European Grid of Solar Observations
Project n. IST-2001-32409

FEATURES PARAMETERS DESCRIPTION AND ORGANIZATION

Title	**Features Parameters Description and Organization**
Document number	EGSO-WP5-IR3-2.3
Version	2.3
Date	11-Oct-04
Editors	**J. Aboudarham (Paris Obs.) and S. Zharkov (Bradford Univ.)**
Contributors	V. Zharkova, A. Benkhalil, S. Ipson, (Bradford University), N. Fuller, Q.N. Nguyen (Paris Observatory)
Distribution	Internal

Document Version History

Version	Date	Released by	Details
1.0	2003/11/14	Aboudarham	First full version of the document
1.1	2003/12/05	Zharkov	Update of keywords lists
1.2	2004/01/14	Zharkov, Benkhalil, Fuller, Zharkova,	Correction and homogenization of keywords lists for the various solar structures
1.3	2004/01/15	Zharkov, Zharkova	Update of database organization
1.4	2004/01/20	Zharkova, Benkhalil	File description of active regions included
1.5	2004/01/22	Aboudarham	Document history included
1.6	2004/01/22	Zharkova	Rationalized pages and contents, added number of pages and file location
1.7	2002/01/28	Zharkova, Benkhalil	Including Bob Bentley comments
1.8	2004/02/04	Zharkova,Benkhalil, Fuller, Aboudarham	Added Filaments part (5.3), changed definitions with a skeleton midpoint and included Bob Bentley comments
1.9	2004/07/28	Zharkov, Benkhalil	Matching the parameters name as in the SFC database
2.0	2004/07/30	Zharkov, Benkhalil	Matching the parameters name as in the SFC database
2.1	2004/09/06	Benkhalil	Describing a raster scan
2.2	2004/09/15	Stan Ipson	Overall check
2.3	2004/10/11	Valentina Zharkova	General corrections

Table of Contents

I. General organization

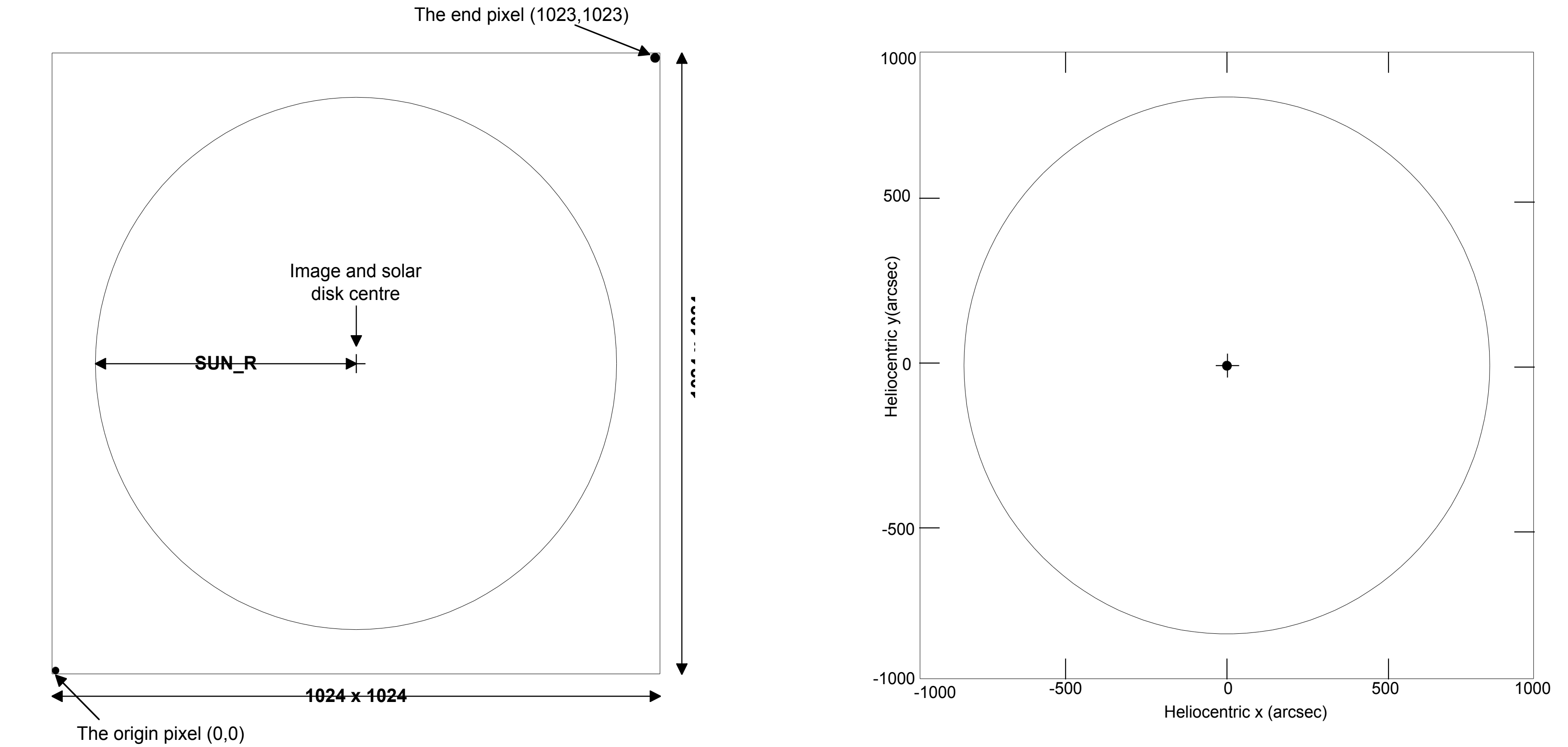
1.1 Definitions

The process of automatic Solar Features Recognition can be roughly separated into the two main steps:

- Cleaning the original solar image, leading to what is called a 'pre-processed'/'cleaned'/ image
- Features recognition on this pre-processed image.

In this document, the following *definitions* are used to describe the various elements of the whole process:

- *Initial observation*: This is the raw image obtained from an observatory's database/archive, on which the whole process will be applied.
- *Cleaning code*: This is the code which corrects the image faults (in term of the processing used here) of the initial observation, leading to pre-processed images.
- *Pre-processing*: This is the step corresponding to the cleaning code usage.
- *Pre-processed observation*: This is the image after application of the cleaning code. In this image, the Sun is circular, centered in the image and scaled to the standard dimensions (image dimensions 1024x1024 pixel and solar radius 420 pixel), limb darkening is corrected in the case of spectroheliograms, and observational faults are corrected (such as intensity fluctuations due to clouds, strips due to dust on the slit, etc). As long as the working database is in test mode, the pre-processed images will be kept in order to quickly re-process them, if required.
- *Raster Scan (RS)*: Represents contents of a bounding rectangle as runs of pixel values 0, 1 and 2 where 0 corresponding to quiet sun, 1 to penumbra, 2 to umbra. The pixel at the start of the first run corresponds to bottom left corner of the bounding rectangle.
- *Chain code (CC)*: This is a description of a feature boundary or a skeleton. A CC starting point is given (in pixels or arcseconds) with a set of directions indicated by numbers 0 to 7 as defined in Fig. 4. With these CC values the shape of the feature structure can be superimposed on any full solar disk image.
- *Skeleton*: In the case of filaments, a skeleton is a single line without spurs representing the filament. It is expressed as a chain code above.
- *Rectangular image (Bounding rectangle*): is the smallest rectangle in the pre-processed image that contains a full detected feature with its pixel values.
- *Gravity Center*: The centre of gravity is the average location of the weight of features.
- *Skeleton center*: The middle point of a filament skeleton
- *Pixel origin*: The starting position (0,0) for counting pixels up from the bottom left corner by rows and columns as shown in Fig. 1.



Pixel origin pixel

Arcsec origin pixel

Fig. 1: Image dimensions and origin locations.

1.2. Practical organization

The original images are pre-processed before use for feature detection. Every complete process will lead to a set of three ASCII files containing information on the original image, the preprocessed image and the extracted features. These files are used to populate the SFC, after which the preprocessed images may be deleted (but not during the test period). IDL code is available to reconstruct those feature parameters, such as chain code boundaries, which are stored in the SFC in an encoded form.

1.3. File organization

Note: This part is under development since we are experimenting with the file formats. The SFC database is expected to generate either ASCII or XML files, or VO tables. At the moment we have only ASCII files, which are described below. At a later stage we will change them according to the UOC standards.

The cleaning process creates the following files:
- *yyyymmdd_hhmmss_xx_init.txt* where the letters y, m, etc. stand for year, month, day, hour, minute and second. The 'xx' correspond to the kind of feature that will be detected using this file ('ss' for sunspots, 'ar' for active regions, 'fi' for filaments, 'pr' for prominences, 'ch' for coronal holes, …). This file includes all the information concerning the initial observations. The file is in ASCII format.
- *yyyymmdd_hhmmss__xx_norm.txt* This file includes all the information concerning the pre-processed observation. It is in ASCII format.
- *yyyymmdd_hhmmss_xx_param.txt* This file includes all the values of the adjustable parameters used in the cleaning code(s), as well as the information on the code used for cleaning (name, version, …). It is in ASCII format.
- *yyyymmdd_hhmmss_xx_norm.fts* This file contains the pre-processed image in FITS format.

The feature recognition part of the process creates the following files:
- *yyyymmdd_hhmmss_xx_feat.txt* This file includes all the useful information concerning the detected features. It is in ASCII format.
- *yyyymmdd_hhmmss_xx_ccode.txt* This file includes the chain codes describing the detected features. It is in ASCII format.
- *yyyymmdd_hhmmss_xx_image.cdf* This file includes the rectangular images containing the detected features. It is in CDF format.
- *yyyymmdd_hhmmss_xx_fpar.txt* This file includes the values of the adjustable parameters of feature recognition codes as well as information on the code used (name, version, …). It is in ASCII format.

II. Database organization

2.1. Philosophy of the organization

The original observations are subject to various distortions in shape and intensity some of which are corrected at the pre-processing stage using the cleaning code. The cleaning code setup is stored in the database, to allow the repetition of the pre-processing operations on an original image, in a way that is described below in section 2.2. Hence, for every initial observation (original image) there is a corresponding pre-processed observation. The detection is performed on a cleaned (pre-processed) observation and the results of detection are related to this pre-processed observation Every pre-processed observation has one or more features detected in it and, therefore, several feature-related parameters may be associated with a single pre-processed observation. Currently, the following features are detected: sunspots, active regions and filaments..

2.2. Database structure

In the Feature link table shown in Fig 2, the label pre-processed 1 corresponds to the observations that has been used for the primary extraction of the feature. Labels pre-processed 2 and 3 correspond to other files (if any) that have been used to improve the FR.

2.3. Description of the tables

At this time, nine database tables are defined, as listed in the following subsections. For a description of the keywords used in these tables, refer to the corresponding sections in section III.

2.3.1. Observatory table

Name: OBSERVATORY
Description: This table contains all useful information concerning the observatory/telescope/instrument
Keywords: OBSERVAT, INSTRUME, TELESCOP, BITPIX, UNITS, WAVELNTH, WAVENAME, WAVEUNIT, OBS_TYPE
See section 3.1

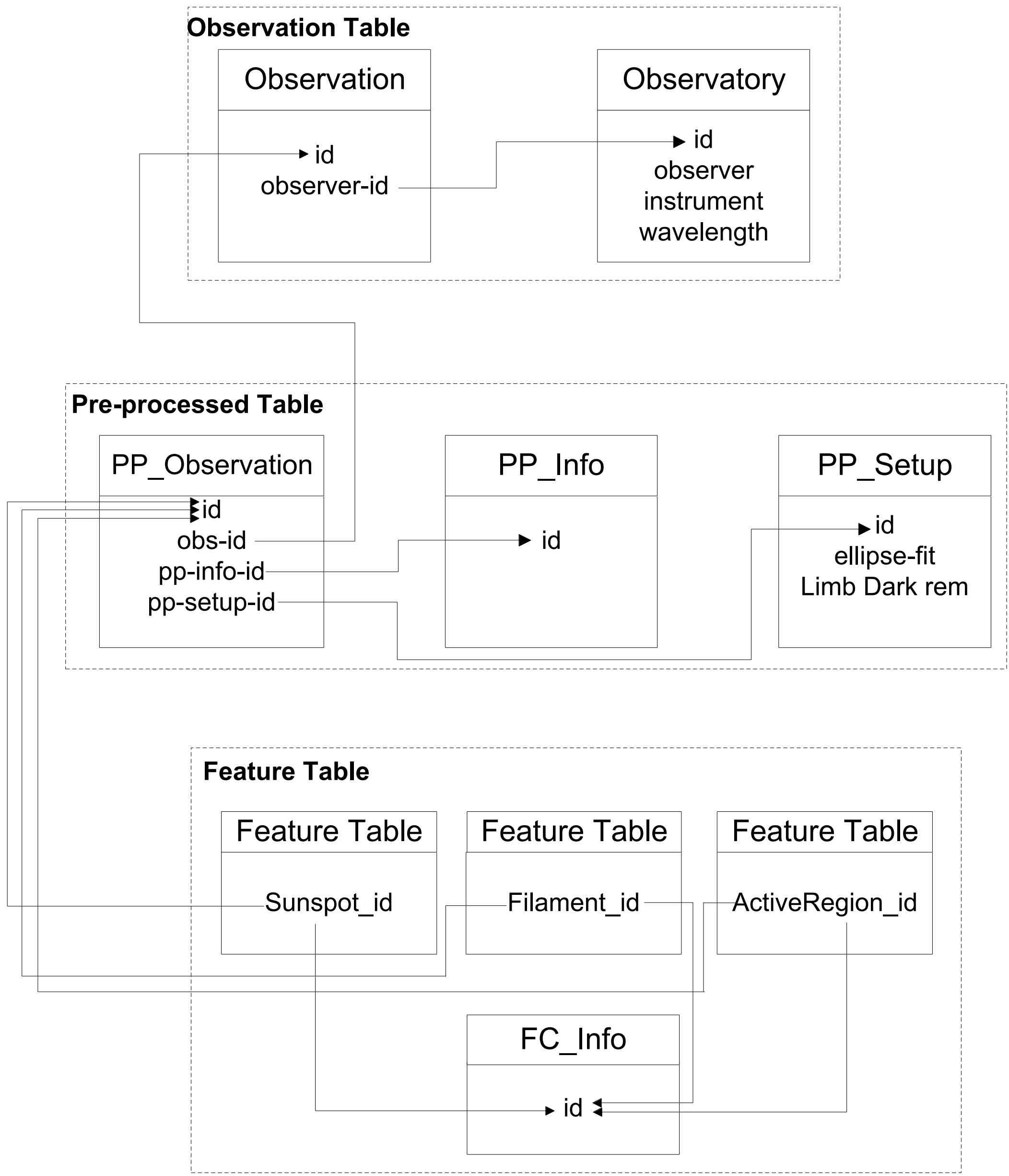


Fig. 2 :Feature link table

2.3.2. Observation table

Name: OBSERVATIONS
Description: This table contains all the useful information concerning the original image.
Keywords: OBSERVATORY_ID, DATE-OBS, DATE-END, JDINT, JDFRAC, EXP_TIME, C_ROTATION, BSCALE, BZERO, BITPIX, NAXIS1, NAXIS2, R_SUN, CENTER_X, CENTER_Y, CDELT1, CDELT2, QUALITY, FILENAME, COMMENT
See section 3.2

2.3.3. Pre Processing Information Table

Name: PP_INFO
Description: This table contains the information related to the cleaning code and who run it.
Keywords: INSTITUT, CODE, VERSION, CONTACT
See section 3.3

2.3.4. Pre Processing Setup

Name: PP_SETUP
Description: This table contains the information related to the cleaning code setup – describing the algorithm and the adjustable parameters listed in the normalization processing. These parameters along with version and name from pp_info table is sufficient to rerun the code to obtain the pre-processed image.
Keywords: EFIT, STANDARD, LIMBDARK, BACKGROUND, LINECLEAN, QSUNINT, PERCENT, NAXIS1, NAXIS2, CENTER_X, CENTER_Y, R_SUN, DIVISION, INORM
See section 3.4

2.3.5. Pre Processing Output Table

Name: PP_OUTPUT
Description: This table contains the values amended or extracted during the pre-processing stage
Keywords: PP_INFO_ID, PP_SETUP_ID, OBSERVATION_ID, RUN_DATE, EL_CEN_X, EL_CEN_Y, EL_AXIS1, EL_AXIS2, EL_ANGLE, STDEV, STDEVGEO, ALGERR, CDELT1, CDELT2, BITPIX, QSUN_INT, LOC_FILE, RUN_DATE
See section 3.5

2.3.6. Feature Recognition Code Information Table

Name: FRC_INFO
Description: Similar to PP_INFO, this table contains information about different versions of the feature recognition codes and the people responsible for running it.
Keywords: INSTITUT, CODE, VERSION, FEATURE_NAME, CONTACT
See section 3.6

2.3.7. Feature Tables

(Sunspots, Active Regions, Filaments)

Description: This table contains all the parameters describing the detected feature. There is one table entry for one feature.
Note: If necessary, this table could be split into as many tables as the kind of features detected. But this will affect the use of the FEAT_LINK and PARAM_FEAT tables.
Keywords: FRC_INFO_ID, PROCD_OBS, RUN_DATE, GC_ARC_X, GC_ARC_Y, GC_CAR_LAT, GC_CAR_LON, FEAT_NPIX, FEAT_AREA, FEAT_MEAN2QSUN, BR_ARC (BR_ARC_X0, BR_ARC_Y0, BR_ARC_X1, BR_ARC_Y1), BR_PIX (BR_PIX_X0, BR_PIX_Y0, BR_PIX_X1, BR_PIX_Y1), FEAT_MAX_INT, FEAT_MIN_INT, FEAT_MEAN_INT, ENC_MET

Sunspots:	N_UMBRAS, UPIXSIZE, DIAMETER, RASTER_SCAN
Active Regions:	CC_PIX_X, CC_PIX_Y, CC_ARC_X, CC_ARC_Y, CCODE_LNTH, CHAIN_CODE
Filaments:	CURVATURE, ELONG, ORIENTATION, COD_SKE_PIX_X, COD_SKE_PIX_Y, COD_SKE_ARC_X, COD_SKE_ARC_Y, CC_PIX_X, CC_PIX_Y, CC_ARC_X, CC_ARC_Y, CHAIN_CODE

(See sections 3.7.1 for sunspots, 3.7.2. for active regions and 3.7.3 for filaments)

III. Keyword descriptions

3.1. Observatory (Instrument) Table

Name	Format MySQL	Format XML	Description	Notes
ID	Int(11)	Int(11)	Index to identify file and link files together	Primary Key
OBSERVAT	Varchar(255)	Varchar(255)	Name of the observatory that made the observation	e.g. Meudon
INSTRUME	Varchar(150)	Varchar(150)	Name of the instrument that made the observation	e.g. Spectroheliograph
TELESCOP	Varchar(150)	Varchar(150)	Name of the sub-part of the instrument that made the observation	e.g. C2 in case of LASCO
UNITS	Varchar(100)	Varchar(100)	Units of the original observation intensity	e.g. counts in most cases
WAVELNTH	Float	Float	Wavelength of the original observation (nm)	Maybe another keyword should be added for the unit (hard-X, optical or radio don't use the same units: keV, nm, MHz)
WAVENAME	Varchar(50)	Varchar(50)	Name of the wavelength of the original observation (if any)	e.g. H alpha, Ca II, Fe IX
WAVEUNIT	Int(4)	Int(4)	A, nm, or others	6768 A (Ni I line in MDI)
OBS_TYPE	Varchar(150)	Varchar(150)	Spectral domain in which observations were made	e.g. optical, SXR, EUV
COMMENT	text	text		

3.2. Observation Table

Name	Format	Format	Description	Notes
ID	Int(11)	Int(11)	Primary Index	Internal use, may be used as an unique ID
OBSERVATORY_ID	Int(11)	Int(11)	Pointing to observatory, wavelength etc	ID in Observatory table
DATE-OBS	Datetime	Datetime	Date and time of the start of the observation in	e.g. 2003-10-01T17:15:32.123

			UTC	
DATE-END	Datetime	Datetime	Date and time of the end of the observation in UTC	Same format as DATE_OBS
JDINT	Int(11)	Int(11)	Julian day of the observation, integer part	Internal use
JDFRAC	Double	Double	Julian day of the observation, fraction part	Internal use
EXP_TIME	Float	Float	Exposure time (if available), in seconds and fractions of s	
C_ROTATION	Int(7)	Int(7)	Carrington rotation	Must be calculated from DATE_OBS
BSCALE	Double	Double	As extracted from the header	
BZERO	Double	Double	As extracted from the header	
BITPIX	Int(3)	Int(3)	Coding of the original image	
NAXIS1	Int(6)	Int(6)	First dimension of the original image (X)	
NAXIS2	Int(6)	Int(6)	Second dimension of the original image (Y)	
R_SUN	Double	Double	Radius of the Sun, in pixels	(as extracted from the Header)
CENTER_X	Double	Double	X coordinate of Sun centre in pixels	(as extracted from the Header)
CENTER_Y	Double	Double	Y coordinate of Sun centre in pixels	(as extracted from the Header)
CDELT1	Double	Double	Spatial scale of the original observation (X axis) (in arcsec)	
CDELT2	Double	Double	Spatial scale of the original observation (Y axis) (in arcsec)	
QUALITY	Varchar(20)	Varchar(20)	Quality of the original image (in terms of processing)	Has to be defined
FILENAME	Varchar(100)	Varchar(100)	Name of the original file	Path is useful for some MDI files
DATE_OBS_STRING	Varchar(150)	Varchar(150)		
DATE_END_STRING	Varchar(150)	Varchar(150)		
COMMENT	Text	text	As extracted from the Header	
LOC_FILENAME	Varchar(200)	Varchar(200)		Internal use
ID2	Int(11)	Int(11)		Internal use

3.3. PreProcessing_Info Table

ID	Int(11)	Int(11)	Primary Index	Internal use, may be used as an unique ID
INSTITUT	Varchar(150)	Varchar(150)	Institute responsible for running the cleaning code	e.g. Bradford, Meudon
CODE	Varchar(150)	Varchar(150)	Name of the cleaning code	
VERSION	Varchar(50)	Varchar(50)	Version of the cleaning code	
CONTACT	Varchar(150)	Varchar(150)	Person responsible for running cleaning code	

3.4. PreProcessing_Setup Table

Name	Format	Format	Description	Notes
ID	Int(11)	Int(11)	Primary Index	Internal use, may be used as an unique ID
EFIT	tinyint(1)	tinyint(1)	Has ellipse fitting been used	Yes(1) or No(0)
STANDARD	tinyint(1)	tinyint(1)	Has standardisation been used	Yes(1) or No(0)
LIMBDARK	tinyint(1)	tinyint(1)	Has limb darkening removal been used	Yes(1) or No(0)
BACKGROUND	tinyint(1)	tinyint(1)	Has background cleaning been performed	Yes(1) or No(0)
LINECLEAN	tinyint(1)	tinyint(1)	Has line cleaning been used	Yes(1) or No(0)
QSUNINT	tinyint(1)	tinyint(1)	Was Quiet Sun Intensity determined	Yes(1) or No(0)
PERCENT	Float	Float	Used in ellipse fitting	Default = 0.5
NAXIS1	Int(8)	Int(8)	First dimension of the pre-processed image (X)	
NAXIS2	Int(8)	Int(8)	Second dimension of the pre-processed image (Y)	
CENTER_X	Float	Float	X coordinate of Sun centre in pixels	Origin 0,0
CENTER_Y	Float	Float	Y coordinate of Sun centre in pixels	Origin 0,0
R_SUN	Float	Float	Radius of the Sun in pixels	
DIVISION	tinyint(1)	tinyint(1)	Method used to normalise image	Division (1), Subtraction (0)
INORM	Float	Float	Normalizing parameter for division method	Optional

3.5. Processed Observation Table

Name	Format	Format	Description	Notes
ID	Int(11)	Int(11)	Primary Index	Internal use, may be used as an unique ID
PP_INFO_ID	Int(6)	Int(6)	Pointing to information about Pre-Processing code, version, institute	
PP_SETUP_ID	Int(6)	Int(6)	Pointing to information about Preprocessing setup	
OBSERVATION_ID	Int(11)	Int(11)	Pointing to Observation	
RUN_DATE	datetime	datetime	Date where the PP code was run	
LOC_FILE	Varchar(100)	Varchar(100)	Name of the pre-processed file, including the path from the local organization	
EL_CEN_X	Double	Double	X coordinate of Ellipse centre in pixels	0 if no ellipse fitting used
EL_CEN_Y	Double	Double	Y coordinate of Ellipse centre in pixels	
EL_AXIS1	Double	Double	Ellipse long axis (in pixels)	
EL_AXIS2	Double	Double	Ellipse short axis (in pixels)	
EL_ANGLE	Double	Double	Ellipse angle (°)	
STDEV	Double	Double	Standard deviation(in pixels)	
STDEVGEO	Double	Double	Standard deviation geometric(in pixels)	
ALGERR	Double	Double	Algebraic error (in pixels)	
CDELT1	double	double	Spatial scale of the pre-processed observation (X axis) (in arcsec)	Calculated based on standardization params
CDELT2	double	double	Spatial scale of the pre-processed observation (Y axis) (in arcsec)	
BITPIX	Int(3)	Int(3)	Coding of the pre-processed image	Changes if line cleaning is used
QSUN_INT	Float	Float	Quiet Sun value estimated after pre-processing	
RUN_DATE	datetime	datetime		
PR_LOCFNAME	Varchar(150)	Varchar(150)		
ORG_FNAME	Varchar(150)	Varchar(150)		
ID_ASCII	Int(11)	Int(11)		

3.6. FRC_Info Table

ID	Int(11)	Int(11)	Primary Index	Internal use, may be used as an unique ID
INSTITUT	Varchar(150)	Varchar(150)	Institute responsible for running the FR code	e.g. Bradford, Meudon
CODE	Varchar(100)	Varchar(100)	Name of the FR code	
VERSION	Varchar(50)	Varchar(50)	Version of the FR code	
FEATURE_NAME	Varchar(100)	Varchar(100)	Features Detected	e.g. Sunspot
CONTACT	Varchar(150)	Varchar(150)	Person responsible for running FR code	

3.7. Features description

3.7.1. Sunspots

Name	Format	Format	Description	Notes
ID_ASCII	Int(11)	Int(11)	Index to recognize file and link files together	Internal use, may be used as an unique ID
FRC_INFO_ID	Int(4)	Int(4)	Ref. to FRC info table	
PROCD_OBS	Int(11)	Int(11)	Ref. to Processed Observation table	
RUN_DATE	datetime	datetime	Date when FR code was run	
GC_ARC_X	Double	Double	Gravity centre X coordinate (arcsec)	
GC_ARC_Y	Double	Double	Gravity centre Y coordinate (arcsec)	
GC_CAR_LAT	Double	Double	Gravity centre in Carrington coordinates (°)	
GC_CAR_LON	Double	Double	Gravity centre in Carrington coordinates (°)	
FEAT_NPIX	Int(11)	Int(11)	Number of pixels included in the feature	
FEAT_AREA	Double	Double	Area of the feature, in degrees^2	
FEAT_MEAN2QSUN	Double	Double	Mean of the feature to QS intensity ratio	
BR_ARC	Double	Double	Bounding rectangle coordinates, in arcsec	From lower left to upper right: X_{ll}, Y_{ll}, X_{ur}, Y_{ur}; (BR_ARC_X0, BR_ARC_Y0, BR_ARC_X1, BR_ARC_Y1)
BR_PIX	Int(8)	Int(8)	Bounding rectangle coordinates in pixels	Same as BR_ARC; (BR_PIX_X0, BR_PIX_Y0, BR_PIX_X1, BR_PIX_Y1)
FEAT_MAX_INT	float	float	Feature max. value, in units of the original obs.	As in UNITS
FEAT_MIN_INT	float	float	Feature min. value, in units of the original obs.	As in UNITS
FEAT_MEAN_INT	float	float	Feature mean intensity value, in units of the original obs.	As in UNITS

ENC_MET	Varchar(50)	Varchar(50)	Encoding method	e.g. raster, chain code, None… TBC
RASTER_SCAN	text	text		
N_UMBRAS	Int(4)	Int(4)	Number of umbras	
UPIXSIZE	Int(11)	Int(11)	Umbra area in pixels	
DIAMETER	Double	Double	Diameter of the sunspot in degrees	
RSCAN_LENGTH	Int(6)	Int(6)	Length of the raster scan string	
PR_LOCFNAME	Varchar(150)	Varchar(150)		
TOTALFLUX	Float	Float		
ABSTOTALFLUX	Float	Float		
MAXFLUX	Float	Float		
MINFLUX	Float	Float		
TOTAL_UFLUX	Float	Float		
ABSTOTAL_UFLUX	Float	Float		
MAX_UFLUX	Float	Float		
MIN_UFLUX	Float	Float		
ID_OBS	Int(4)	Int(4)		
ID	Int(11)	Int(11)	Unique Feature ID	

3.7.2. Active regions

Name	Format	Format	Description	Notes
ID	Int(11)	Int(11)	Index to identify file and link files together	Internal use, may be used as an unique ID
FRC_INFO_ID	Int(4)	Int(4)	Ref. to FR code information	
PROCD_OBS	Int(11)	Int(11)	Ref. to Processed Observation where detec. Was made	
RUN_DATE	datetime	datetime	Date when FR code was run	
GC_ARC_X	Double	Double	Gravity centre in latitude X (arcsec)	
GC_ARC_Y	Double	Double	Gravity centre in longitude Y (arcsec)	
GC_CAR_LAT	Double	Double	Gravity centre in heliographic (°)	
GC_CAR_LON	Double	Double	Gravity centre in heliographic (°)	
FEAT_NPIX	Int(11)	Int(11)	Number of pixels included in the feature	
FEAT_AREA	Double	Double	Area of the feature, in degrees^2	

FEAT_MEAN2QSUN	Double	Double	Mean of the feature to QS intensity ratio	
BR_ARC	double	double	Bounding rectangle coordinates, in arcsec	From lower left to upper right: X_{ll}, Y_{ll}, X_{ur}, Y_{ur}; (BR_ARC_X0, BR_ARC_Y0, BR_ARC_X1, BR_ARC_Y1)
BR_PIX	Int(8)	Int(8)	Bounding rectangle coordinates in pixels	Same as BR_ARC; (BR_PIX_X0, BR_PIX_Y0, BR_PIX_X1, BR_PIX_Y1)
FEAT_MAX_INT	Float	Float	Feature max. value, in units of the original obs.	As in UNITS
FEAT_MIN_INT	Float	Float	Feature min. value, in units of the original obs.	As in UNITS
FEAT_MEAN_INT	Float	Float	Feature mean intensity value, in units of the original obs.	As in UNITS
ENC_MET	Varchar(50)	Varchar(50)	Encoding method	e.g. raster, chain code, None… TBC
CC_PIX_X	Int(8)	Int(8)	X coordinate of chain code start position in pixels	To Be Confirmed
CC_PIX_Y	Int(8)	Int(8)	Y coordinate of chain code start position in pixels	TBC
CC_ARC_X	Float	Float	X coordinate of chain code start position in arcsec	TBC
CC_ARC_Y	Float	Float	Y coordinate of chain code start position in arcsec	TBC
CHAIN_CODE	text	text		
ID_ASCII	Int(11)	Int(11)		
CCODE_LNTH	Int(11)	Int(11)		
PR_LOCFNAME	Varchar(150)	Varchar(150)		

3.7.3. Filaments

Name	Format	Format	Description	Notes
ID	Int(11)	Int(11)	Index to identify file and link files together	Internal use, may be used as an unique ID
FRC_INFO_ID	Int(4)	Int(4)	Ref. to FR code information	
PROCD_OBS_ID	Int(11)	Int(11)	Ref. to Processed Observ. where detect. Was made	
RUN_DATE	datetime	datetime	Date when FR code was run	
SC_ARC_X	Double	Double	X coordinate of skeleton centre in arcsec	
SC_ARC_Y	Double	Double	Y coordinate of skeleton centre in arcsec	Different
SC_CAR_LAT	Double	Double	Carrington latitude of skeleton centre (°)	
SC_CAR_LON	Double	Double	Carrington longitude of skeleton centre (°)	
FEAT_NPIX	Int(11)	Int(11)	Number of pixels included in the feature	

FEAT_AREA	Double	Double	Area of the feature, in degrees^2	
FEAT_MEAN2QSUN	Double	Double	Mean of the feature to QS intensity ratio	
BR_ARC	Double	Double	Bounding rectangle coordinates, in arcsec	From lower left to upper right: X_{ll}, Y_{ll}, X_{ur}, Y_{ur} ; (BR_ARC_X0, BR_ARC_Y0, BR_ARC_X1, BR_ARC_Y1)
BR_PIX	Int(8)	Int(8)	Bounding rectangle coordinates in pixels	Same as BR_ARC; (BR_PIX_X0, BR_PIX_Y0, BR_PIX_X1, BR_PIX_Y1)
FEAT_MAX_INT	Float	Float	Feature max. value, in units of the original obs.	As in UNITS
FEAT_MIN_INT	Float	Float	Feature min. value, in units of the original obs.	As in UNITS
FEAT_MEAN_INT	Float	Float	Feature mean intensity value, in units of the original obs.	As in UNITS
ENC_MET	Varchar(50)	Varchar(50)	Encoding method	e.g. raster, chain code, None… TBC
CC_PIX_X	Int(8)	Int(8)	X coordinate of chain code start position in pixels	To Be Confirmed
CC_PIX_Y	Int(8)	Int(8)	Y coordinate of chain code start position in pixels	TBC
CC_ARC_X	Float	Float	X coordinate of chain code start position in arcsec	TBC
CC_ARC_Y	Float	Float	Y coordinate of chain code start position in arcsec	TBC
SKE_LEN_DEG	Float	Float	Length of the filament in degrees	
CURVATURE	Float	Float	Index of curvature of the skeleton	
ELONG	Float	Float	Elongation factor	=area/(2d)^2 where d=thickness
ORIENTATION	Float	Float	Orientation of the filament	
COD_SKE_PIX_X	Int(8)	Int(8)	X coordinate of skeleton chain code start in pixels	
COD_SKE_PIX_Y	Int(8)	Int(8)	Y coordinate of skeleton chain code start in pixels	
COD_SKE_ARC_X	Float	Float	X coordinate of skeleton chain code start in arcsec	
COD_SKE_ARC_Y	Float	Float	Y coordinate of skeleton chain code start in arcsec	
CHAIN_CODE	text	text	Boundary chain code	
CHAIN_CODE_SKE	text	text	Skeleton chain code	
ID_ASCII	Int(11)	Int(11)		
CCODE_LNTH	Int(11)	Int(11)		
CCODE_SKE_LNTH	Int(11)	Int(11)		
PR_LOCFNAME	Varchar(150)	Varchar(150)		

IV. Feature recognition parameters

The explanations of the feature recognition parameter keywords included in the tables in section III are amplified where necessary in this section.

Observatory **and** ***Observation parameters*** – most of the associated table fields are inherited from the fits-file headers of the original images. However, the Carrington Rotation field will be calculated (via SolarSoft routines), if not available in the header. Some of the *Observatory table* entries are entered manually based on the information available at the observatory web-site.

Preprocessing Information, Preprocessing Setup and Feature Recognition Code Information parameters – the associated keyword descriptions are self-explanatory.

Preprocessing Output parameters

- The ellipse fitting procedure outputs ellipse center coordinates (EL_CEN_X & EL_CEN_Y) which are calculate in IDL coordinates with (0, 0) corresponding to bottom left corner of the image. The calculated ellipse angle EL_ANGLE, is the angle between the long axis and the E->W axis. The ellipse fit errors STDEV, STDEVGEO and ALGERR are calculated from the extracted limb and the fitted ellipse.
- The standardization procedure normalizes the image to a given radius, so CDELT1, CDELT2 which depend on the date of the observation have to be calculated for the pre-processed image. The BITPIX value is affected when Background cleaning procedure is used. The quiet sun intensity (QSUN_INT) is defined as the most frequently occurring intensity value and is estimated from the histogram maximum of a pre-processed (flat) image.

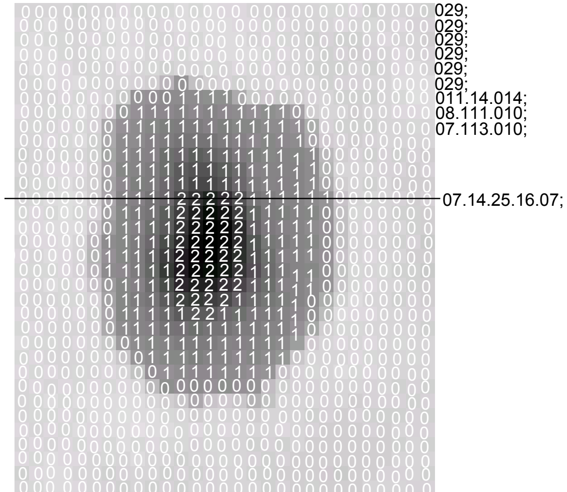
Feature parameters:

The feature tables for sunspots, active regions and filaments include common and individual parameters, some of which require further explanation.

Sunspots

- The areas and diameters of sunspots (FEAT_AREA & DIAMETER) are calculated by mapping (back projection) the detected region to the heliographic surface (with length of one pixel equal to 0.1 degree by default). The diameter is defined as the maximum distance between any two points of the feature.
- The sunspot intensity parameters associated with the keywords FEAT_MEAN2QSUN, FEAT_MAX_INT, FEAT_MIN_INT, FEAT_MEAN_INT are calculated using the detected regions and pre-processed (flat) image.
- The smallest rectangle (bounding rectangle) containing a sunspot region (BR_PIX, BR_ARC) is represented by four integers representing the x, y coordinates, in pixel or arcsec, of the lower left corner followed by the upper right corner of the rectangle.

- **RASTER SCAN** is used to represents the contents of a rectangular region bounding an extracted sunspot with pixel values equal to 0 corresponding to quiet sun, 1 to penumbra, 2 to umbra (as shown in Fig. 3). The one dimensional array of pixel data formed by concatenating the rows of the rectangular region starting from the bottom left corner is encoded using Run-Length Encoding (RLE).. In the encoded data each run, comprises the value of the pixels forming the run followed by the length of the run, is separated by a decimal point. Examples of RLE data for four sunspots are shown in Fig. 3. The encoding method is called a Raster Scan and the routine used is called Raster Scan 2.



(a)

```
Raster Scan 2;     08.12.01.11.08.19.06.110.05.113.02.114.02.17.22.112.26.110.26.14.01.14.27.14.01.15.25.111.25.15.01.15.22.17.03.13.
 Raster Scan 2;     01.15.02.15.01.116.21.16.21.15.23.13.01.23.13.01.11.21.13.02.14.02.;
  Raster Scan 2;     08.11.017.16.011.19.08.111.05.114.02.116.02.19.21.15.03.14.22.13.23.14.01.14.23.13.23.110.22.13.23.110.22.13.22.
   Raster Scan 2;     07.12.08.14.05.17.03.18.02.11.23.15.01.11.24.17.23.117.01.110.03.13.21.14.04.11.21.15.04.16.06.15.07.11.04.;
```

(b)

Fig. 3. (a) a RASTER SCAN example, (b) a cropped section of the ASCII file shows the RASTER SCAN RLE representation

Active Regions

- The area of an active region (FEAT_AREA) is calculated by mapping (back projection) the detected region to the heliographic surface (with length of one pixel equal to 0.1 degree by default).
- The bounding rectangle associated with an active region (BR_PIX, BR_ARC) is the smallest rectangle which encloses the active region. It is represented as described under sunspots.
- The boundary of an active region is represented by a chain code (CHAIN_CODE) which starting from any boundary pixel lists the directions required to move from one pixel to the next anti-clockwise round the boundary until the starting pixel is reached. The direction to the next boundary pixel is represented by an ASCII codes for the 0 to 7. The coordinates of the pixel at the start of a chain code (CC_PIX_X, CC_PIX_Y, CC_ARC_X, CC_ARC_Y) are stored in units of pixels and arcsecs.

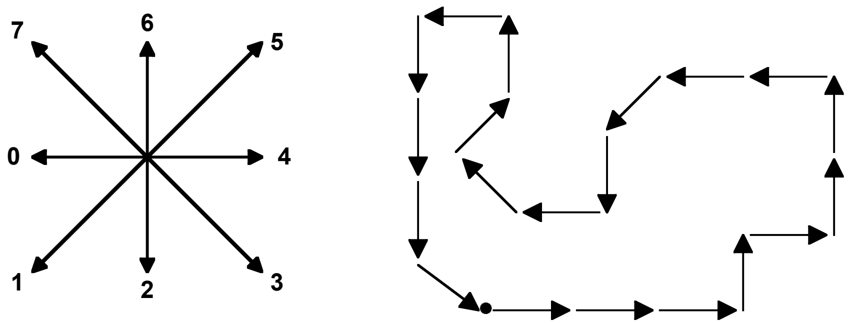


Fig. 4 : Chain Code in 8-connectivity, and its derivative code: 4 4 4 6 4 6 6 0 0 1 2 0 75 6 0 2 2 2 3

Filaments

- The coordinates of the centre of a filament skeleton (SC_ARC_X, GC_ARC_Y, SC_CAR_LAT, GC_CAR_LON) are coordinates of the middle pixel of the filament's skeleton converted to units of arcsec or to Carrington coordinates.
- The filament parameters associated with its intensity (FEAT_MEAN2QSUN, FEAT_MAX_INT, FEAT_MIN_INT, FEAT_MEAN_INT) are calculated with the cleaned image pixel values.
- The area and length of a filament (FEAT_AREA, SKE_LEN_DEG) are calculated by mapping (back projection) the detected region to the heliographic surface.

- The bounding rectangle associated with a detected filament (BR_PIX, BR_ARC) is the smallest rectangle which encloses the filament skeleton. It is represented as described under sunspots.
- The boundary of a filament is represented using the chain code (CHAIN_CODE) represented as described under active regions.
- The skeleton of a filament (CHAIN_CODE_SKE) is represented using a chain code as defined for CHAIN_CODE which starts from one extremity (COD_SKE_PIX_X, COD_SKE_PIX_Y) of the skeleton and ends at the other extremity.
- The shapes of filaments are represented by two parameters; an elongation factor (ELONG) defined by FEAT_AREA/(2d)_ where 'd' is the thickness of the detected region and a curvature index (CURVATURE) defined as 10 * (1 - (distance between end points)/length).
- The orientation of a filament (ORIENTATION) is the main direction of the filament, in degrees counted clockwise from Ox.

V. Input files description – sample

The files below are produced as a query search from the SFC database by an observation date/time and instrument/wavelength which are assumed to be fixed for these files as stated in the file descriptions. In the real SFC database these data will be also incorporated into the resulting ASCII file produced for a user.

5.1. Active Regions

For the active region database demo the following three ASCII files are produced for each month

1. *xxxx*_AR_Observation_Table_*yyyymm*.txt (containing all the useful information concerning the original image)
2. *xxxx*_AR_Processed_*yyyymm*.txt (containing information concerning the processed image)
3. *xxxx*_AR_*yyyymm*.txt (containing all the parameters describing the detected active regions)

xxxx used wavelength (i.e. Ca II k3, H_)
AR, active regions files
yyyy the selected year
mm the selected month

e.g.
CaIIK3_AR_Observation_Table_200204.txt
CaIIK3_AR_Processed_200204.txt

CaIIK3_AR_200204.txt

5.1.1. Observation Table (*xxxx*_AR_Observation_Table_*yyyymm*.txt, CaIIK3_AR_Observation_Table_200204.txt)

```
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
 0; 2002-04-01T08:56:0.0; 2002-04-01T08:56:0.0; 2452365; 0.8723359046;\N; 1988; 1.0; 0.0; 939; 965; 419.2; 466.0; 465.0; 2.29; 2.29;\N; meud_cak31_fd_20020401_085600_b.fts; F:/meudon/k3/0204/mK020
 1; 2002-04-02T07:09:0.0; 2002-04-02T07:09:0.0; 2452366; 0.7890027074;\N; 1988; 1.0; 0.0; 933; 965; 419.1; 464.0; 480.0; 2.29; 2.29;\N; meud_cak31_fd_20020402_070900_b.fts; F:/meudon/k3/0204/mK020
 2; 2002-04-03T08:51:0.0; 2002-04-03T08:51:0.0; 2452367; 0.8680029309;\N; 1988; 1.0; 0.0; 959; 927; 419.0; 479.5; 468.5; 2.29; 2.29;\N; meud_cak31_fd_20020403_085100_b.fts; F:/meudon/k3/0204/mK020
 3; 2002-04-04T07:30:0.0; 2002-04-04T07:30:0.0; 2452368; 0.8120031544;\N; 1988; 1.0; 0.0; 920; 923; 418.9; 462.0; 465.5; 2.29; 2.29;\N; meud_cak31_fd_20020404_073000_b.fts; F:/meudon/k3/0204/mK020
 4; 2002-04-05T08:12:0.0; 2002-04-05T08:12:0.0; 2452369; 0.8410033631;\N; 1988; 1.0; 0.0; 920; 936; 418.7; 458.0; 472.0; 2.29; 2.29;\N; meud_cak31_fd_20020405_081200_b.fts; F:/meudon/k3/0204/mK020
 5; 2002-04-06T07:13:0.0; 2002-04-06T07:13:0.0; 2452370; 0.8003369775;\N; 1988; 1.0; 0.0; 920; 939; 418.6; 458.0; 474.5; 2.29; 2.29;\N; meud_cak31_fd_20020406_071300_b.fts; F:/meudon/k3/0204/mK020
 6; 2002-04-07T08:24:0.0; 2002-04-07T08:24:0.0; 2452371; 0.8503371563;\N; 1988; 1.0; 0.0; 913; 958; 418.5; 454.5; 492.0; 2.29; 2.29;\N; meud_cak31_fd_20020407_082400_b.fts; F:/meudon/k3/0204/mK020
 7; 2002-04-08T07:10:0.0; 2002-04-08T07:10:0.0; 2452372; 0.7983373828;\N; 1988; 1.0; 0.0; 928; 942; 418.4; 463.5; 478.5; 2.29; 2.29;\N; meud_cak31_fd_20020408_071000_b.fts; F:/meudon/k3/0204/mK020
 8; 2002-04-09T06:36:0.0; 2002-04-09T06:36:0.0; 2452373; 0.7753374543;\N; 1988; 1.0; 0.0; 919; 930; 418.3; 461.0; 466.0; 2.29; 2.29;\N; meud_cak31_fd_20020409_063600_b.fts; F:/meudon/k3/0204/mK020
 9; 2002-04-10T07:21:0.0; 2002-04-10T07:21:0.0; 2452374; 0.8056708931;\N; 1988; 1.0; 0.0; 938; 968; 418.1; 457.0; 473.0; 2.29; 2.29;\N; meud_cak31_fd_20020410_072100_b.fts; F:/meudon/k3/0204/mK020
10; 2002-04-11T14:44:0.0; 2002-04-11T14:44:0.0; 2452376; 0.1133359046;\N; 1988; 1.0; 0.0; 940; 931; 418.0; 475.0; 470.5; 2.29; 2.29;\N; meud_cak31_fd_20020411_144400_b.fts; F:/meudon/k3/0204/mK020
```

Sample of the CaIIK3_AR_Observation_Table_042002.txt file which shows the parameters used

No	Name	Format	Description	Notes
0	INDEX	Long	Primary Index	Internal use, may be used as an unique ID
1	DATE-OBS	String	Date and time of the start of the observation in UTC	e.g. 2003-10-01T17:15:32.123
2	DATE-END	String	Date and time of the end of the observation in UTC	Same format as above
3	JDINT	Long	Julian day of the observation, integer part	Internal use
4	JDFRAC	Double	Julian day of the observation, fraction part	Internal use
5	EXPTIME	Float	Exposure time (if available), in sec. and fractions of sec.	
6	CARROT	Integer	Carrington rotation	Must be calculated from DATE_OBS
7	BSCALE	Float	As extracted from the header	
8	BZERO	Float	As extracted from the header	
9	NAXIS1	Integer	First dimension of the original image (X)	
10	NAXIS2	Integer	Second dimension of the original image (Y)	
11	R_SUN	Float	Radius of the Sun, in pixels	(as extracted from the Header)
12	CENTER_X	Float	Coordinate of Sun centre in X, in pixels	(as extracted from the Header)
13	CENTER_Y	Float	Coordinate of Sun centre in Y, in pixels	(as extracted from the Header)
14	CDELT1	Float	Spatial scale of the original observation (X axis) (in arcsec)	
15	CDELT2	Float	Spatial scale of the original observation (Y axis) (in arcsec)	
16	QUALITY	TBD	Quality of the original image (in terms of processing)	Has to be defined (/N)
17	FILENAME	String	Name of the original file as in the image header	
18	FILENAME2	String	Name and path to the original file	

19	COMMENT	String	As extracted from the Header	

\N means no data available for the parameter

5.1.2. Processed Observation Table (*xxxx*_AR_Processed_*yyyymm*.txt , CaIIK3_AR_Processed_200204.txt)

```
0         1                     2                           3      4    5                            6                                            7
0; 2004-01-13 17:32:37;/CaK3/April2002/mK020401.085600.fits_sub_pro.fits; 2.28; 2.28; 671;F:/meudon/processed/CaK3/April2002/mK020401.085600.fits_sub_pro.fits; F:/meudon/k3/0204/mK020401.085600.fits
1; 2004-01-13 17:32:40;/CaK3/April2002/mK020402.070900.fits_sub_pro.fits; 2.28; 2.28;1048;F:/meudon/processed/CaK3/April2002/mK020402.070900.fits_sub_pro.fits; F:/meudon/k3/0204/mK020402.070900.fits
2; 2004-01-13 17:32:43;/CaK3/April2002/mK020403.085100.fits_sub_pro.fits; 2.28; 2.28; 426;F:/meudon/processed/CaK3/April2002/mK020403.085100.fits_sub_pro.fits; F:/meudon/k3/0204/mK020403.085100.fits
3; 2004-01-13 17:32:46;/CaK3/April2002/mK020404.073000.fits_sub_pro.fits; 2.28; 2.28;1053;F:/meudon/processed/CaK3/April2002/mK020404.073000.fits_sub_pro.fits; F:/meudon/k3/0204/mK020404.073000.fits
4; 2004-01-13 17:32:49;/CaK3/April2002/mK020405.081200.fits_sub_pro.fits; 2.28; 2.28; 760;F:/meudon/processed/CaK3/April2002/mK020405.081200.fits_sub_pro.fits; F:/meudon/k3/0204/mK020405.081200.fits
5; 2004-01-13 17:32:52;/CaK3/April2002/mK020406.071300.fits_sub_pro.fits; 2.28; 2.28; 630;F:/meudon/processed/CaK3/April2002/mK020406.071300.fits_sub_pro.fits; F:/meudon/k3/0204/mK020406.071300.fits
6; 2004-01-13 17:32:54;/CaK3/April2002/mK020407.082400.fits_sub_pro.fits; 2.28; 2.28; 803;F:/meudon/processed/CaK3/April2002/mK020407.082400.fits_sub_pro.fits; F:/meudon/k3/0204/mK020407.082400.fits
7; 2004-01-13 17:32:57;/CaK3/April2002/mK020408.071000.fits_sub_pro.fits; 2.28; 2.28; 589;F:/meudon/processed/CaK3/April2002/mK020408.071000.fits_sub_pro.fits; F:/meudon/k3/0204/mK020408.071000.fits
8; 2004-01-13 17:33:00;/CaK3/April2002/mK020409.063600.fits_sub_pro.fits; 2.28; 2.28; 724;F:/meudon/processed/CaK3/April2002/mK020409.063600.fits_sub_pro.fits; F:/meudon/k3/0204/mK020409.063600.fits
9; 2004-01-13 17:33:59;/CaK3/April2002/mK020410.072100.fits_sub_pro.fits; 2.28; 2.28;1029;F:/meudon/processed/CaK3/April2002/mK020410.072100.fits_sub_pro.fits; F:/meudon/k3/0204/mK020410.072100.fits
```

Sample of the CaIIK3 CaIIK3_AR_Processed_042002.txt file shows the used parameters

No	Name	Format	Description	Notes
0	INDEX	Long	Primary Index	Internal use, may be used as an unique ID
1	RUN_DATE	String	Date where the PP code was run	
2	LOC_FILE	String	Name of the pre-processed file, including the path from the local organization	
3	CDELT1	Float	Spatial scale of the pre-processed observation (X axis) (in arcsec)	Calculated based on standardisation parameters
4	CDELT2	Float	Spatial scale of the pre-processed observation (Y axis) (in arcsec)	
5	QSUN_INT	Float	Quiet Sun value estimated after pre-processing	
6	FILENAME2	String	Name of the pre-processed file, including the full path from the local organization	
7	FILENAME2	String	Name and path to the original file	As 18 in the previous table, used to link the db tables

5.1.3. Detected Active Regions description (xxxx_AR_yyyymm.txt, CaIIK3_AR_200204.txt)

```
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
 257.1401;-197.7122;-18.1097; 345.5906; 1624; 4.84173e+011; 1.1712;  28.5711;-426.2819; 483.4234;  28.5715; 524; 325; 723; 524; 848; 743; 786;ChainCode; 613; 394; 231.4532;-268.3845; 335;F:/meu
-643.4218;-145.1413;-13.4500; 285.9186; 4458; 1.72333e+012; 1.2213;-871.9913;-373.7107;-417.1385;  81.1426; 130; 348; 329; 547; 882; 759; 819;ChainCode; 228; 388;-647.3421;-282.9856; 679;F:/meu
-753.1348; -44.5710; -6.6993; 277.3311;  583; 2.58488e+011; 1.2345;-810.2779;-101.7134;-698.2783;  10.2867; 157; 467; 206; 516; 880; 783; 828;ChainCode; 187; 473;-741.9834; -87.6723; 162;F:/meu
-190.8551; -21.7141; -7.6915; 317.7765; 1366; 3.83592e+011; 1.1823;-419.4245;-250.2839;  35.4282; 204.5694; 328; 402; 527; 601; 845; 744; 793;ChainCode; 412; 476;-227.1276; -81.7823; 239;F:/meu
-526.8516; 106.2846;  0.8682; 296.1515; 2403; 7.82383e+011; 1.2189;-755.4217;-122.2841;-300.5687; 332.5683; 181; 458; 380; 657; 875; 763; 817;ChainCode; 253; 530;-590.9844;  42.5571; 389;F:/meu
-401.1386; 284.5684; 11.2737; 304.1850; 2873; 9.00483e+011; 1.1926;-629.7086;  55.9997;-174.8555; 510.8526; 236; 536; 435; 735; 862; 745; 800;ChainCode; 312; 608;-455.6556; 220.9012; 459;F:/meu
-181.7124; 289.1398; 11.0435; 318.2253; 3117; 8.94565e+011; 1.1857;-410.2813;  60.5712;  44.5716; 515.4238; 332; 538; 531; 737; 854; 751; 795;ChainCode; 462; 604;-113.1254; 211.6013; 430;F:/meu
 679.9928; 343.9963; 16.5875; 376.7711;  795; 3.51746e+011; 1.1868; 451.4242; 115.4276; 906.2768; 570.2802; 709; 562; 908; 761; 862; 742; 796;ChainCode; 819; 645; 702.1649; 305.9878; 213;F:/meu
 503.9947; 412.5670; 19.9803; 363.1241; 1113; 3.95900e+011; 1.1683; 275.4268; 183.9983; 730.2783; 638.8504; 632; 592; 831; 791; 847; 730; 784;ChainCode; 741; 652; 524.8456; 321.2835; 247;F:/meu
 444.4403;-209.0812;-18.2219; 346.1343; 2457; 8.10164e+011; 1.1426; 215.9367;-437.5857; 670.6599;  17.1383; 606; 320; 805; 519;1269;1132;1197;ChainCode; 736; 379; 512.7867;-302.9889; 410;F:/meu
-435.3001;-220.5064;-18.9473; 288.5526; 4654; 1.51143e+012; 1.1167;-663.8046;-449.0104;-209.0811;   5.7134; 221; 315; 420; 514;1272;1090;1170;ChainCode; 313; 401;-453.1222;-252.8764; 676;F:/meu
-478.7159;-124.5347;-13.0190; 286.4245; 4053; 1.31578e+012; 1.1259;-707.2206;-353.0396;-252.4972; 101.6846; 202; 357; 401; 556;1272;1107;1179;ChainCode; 313; 402;-453.2235;-250.9529; 603;F:/meu
 602.1080;-161.0953;-14.6098; 357.3270;  477; 1.72983e+011; 1.1414; 544.9827;-218.2214; 656.9491;-106.2548; 750; 416; 799; 465;1260;1153;1196;ChainCode; 778; 430; 608.3426;-186.3462; 125;F:/meu
-618.1033; -19.4228; -6.1172; 276.8858;  945; 3.36594e+011; 1.1106;-846.6074;-247.9275;-391.8843; 206.7966; 141; 403; 340; 602;1251;1092;1163;ChainCode; 251; 482;-595.7634; -67.2351; 242;F:/meu
 199.9410;   7.9976; -5.8638; 329.1162;  555; 1.55789e+011; 1.1491; 142.8154; -49.1284; 254.7821;  62.8399; 574; 490; 623; 539;1256;1158;1204;ChainCode; 603; 501; 209.4729; -23.4529; 135;F:/meu
-325.6182; 122.2496;  1.1893; 297.3352; 2655; 7.73214e+011; 1.1367;-554.1228;-106.2546; -99.3994; 348.4699; 269; 465; 468; 664;1263;1132;1191;ChainCode; 348; 541;-373.9278;  67.5496; 388;F:/meu
   5.7126; 295.9127; 11.3961; 317.4295; 7208; 2.05221e+012; 1.1403;-222.7911;  67.4093; 231.9327; 522.1323; 414; 541; 613; 740;1269;1141;1195;ChainCode; 546; 601;  78.3856; 204.2225; 966;F:/meu
-197.6560; 298.1977; 11.6885; 304.9958; 8381; 2.38807e+012; 1.1348;-654.6649;-158.8108; 257.0673; 752.9214; 225; 442; 624; 841;1269;1129;1188;ChainCode; 595; 588; 190.7634; 174.7834;1110;F:/meu
```

```
24 25 26
/processed/CaK3/April2002/mK020401.085600.fits_sub_pro.fits;04465456566567665544444544443357676654431245454454577677655666544444443323322111010222444444356566566665543346665544436667770770010107
/processed/CaK3/April2002/mK020401.085600.fits_sub_pro.fits;04444445546655324444555655532444444443677667555544560075665566653433232222123233566776655565707766666667666566544566655665700077676767
/processed/CaK3/April2002/mK020401.085600.fits_sub_pro.fits;06666554333444545654545555007600121010210000017766766654444565544434556547701070070000761076771000111017766666122121122222223122212223333
/processed/CaK3/April2002/mK020401.085600.fits_sub_pro.fits;04666543321456656656556566545444332111022222232436766565444544443444556567776666766666556565655344666656710776770070077666665554544670100
/processed/CaK3/April2002/mK020401.085600.fits_sub_pro.fits;04665355650777766544443322434344457654433434332465654334656565545445433233234656556654545465444434544432222232454454677766607007766
/processed/CaK3/April2002/mK020401.085600.fits_sub_pro.fits;06544454544355554455455555443355466765654444444344344444443554665666653360754444656556665343334334467767666666565456766666676077676774
/processed/CaK3/April2002/mK020401.085600.fits_sub_pro.fits;06666760070770777666554444544444533222222066545454565443232454544345454576567676655676555570711707007001022321212322100766667660707766
/processed/CaK3/April2002/mK020401.085600.fits_sub_pro.fits;04766565432225766666575654343323445466677667676767700007002211000077676666666665770767777676666666666002222332217007767770232233444334443
/processed/CaK3/April2002/mK020401.085600.fits_sub_pro.fits;04666666676665655446667507007776666565545434333456767560717767777665566666766700000766766765772121222212111010210761221775666676677760
/processed/CaK3/April2002/mK020402.070900.fits_sub_pro.fits;04444454466767776076544666566766545566665556666666707211112100010766766555444445456656676770700000007001110767001021000776766001776070000
/processed/CaK3/April2002/mK020402.070900.fits_sub_pro.fits;04544566653232444445445433346667676667667655544434432332544656544346667676675665466700001121223212100110777767666566666766767776554434444
/processed/CaK3/April2002/mK020402.070900.fits_sub_pro.fits;04445467654332245443554443434667767657676665654543067676766656666766767766654444444443434354445665666760765666766656656554545676667566660
/processed/CaK3/April2002/mK020402.070900.fits_sub_pro.fits;06655443454543666766666707760100007700000770017070077007002122121212222325444444567607766654444333223222222232222346654443443344;-999.99
/processed/CaK3/April2002/mK020402.070900.fits_sub_pro.fits;04576676666546665665565544443334445665665767011011070021107767566071212177666777667656665655565666667076665354667677710100070777770212222
/processed/CaK3/April2002/mK020402.070900.fits_sub_pro.fits;04445656655555471777777676667666556554324354445666667600700000002322312111101000001000000070077133323223223232222554444343210222234444
/processed/CaK3/April2002/mK020402.070900.fits_sub_pro.fits;04665565665453355343210023234444455656665555544443433344443445545445554554454444546765656601000070010077707077653544465666656545454444333
/processed/CaK3/April2002/mK020402.070900.fits_sub_pro.fits;04444445556667000000007777666654544445443344444323346544355444343324323322224433443444667777654766670077070756534543454323466666675553
/processed/CaK3/April2002/mK020402.070900.fits_sub_pro.fits;04455665544444466666767676676666546677766022122122100021101077766546677607007776544434543344666766554346665544554334343434445333211100000
```

Sample of the CaIIK3 CaIIK3_AR_ 042002.txt file shows the used parameters

No	Name	Format	Description	Notes
0	GC_ARC_X	Float	Gravity centre in latitude X (arcsec)	
1	GC_ARC_Y	Float	Gravity centre in longitude Y (arcsec)	
2	GC_CAR_LAT	Float	Gravity centre in heliographic (°)	
3	GC_CAR_LON	Float	Gravity centre in heliographic (°)	
4	FEAT_NPIX	Long	Number of pixels included in the feature	
5	FEAT_AREA	Float	Area of the feature, in degrees	
6	FEAT_MEAN2QSUN	Float	Mean of the feature to QS intensity ratio	
7-10	BR_ARC	Float(4)	Bounding rectangle coordinates, in arcsec	From lower left to upper right: X_{ll}, Y_{ll},X_{ur},Y_{ur};(BR_ARC_X0,BR_ARC_Y0, BR_ARC_X1,BR_ARC_Y1)
11-14	BR_PIX	Integer(4)	Bounding rectangle coordinates in pixels	As above, (BR_PIX_X0, BR_PIX_Y0, BR_PIX_X1, BR_PIX_Y1)
15	FEAT_MAX_INT	Integer	Feature maximum value, in units of the original obs.	As in UNITS
16	FEAT_MIN_INT	Integer	Feature minimum value, in units of the original obs.	As in UNITS
17	FEAT_MEAN_INT	Float	Feature mean intensity value, in units of the original obs.	As in UNITS
18	ENC_MET	String	Encoding method	e.g. raster, chain code, None… TBC
19	CC_PIX_X	Integer	Coding 1st position in pixels, X axis	
20	CC_PIX_Y	Integer	Coding 1st position in pixels, Y axis	
21	CC_ARC_X	Integer	Coding 1st position in arcsec, X axis	
22	CC_ARC_Y	Integer	Coding 1st position in arcsec, Y axis	
23	CCODE_LNTH	Integer	Number of pixels included in the chain code	
24	FILENAME2	String	Name of the pre-processed file, including the full path from the local organization	As 6 in the previous table, used to link the db tables
25	CHAIN_CODE	String	As described above	
26	EOL	Float	-999.99, Indicating the end of one feature parameter	For db use

5.2. Filaments

For the filament database demo the following three ASCII files are produced for each month:

1. Ha_FIL_Observation_Table_*yyyymm*.txt (containing information concerning the original image)
2. Ha_FIL_Processed_*yyyymm*.txt (containing information concerning the processed image)
3. Ha_FIL_*yyyymm*.txt (containing all the parameters describing the detected filaments)

Ha : Halpha wavelength
mm : the selected month
yyyy : the selected year

5.3.1. Observation Table (Ha_FIL_Observation_Table_200204.txt)

```
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
1;2002-04-01T08:45:00.000;2002-04-01T08:45:00.000;2452365;0.86458333;\N;1988;1.00000;0.000000;16;914;917;420.67999;452.00000;447.00000;2.2800000;2.2800000;\N;meud_halph_fd_20020401_084500_b.fts;
2;2002-04-02T08:57:00.000;2002-04-02T08:57:00.000;2452366;0.87291667;\N;1988;1.00000;0.000000;16;933;965;420.56000;464.00000;480.00000;2.2800000;2.2800000;\N;meud_halph_fd_20020402_085700_b.fts;
3;2002-04-03T08:44:00.000;2002-04-03T08:44:00.000;2452367;0.86388889;\N;1988;1.00000;0.000000;16;920;911;420.44000;462.00000;467.00000;2.2800000;2.2800000;\N;meud_halph_fd_20020403_084400_b.fts;
4;2002-04-04T07:23:00.000;2002-04-04T07:23:00.000;2452368;0.80763889;\N;1988;1.00000;0.000000;16;920;923;420.32001;463.00000;468.00000;2.2800000;2.2800000;\N;meud_halph_fd_20020404_072300_b.fts;
5;2002-04-05T08:09:00.000;2002-04-05T08:09:00.000;2452369;0.83958333;\N;1988;1.00000;0.000000;16;920;936;420.19000;461.50000;478.00000;2.2800000;2.2800000;\N;meud_halph_fd_20020405_080900_b.fts;
6;2002-04-06T07:10:00.000;2002-04-06T07:10:00.000;2452370;0.79861111;\N;1988;1.00000;0.000000;16;907;904;420.07001;452.00000;450.00000;2.2800000;2.2800000;\N;meud_halph_fd_20020406_071000_b.fts;
7;2002-04-07T08:20:00.000;2002-04-07T08:20:00.000;2452371;0.84722222;\N;1988;1.00000;0.000000;16;897;936;419.95001;444.50000;468.50000;2.2800000;2.2800000;\N;meud_halph_fd_20020407_082000_b.fts;
8;2002-04-08T07:36:00.000;2002-04-08T07:36:00.000;2452372;0.81666667;\N;1988;1.00000;0.000000;16;928;942;419.82999;464.50000;470.00000;2.2800000;2.2800000;\N;meud_halph_fd_20020408_073600_b.fts;
9;2002-04-09T07:41:00.000;2002-04-09T07:41:00.000;2452373;0.82013889;\N;1988;1.00000;0.000000;16;919;930;419.70999;444.00000;471.00000;2.2800000;2.2800000;\N;meud_halph_fd_20020409_074100_b.fts;
```

```
20 21 22 23
;/data2/fuller/FITS/Ha/2002/mh020401.084500.fits.Z;2002-04-01T08:45:00.000;2002-04-01T08:45:00.000;= 'Y axis is the North/South axis of the Sun';
;/data2/fuller/FITS/Ha/2002/mh020402.085700.fits.Z;2002-04-02T08:57:00.000;2002-04-02T08:57:00.000;= 'Y axis is the North/South axis of the Sun';
;/data2/fuller/FITS/Ha/2002/mh020403.084400.fits.Z;2002-04-03T08:44:00.000;2002-04-03T08:44:00.000;= 'Y axis is the North/South axis of the Sun';
;/data2/fuller/FITS/Ha/2002/mh020404.072300.fits.Z;2002-04-04T07:23:00.000;2002-04-04T07:23:00.000;= 'Y axis is the North/South axis of the Sun';
;/data2/fuller/FITS/Ha/2002/mh020405.080900.fits.Z;2002-04-05T08:09:00.000;2002-04-05T08:09:00.000;= 'Y axis is the North/South axis of the Sun';
;/data2/fuller/FITS/Ha/2002/mh020406.071000.fits.Z;2002-04-06T07:10:00.000;2002-04-06T07:10:00.000;= 'Y axis is the North/South axis of the Sun';
;/data2/fuller/FITS/Ha/2002/mh020407.082000.fits.Z;2002-04-07T08:20:00.000;2002-04-07T08:20:00.000;= 'Y axis is the North/South axis of the Sun';
;/data2/fuller/FITS/Ha/2002/mh020408.073600.fits.Z;2002-04-08T07:36:00.000;2002-04-08T07:36:00.000;= 'Y axis is the North/South axis of the Sun';
;/data2/fuller/FITS/Ha/2002/mh020409.074100.fits.Z;2002-04-09T07:41:00.000;2002-04-09T07:41:00.000;= 'Y axis is the North/South axis of the Sun';
```

Sample of the Ha_FIL_Observation_Table_200204.txt file

No	Name	Format	Format	Description
1	INDEX	Long	Long	Primary Index
2	DATE-OBS	String	String	Date and time of the start of the observation in UTC
3	DATE-END	String	String	Date and time of the end of the observation in UTC
4	JDINT	Long	Long	Julian day of the observation, integer part
5	JDFRAC	Double	Double	Julian day of the observation, fraction part
6	EXPTIME	Float	Float	Exposure time
7	CARROT	Integer	Integer	Carrington rotation
8	BSCALE	Float	Float	
9	BZERO	Float	Float	
10	BITPIX	Integer	Integer	Coding of the original image
11	NAXIS1	Integer	Integer	First dimension of the original image (X)
12	NAXIS2	Integer	Integer	Second dimension of the original image (Y)
13	R_SUN	Float	Float	Radius of the Sun, in pixels
14	CENTER_X	Float	Float	Coordinate of Sun centre in X, in pixels
15	CENTER_Y	Float	Float	Coordinate of Sun centre in Y, in pixels
16	CDELT1	Float	Float	Spatial scale of the original observation (X axis)
17	CDELT2	Float	Float	Spatial scale of the original observation (Y axis)
18	QUALITY	TBD	TBD	Quality of the original image (in terms of processing)
19	FILENAME	String	String	Name of the original file
20	LOCAL_FILENAME	String	String	Name and path to the original file
21	DATE-OBS-STRING	String	String	Date and time of the start of the observation in UTC
22	DATE-END-STRING	String	String	Date and time of the end of the observation in UTC
23	COMMENT	String	String	

\N means no data available for the parameter

5.3.2. Processed Observation Table (Ha_FIL_Processed_200204.txt)

```
1         2                   3                               4         5         6         7                                          8
1;2003-02-26 12:50:25;/Ha/2002/PROCESSED/mh020401.084500_subtract_processed.fits;2.2836900;2.2836900;1050.00;/data2/fuller/FITS/Ha/2002/mh020401.084500.fits.Z;/data2/fuller/FITS/Ha/2002/PROCESSED/mh020401.084500_subtract_processed.fits;
2;2003-02-26 12:51:02;/Ha/2002/PROCESSED/mh020402.085700_subtract_processed.fits;2.2830400;2.2830400;1541.00;/data2/fuller/FITS/Ha/2002/mh020402.085700.fits.Z;/data2/fuller/FITS/Ha/2002/PROCESSED/mh020402.085700_subtract_processed.fits;
3;2003-02-26 12:51:38;/Ha/2002/PROCESSED/mh020403.084400_subtract_processed.fits;2.2823900;2.2823900;1879.00;/data2/fuller/FITS/Ha/2002/mh020403.084400.fits.Z;/data2/fuller/FITS/Ha/2002/PROCESSED/mh020403.084400_subtract_processed.fits;
4;2003-02-26 12:52:13;/Ha/2002/PROCESSED/mh020404.072300_subtract_processed.fits;2.2817400;2.2817400;2122.00;/data2/fuller/FITS/Ha/2002/mh020404.072300.fits.Z;/data2/fuller/FITS/Ha/2002/PROCESSED/mh020404.072300_subtract_processed.fits;
5;2003-02-26 12:52:50;/Ha/2002/PROCESSED/mh020405.080900_subtract_processed.fits;2.2810300;2.2810300;1874.00;/data2/fuller/FITS/Ha/2002/mh020405.080900.fits.Z;/data2/fuller/FITS/Ha/2002/PROCESSED/mh020405.080900_subtract_processed.fits;
6;2003-02-26 12:53:24;/Ha/2002/PROCESSED/mh020406.071000_subtract_processed.fits;2.2803800;2.2803800;1223.00;/data2/fuller/FITS/Ha/2002/mh020406.071000.fits.Z;/data2/fuller/FITS/Ha/2002/PROCESSED/mh020406.071000_subtract_processed.fits;
7;2003-02-26 12:53:59;/Ha/2002/PROCESSED/mh020407.082000_subtract_processed.fits;2.2797300;2.2797300;1429.00;/data2/fuller/FITS/Ha/2002/mh020407.082000.fits.Z;/data2/fuller/FITS/Ha/2002/PROCESSED/mh020407.082000_subtract_processed.fits;
8;2003-02-26 12:54:34;/Ha/2002/PROCESSED/mh020408.073600_subtract_processed.fits;2.2790800;2.2790800;1567.00;/data2/fuller/FITS/Ha/2002/mh020408.073600.fits.Z;/data2/fuller/FITS/Ha/2002/PROCESSED/mh020408.073600_subtract_processed.fits;
9;2003-02-26 12:55:11;/Ha/2002/PROCESSED/mh020409.074100_subtract_processed.fits;2.2784300;2.2784300;1721.00;/data2/fuller/FITS/Ha/2002/mh020409.074100.fits.Z;/data2/fuller/FITS/Ha/2002/PROCESSED/mh020409.074100_subtract_processed.fits;
```

Sample of the Ha_FIL_Processed_200204.txt file

No	Name	Format	Description	Notes
1	INDEX	Long	Primary Index	Internal use
2	RUN_DATE	String	Date when the PP code was run	
3	LOC_FILE	String	Name of the pre-processed file, including the path from the local organization	
4	CDELT1	Float	Spatial scale of the pre-processed observation (X axis)	Calculated based on standardisation parameters
5	CDELT2	Float	Spatial scale of the pre-processed observation (Y axis)	
6	QSUN_INT	Float	Quiet Sun value estimated after pre-processing	
7	LOCAL_FILENAME	String	Name and path to the original file	Internal use
8	PP_LOCAL_FILENAME	String	Name of the pre-processed file, including the full path from the local organization	Internal use

5.3.3. Detected Filaments description (Ha_FIL_200204.txt)

```
1;2004-01-22T17:09:04;-67.368855;-840.42720;-67.540324;318.82624;129;15.758405;0.81109637;-87.922065;-855.24190;-44.531955;-825.55394;473;137;492;150;1122;630;851.651;CHAIN CODE;
485;136;-60.517785;-857.52559;6.9963512;-1;0.895833;-24.7859;491;144;-46.815645;-839.25608;444554566656670000000770007070700122333322333344433;51;111007007077770770;18;
;/data2/fuller/FITS/Ha/2002/PROCESSED/mh020401.084500_subtract_processed.fits;
```

Sample of the Ha_FIL_200204.txt file (one line)

No	Name	Format	Description	Notes
1	IND	Long	Observation index	Internal use
2	RUN_DATE	String	Date when the feature recognition code was run	
3	GC_ARC_X	Float	Gravity centre in arcsecs (X)	
4	GC_ARC_Y	Float	Gravity centre in arcsecs (Y)	
5	GC_CAR_LAT	Float	Gravity centre in heliographic (°)	
6	GC_CAR_LON	Float	Gravity centre in heliographic (°)	
7	FEAT_NPIX	Long	Number of pixels included in the feature	
8	FEAT_AREA	Float	Area of the feature, in square degrees	
9	FEAT_MEAN2QSUN	Float	Mean of the feature to QS intensity ratio	
10	BR_ARC_X0	Float	Bounding rectangle coordinates, in arcsec (x, lower left)	
11	BR_ARC_Y0	Float	Bounding rectangle coordinates, in arcsec (y, lower left)	
12	BR_ARC_X1	Float	Bounding rectangle coordinates, in arcsec (x, upper right)	
13	BR_ARC_Y1	Float	Bounding rectangle coordinates, in arcsec (y, upper right)	
14	BR_PIX_X0	Integer	Bounding rectangle coordinates, in pixels (x, lower left)	

15	BR_PIX_Y0	Integer	Bounding rectangle coordinates, in pixels (y, lower left)	
16	BR_PIX_X1	Integer	Bounding rectangle coordinates, in pixels (x,upper right)	
17	BR_PIX_Y1	Integer	Bounding rectangle coordinates, in pixels (y,upper right)	
18	FEAT_MAX_INT	Integer	Feature maximum value, in units of the original obs.	As in UNITS
19	FEAT_MIN_INT	Integer	Feature minimum value, in units of the original obs.	As in UNITS
20	FEAT_MEAN_INT	Float	Feature mean intensity value, in units of the original obs.	As in UNITS
21	ENC_MET	String	Encoding method	e.g. raster, chain code, None… TBC
22	CC_PIX_X	Integer	Coding 1st position in pixels, X axis	
23	CC_PIX_Y	Integer	Coding 1st position in pixels, Y axis	
24	CC_ARC_X	Float	Coding 1st position in arcsecs, X axis	
25	CC_ARC_Y	Float	Coding 1st position in arcsecs, Y axis	
26	SKE_LNTH_DEG	Float	Skeleton length in degrees	
27	CURVATURE	Float	Curvature index (from 0 to 10)	ratio btw length and distance btw end points
28	ELONG	Float	Elongation factor (-1 if not enough points)	Area/(2d)_ where d=thickness
29	ORIENTATION	Float	Global orientation of the filament (CCW from Ox axis)	
30	CC_SKE_PIX_X	Integer	Skeleton coding 1st position in pixels, X axis	
31	CC_SKE_PIX_Y	Integer	Skeleton coding 1st position in pixels, Y axis	
32	CC_SKE_ARC_X	Float	Skeleton coding 1st position in arcsecs, X axis	
33	CC_SKE_ARC_Y	Float	Skeleton coding 1st position in arcsecs, Y axis	
34	CHAIN_CODE	String	Chain code of the filament boundary	
35	CC_LNTH	Integer	Number of pixels included in the chain code	
36	CHAIN_CODE_SKE	String	Skeleton chain code	
37	CC_SKE_LNTH	Integer	Number of pixels included in the skeleton chain code	
38	PP_LOCAL_FILENAME	String	Name of the pre-processed file, including the full path from the local organization	Internal use