

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.

The manuscript provides a unique data set obtained from GALA Earth flyby and describes how they used the data to verify the GALA receiver bore-sight after launch. The result shows a potential bore-sight shift of 700 micro radian compared to the pre-launch measurement. The timing offset between the GALA data and the spacecraft attitude is assumed to originate entirely from the GALA bore-sight misalignment with respect to the spacecraft coordinate system.

However, the manuscript does not give the latencies of the GALA and JANUS camera data which could also cause a time offset in the received data. The direction of the bore-sight shift is not provided (along or cross the bore-sight scan), which could have significant effect on the result.

Response: As GALA and JANUS observations are referenced to the same clock on the spacecraft, no time delays between the two instruments exist. The direction of the boresight shift is provided in the spacecraft reference frame. The offset contains components both along and cross the spacecraft attitude shift as seen in Figure 3 and 5. We will add a short description in the revised manuscript to clarify this point.

The timing resolution of the data, ~ 1 mrad over 25 minutes, or 40 urad per data point, should be fine enough to solve for the bore-sight offset without interpolations. Three interpolation methods are used in the data analysis which give conflicting results.

Response: The temporal resolution of the JUICE attitude data is not sufficient. While the attitude data was acquired at 1-minute intervals, the GALA FOV location with respect to the Earth moves at shorter timescales. This requires interpolation of attitude data for comparison between GALA noise data with JANUS-based models. In addition, the correlation coefficients between GALA noise and JANUS-based models are not subject to the interpolations as mentioned at lines 250–252.

The bore-sight shift of JANUS after launch could also play a role in the time offset of the data. Although the JANUS bore sight can be solved separately from the time of the spacecraft

attitude data and the Earth image, it is not included in the data analysis presented in the manuscript.

Response: In the simulation, we used the JANUS boresight direction based on pre-launch calibration. Although upcoming boresight calibrations of JANUS are yet to be published, the boresight offset of JANUS is not expected to be small. For example, previous thermal analysis shows that the boresight does not change more than 10 microrad. Also, images from this campaign show that the Earth position in the JANUS image is consistent with the assumed boresight vector well within an error of 2 pixels (i.e., 30 microrad). These values are smaller than the boresight offset reported in this study by an order of magnitude and have negligible amount of contribution to the analysis. In the revised document, we will explain this point in the discussion.

The use of LOLA in orbit bore-sight shift as an example, which is not relevant to this study. LOLA bore-sight offset was mostly in the laser transmitter, which is pulled by the thermal blanket. It was an anomaly rather than a typical case. We hope GALA does not have the same problem.

Response: We mentioned LOLA to show other laser altimeter cases, not to show a directly relevant case to this study. In other missions, such as NLA onboard NEAR and LIDAR onboard Hayabusa2, similar offsets of laser boresight vectors have been measured. In the revised manuscript, we will briefly mention other cases as well with more clarification on our intention.

I feel there are too much uncertainties in the result for the publication. A bore-sight offset of GALA would have a major implication to the JUICE mission. It warrants a more thorough study with all available data to obtain a more certain solution.

Response: We cannot rule out all uncertainties related to the JUICE attitude data, but we have combined all available data in this analysis. As only JANUS can provide images at the same direction as GALA, combination with JANUS is the only way to obtain the solution for the GALA boresight vector. While we are not completely sure what kind of data the reviewer mentions, we think this approach already demonstrates a method of GALA calibration with all existing data. Note that the scope of this paper is to study the status of GALA, not JUICE spacecraft itself. Finally, further calibration efforts for the GALA boresight vector are planned in the cruise phase of JUICE, e.g. establishing a laser link with a laser ranging station on Earth.