

SCORE Data Display and Analysis
Software

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SCORE DATA DISPLAY and ANALYSIS SOFTWARE

SCORE Project

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CHANGE LOG

Date	issue	Revision	released by	comments
06 Jun 2007	0.0		S. Giordano	Preliminary release sent to team members
06 Sep 2007	0.1		S. Giordano	First Software release for Eclipse data analysis
06 Nov 2008	0.2		S. Giordano	Software release with shutter-less correction
22 Jan 2009	1.0		S. Giordano	Improved software description

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UVCI FITS Keywords

<i>KEYWORD</i>	<i>TYPE</i>	<i>VALUES</i>	<i>DESCRIPTION</i>
SIMPLE	S*1	T	Conforms to FITS standard
BITPIX	I*2	16	Number of bits per pixel
AXIS	I*2	2	Number of axes in the image
NAXIS1	I*2	512	Length of the first axis (columns)
NAXIS2	I*2	512	Length of the second axis (rows)
FILENAME	S*30	'12006460.fits'	Name of the FITS file
ONUM	I+2	1234	Observation Number
TLM_FILE1	S*30	'960501_033016.img'	Name of the raw telemetry file
TLM_FILE2	S*30	'960501_033016.img'	Name of the raw telemetry file
DATE	S*23	'1996/06/06 14:16:50.193'	Date of file generation
DATE-OBS	S*10	'1996/05/01'	Date of the start of the exposure
TIME-OBS	S*12	'03:29:43.489'	Time of the start of the exposure
EXPTIME	S4	16.0938	Number of seconds of the exposure time
TELESCOP	S*8	'HERSCHEL'	Name of the satellite
INSTRUME	S*8	'SCORE'	Name of the instrument
DETECTOR	S*8	'VLD'	Name of the telescope
TEMP	R*4		WLCR Temperature
VOLT	R*4		WLCR Voltage
P1COL	I*2	276	CCD column number of start of image
P1ROW	I*2	257	CCD row number of start of image
P2COL	I*2	787	CCD column number at end of image
P2ROW	I*2	768	CCD row number at end of image
SUMROW	I*2		Number of rows being summed on the CCD
SUMCOL	I*2		Number of columns being summed on the CCD
LAMP	I*2		Calibration lamp was/was not commanded
FILTER	S*8		Position of the filter wheel
POLAR	S*8	'+60 deg'	Position of the polarizer
OS_NUM	I*2		Observing Sequence Number
WAVELENG	R*4	30.4	Central observed wavelength
PLATESCL	R*4	5.60000	Number of arc seconds per pixel
OFFSET	I*2	320	Electronic offset in DN
OBT_TIME	R*4	1.2096126e+09	Value of the On-Board Time
DATAMIN	R*4		Minimum value of the image, including the bias
DATAMAX	R*4		Maximum value of the image
DATAZER	I*4		Number of zero pixels in the image
DATAAVG	R*4		Average value of the image
DATASIG	R*4		Standard deviation in computing the average
CRPIX1	R*4		Column number of the reference pixel
CRPIX2	R*4		Row number of the reference pixel
CRVAL1	R*4		Number of arc seconds of the center of the sun from the reference position in the azimuthal direction (E-W). Positive is to the solar west
CRVAL2	R*4		Number of arc seconds of the center of the sun from the reference position in the elevation direction (N-S). Positive is to solar north
CROTA1	R*4		Rotation of axis 1 with respect to solar north Positive is westward (clockwise)
CROTA2	R*4		Rotation of axis 2 with respect to solar north Positive is westward (clockwise)
CTYPE1	S*8	SOLAR-X	Type of units of axis #1
CTYPE2	S*8	SOLAR-Y	Type of units of axis #2
CUNIT1	S*8	ARCSEC	Units along axis #1
CUNIT2	S*8	ARCSEC	Units along axis #1
CDELTA1	R*8	7.0	Increment along axis #1 (Number of arcseconds per pixel)
CDELTA2	R*8	7.0	Increment along axis #2 (Number of arcseconds per pixel)
HISTORY	S*80		History of processing. Can be repeated
COMMENT	S*80		Comments. Can be repeated
END			

Data processing pipeline

Level 0 - Telemetry

Level 0.5 – FITS

Raw data

- file format
- file keywords

Level 1 – from raw into physical units

Calibration Processing Steps

- Subtract bias
- Multiply by flat field
- Replace missing blocks or spikes
- Multiply by (inverse) vignetting function/array
- Multiply by calibration factor (radiometric sensitivity)
- Subtract stray light
- Distortion correction
- Multiply by (distortion corrected) mask of occulter/pylon/outer edge

Level 2 – image processing

image restoration (PSF deconvolution)

image filtering

image enhancement

sharpening/smoothing/region stretching

difference images

An open issue is the final data calibration flow, which must be discussed and described in order to develop the data processing code.

Data Display/Analysis software

A preliminary Graphical User Interface (GUI) of the SCORE Data Display and Analysis Software, Version 0.0, has been developed in Interactive Data Language (IDL) and released to the team on Jun 06 2007 for the analysis of March 2006 eclipse images and comparison with SOHO imagers (LASCO and EIT) and UVCS observations. The code is Operating Systems (OS) independent, that is, it has been tested on Mac OSX, Linux and MS Windows OS. Some features of the developed program requires to run the code into SolarSoft environment, in particular for what concerns the analysis of LASCO and EIT images. An updated version has been released on Nov 6, 2008 with improvements mainly related to instrumental effects correction (shuttler-less correction)

Software features requirements

- Read raw data (level 0.5)
- Display data
 - display images
 - zoom images
 - plot x and y profiles
- Calibrate data (to level 1) TBD
- Save level 1 data
- Image processing
- Print images and plots

The main features implemented are:

- File menu
 - Read FITS *Read a generic FITS file*
 - FI FITS *Read FITS files generated by Firenze group (calibration files)*
 - Read LASCO *Read LASCO C2 and C3 FITS files*
 - Read EIT *Read EIT FITS files*
 - Write
 - Keywords

- Calibration menu
 - remove dark count
 - apply flat field
 - correct distortion
 - shutterless correction
 - define coordinates
 - LASCO C2 Background
 - Undo

- Edit menu
 - filters
 - unsharp
 - radial
 - sobel
 - rotate
 - reverse
 - modify data range
 - cut edges
 - despike
 - zoom
 - cut region
 - composite *Composite images from different uploaded files*
 - UVCS slit *Overlap UVCS slit positions*
 - Undo

- Save menu
 - Image array
 - image
 - plot
 - x
 - y
 - radial
 - polar

The following procedure allows the user to install the package from distributed compressed file *pro.zip* and run the code:

1. Unpack the *pro.zip* file
2. The following directory is created
 - i. *PRO*
3. Run IDL, compile the code and run the GUI
 - i. *ssw* ; run the SolarSoft environment
 - ii. *idl*
 - iii. Working directory *PRO/*
 - iv. *@mn*
 - v. *SCORE_DDAS_MW*

The following figure shows the main window of SCORE Data Display and Analysis Software.

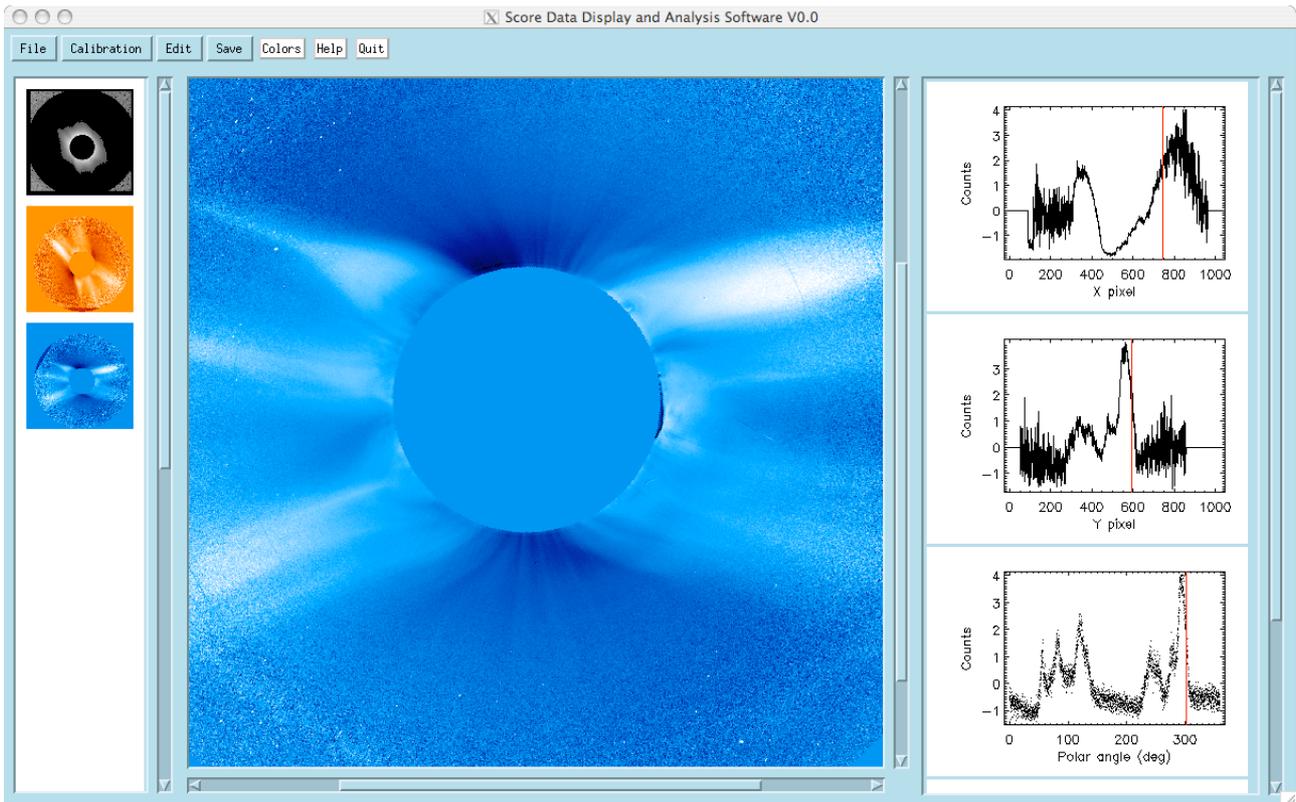


Figure 1: main window of SCORE Data Display and Analysis Software(V0.0)

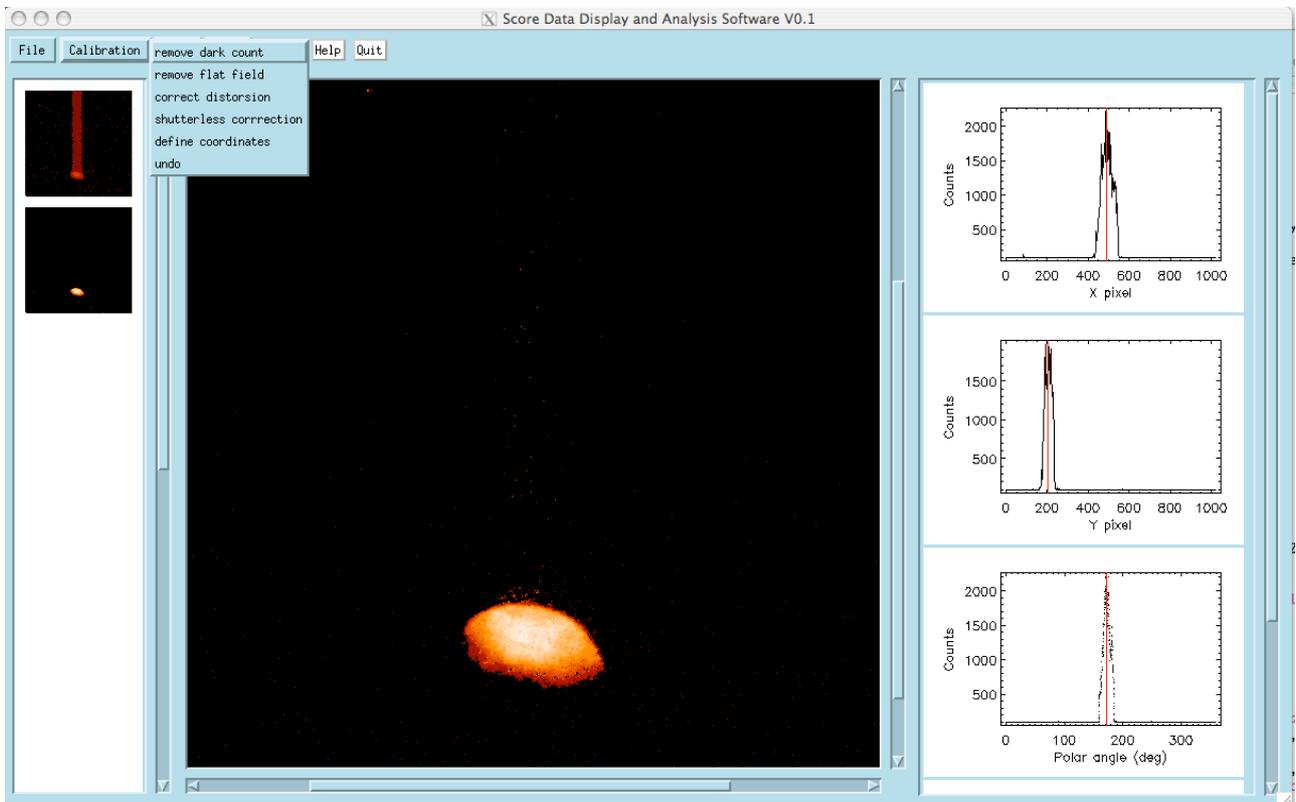


Figure 2: Example of shutterless correction (Software V0.1)