment, we will move Table 1 to section 2.1 in the revised manuscript.

Section 2.1: it would be useful to include further details of this Earth-observation campaign including slew rate, targeting pattern, etc. Even though the telemetry is only at the 1-minute level, you should be able to use the commanded slew rate and onboard time to ascertain when exactly the FOV should leave the disk.

Response: In this observation, the JUICE spacecraft was simply staring at the Earth, but there is no specific pattens in targeting. To show the commanded slew, we will add the planned attitude information in the revised Figure 1. However, it should be noted that the commanded attitude does not align with the observed attitude because of guidance error of the spacecraft. Also, the simulated start and end of the slew are not consistent with those of the noise increase when the planned attitude is assumed. Therefore, in this study, we do not use the planned attitude model for comparison between simulations and data.

Figure 1b: Y-axis should probably changed to "angle between Earth and GALA-Rx-LOS (urad)" rather than "distance between…"

Response: Following the comment, we will change the label of y-axis in the revised manuscript.

Figure 1b: the switch from linear to log within a single y-axis makes it very hard to assess the transition between the two scales (and is also something I've never seen done before). My recommendation would be to break up Figure 1 into two figures. The new Figure 1 will keep

Figure 1a as is, change Figure 1b to be fully on log scale, and add a Figure 1c which is the same as 1b but on a linear scale and with Y-limits between 600 and ~1000. The original Figure 1C would then become the new Figure 2, which it perhaps should be already.
Response: Thank you for your recommendation. We will revise the figures, following the recommendations.

Figure 1b: Are the large arrow in the figure, the shading, and the arrows on the left hand side all giving the same information? If so I think you only need one method. Perhaps adding a horizontal line at the angle where the GALA LoS is within the Earth disk. Also is that the FOV fully within the disk or is that the start of the GALA FOV inside the disk?
Response: It is true that the arrows and shading give almost identical information. The horizontal line shows that the GALA Rx-LoS (i.e., center of FOV) is within the Earth disk. In the revised manuscript, we will omit the arrows and add two horizontal lines to show timings when the FOV is fully within the disk and when the FOV starts to be inside the disk for clarity.

Figure 1b: Although the three spline methods agree quite well with each other it is very hard to trust the large step between 10:07 and 10:08.
Response: Since no high-frequency attitude data is available, we will keep using the interpolation, but will emphasize limitations of the data.

Figure 1c: This portion should come in Section 4, not in section 2 before any of the details of the analysis are discussed. Also, what are the yellow lines and yellow bar in the left hand portion? Is that the slew track?
Response: We will add a new figure in Section 4 to summarize final results. The yellow line in the left panel shows the slew track.

Section 3.1: You should provide the spectral curves of the Filter 12 and GALA BPF bandpasses in this paper rather than just referencing the Enya and Palumbo papers. That will give a check on whether or not the value from Equation 1 was properly calculated.
Response: Thank you for your suggestion. We understand your suggestion; however, we decided not to add a new figure showing this specific detail (spectral responses of GALA and JANUS) because these would be a replication of figures already available in previous papers by Enya et al. and Palumbo et al. The interested reader can easily access the plots in these papers.

Line 170: “Noise Level” should also include units. “N” suggests photon number or rate, but then Nds is described as current.

Response: We will add "[mV]" to show the unit. However, "N" will be kept as has been used in previous papers (like Steinbruegge et al., 2018). Also, photon number is not mentioned in current manuscript.

Section 3.2: Was the temperature of the APD monitored during this experiment? That may have an effect on both the noise and the responsivity (see Xiaoli Sun, J. Bryan Blair, Jack L. Bufton, Marcela Faina, Sigrid Dahl, Philippe Bérard, Richard J. Seymour, "Advanced silicon avalanche photodiodes on NASA's Global Ecosystem Dynamics Investigation (GEDI) mission," Proc. SPIE 11287, Photonic Instrumentation Engineering VII, 1128713 (2 March 2020); https://doi.org/10.1117/12.2545203)
Response: The APD temperature is monitored during the experiment, but it is kept constant at 25°C except for the warm-up phase (< 1 min) at the beginning of the observation campaign (where GALA was observing open space). While the noise level fluctuates during the Earth slew, the APD temperature variation is always smaller than 0.1 K, corresponding the responsivity changes less than 0.4%. This variation does not show any patterns similar to the observation. Therefore, the APD temperature cannot explain observed noise variation and is excluded from the analysis. We will mention this point explicitly in the revised manuscript.

Figure 3: Titles to each Row should be added to indicate which interpolation method was used.
Response: Thank you for the suggestion. We will add titles in the revised manuscript.

Section 4.1: The use of RMS to quantify the offset does not seem quite right. Assuming you had perfect knowledge of the spacecraft telemetry, the geometry of a fixed offset of the boresight should result in a constant magnitude but inverse sign offset for the onset and falloff of the noise. In fact your results don't show that (Figure 2). A table of the timing delays for the 6 cases (Three interpolation methods and onset and fallow) should be given somewhere in the paper as well, along with uncertainties. Using the RMS makes it seem like the onset and falloff measurements should be taken combined, but what it actually seems like is the telemetry uncertainty is overwhelming any pointing offset. Also, the RMS values for the three interpolation methods should be given in a table. If the size of the timing offset is of the same magnitude as the spread of the three interpolation methods (it looks like it does from Figure 3c,f,i) this raises questions about the feasibility of the analysis using such coarse telemetry.
Response: Thank you for the detailed comment. The inverse sign for the onset and falloff is actually observed in the case of linear interpolation, which is one of the reasons behind the use of linear interpolation in Section 4.2. However, magnitude of the time offset cannot be the same for the onset and falloff because the slew speed with respect to the Earth is not the same for both timings. We do not argue that uncertainty due to the coarse attitude telemetry

can be ruled out. However, as shown in Figure 2, the timing offset among the three interpolations is less than 15 s, which provides basis of the criterion used in our analysis in Section 4.2. In the revised manuscript, we will clarify these points above and add a table to summarize time offsets for all interpolation methods.

Figure 4: Is there an assumption here that the JANUS radiometry is "perfect"? You are looking at very small changes here (several percent level), so the JANUS radiometry being off at that level seems possible. Was the JANUS radiometry verified during this Earth-imaging campaign?
Response: The relative radiometric accuracy of JANUS is expected to be about 1%, which is small enough to correlate the GALA noise variation with incoming photon flux, because we use spatial variation in reflected sunlight as the source of the calibration. For the absolute radiometric accuracy, Langevin et al. (this issue) report an offset of 20% between radiances measured by JANUS and MAJIS. This may result in an offset to the average. However, because of the non-linearity between incoming photon flux and noise level (Eq. 7), this offset corresponds to only 6 % in the GALA noise, being smaller than the threshold of the mean difference used to infer the final results. We will document this point in the manuscript.

Langevin et al. (this issue): https://egusphere.copernicus.org/preprints/2026/egusphere-2026-410/egusphere-2026-410.pdf

Line 235: The increase in the noise after 9:47 is quite subtle, as is the decrease in the simulated noise in the pre-launch boresight curve. Based on the generally poor fit between all the simulated curves and the GALA data in general the claim that this portion of the time series is indicative of a boresight offset is not strongly supported.
Response: As the noise data show much smaller variations within neighboring measurements, the noise increase after 9:47 is not subtle but statistically significant. Because of limited knowledge of the spacecraft attitude data in time, we cannot trust all noise variations at the short time scales (i.e., less than attitude data acquisition rate) but can rely on noise trend over the entire observation window. However, the overall trend is clearly different from the one expected with the pre-launch boresight vector. As ~30 observation points of JUICE attitude data exist, the overall trend may be optimized as shown with the red and blue lines in Figure 4.

Line 260: The 0.1 mV difference (out of 3.1 mV total) is only 3%, which is much less than the 9% described earlier from changes in the spectral sampling of different terrain types. Doesn't this present a problem where the offset could be the radiance ratio of GALA and JANUS rather than the boresight?

Response: As the noise level is influenced by the square root of incoming flux (Eq. 7), the 9% error from spectral shape on conversion ratio corresponds to 4.4 % in GALA noise. The 0.1 mV difference mentioned at this line is smaller than the potential bias due to the conversion ratio assumption. However, in the latter discussion (the last paragraph of section 4.2), we used 0.25 mV to exclude boresight vectors when the best fit is defined. So, this point does not affect the latter discussion. We will clarify this point in the revised manuscript.

Line 260: Again, the temperature effects on the detector need to be taken into account here. A 0.1 mV offset is well within the range of the variability of the detector responsivity as a function of temperature (see Sun et al paper above). Figure 6 in that paper shows the responsivity changes about 1% per degree C, so a 3% offset in voltage could easily be explained by a 3 C difference in detector temperature that is not taken into account here.
Response: As answered above, the APD temperature cannot explain the observed noise variation.

Line 267: Aren't the mean offset and correlation coefficients correlated with each other? They are being discussed as being two independent lines of evidence in the text. If you first normalize all the simulations to the same zero mean offset do the correlation maps change?
Response: As the correlation coefficient is not subject to the mean value mathematically, normalization of the simulations to the same zero mean offset does not change the correlation maps. Therefore, the mean offset and correlation coefficients can be treated as two independent measures of boresight offsets.

Line 277: The qualitative match of the clouds at 9:39 is completely absent for the interpolation case, and the magnitude of the match is very poor and much larger (0.25 mV) than the offset of the pre-launch boresight vector to the GALA noise data.
Response: In the interpolated case, it is true that the offset at 9:39 is larger. However, the overall increasing trend rather resembles the observation, which made the correlation coefficients higher than the pre-launch vector assumption. We will explain this point more in detail in the revised manuscript.

Line 287: The LOLA boresight issue stemmed from force applied on the transceiver by the thermal blankets under varying thermal conditions. Were the TVAC tests in Hussman et al 2025 performed with the final spacecraft thermal blanketing installed or not?
Response: The thermal vacuum test was performed together with the baffles. The baffle is connected to the base of GALA but is decoupled from transmitter and telescopes,

meaning that the thermal variation is not expected to be the cause of the offset based on the thermal vacuum test in Hussmann et al. (2025).

The intention behind the description about LOLA is to show other laser altimeter cases. In the revised manuscript, we will also discuss this point in comparison with other laser altimeters, such as NLA onboard NEAR and LIDAR onboard Hayabusa2, both of which are known to have post-launch offsets larger than the one reported in this manuscript.

Line 307: Figure 1C is for the Earth observation, not the lunar observation, correct? Where are the lunar passive radiometry data from GALA?

Response: There are no lunar observations by GALA, but JANUS measured the Moon in the same picture as shown in Figure 1C. We will clarify this point in the revised manuscript.

Line 309: Where is the 110% number coming from? I can't determine where in Figure 6 this number originates.

Response: The number comes from the noise level compared to the pure background level. We will add a short description in the revised manuscript.

Figure 6: The caption should explain what the vertical dotted lines are.

Response: We will explain the dotted lines in the revised manuscript.

Section 5: It is misleading to call this a "noise" measurement, since it is actually a passive reflectance measurement, which is distinct from the noise from the detector itself. I understand that in the context of pulse detection and ranging the solar background acts as a noise source, but it is confusing (especially in section 5 where you start talking about "maximum possible noise increase". You should carefully discriminate between passive radiometry measurements and noise during ranging measurements.

Response: Thank you so much for the comment. We will carefully discriminate this type of measurements in the revised manuscript.

Section 5. Can the authors provide a timeline for when future calibration activities will occur? Is there another Earth flyby happening? When will the lunar data be available and used for calibration?

Response: It is impossible to mention exactly when and whether future calibration activities occur because future negotiation for operation is still needed. Instead, we will broadly mention possible observation windows at future flybys at the Earth and icy moons in the revised manuscript.