

PDS Data Review

Lucy L'LORRI
Didymos Data

Tony Farnham

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L'LORRI Instrument

- Panchromatic high resolution camera
 - 0.29 degree square FOV
 - high resolution (5 microradian/pixel)
 - 1024x1024 pixel CCD detector
 - Operates in 1x1 or 4x4 on-chip binning modes
- Raw data format
 - FITS files with 4 extensions
 - Primary image (DN), histogram, housekeeping data and instrument descriptor
- Calibrated data format
 - FITS files with 3 extensions
 - Primary image (DN), Error map, Quality flag image
 - Do-it-yourself flux calibration: Radiance and Irradiance calibration coefficients are given in the Users Guide

General Comments

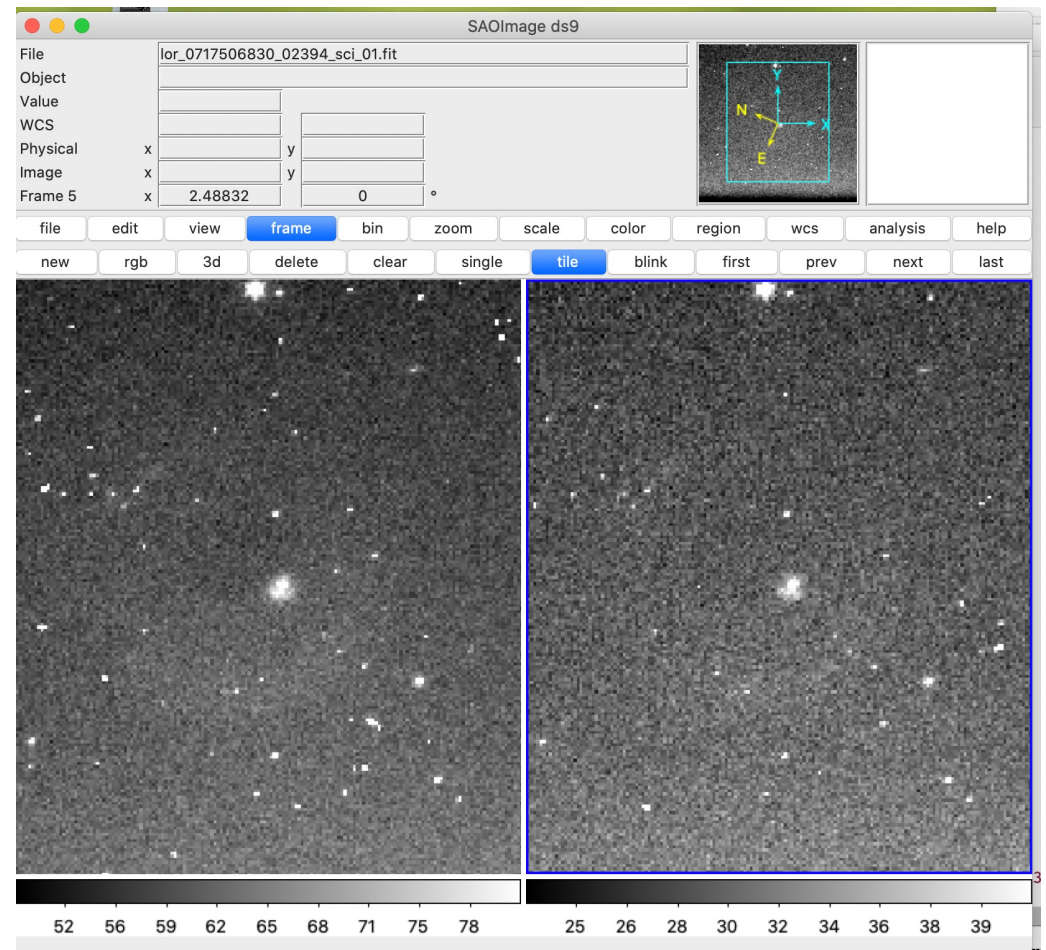
- Datasets:
 - Didymos data, Uncalibrated and Calibrated
 - 1549 images in each dataset
 - Calibration data files
- Well documented with lots of description and information available
- Users guide specifies that this data set is a “best effort” and thus the full pipeline is not implemented
 - Review with that in mind, but also include suggestions for future implementations
 - Will full pipeline be used for an updated version?

Documents

- Users Guide
 - PDF document describing the mission phase, the data and the data reduction and calibration
 - Includes calibration coefficients
 - Specify a coefficient for Didymos? Or specify which existing value should be preferred?
 - Include in the headers, as with NH images
- Includes the geometric information for the time of the DART impact
 - Little change for other image times
- Section 1.3 The L'LORRI Preliminary Archive Bundle
 - Describes directory structure as DATA_DIDYMOS_RAW and DATA_DIDYMOS_CALIBRATED
 - Data set currently uses UNCALIBRATED and CALIBRATED
- Section 5: Calibration products
 - Says the units on the Flat Field images are DN/s
 - Should be unitless, normalized to an average of 1

Data

- Data are in good shape
 - Read with IDL FITS readers and PDS_READ
 - Includes extensions
 - Read and displayed every image
- Read and displayed every image
- Tested to make sure data could be manipulated and measured
- Files are consistent between the uncalibrated/calibrated datasets



Data Units

- Calibrated data Units
 - Label says image and error units are both DN/s

<input type="checkbox"/> name	LLORRI observational image
<input type="checkbox"/> local_identifier	image
<input type="checkbox"/> offset	
<input type="checkbox"/> axes	2
<input type="checkbox"/> axis_index_order	Last Index Fastest
<input type="checkbox"/> description	Image Array
<input type="checkbox"/> Element_Array	(data_type, unit?, scaling_factor?, value_offset?)
<input type="checkbox"/> data_type	IEEE754MSBSingle
<input type="checkbox"/> unit	DN/s

- Users guide Section 4 says the image and error units are both DN/s

1. **L'LORRI Calibrated Image** - The L'LORRI calibrated data product is a three data array (HDU) fits file. The primary data array is a 2-dimensional primary image data array of 32-bit real values in units of **DN/s** in an array size of 1024x1024 or 256x256 depending on image binning. The secondary data array is a 2-dimensional error image data array of 32-bit real values in units of **DN/s** in an array size identical to the primary array. The tertiary data array is a 2-dimensional quality flag data array

Data Units

- Users Guide Section 6.4 is somewhat ambiguous

$$I = S / t_exp / RTROJANR \quad (\text{for a diffuse target})$$

where:

I is the diffuse target radiance at the pivot wavelength with units of

(ergs cm⁻² s⁻¹ Angstrom⁻¹ sr⁻¹)

S is the measured signal in a pixel (DN)

t_exp is the exposure time (s)

RTROJANR is the L'LORRI diffuse photometry keyword for targets with an SED similar to a red Trojan

- LLORRI SIS from the other LLORRI dataset
 - Section 2.3.2.2.6 Flat Field Correction implies the data are in DN

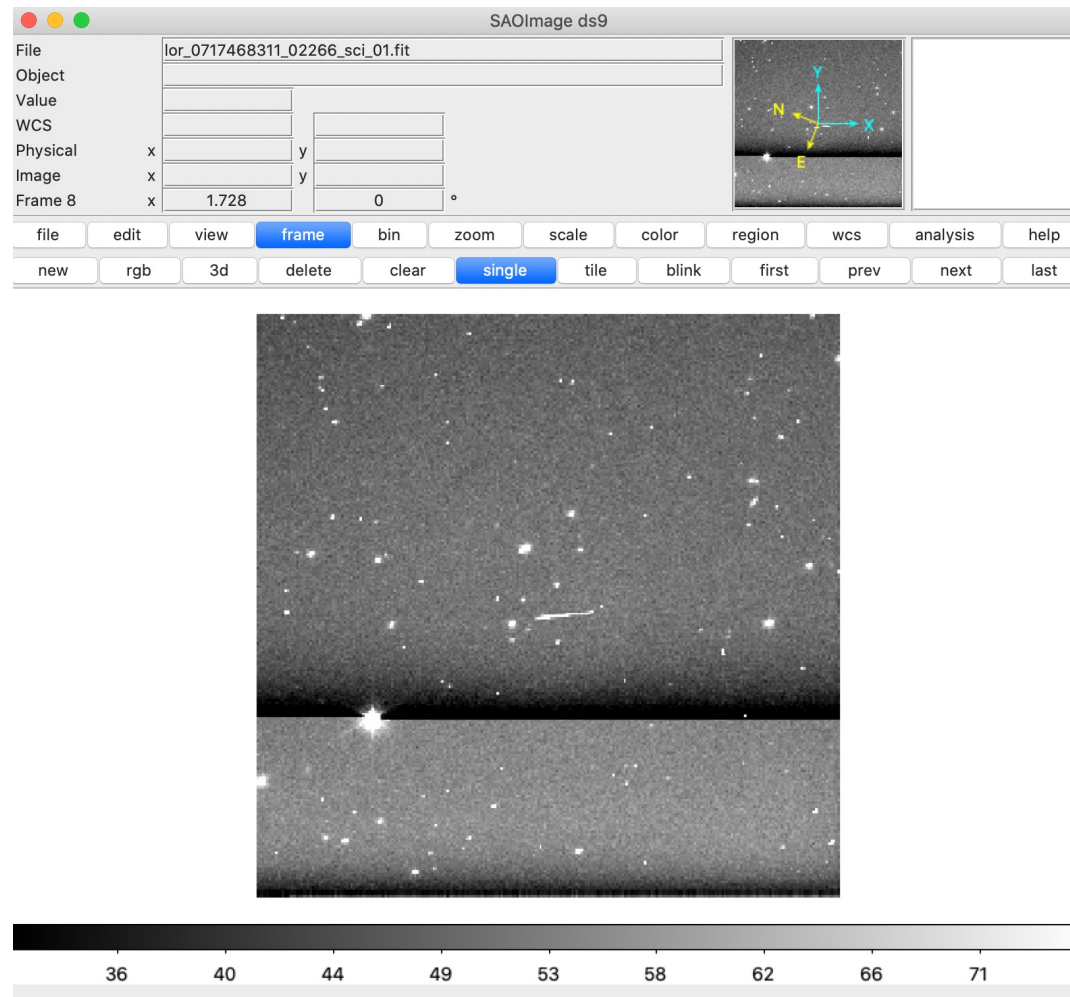
The final step in the calibration is the absolute calibration. The calibration software pipeline will not perform per-pixel conversion from DN to physical units, because that conversion requires knowledge of the spectral distribution (i.e., color) of the target. Instead, the pixel values are left in their corrected (calibrated) DN units from the flat-fielding, and the absolute calibration step adds “photometry” keyword divisors to the FITS header. Each divisor scales per-pixel count rate values from DN/s/pixel to physical units according to its assumed spectral type and spatial distribution (diffuse vs. point source) for the target.

Data Units

- The images suggest that the count levels are currently in DN
 - 4.9 s images have half the value of 9.9 s images
 - Compare lor_0717506830_02394_sci_01.fit (4.9 s) and lor_0717506893_02572_sci_01.fit (9.9 s)
 - Reduction process is not normalizing to 1 sec integration time?
- Need to resolve the units issue and make things clear and consistent throughout all the documentation

Data Issues

- Saturation seems to produce an extreme effect
 - Appears in both uncalibrated and calibrated versions
 - Not part of smear removal



Data Issues

- Items that seem to be incomplete
 - Extensions in calibrated images: Error arrays and data quality arrays are all zeros
 - RA and Dec are included, but Celestial North Clock Angle is undefined
 - Useful to know for the orientation of the vapor plume
 - Have a quaternion for converting from instrument to J2000 coords and a WCS in the header, so this should be computable
 - Other geometry would be useful for future data sets
 - Other data sets contain additional geometric values

SPICE Check

- Kernels are listed in the labels, but the only geometry included is the predicted RA and Dec of the boresight
 - None of the CK kernels listed are available at NAIF
 - RA and Dec computations that I have agree well with those in the labels
- Recommend including additional geometry in future data sets
 - Include geometry in the header/label for ease of use
 - Facilitates radiometric calibration process

L'LORRI Status

- A few minor issues with Users Guide
- Labels are minimal and could use some additional information
 - "Best effort" limitations
- Data are not certifiable until Units issue is resolved