Review of PDS4 SBN Submission:
LICIACube Calibrated and Merged LUKE Images V1.0

Dave Glenar, UMBC, Oct. 17, 2025

- ❑ Reviewed 'Data Summary' text
  - Some calibration details are missing (in this respect, description does not stand on its own)

- ❑ Checked the file inventory
  - 'pds4_tools' (python) used to compare 'collection.xml' archive with content of data folders. Listings are identical (no inconsistencies).
  - No data gaps

- ❑ Checked .fts header quantities against table values of Lolachi et al. (PSJ, 6:199, 2025)
  - Using 'astropy' fits-read tools, looked at one approach image and one departure image.
  - Compare with table values from Lolachi et al. Small discrepancies can be explained by the use of different kernel versions in these two studies.

- ❑ Compared LUKE RGB response calibration with the independent calibration of Lolachi et al.
  - Examined both Calibrated and Merged data (limited to the sample approach and departure images).
  - Images and Row plots show general agreement in plume brightness (less so in the departure image).

- ❑ Summary Comments and Recommendations

Data Summary

Data Processing and Calibration:

- The description of the calibration is lacking. The second paragraph should be expanded to include the calibration information described by Farnham et al. '25 (latter part of the first paragraph in Sec 2.2).

- Per Farnham et al. '25, calibration was obtained (I think) exclusively from χ2 Ceti observations. Derived RGB responses (in $Wm^{-2}nm^{-1}$ sr^{-1}) are weighted averages over the RGB filter response functions(?). These points should be explained in the calibration description.

- There is no mention of uncertainties in the RGB radiance conversions (DN s^{-1} –to- $Wm^{-2}nm^{-1}$ sr^{-1}) here or in Farnham et al. '25. Were those estimated?

***Merged Images*:**

- Method of selecting integration times and image-segment substitution to produce merged (red) images is clearly described. OK here.

***SPICE kernels*:**

- The set needs to be updated to include spk and ck files as listed in each .fts header.
- Why not list the complete kernel set so it appears just once in the Data Summary (easy to copy/paste) and remove it from each of the .fts headers?
- I could not find specific Farnham-derived ephemeris files (e.g., LCC_Trajectory_TF_V03.1.bsp) in the on-line DART SPICE library. How would they be accessed?
- How/where is 'licia_close_app_frame.tf' used?

File inventory

- Compared the file listings in "collection.xml" with those in "data/calibrated" and "data/merged" (using python's PDS-4 tools and sorting operations). The two pairs of lists were identical. (n_cal= 183, n_merged=63). All good.
- Also checked the first and last few entries of "inventory.csv" as well as the total file count. All in agreement.

"document"

- This folder appears to just be tacked on to this PDS submission. Better to relabel it "DART boulders" to indicate what's inside.

Comparison of Ephemeris (.fts header) Quantities

- Compared the results of one approach observation and one departure observation, common to the data set used by Lolachi et al. (Full LUKE frame format: 1088 rows x 2048 cols)
- Discrepancies of a few degrees and a few pixels appear between corresponding ephemeris quantities. (Easily explained, since this submission uses revised kernels. The Lolachi et al. study used earlier –Aug '23 - versions of the Farnham SPICE kernel set.)

Approach observation: 1664234204_00505_01 (UTC: 2022-09-26T23:16:44.050)

	et	**t_elap (s)**	**d_DIM (km)**	**Phase Angle (°)**	**Bore RA (°)**	**Bore DEC (°)**	**DIM xpx (col)**	**DIM ypx (row)**	**DDY xpx (col)**	**DDY ypx (row)**
This PDS submission	717506273.4	140.08	174.9	50.1	323.6	-29.3	959	279	911	352
Lolachi et al.	717506273.2	139.87	177.9	52.4	322.9	-32.9	956	275	907	347

Departure observation: 1664234250_00005_01 (UTC: 2022-09-26T23:17:30.000)

	et	**t_elap (s)**	**d_DIM (km)**	**Phase Angle (°)**	**Bore RA (°)**	**Bore DEC (°)**	**DIM xpx (col)**	**DIM ypx (row)**	**DDY xpx (col)**	**DDY ypx (row)**
This PDS submission	717506319.4	186.08	130.4	103.7	107.6	-1.9	584	393	650	479
Lolachi et al.	717506319.2	185.82	131.9	105.3	109.2	-6.0	581	387	650	475

Comparison of LUKE RGB Calibrations (256 x 256 zoom images)

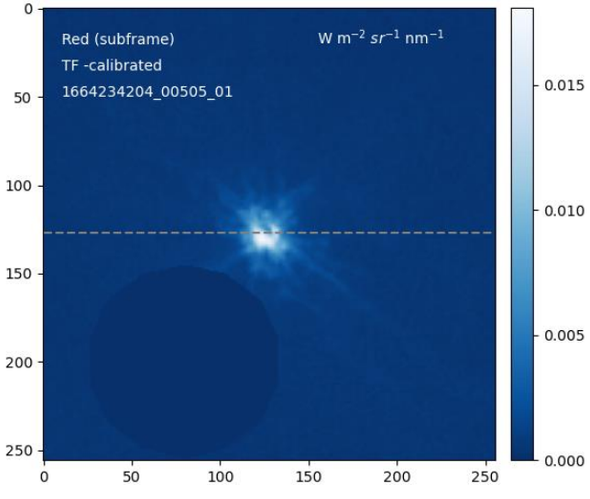
- Farnham et al. ‘25 derived LUKE RGB response by rescaling prior Zinzi & DellaCorte PDS image data to W m^{-2} sr^{-1} nm^{-1}. Background was estimated from a single l0 blank sky frame (1664234361_00008_01.fits). Two sub-archives were created for this submission: “Calibrated” includes all observations & integration times. “Merged” is RED channel-only data with images segmented as needed to avoid saturation.

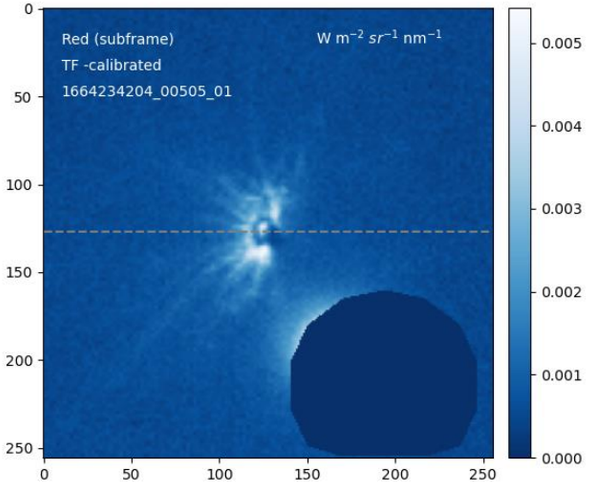
- Lolachi et al. independently derived LUKE RGB response in the same units (also by rescaling Zinzi & DellaCorte PDS images) using measurements of Pleiades, supported by a single χ2 Ceti observation. Uncertainties (error bars) are included in the plots. Background is forced to zero at the boundaries of 1024x1024 subimages, in order to estimate plume integrated light.

Approach

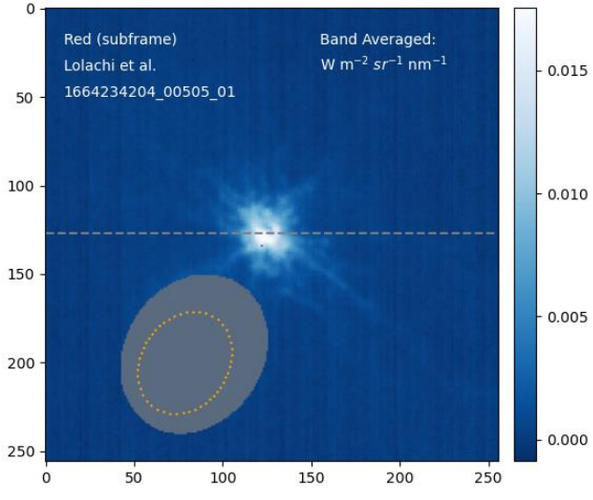
Departure

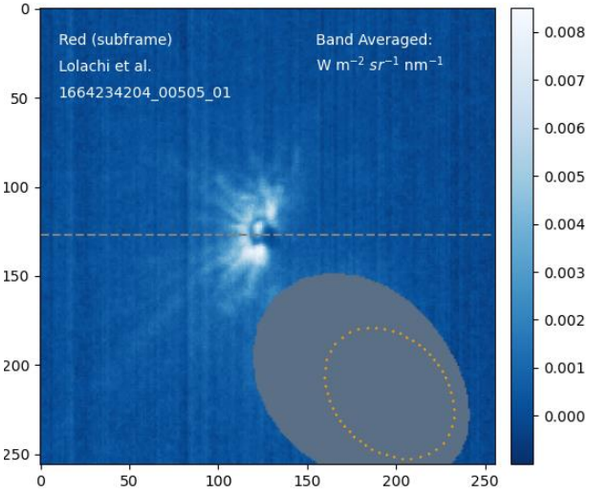
TF (calibrated)

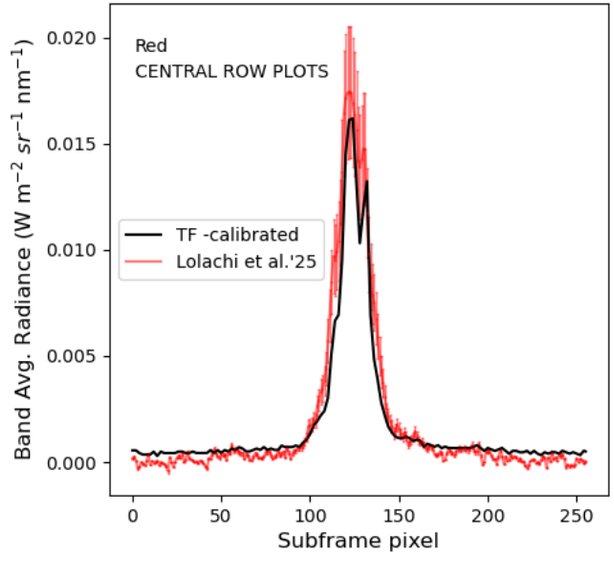


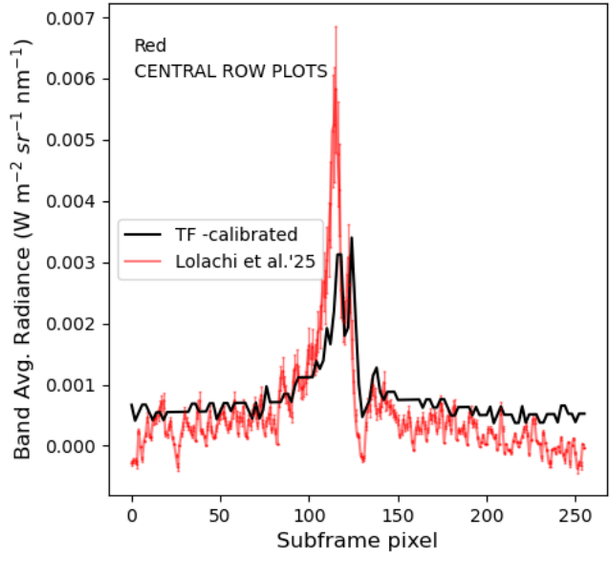


Lolachi et al. ‘25



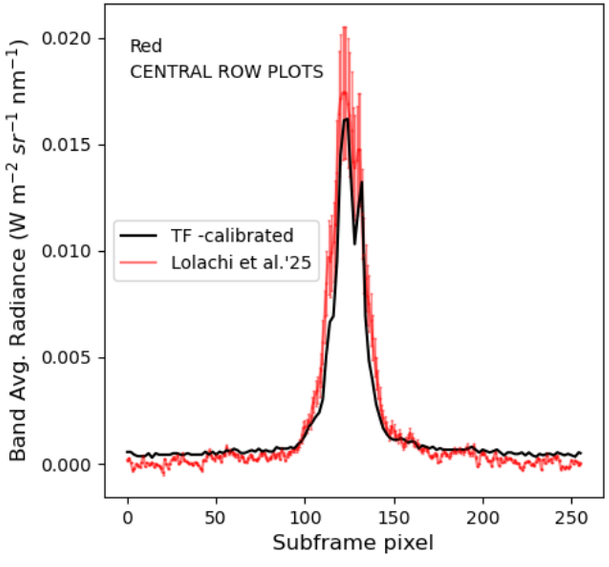


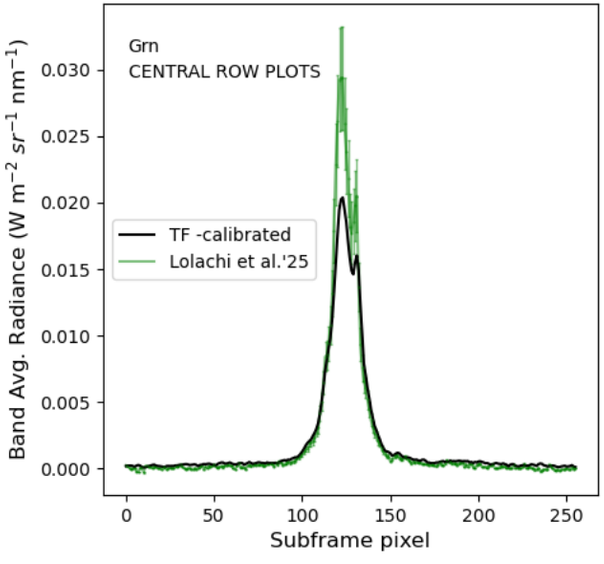


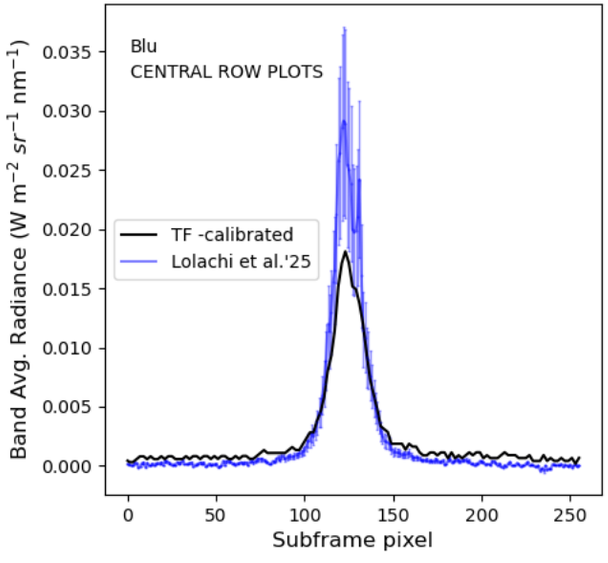


All-Color Comparisons

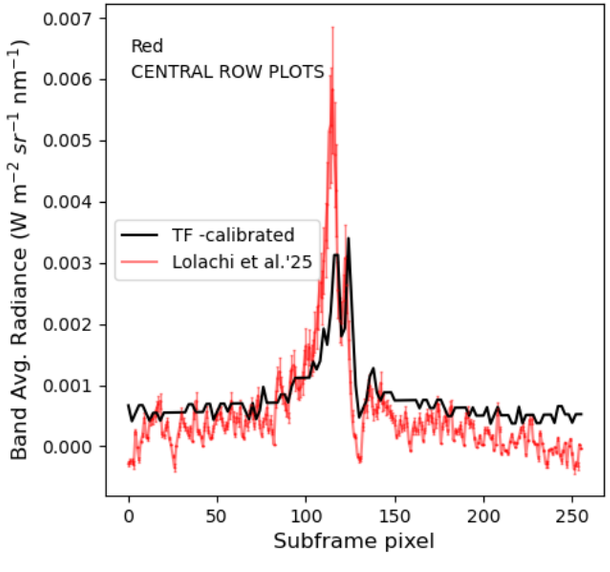
Approach

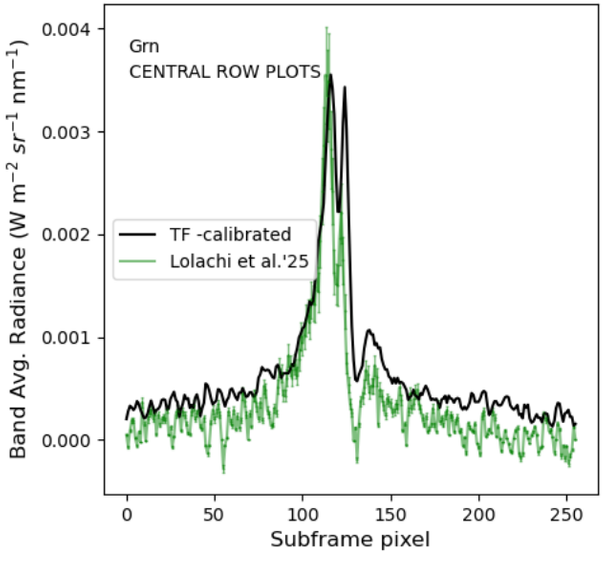


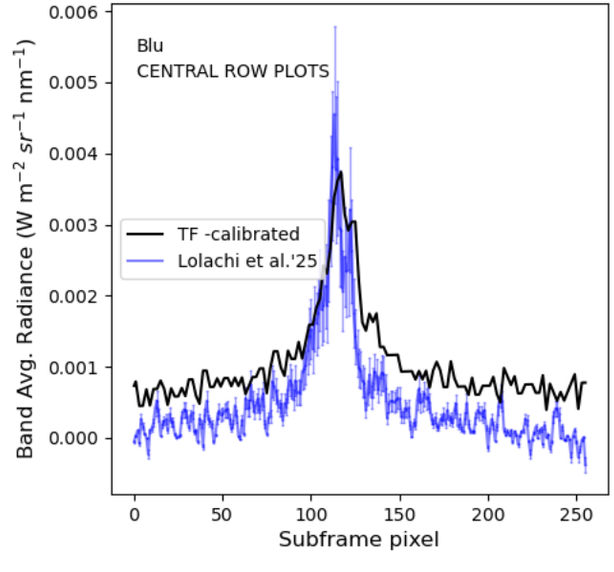




Departure





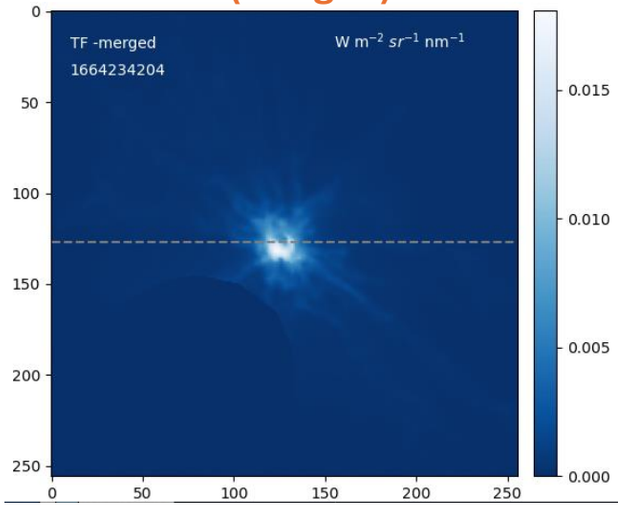


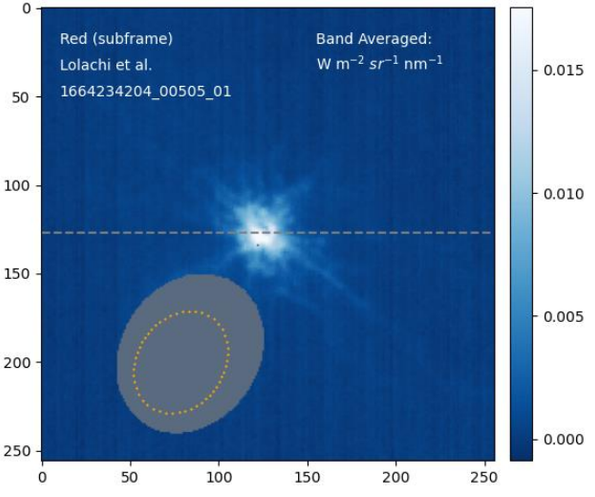
Merged Subimages vs. Lolachi et al. (RED)

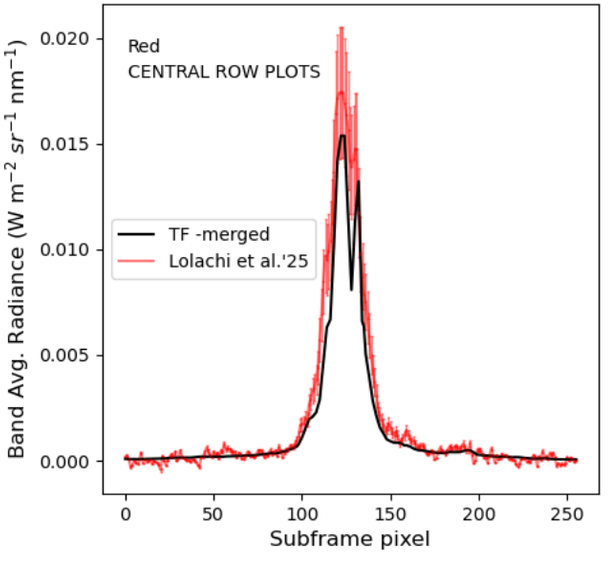
TF (merged)

Lolachi et al. ‘25

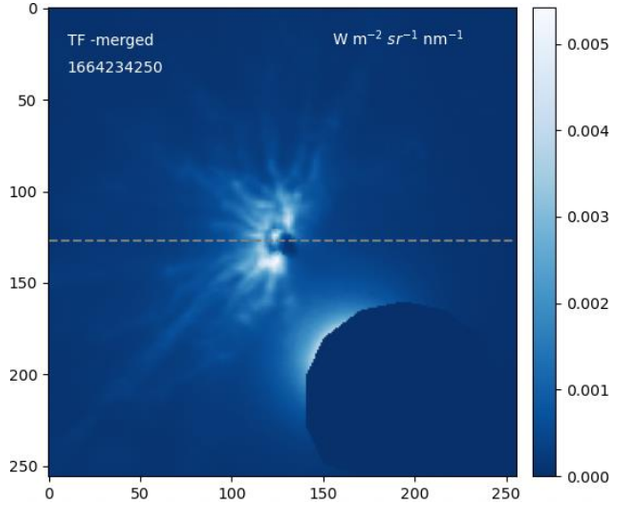
Approach

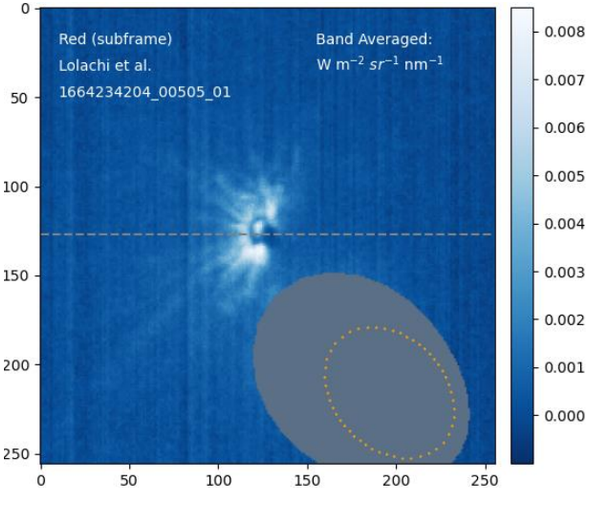


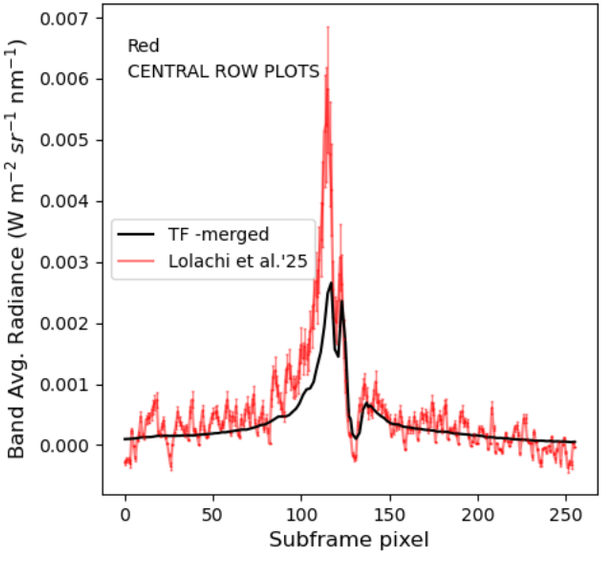




Departure







Summary Comments and Recommendations

Generally this is a well-organized PDS4 submission that includes complete coverage of the LICIACube/LUKE observations during the DART flyby. The "data_summary" describes the contents of the LUKE data sets. I found it straightforward to do a thorough comparison of sample .fts files in this submission, with independently calibrated results of Lolachi et al. '25. However, the submission has a few shortcomings. Recommendations are:

- Expand the Calibration description so it stands on its own by including details stated in Farnham et al. '25 (without sending the user to that paper to look up the information).
- SPICE kernels listed in the data summary are incomplete, nor do they match the listings in each of the .fts headers (Why include them in each header?)
- TF-derived ephemeris kernels not in the naif database should be included, either in this PDS4 submission, or in a parallel submission that is cited here.
- Relabel "document" to "DART_boulders"