
PHI

L2 + L3 Data Products

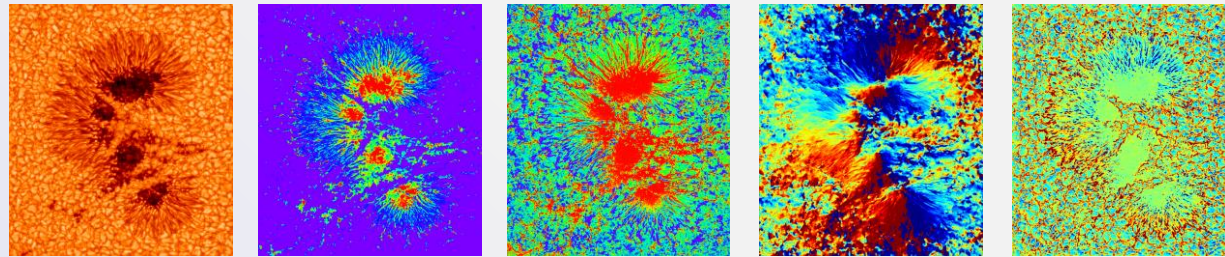
J. Hirzberger

SOWG #12

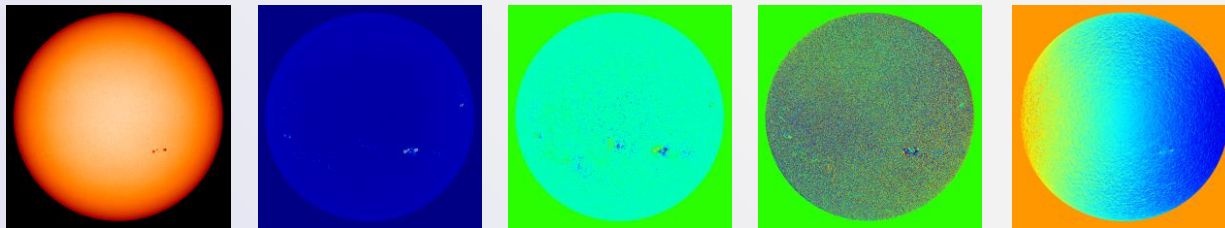
2018-07-11

PHI data products

1. Standard data products: calibrated and processed data;



high resolution



full disk

*continuum
intensity*

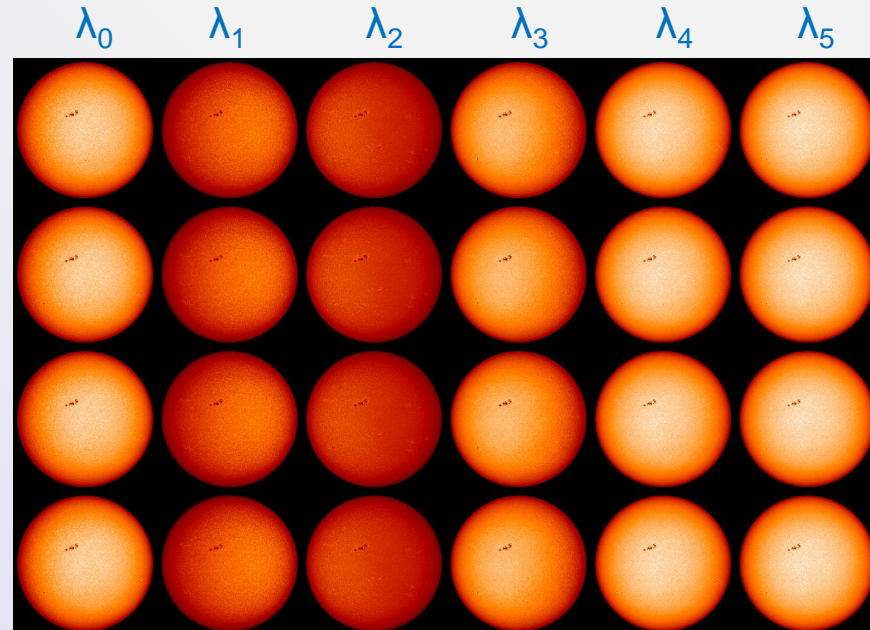
field strength

field inclination

field azimuth

LOS velocity

2. Raw data: fully uncalibrated data;
high resolution or full disk



pol.
state 0

pol.
state 1

pol.
state 2

pol.
state 3

Filenames

source_level_descriptor_datetime_Vversion_freefield.extension

- **extension:** all data will be .fits
- **descriptor:** allowed descriptor keywords are:

descriptor	level	description
'phi-fdt-icnt'	L0, L1, L2, L3, LL01, LL02, LL03	FDT continuum intensity
'phi-hrt-icnt'	L0, L1, L2, L3	HRT continuum intensity
'phi-fdt-bmag'	L2, L3, LL01, LL02, LL03	FDT magnetic field strength
'phi-fdt-binc'	L2, L3	FDT magnetic field inclination
'phi-fdt-bazi'	L2, L3	FDT magnetic field azimuth
'phi-hrt-bmag'	L2, L3	HRT magnetic field strength
'phi-hrt-binc'	L2, L3	HRT magnetic field inclination
'phi-hrt-bazi'	L2, L3	HRT magnetic field azimuth
'phi-fdt-vlos'	L2, L3	FDT LOS velocity
'phi-hrt-vlos'	L2, L3	HRT LOS velocity
'phi-fdt-ilam'	L0, L1, CAL	FDT narrow-band filtergram
'phi-hrt-ilam'	L0, L1, CAL	HRT narrow-band filtergram
'phi-fdt-stokes'	L0, L1, CAL	FDT narrow-band filtergram
'phi-hrt-stokes'	L0, L1, CAL	FDT narrow-band filtergram
'phi-dark'	CAL	dark field
'phi-fdt-flat'	CAL	FDT flat field
'phi-hrt-flat'	CAL	HRT flat field
'phi-fdt-dmod'	ANC	FDT polarimetric demodulation matrices
'phi-hrt-dmod'	ANC	HRT polarimetric demodulation matrices
'phi-ctc-imag'	CAL	CTC images
'phi-iss-param'	ANC	ISS ancillary data

Data Product: Level 0, Level 1

Usual level-0 data:

fully uncalibrated; limited metadata information (only instrumental parameters)

- PHI raw data will have levels L0, L1, L2, ...
- PHI processed data will have levels L2, ... (no L0, L1)
- partially processed data might have level L1 (tbc)

Level-0 data contain:

- basic FITS keywords
- General description keywords
- Instrument and campaign description keywords
- pre-observation-H/K
- post-observation-H/K

Level-1 data will add:

- WCS and ephemeris keywords
- ground processing information

Typical .fits header

```
SIMPLE      =          T / Written by IDL:  Fri Jun 22 15:04:36 2018
BITPIX     =          32 / Number of bits per data pixel
NAXIS      =           2 / Number of data axes
NAXIS1     =        2048 /
NAXIS2     =        2048 /
EXTEND     =          T / FITS data may contain extensions
BZERO     =           0 /
DATE       = '2018-06-22' / Creation date of FITS header
O_BZERO    =        2.14748E+09 /Original Data is unsigned Integer
OBSRVTRY= 'Solar Orbiter' / Satellite Name
TELESCOP= 'SOLO/PHI/HRT' / Telescope
INSTRUME= 'PHI      ' / Instrument name
FILENAME= 'solo_L0_1806220711_20180622T130326.fits' / Filename
PROCNODE= 'Hirzberger-TLM7' / System which processed file
SITE      = 'BT1.E0.605' / site of observation
ENGINEER= 'AG,DG,JH' / responsible engineer
PURPOSE   = 'FS HRT calibration' / purpose of test
SUBJECT   = 'random dot target' / subject of test
FILE_RAW= '1806220711.phi' / Raw filename
DATE_MOD= '2018-06-22T13:04:36.409' / Last modified
DATE-BEG= '2018-06-22T13:03:26.307' / [UTC] Start time of observation
DATE-END= '2018-06-22T13:03:26.357' / [UTC] End time of observation
OBT_BEG   =        1529672606.31 / [OBT] Start time of observation
OBT_END   =        1529672606.36 / [OBT] End time of observation
DPUBOOT   = '2018-06-22T06:52:19.046' / Time when DPU booted [UTC]
INTTIME   =          0.0500000 / [s] Exposure time of single readout
 / PHI_FITS_DPU_prehk
I_SYSST1= 'DEBUG      ' / Instrument system state
CPULOAD1=          17.8100 / [%] CPU load
SPWDROP1=          0.00000 / Number of dropped SpaceWire packets
IICPCTN1=          5560.00 / Number of IIC packets
IICSEQN1=          6115.00 / Sequence number of the last IIC packet
OBSWVER1=          7576 / On-board software version
```

etc.

Data Product: Level 2

Level 2 = fully calibrated and inverted data:

- **on-board processed data** will be supplemented with WCS and ephemeris keywords; these data contain already FITS extensions including info about on-board processing
- **raw-downlinked data** will be:
 - calibrated and demodulated (Level-1)
 - RTE inverted (standard ME)
 - ground-processing metadata will be added as FITS extension

Displaying Level-2 data (e.g. JHelioviewer):

- FDT data have variable disk size => interpolation procedure required for JH and other tools
- HRT data can be displayed on a solar coordinate grid => geometrical interpolation

Since PHI provides 5 typical parameters, dedicated color tables should be generated

Question: geometrical calibration (distortion) correction already for Level 2 ?

Data Product: Level 3 and higher

Data levels 3 and higher will include:

- **on-board processed data:**
 - geometrical calibration (inter-calibration with EUI ?)
 - inter-calibration with other instruments (e.g. HMI for azimuth disambiguation)
- **raw-downlinked data:**
 - geometrical calibration (inter-calibration with EUI ?)
 - inter-calibration with other instruments (e.g. HMI for azimuth disambiguation)
 - more complex RTE inversion
- additional data products:
 - synoptic field maps
 - PFSS extrapolations (=> MADAWG)
 - helicity maps (tbc)
 - helioseismology products (tbc)
- Metadata:
 - ??