NASA PDS Small Bodies Node Peer Review

SOHO's Sungrazing Comets

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Main talking points:

- LASCO Calibrations

- Images & image processing

- Comets and comet data

- READPDS bug

- Documentation comments

Calibrations

- Vignetting
  - Vignetting functions are very out-of-date (example to be given later)
  - Available online, via *SolarSoft* updates, or via LASCO data tech (me!)
  - Only two needed: C2 and C3 full-resolution (1024x1024)
- Calibration factors, time corrections, occulter masks, etc...

Images – processing levels

- Distinction between Level-0.5 and Level-1:

  - Level-0.5

    - Rectified (Solar North "up") fits files
    - Pixel values are in units of DN (counts)
    - With background subtraction, are used to make "pretty picture" gifs

  - Level-1

    - Calibrated into physical units (mean solar brightness)
    - Used for quantitative analysis (no "pretty pictures")
    - Calibrations similar to description by Matthew Knight

LASCO image processing

- LASCO Level-0.5 processing

    - Background subtraction needed to remove F (dust) corona

        - Backgrounds created ~weekly

    - Software is essentially static

- LASCO Level-1 processing

    - 'Final' software versions released -> summer/fall 2005

        - All in *SolarSoft* lasco library

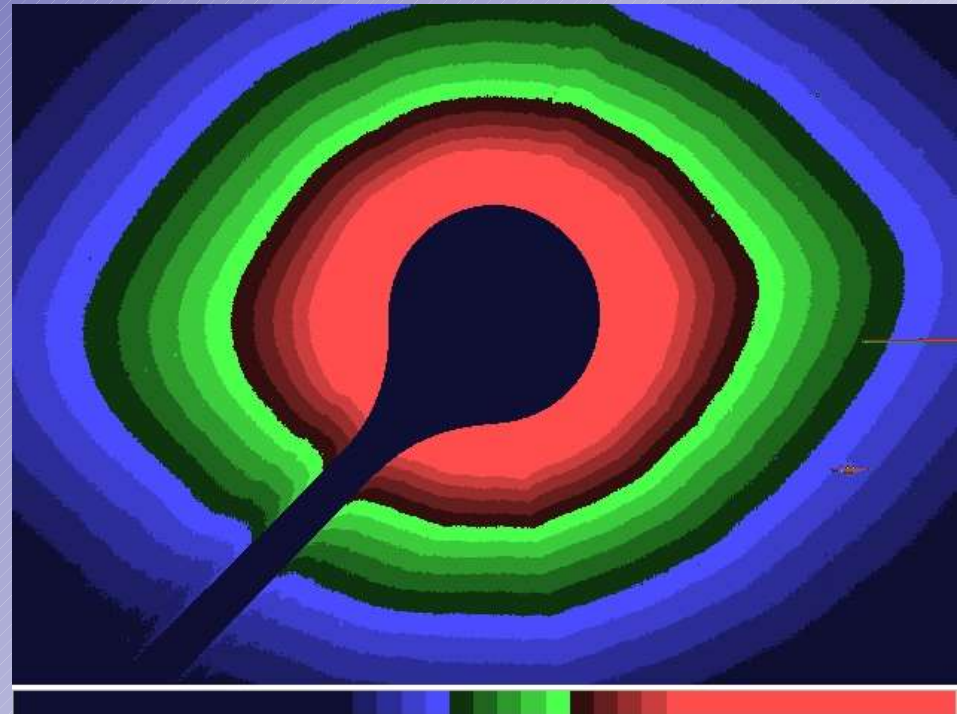   - Data available for download (LASCO database)

        - http://lasco-www.nrl.navy.mil/database.html

Current PDS LASCO C3 fits image:
- 1995 vig. function omits lower-left
  quadrant (bad!)
- no apparent C3 mask to cover
  pylon (not ideal)
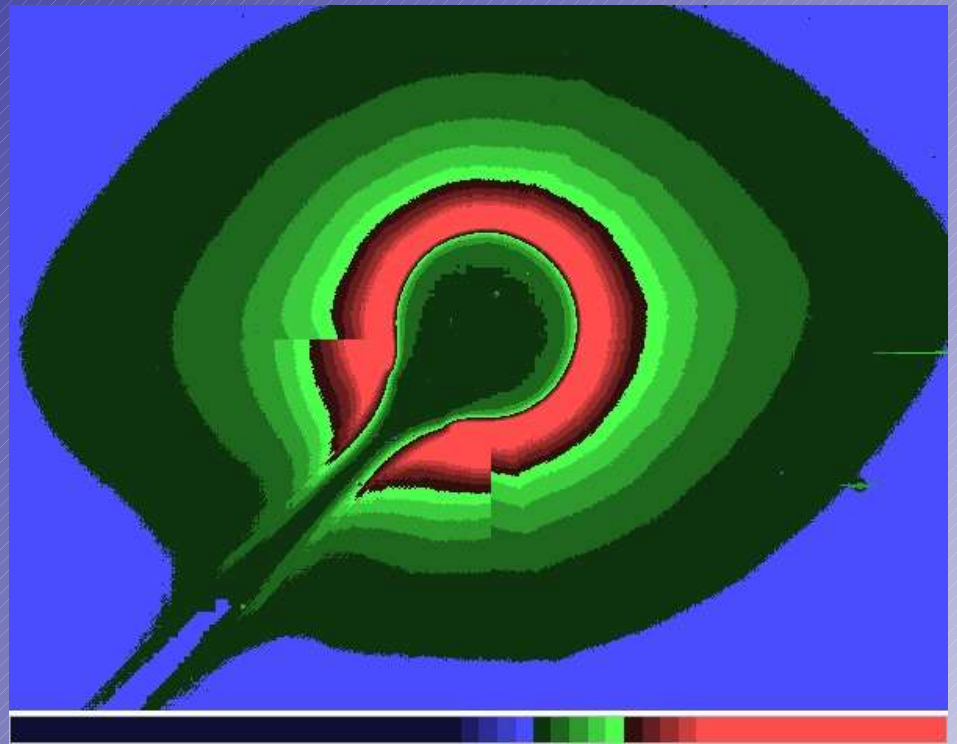
NRL Level-1 processed fits image:
- latest vig. function, mask and
  calibration coefficients.
- units are solar brightness (easy
  conversion to DN/sec)

Note: Images created using SAOImage DS9, Smithsonian
Astrophysical Observatory.
Images are log-scaled and zoomed, with 'rainbow' color table.

Options:

1. Give users the Level-0.5 product and supply them with the software (*SolarSoft*) and calibration files to create *either* pretty pictures & movies *or* fully calibrated images

2. Give users Level-1 product and calibration files. Scale factor either DN/sec or mean solar brightness. Point to Level-0.5 product (NRL)?

Recommendations:

- Fully document the methods and software routines (SolarSoft?) used to create the files, and the differences between the products.
- Recommend using NRL data products
- NOTE: It is **not** possible to fully reproduce the Level-0.5 product from its equivalent Level-1 product (due to interpolations in L1 processing).

Comets

- Observing programs for bright comets
  - different exposure times
  - filter/polarizer sequences
- Orbital elements fro IAU?
- Group membership?
  - Separate list? Part of "pos_YYYY.tab"?
- Possible to include photometry results? (post-publication, of course, e.g. Biesecker et al.)

Comets (cont...)

- Astrometry:
  - SOHO coordinates (S/C X,Y,Z)
  - Stars in fov
  - Stars in astrometry files
  - Where are the 'original' astrometry files? (see example – next slide)
- Credit for detections? ("comet-hunter" name)
- SOHO 'X-Comets'? (just mention in docs, perhaps?)

SOHO astrometry file:

- Example of SOHO astrometry file:

```
# Observations
    DATE          TIME (hrs)   S/C-X (AU)       S/C-Y (AU)       S/C-Z (AU)  # OBJECTS
  SAO    x-pixel   y-pixel   RA(HIC)   DEC(HIC) KNOW    DATE         TIME(UT)        EXP
--------------------------------------------------------------------------------------
9   X/2002
2002/04/04         13.9056    0.010226808    0.0043522315   0.00095678632      12
       0    48.740    76.250    0.0000    0.0000  0  2002/04/04  13:54:07.049   26.099
    4445  1004.803   606.991   11.6867    5.3458  1  2002/04/04  13:54:07.049   26.099
    4526   777.925   963.237   11.8485    6.7410  1  2002/04/04  13:54:07.049   26.099
    4628   905.451   536.770   12.0957    5.2806  1  2002/04/04  13:54:07.049   26.099
    4760   670.484   801.614   12.4163    6.4071  1  2002/04/04  13:54:07.049   26.099
    4898   511.043   888.845   12.7657    6.8998  1  2002/04/04  13:54:07.049   26.099
    5143   727.002    52.497   13.3312    4.0862  1  2002/04/04  13:54:07.049   26.099
    5180   276.845   898.509   13.4561    7.2711  1  2002/04/04  13:54:07.049   26.099
    5336   229.354   737.361   13.8315    6.8542  1  2002/04/04  13:54:07.049   26.099
    5614   183.172   385.613   14.4753    5.8718  1  2002/04/04  13:54:07.049   26.099
    5654    30.985   636.502   14.5811    6.8443  1  2002/04/04  13:54:07.049   26.099
    5929   125.443    13.394   15.2113    4.8340  1  2002/04/04  13:54:07.049   26.099
2002/04/04         14.1050    0.010226764    0.0043526345   0.00095686654      12
       0    59.382    85.035    0.0000    0.0000  0  2002/04/04  14:06:05.442   25.296
    4445  1008.412   608.394   11.6867    5.3458  1  2002/04/04  14:06:05.442   25.296
    4526   780.356   963.354   11.8485    6.7410  1  2002/04/04  14:06:05.442   25.296
    4628   907.910   536.968   12.0957    5.2806  1  2002/04/04  14:06:05.442   25.296
    4760   673.082   801.659   12.4163    6.4071  1  2002/04/04  14:06:05.442   25.296
    4898   513.495   889.125   12.7657    6.8998  1  2002/04/04  14:06:05.442   25.296
```

- Has S/C position, bright stars, etc

'READPDS' routine bug?

- Bug encountered:

  IDL> fn = '../2000j4_c3_004.fit'

  IDL> d = readpds(fn)

  Now reading header: /home/reduce/Desktop/PDS-SBN/document/comet_pos/pos_2000.lbl

  Now verifying label for: /home/reduce/Desktop/PDS-SBN/document/comet_pos/pos_2000.lbl

  Now reading 2680 by 16 table

  ** Structure <84719fc>, 2 tags, length=418276, data length=418274, refs=1:

    OBJECTS   INT   1

    TABLE   STRUCT   -> <Anonymous> Array[1]'

  IDL> d = readpds(fn,/noscale)

  Now reading header: /home/reduce/Desktop/PDS-SBN/2000j4_c3_004.fit

  Now verifying label for: /home/reduce/Desktop/PDS-SBN/2000j4_c3_004.fit

  % CHECK_SFDU_PDS: Error: No PDS_VERSION_ID keyword found in label.

  % Error occurred at: CHECK_SFDU_PDS   82 /home/reduce/Desktop/PDS-SBN/READPDS/verify_label.pro

  %   VERIFY_LABEL   295 /home/reduce/Desktop/PDS-SBN/READPDS/verify_label.pro

  %   READPDS   106 /home/reduce/Desktop/PDS-SBN/READPDS/readpds.pro

  % $MAIN$

  % Execution halted at: $MAIN$

- Can only read a given file once? Second read causes crash. Must read in different file before reading the original again. Found no simple get-around. Not just SOHO data.

Documentation

"catalog/dataset.cat"

- "Data Set Overview'

  - *"Nearly all of the SOHO discovered..."* could read *"Approximately 95% of the SOHO-discovered..."* (being picky...)

  - mention that synoptic programs are full-res (1024^2)

  - increased LASCO telemetry during 'keyholes'

  - reduced fov during early part of mission

- "Processing"

  - Level-0.5 and/or Level-1 processing should perhaps be explained with reference to *SolarSoft*

  - Clarify the different processing levels (as per earlier slides)

Documentation (cont...)

"catalog/dataset.cat"

- "Calib"

    – Note that ZP's might change (calibration papers from NRL/Marseille due for publication)

- "Processing" (cont...)

    – "*vignetting corrections have remained constant throughout the mission*"

            -- rephrase!

            -- not true for c3 (post-interrupt)

Conclusions

- Latest LASCO calibrations are needed

- C3 images must be corrected. C2 corrections recommended.

- Consider extra comet information such as group membership, S/C positions, X-comets, etc

- Determine source of readpds bug.

- Consider modificatons/clarifications to 'dataset.cat' file.