

Thanks again to the reviewers for their comments and suggestions. Our responses here are very similar to our previous replies but we have added specific references to changes in the manuscript.

Reviewer 1:

Lines 22-27: What is meant by “first ever”? Is this the first time JUICE flew by the Earth and Moon, or the first time any spacecraft has flown by both objects?

It was the first time any spacecraft performed a double flyby like this. We have clarified this (lines 23-24).

Figure 1: Is it possible to include a higher resolution version of this image?

We have replaced the photograph of the full instrument with a higher resolution version and have edited the slit inset slightly to make it clearer.

Line 81: Please define UVS NECP

NECP was the Near-Earth Commissioning Phase when we first switched on and checked the basic instrument functions a few months after launch. It's defined on line 38 and we've added a reminder on line 81.

Lines 82-83: Please include a brief justification explaining why the active area of the detector is a small fraction of the available space

This is because a microchannel plate detector doesn't have physical pixels but instead uses a cross-delay line (XDL) anode to map the position of events on the detector. Each incident photon generates a charge cloud that moves through the two orthogonal delay lines, and the difference in arrival time at each end of the two lines allows the x and y position of the photon to be deduced. The JUICE-UVS detector electronics use 12-bit encoding for both x and y position, leading to a 4096 x 4096 image size. The size of the active area is limited by the physical size of the detector and the time resolution of the electronics to a small fraction of this, but the extra space is useful for multiple reasons. First, it lets us include additional stimulated signals outside of the active area (the stim pixels in Figure 2) to monitor the instrument health and any drift in the position of the active area with temperature. Additionally, at high count rates the detector is unable to process every event fast enough and we start to see signal incorrectly mapped to regions outside of the active area. In this case, the extra pixels are useful for monitoring the fraction of dropped counts, allowing better calibration of the data.

We have added a few sentences explaining this on lines 84-92.

Figure 2: There is brightening that is visible at the edges of the detector spectral area. This is most evident at the rightmost edge of the AP histogram. Is this a detector effect?

Yes, this pileup edge effect is typical of MCP detectors and results from field interactions with the MCP mounting clamps (e.g., Davis et al. 2011: <https://doi.org/10.1117/12.894274>; Siegmund et al.

2013: [10.1109/TNS.2013.2252364](https://doi.org/10.1109/TNS.2013.2252364)). We have noted this in the figure caption and added these two references to the manuscript.

Lines 98-99: Helium is given in nm, but the figures are all given in spectral bins/pixels. Please include a pixel that corresponds to 58.4, similar to what is done with H I Lyman alpha in the previous line.

Thanks for this suggestion. We have added the pixel value for 58.4 nm (pixel 871), now shifted to line 111 because of the earlier edits.

Line 202: Please explain what is meant by “extensive and intense”.

We meant that there are more dayglow than nightglow lines, and the dayglow emissions are brighter and cover an extended spectral range rather than being concentrated in the 121.6 – 135.6 nm region containing hydrogen Lyman alpha and the two oxygen emissions, which are the only UV lines present at detectable levels on the night side. The dayglow and nightglow emissions are also excited via different processes, leading to large differences in intensity: for example, the nightside UV oxygen emissions result from radiative recombination of O⁺ ions and electrons, while on the dayside they are produced by resonant scattering of sunlight and photoelectron impact excitation (e.g., Meier 1991: <https://doi.org/10.1007/BF01206000>).

We have rephrased the beginning of this paragraph (lines 217-220) to address this comment.

Figure 11: Interestingly, HD26793 and HD25330 are not visible in the Lyman alpha panel at all!

Yes! It's a combination of the magnitude and spectral type of each star that determines whether we can detect it at Lyman alpha. We haven't looked at all the stars in enough detail to say which of these factors is most important for each one, but HD26793 is the coolest of the stars in the bottom half of the image (spectral type B9), so its spectrum will be shifted to longer wavelengths, which probably explains why that one wasn't visible at Lyman alpha despite being relatively bright in the summed image.

We have noted on line 331 that the relative intensity of each star at Lyman alpha varies depending on magnitude and spectral type.

Line 418: A placeholder DOI is included – please ensure the data is published at the time of publication

We've added the correct information for the Guest Storage Facility archive associated with this special issue.

Reviewer 2:

- Thanks to the authors for including brightness values for the emission lines from the Earth. However, the comparison values from Meier 1991 are out of date, since they are not for a similar level of solar activity and based on early uncertain measurements with large uncertainties. The Meier 1304 daytime values are known to be unrealistically high. More

recent observations by missions such as TWINS, PROCYON/LAICA, and GUVI would give more appropriate comparisons. In addition, for reference recent observations of the H Lyman-alpha emission from the Earth's dayside have shown brightnesses of 50-60 kR, compared with an apparent measurement of ~ 20 kR in this paper (Fig. 10). The recent data are roughly consistent with brightness values near solar max. reported from the STP-78 mission (Chakrabarti et al., JGR, 88, 4898-4904 (1983)). They found a total (looking up + looking down from 600 km) of 12-13 kR for OI 1304 A and 57 kR for H 1216 A during a period of high solar activity. These total columns correspond to what a distant mission would observe looking down into the sunlit atmosphere. I do recommend that Figure 10 at least be changed to compare with some other measurement than Meier 1991, and that the authors consider comparing to a different data set for both Lyman-alpha and OI 1304 brightnesses.

We are happy to include additional references. The Meier values were intended to demonstrate a broad, order-of-magnitude agreement with expectations, and that paper remains the best available compilation of UV airglow processes and emission intensities. We can't directly compare our results to TWINS or PROCYON/LAICA, because published studies using those missions exclude the region near the Earth and we weren't able to find anything within ~3 RE. It's also surprisingly difficult to find papers from any recent mission about UV dayglow rather than aurora or nightglow emissions. However, Fig. 4 in Paxton et al. 2017 (<https://doi.org/10.1002/2016JA023578>) shows GUVI measurements of dayglow 130.4 nm and Lyman alpha emissions peaking in the low 10s of kR, consistent with our observations.

We checked the GUVI level 1B summary products (https://guvitimed.jhuapl.edu/index.php/guvi-galleryl1bspec_V013) for the day of the JUICE Earth flyby, and their dayside intensities agree very well with ours, with both Lyman alpha and 130.4 nm peaking around 20 kR – see the left panel of the screenshot below. Note that although there was a difference in altitude between TIMED/GUVI and JUICE (625 km for TIMED vs. ~7000 km for JUICE), we expect to measure similar intensities in the nadir direction because the emissions are optically thick, limiting the line-of-sight through the emitting region.

We have made the following changes to the manuscript in response to this comment:

- Lines 277 – 280: We have explained that the Meier paper remains the most useful compilation of airglow lines, but we acknowledge that more recent observations are available. We have added a reference to a TIMED/GUVI paper here.
- Lines 290 – 293: We have added a reference to the GUVI spectral summary plots and noted the similarities between our peak Lyman- α and 130.4 nm intensities and GUVI peak intensity values measured on the same day.
- Figure 10: We have added the peak GUVI intensity values to the top panel.