

ESOC, 1 June 2026

Dear Editor and Reviewers,

we thank you for the careful evaluation of our manuscript entitled:

"The JUICE Lunar–Earth Gravity Assist from Trajectory Design, Navigation and Spacecraft Operations Perspective"

We are grateful for the constructive comments and suggestions, which have helped us improve the clarity and quality of the manuscript. We have carefully considered all remarks and revised the manuscript accordingly.

Reviewer #1 provided a number of valuable suggestions aimed primarily at improving readability, terminology consistency, figure annotations, formatting, references, and explanatory notes for a broader audience. We have addressed all comments, including the addition of missing references, clarification of acronyms, correction of figure labels, improvement of terminology consistency throughout the manuscript, and revision of several passages identified by the reviewer.

Reviewer #2 provided a detailed review and numerous constructive recommendations regarding clarity, terminology, manuscript structure, references, figure presentation, and explanation of several technical aspects of the LEGA operations and navigation strategy. We have addressed all comments and revised the manuscript accordingly. The revisions include clarification of technical terminology, restructuring and reformulation of several paragraphs, addition of relevant references and footnotes, improvements to figure captions and layouts, clarification of safety considerations and ΔV -related discussions, and corrections to formatting and wording throughout the manuscript.

We also thank the Editor for the additional comments. In response:

1. Figure 5 has been corrected to remove unintended editing artifacts and improve the presentation of the schematic.
2. We have added a dedicated description of the post-LEGA short-pointing activity conducted on 9 September 2024. This addition provides further context regarding payload operations performed during the LEGA campaign.

A detailed point-by-point response to all reviewer comments is provided in the accompanying response document. All modifications in the revised manuscript have been highlighted for ease of review.

We appreciate the time and effort invested by the reviewers and the Editor and hope that the revised manuscript is now suitable for publication.

Sincerely,

Angela Dietz

On behalf of all authors

Comments	Actionee	Answer
Referee #1		
The paper provides a clear and useful overview of the moon-earth gravity assist from a trajectory design, navigation and spacecraft operations perspective.		
A few suggestions are provided below, mainly to provide a few explanations which will help a broader audience to understand the paper.		
1 use always the same format for the dates (e.g. 14 April 2023 (line 22)) throughout the paper. Different formats are use: e.g. caption Fig. 2, line 190, ...	AD	Fixed
2 Line 15-16 can be removed, they look out of scope in the abstract and the papers are references elsewhere in the article.	AD	Lines removed
3 Line 41: explain what cold- and hot-redundancy means	AD	Simplified sentence and just stated unit redundancies.
4 Line 50 to 55: add references to the listed instruments. Here are a few: JANUS: Palumbo et al 2025, MAJIS: Poulet et al. 2024, RIME: Bruzzone et al. 2015	AD	References to relevant instrument publications have been painfully added.
5 Line 66: explain what delta-V is	AB	Footnote was added
6 Line 104: Ariane 5 ECA: explain acronym (ECA)	AB	Footnote was added
7 Fig 2: Change 19th and 20th August to 19 and 20 August (to be consistent with the other dates throughout the paper)	AB	Fixed
8 Fig 2: S/C vel change into S/C velocity	AB	Fixed
9 Fig 3: the label "outgoing" would be better place on the left-hand side of the plot, close to the line	AB	The labels "incoming" and "outgoing" represent the connection with the heliocentric part of the trajectory. They take place when the distance w.r.t. the Earth becomes large, hence they are located on the right side of the plot
10 Line 127: Different "cases", scenarios might be better than cases	AB	Fixed
11 Line 129: explain what periselenium is	AB	this term was removed
12 Line 155: replace "see next section" with "see Sec. XXX" with ref to the section number.	AB	Fixed
13 Line 176: replace "the previous section" with "Sec. XXX" with ref to the section number.	FB	Fixed
14 Line 180: replace 1/1/2025 with 1 January 2025	FB	Fixed
15 Fig 5: in the caption: remove schedule after TCM. Write "data-cutoff" in a consistent way throughout the paper: either data cutoff or data-cutoff	FB	Fixed
16 Line 190: replace 16/07/2024 with 16 July 2024	FB	Fixed
17 Line 204: replace 31/07 and 06/08/2024 with 31 July and 6 August 2024	FB	Fixed
18 Line 205: correct reference to Fig. 7 (and not Fig. 6)	FB	Fixed
19 Line 211: caption Fig. 7: replace 31/07/2014 with 31 July 2024 and 06 August/2024 with 6 August 2024	FB	Fixed
20 Line 228, 231, 236, 237, 247, 254: correct date format	FB	Fixed
21 Line 247: change Km into km	AD	Fixed
22 Line 263: change closest approach + 5 minutes into CA+5min	AD	Fixed
23 Line 289: replace dry-run with rehearsal (it's a more broadly understood term)	AD	Fixed
24 Line 291: after "-X Sun pointing throughout the entire phase" add what that means, e.g. though using the high-gain antenna as a sun shield.	AD	Fixed
25 Line 300 and 301: replace figure with Figure	AD	Fixed
26 Line 302 and 306: caption Fig. 9 and Fig. 10: correct date format	AD	Fixed
27 Line 311: use flyby instead of swingby to be consistent throughout the paper.	AD	Fixed
Referee #2		
Dear authors, thank you for this nice paper describing the JUICE LEGA very clearly. The figures support the paper very well and help explaining the content of the paper. Overall, I do have some minor comments. The title and abstract of the paper describe and summarize the paper well and allow for a good overview of the paper. The text is mostly written in a clear and structured manner and mostly easy to understand. It clearly shows the novelty of the LEGA and the gain for the mission, but it is hard to see where the authors directly contributed to the work. As a general remark please consider to add a plural "s" to abbreviations when needed.		
In detail, please consider the following comments:		
1 Line 9: "... redirecting JUICE toward its..." should be "towards".	AD	Fixed
2 Line 28: I suggest to replace the "-" between "500-km" and "200-km" with a " ".	AD	Fixed
3 Lines 19-29: Could you add some references to papers describing the JUICE mission (e.g. the special issue of JUICE describing all instruments which is hopefully published this year).	AD	Added spacecraft design, JUICE mission and ground segment references.
4 Line 38: You mentioned that the main engine is a bi-propellant engine consider adding for the attitude and orbit control thrusters that these are bi-propellant as well.	AD	Removed "bi-propellant" for simplicity.
5 Lines 50-58: Consider adding references to instrument descriptions (if not published yet maybe also reference the JUICE special issue which is hopefully published this year).	AD	References to relevant instrument publications have been painfully added.
6 Lines 59-61: Maybe consider adding RADEM here?	AD	Very good point. RADEM was added.
7 Line 72: B-plane is not introduced here as Body-plane. Maybe introduce it here already and not in line 168-170.	AB	Footnote was added
8 Lines 70-75: The paragraph in general is written a bit unclear and interrupting the flow of the text. Would it be possible to connect it better to the previous paragraph for example by explaining the "patched conic model" in more detail and with some reformulations?	AB	Reformulated
9 Line 78: "measurements" should be singular here ("measurement").	AB	Fixed
10 Lines 86-98: The three paragraphs do not link together very well. Maybe move the paragraph lines 90-93 to another place or reformulate it to get a better connection as you did not write about the launch window so far.	AB	This comment was answered last. It led to a major reshuffle of the entire section. This outdates some of the answers to other comments
11 Lines 91-93: Reformulate this sentence and potentially split in two as the term "... close these days..." for example is not clearly stating that you mean: "remove these days from the launch window".	AB	Reformulated. REM: "closing" the launch window is the official wording
12 Line 104: "Ariane 5 ECA" Why do you use this special version? Maybe clearly state that it was used to bring JUICE to orbit and add a reference to it? You could also already introduce it in the paragraph spanning lines 90-93.	AB	Clarified
13 Line 110: Consider replacing "specificity" by "characteristic".	AB	Fixed
14 Lines 110-113: This paragraph feels out of place here and disturbs the text flow maybe consider linking it differently to the previous paragraph.	AB	Comment not understood - it already seems clear enough.
15 Line 114: This was already mentioned in line 94. Is it needed here?	AB	Reformulated
16 Lines 126-130: Why does this concern safety? From your first sentence in this paragraph the impression is that you will talk about safety but this is not the case here.	AB	Clarified
17 Line 134: "This difference partially compensates the deterministic Delta-V saving." Does it really compensate for the Delta-V saving and not reduce the Delta-V saving?	AB	Fixed
18 Line 135: "The preliminary estimate..." The estimate of the compensation or the estimate of Delta-V? Please clarify.	AB	Clarified
19 Line 140: Suggested to remove the part in parenthesis.	AB	Removed
20 Lines 140-141: "... than without it (). This is..." Consider adding a paragraph before "This is..."	AB	Done
21 Line 141: "(which is slightly different for both the LEGA and the EGA cases)" you did so far not state that an EGA case was considered at certain parts of the launch windows. This should be added earlier maybe mention this already in the paragraph lines 90-93?	AB	Fixed, sentence added in the paragraph before Figure 2
22 Lines 144-145 (Figure4): if you adjust the x-axis in figure for according to my comment below remove the date conversion in parenthesis.	AB	Removed
23 Lines 151-155: You mentioned safety before. Consider merging both paragraphs into one and expand more on the safety criteria. It is not clear why the safety aspect is important and has to be considered with the current formulation.	AB	Safety was mentioned before only to introduce it as a challenge. One sentence is added to clarify
24 Line 159: Do you have a reference for the LEGA inception from 2012?	AB	Yes, it is the paper of Schoenmaekers, Langevin, Boutonnet and Martens mentioned in the abstract
25 Line 164: Consider removing "by the interested readers".	FB	Removed
26 Line 166: "... a-priori zero and..." to what is the zero referring to? Please clarify.	FB	Added Delta-Vs
27 Lines 168-170: Could be removed if the B-plane was introduced before.	FB	Shortened and reference is made to section 2
28 Lines 170-171: "The two directions in the plane are defined as T and R whereby the former..." It is not clear if the former refers to the "T" or the plane and the R axis is not defined. Please clarify.	FB	Made more explicit.
29 Line 205: "... Figure 6..." This reference should be Figure 7.	FB	Fixed
30 Line 241: "Jupiter system" suggest to change to "Jovian system".	FB	Done
31 Line 247: "Km" should be "km".	AD	Fixed

32	Line 263: Consider removing "shortly".	AD	Done
33	Line 267: "...optical head blindings and straylight happened..." consider adding "detections" (or something suitable) after "straylight".	AD	Done
34	Lines 269-270: "...using only internal measurement unit (IMU)" insert "the" + "...using only the internal measurement unit (IMU)".	AD	Fixed
35	Lines 285-286: Consider changing the layout here, as the "-" sign does not clearly belong to the number following. The same counts for the "+" sign.	AD	Fixed
36	Lines 293-298: Layout change from lines 285-286 should be propagated to here as well.	AD	Fixed
37	Line 299: "-" can be mistaken as a minus.	AD	Fixed
38	Line 317: remove "team" in "Flight Control team".	AD	Fixed
39	Add section "Author Contributions" before Acknowledgements.	AD	Section was added.
	Figures:		
40	Figure 2: The dotted lines which intersect between the lunar orbit and the JUICE trajectory are not mentioned anywhere. Either remove them or explain their meaning by e.g. indicating that each intersection of one of these dotted lines with one of the trajectories corresponds to some specific date. Change either red or green color due to red green blindness.	AB	Fixed
41	Figure 3: Consider to add arrows to indicate the direction. Move "Moon Orbit" to the left of dashed line and use the blue color from the dashed line.	AB	Fixed
42	Figure 4: Consider to convert the x-axis into a format of either DOJ or actual calendar dates to improve readability. Additionally, consider in the image caption to change "vertical black lines" to "vertical black lines with star marks". Consider changing red or green color to something else.	AB	Fixed
43	Figure 5: Replace Figure so that selection of middle box is removed.	FB	Plot was corrected.
44	Figure 6: "... overlaid contour plot..." Why is the contour plot so much smaller than the actual figure? Maybe increase the size so in the contour plot it is visible that the estimated impact point and the target are within the contour. Explain legend of the right plot in the image caption more as the dates are not present in Figure 5 and STP# references are not explained at all. Move "Decision to execute TCM-4w" to bottom left of figure to make it consistent with Figure 7.	FB	The contour plot is pre-computed, i.e. starting from the optimum target point the impact point is systematically perturbed by small Delta-Rs and Delta-Ts, and for each the full JUICE trajectory is re-optimised and the required mission Delta-v computed. This is a heavy numerical process which had been performed up to some reasonable upper limits of Delta-T and Delta-R, i.e. there is no data available beyond the contour points that are displayed. However, I do not see this as a significant disadvantage for the flow and understanding of the paper. The caption of Figure 6 has been updated to explain the legend in more detail and to link it towards the diagram in Figure 5. I prefer not to move "Decision to execute TCM-4w" since this plot is different to Figure 7 in the sense that it shows the same data at different zoom levels, whereas in Figure 7 two different solutions are at different epochs are shown. I consider the location as is also more suitable since it aligns with the text on the left side of the plot ("Status 16 July 2024").
45	Figure 7: The estimated impact point seems to not have moved in the left panel of the figure. Compared to Figure 6 is this correct? If so why is a 10m/s correction maneuver enough?	FB	The red impact point and error ellipse in Figure 7 are identical to the red one in Figure 6 - these are just re-drawn to give a link between both plots. The red impact point would be the result after a perfect execution of TCM-4w (and all other dynamic models are perfect as well). However, the estimated impact point for the DCO after TCM-4w is the yellow one, which has moved.
46	Figures 2-8: Improve resolution.	AB/FB	Done
	Top Editor		
	I have now completed my review of the interactive discussion for your manuscript "The JUICE Lunar-Earth gravity assist from trajectory design, navigation and spacecraft operations perspective". Based on the feedback received and my own reading of your manuscript, the paper can be considered for publication after minor revisions.		
	Both reviewers agree that your work is a useful contribution for providing context for multiple papers of the LEGA special issue and a useful insight to the design process of LEGA itself. I cannot identify any critical ambiguities in the interactive discussion and I consider your responses satisfactory.		
1	I only notice that the 2nd Reviewer's comment (#42) is not well understood. Having looked at the manuscript myself, I can provide a clarification: Figure 5 appears to be a screen-capture of a schematic in a slide, with the text-box writing "Ground Process" appearing as being "selected" (circles + the "rotation" marker around it). The reviewer simply asks to deselect the text box before generating this Figure.	FB	Plot was corrected.
2	My only other comment is that in the paper I find no reference to the post-LEGA short off-pointing campaign in September, during which several instruments operated (unless I missed it). Some papers in the special issue bring this up, you may also consider adding few sentences about it – if relevant to the overall LEGA design, but I leave this up to you.	AD	The special pointing on 9 September 2024 is formally not part of the Lunar-Earth gravity assist. I have nevertheless added it in the operations part as a dedicated payload observation opportunity.
	Considering the aforementioned comments, I would invite to proceed with preparing and submitting a formal revised version of the manuscript (including a tracked changes version), together with a rebuttal letter addressed to the reviewers and to me. The rebuttal letter may repeat one or more answers you provided during the interactive discussion, but feel free to modify or expand them if you think it will improve clarity.		
	Before a formal decision is made, I will review the final responses and the implementation of the changes in the revised manuscript.		