

PDS Data Review

Lowell Discovery Telescope Observing Campaign of Near-Earth Asteroid (3200) Phaethon

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urn:nasa:pds:gbo-lowell:ldt-phaethon-2017::1.0

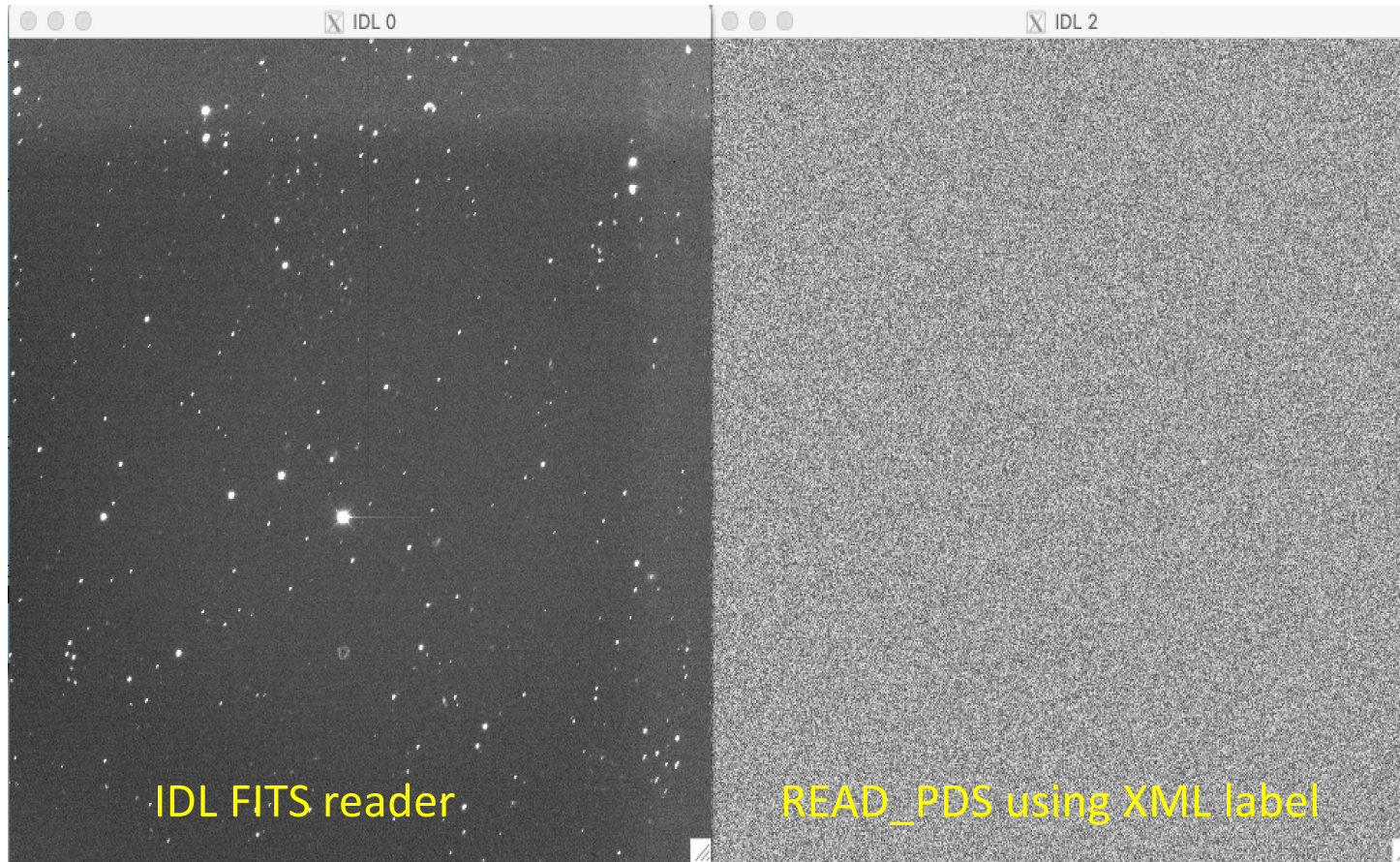
- LMI images of Phaethon and calibration targets
 - HB filters and r' filter
 - Raw and calibrated versions
- DeVeney spectra of Phaethon, C/2017 O1 (ASASSN) and calibration targets
- Data were used to look for evidence of activity
 - No evidence of coma was found, but limits on gas and dust production were computed

Testing the LMI Images

- Read each FITS file
 - IDL FITS routines
 - READ_PDS (PDS4 version) using the XML labels
- Compared the two images to make sure they agree
- Tested the images to make sure that I could measure, display, and manipulate them
- Results
 - IDL FITS reader
 - All images from all dates are good (e.g., FITS files seem fine)
 - READ_PDS reader
 - All raw images and Dec 14 and 15 reduced images are fine
 - Problems with Dec 16, 17 and 18 labels

LMI Images: Problems using READ_PDS

- Dec 16, 17 and 18 reduced data directories
 - Bias and Skyflat frames read ok
 - Most of the reduced images don't (problem with the XML label)



LMI Images: Problems using READ_PDS

- Problem is related to the `data_type` attribute
 - In bad labels = SignedMSB2
 - In good images = IEEE754MSBDouble
- I tried just changing that value, but get a different error (end of file) so there is still some other problem as well

```
lmi_20171218_0321_ppp.fits.xml: <data_type>SignedMSB2</data_type>
lmi_20171218_0322_ppp.fits.xml: <data_type>SignedMSB2</data_type>
lmi_20171218_0323_ppp.fits.xml: <data_type>SignedMSB2</data_type>
lmi_20171218_0324_ppp.fits.xml: <data_type>SignedMSB2</data_type>
lmi_20171218_0325_ppp.fits.xml: <data_type>IEEE754MSBDouble</data_type>
lmi_20171218_0326_ppp.fits.xml: <data_type>IEEE754MSBDouble</data_type>
lmi_20171218_0327_ppp.fits.xml: <data_type>IEEE754MSBDouble</data_type>
lmi_20171218_0328_ppp.fits.xml: <data_type>SignedMSB2</data_type>
lmi_20171218_0329_ppp.fits.xml: <data_type>SignedMSB2</data_type>
lmi_20171218_0330_ppp.fits.xml: <data_type>SignedMSB2</data_type>
lmi_20171218_0331_ppp.fits.xml: <data_type>SignedMSB2</data_type>
```

Testing the DeVeney Data

- 2D Spectrum files
 - IDL FITS readers are ok for both raw and reduced data
 - Data themselves look good
 - Raw data
 - READ_PDS does not take into account the 32768 zero point (get all negative values)
 - Need to add a **VALUE_OFFSET** attribute of 32768

Testing the DeVeney Data

- 2D Spectrum files
 - Reduced data
 - Some of the data are 16-bit and some are 32-bit
 - 16-bit data also have the VALUE_OFFSET problem
 - The XML labels all have data_type “SignedMSB2” so 32-bit data don’t read in via READ_PDS
 - e.g., compare 20171215.0129.reduced.fits and 20171215.0130.reduced.fits
 - Need to either make all data consistent or set the data_type attribute to the proper value for each file

```
20171215.0122.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0123.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0124.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0125.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0126.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0127.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0128.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0129.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0130.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0131.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0132.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0133.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0134.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0135.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0136.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0137.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0138.reduced.fits.xml: <data_type>SignedMSB2</data_type>
20171215.0139.reduced.fits.xml: <data_type>SignedMSB2</data_type>
```

NAME	SIZE	BITPIX
20171215.0122.reduced	2148 516	16
20171215.0123.reduced	2148 516	-32
20171215.0124.reduced	2148 516	-32
20171215.0125.reduced	2148 516	-32
20171215.0126.reduced	2148 516	-32
20171215.0127.reduced	2148 516	-32
20171215.0128.reduced	2148 516	-32
20171215.0129.reduced	2148 516	-32
20171215.0130.reduced	2148 516	16
20171215.0131.reduced	2148 516	16
20171215.0132.reduced	2148 516	16
20171215.0133.reduced	2148 516	16
20171215.0134.reduced	2148 516	16
20171215.0135.reduced	2148 516	16
20171215.0136.reduced	2148 516	-32
20171215.0137.reduced	2148 516	-32
20171215.0138.reduced	2148 516	-32
20171215.0139.reduced	2148 516	-32

Testing the DeVeney Data

- Extracted spectra
 - Reading .cal files directly produces good results
 - Able to plot values, etc.
 - Typical flux values $1e-14$ to $1e-11$
 - Reading using READ_PDS and XML labels
 - Wavelength values match those above
 - Flux values are in the range 1 to 10
 - Problem with the XML labels

Testing the DeVeney Data

- Reading using READ_PDS and XML labels
 - Problem seems to be with the format statements in the labels

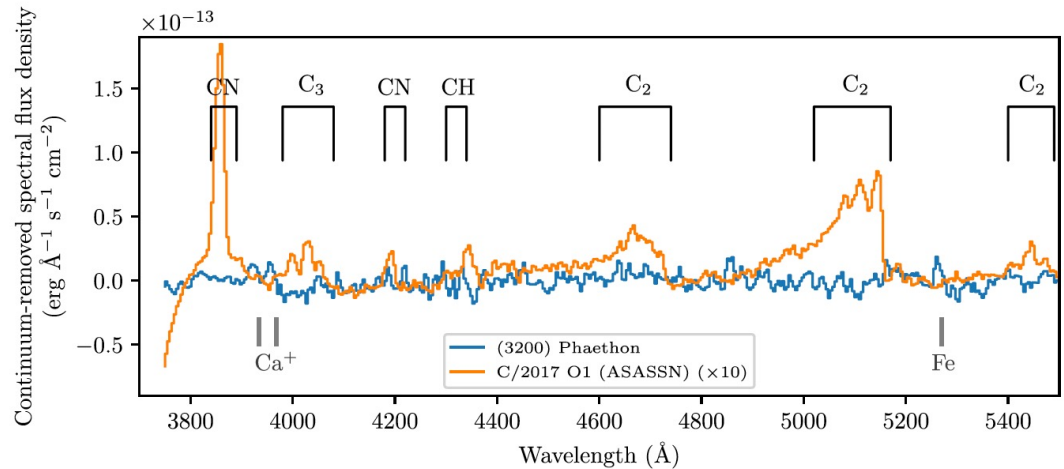
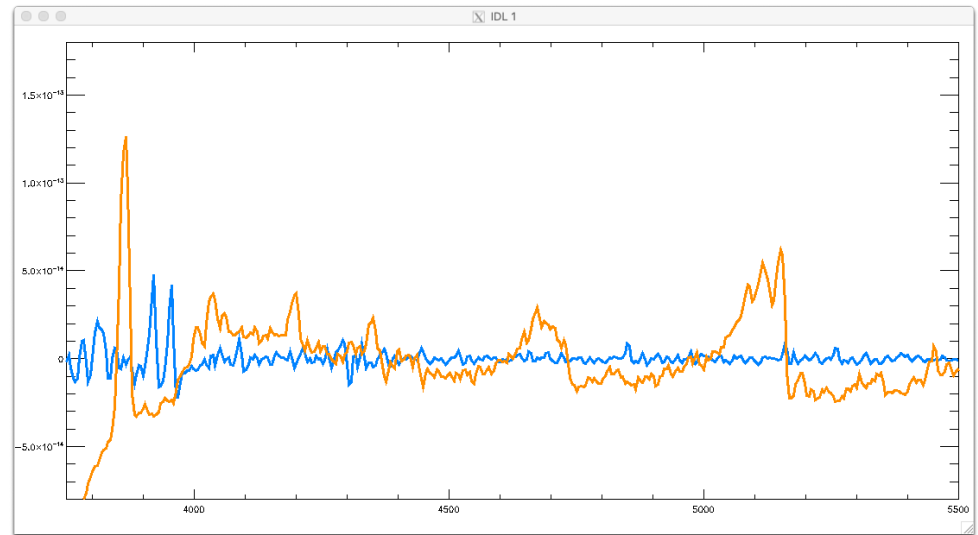
```
<Field_Character>
  <name>Flux</name>
  <field_number>2</field_number>
  <field_location unit="byte">18</field_location>
  <data_type>ASCII_Real</data_type>
  <field_length unit="byte">8</field_length>
  <field_format>%8.6e</field_format>
  <unit>erg/cm2/s/A</unit>
  <description>Flux at the specified wavelength.</description>
</Field_Character>
```

```
3062.67897260370 3.163268e-12
3066.97500864999 3.170184e-12
3071.27104469628 3.206751e-12
3075.56708074257 3.325014e-12
3079.86311678886 3.183640e-12
3084.15915283515 3.182922e-12
3088.45518888144 3.250521e-12
3092.75122492774 3.237031e-12
3097.04726097403 3.185978e-12
3101.34329702032 3.269794e-12
3105.63933306661 3.260672e-12
```

- Change field_length to 13 and field_format to %13.6
 - seems to solve the problem

Testing the DeVeney Data

- Did a quick and dirty reduction, following the paper's description
- Plotted the Phaethon and C/2017 O1 data
- Some oddities in scaling, but compares fairly well to the plot in the Ye et al. paper



Documentation

- DOCUMENTS directory
 - Should include the LMI and DeVeny instrument manuals for reference
 - May want to include a copy of the Phaethon paper (Ye et al.)
- COLLECTION.XML
 - Start and stop times don't correspond to the dates when the images were obtained

```
<Context_Area>  
  <Time_Coordinates>  
    <start_date_time>2005-07-02T03:17:33Z</start_date_time>  
    <stop_date_time>2005-07-18T07:59:35Z</stop_date_time>  
  </Time_Coordinates>
```

- DESCRIPTION.PDF document
 - In table 1, A0 calibrator stars are introduced in association with the BC images, but there is reference for them and no mention of how they are used