From: michael.endl@aasjournals.org
Subject: [EXT]AJ AAS44942: Reviewer Report
Date: March 29, 2023 at 1:29 PM
To: sukrit@arizona.edu
Cc: michael.endl@aasjournals.org, sukrit@alum.mit.edu

29-Mar-2023

Dr. Sukrit Ranjan
University of Arizona
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Tucson, AZ 85721

Title: UV Spectral Characterization of Low-Mass Stars With AstroSat UVIT for Exoplanet Applications: The Case Study of HIP 23309

Dear Dr. Ranjan,

I have received the reviewer's report on your above submission to The Astronomical Journal, and is appended below. As you will see, the reviewer thinks that your manuscript is interesting and that it will merit publication once you have addressed the issues raised in the report.

When you resubmit, please outline the revisions you have made in response to each of the reviewer's comments using plain text in the field provided when you upload the revised manuscript. Citing each of the reviewer's comments immediately followed by your response would be particularly helpful.

Click the link below to upload your revised manuscript;
https://aas.msubmit.net/cgi-bin/main.plex?el=A2KO5zB6A6CARz6J7A9ftdO6wTX6t69HWnLgjDgFiQKwZ
Alternatively, you may also log into your account at the EJ Press web site, https://apj.msubmit.net. Please use your user's login name: sukrit. You can then ask for a new password via the Unknown/Forgotten Password link if you have forgotten your password.

Reviewers find it helpful if the changes in the text of the manuscript are easily distinguishable from the rest of the text. We ask you to highlight the changes in bold. The highlighting can be removed easily after the review process.

The AAS Journals have adopted a policy that manuscript files become inactive, and are considered to have been withdrawn six months after the most recent reviewer's report is sent to the authors.

If you have any questions, feel free to contact me.

Best regards,
Michael Endl
Lead Editor
American Astronomical Society Journals
michael.endl@aas.org
The University of Texas at Austin

Reviewer:
Dear Editors and Authors,

I have carefully reviewed the manuscript entitled "UV Spectral Characterization of Low-Mass Stars With AstroSat UVIT for Exoplanet Applications: The Case Study of HIP 23309" by Ranjan et al. and have concluded that it merits publication in the Astronomical Journal. I have several recommendations outlined below that I believe will substantially improve the utility of the paper. None are mandatory, but I strongly recommend that the authors implement the changes I suggest for the benefit of the readership and the impact of their work.

I wish to particularly compliment the authors on their objectivity. With a few minor exceptions, they communicate the performance of the ASTROSAT instruments without appearing to try to "sell" it to the reader. This is challenging to achieve for anyone who has spent great effort in developing an instrument, yet I consider such objectivity critical to maintaining the credibility and productivity of our field.

Respectfully,
Anonymous

Major Science Recommendation

1. The NUV spectrum appears to flatten at red wavelengths (> ~2400 Å), in contrast with all of the comparison spectra and with all M and K star NUV spectra that I have seen (such as those in Walkowicz et al. 2008). The text does not address this disagreement. I suspect this is a systematic error resulting from the instrument/analysis. I strongly recommend that the authors address this issue by exploring causes of the flattening. Note that activity should cause the spectrum to appear to flatten toward short wavelengths in the

exploring causes of the flattening. Note that activity should cause the spectrum to appear to flatten toward short wavelengths in the UV, not toward long ones.

Minor Science Recommendations

2. I and other readers will likely find more information on the host star's stated youth helpful. Is this evaluation based solely on the star's activity? Are there age estimates in the literature? What is the rotation period?

2a. Okay I looked for TESS data on this system. There is clear rotational variability with a period of 8.5 {plus minus} 0.5 d from trough to trough in the data taken in September and October of 2018. You could add this to the text. A more precise period measurement is no doubt possible with a periodogram or similar analysis, but for the purposes of this paper, I don't think it is necessary.

3. I don't think interpreting the continuum flux offset as a noise floor is accurate and is a likely misconception of noise floor. The noise floor is the level below which flux (assuming a certain integration time) will be undetectable. However, it should be noise, which means it should average to zero. If integrating the continuum yields a value that is within ~1 sigma of zero then perhaps the offset is truly noise. If it yields a value that is over 2 sigma and over the HST data for the star, then this is likely a background subtraction or other issue with the instrument/data reduction.

4. An alternative to systematics that could explain the flux variations is that the star's emission is actually varying (not flares but "quiescent" variations). I don't think this is likely to explain the 2x FUV continuum offset as both the lines and continuum would likely vary in step, but it is a good candidate for explaining the NUV variations. Rotation can cause ~10% variations in GJ 436, an M star that is less active than HIP 23309, (dos Santos et al. 2019). Factor few variations on timescales of ~10 min are also possible (the HAZMAT paper from Loyd et al. 2018). I think it would be worth addressing this possibility in the discussion. If the NUV variation is caused by an 8.5 d sinusoidal variation due to rotation, then I estimate the minimum amplitude of the variation (minimum since we don't know the phase of the signal) to be 60%, which I don't think rules out rotational variations.

5. A brief aside: The discussion around line 180 regarding the radiative transfer assumptions of prebiotic chemistry is very intriguing. I presume there are not yet any updated results for M stars or you would have cited them. The Rimmer et al. 2021b reference appears to focus on the young Sun. I hope the authors are considering updating past results on M stars! By the way, listing the albedo as 0.9 < 1 is confusing to me. Is this meant to imply that the correct albedo is 1? Or simply noting that albedos are only valid in the range of [0,1]?

6. The text mentions Lya as being a cause of error, but I did not catch any mention of how the modeling dealt with the lack of Lya in the UVIT spectra. Was the flux at all wavelengths shortward of the UVIT band set to zero? An explicit statement of how this was handled would help.

7. Similarly to (6), were the rescaled HST spectra rescaled over their full wavelength range? If so, could this have affected the thermal structure of the atmosphere in a way that would propagate into the chemistry?

Language

8. Line 254 could be read to imply that NUV measurements are still possible, but that is not the case, right? If so, then presumably only archival measurements are available. I recommend you revise the text to avoid any confusion.

9. The introduction mentions the paper will discuss implications for the INSIST and UV-SCOPE mission (concepts). However, the conclusions only mention INSIST.

10. Line 59: "It remains preferred" seems vague.

11. Line 76: Excellent agreement seems like a stretch given the continuum errors and flattening of the NUV flux at red wavelengths. Regardless, excellence is subjective so I think you should be epxlicity about who makes this judgment. How about "and find agreement at levels that we consider satisfactory for use in photochemical modeling."

12. Your readership might not be familiar with the ISRO acronym.

13. The wording in the second clause of the sentence on line 165 needs some work.

14. I had to look up "coterminous." Contemporaneous might be more easily understood to your readers.

15. Line 68. Consider stating here that NUV observations are no longer possible. I initially interpreted this to mean that only one NUV optic could be used any longer.

Figures

16. The gray line in Figure 3 is quite challenging to see.

17. The error bars in all figures add a great deal of clutter. Consider using them on a subset of data points or plotting errors as separate lines (e.g., dotted lines of the same color).

18. The error bars in Fig 5 are especially distracting. Consider setting a floor to the error bars so that they impinge less on other lines on a log scale.

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