

FITS data:

- **main fits image data** (2d array), cropped to extend 0-360 degrees in longitude (only data from one CROT). Can be used for analysis in conjunction with header information as described below
- **fits extension 1** (extname='FULL') Uncropped image data (2d array). Longitude range (-30: 390) -- includes 30 degrees longitude data from preceding and following CROTs (used in some plot choices)
- **fits extension 2** (extname='LONG') Longitude data: array of 421 values which contain grid location of longitudes from -30 to 390 (degrees inclusive). Defines horizontal axis of 2d grid in uncropped image data.
- **fits extension 3** (extname='LAT') Latitude data: array of 181 values which contain grid location of latitudes from 0 to 180 (degrees inclusive). Defines vertical axis of 2d grid in uncropped image data.
- **fits extension 4** (extname='POL') Polarity data: 2d array of polarity (-1, 0, +1) corresponding to each point in the uncropped image data ('FULL')

Note: most images are scaled to a uniform no-resolution-lost scale. However, some cases from early in SC23 are not scaled, although they have very similar resolution to the uniform choice. This will not affect analysis since the header contains all the information necessary to do the analysis. In addition, the SC19 Kodaikanal maps are from 0-360 degrees with no extensions and not 'full' -30 to 390 degree longitude maps.

Standard FITS header variables:

cunit1:'degrees'

cunit2:'degrees'

ctype1:'Longitude'

ctype2:'Latitude'

cdelt1: (1/pixel size horizontal)

cdelt2: (1/pixel size horizontal)

crpix1: bottom left pixel horizontal position (set to 0)

crpix2: bottom left pixel vertical position (set to 0)

crval1: bottom left pixel horizontal value degrees longitude (set to 0)

crval2: bottom left pixel vertical value degrees latitude (set to -90)

naxis1: number of array points horizontal dimension (varies)

naxis2: number of array points vertical dimension (varies)

origin: fits file name

date_obs: Carrington rotation begin date

B0: Solar B angle Carrington rotation begin date

L0: Carrington longitude Carrington rotation begin date

r_sun: Distance to Sun Carrington rotation begin date

rsun: Same as r_sun -- FITS headers differ on convention for this name so using both

Additional FITS header variables from digitization:

angledeg: this is angle in degrees original was rotated

northint: this is vertical distance in original scan pixels to top edge of map from bottom of (rotated) scanned image

southint: this is vertical distance in original scan pixels to bottom edge of map from bottom of scanned image

eastint: this is horizontal distance in original scan pixels to right edge of map from left of scanned image

westint: this is horizontal distance in original scan pixels to left edge of map from left of (rotated) scanned image

scalingx: ratio of standard horizontal pixel to original scanned pixel

scalingy: ratio of standard vertical pixel to original scanned pixel

scaling: average of scalingx and scalingy

northinter_scale: vertical intercept distance for a scaled map. For most cases this will be identical to northinter, however, if not, it indicates an image that has not been scaled to the standard uniform scaling. Note that the only difference this makes to the maps is that the size of boundary lines will be slightly different for unscaled maps, since they were scaled to image pixel in Photoshop. It is a small effect, and does not affect lat-lon position of features and so should not affect analysis at all.

tm6060, tm60300, tm90180, tm12060, tm120300: average latitude position of pixels lying in the vicinity of latitude 60, longitude 60 (etc) in original grid (can be used along with others to follow to measure distortion in scan)

ts6060, ts60300, ts90180, ts12060, ts120300: standard deviation of latitude of pixels lying in the vicinity of latitude 60, longitude 60 (etc) in original grid

nm6060, nm60300, nm90180, nm12060, nm120300: average of longitude of pixels lying in the vicinity of latitude 60, longitude 60 (etc) in original grid

ns6060, ns60300, ns90180, ns12060, ns120300: standard deviation of longitude of pixels lying in the vicinity of latitude 60, longitude 60 (etc) in original grid

Additional FITS header variables from observational metadata:

car_rot: CR #### - Carrington Rotation number

current: Current Status of the map either still in progress or finalized

dates_co dates of map (DDMMMYYYY) corresponding to start (-30) and ending (390) longitudes

b_full_s: B angle at start date (usually long = -30 deg)

b_full_e: B angle at end date (usually long = 390 deg)

bc_start: Calculated B angle at the start of CAR_ROT (long = 360)

bc_end: Calculated B angle at end of CAR_ROT (long = 0)

lon_star: Carrington longitude of the map start date (-30 or 0 deg)

lon_end: Carrington longitude of map end date (360 or 390 deg)

mediasrc: media source of hand-drawn map

mapper: initials of mapper(s):

PSM – Pat S. Macintosh
RHM – Robert H. McFadden
SCW – Susan C. Wayland
SLO – Sharon L. Osborn
JEL - Janice E. Leighton
VIM – V.I. Makarov (SC19 only, see [SC19 kodaikanal maps 2020.pdf](#))
KRS – K.R. Sivaraman (SC19 only see [SC19 kodaikanal maps 2020.pdf](#))

changes_: changes made to the final image:

0-no original
1-major adjust
2- coronal hole addition (using daily He 10830 data)
3-coronal hole addition using Skylab
4-minor adjust
5-yellow used to indicate missing data (clarifying discrepancies -- see column O)
6-unchanged

datayp: data included in the map e.g. magnetic field, coronal hole (default)

instrume: contributing observatories, additional ones included in the following comments

comment1: PIL time evolution, yes (default)

comment2: CH time evolution, no (default)

comment3: PIL confidence

comment4: observables (searchable acronyms)

comment5: special features, none (default)

comment6: additional comments

map_warp: locations of possible warp(s) in map (noticeable nonuniformity in grid):

BL - bottom left,
LB - left bottom,
LT - left top,
TL - top left,
TR - top right,
RT - right top,
RB - right bottom,
BR - bottom right

complete: Completeness of coronal hole data (see documentation for full description)

0 - complete;
0.5 - missing small amount of 10830 data;
1 - significant longitude gaps in 10830 data;
2 - Skylab data substituted for 10830 data;
2.5 - same as #2 but with longitude gaps;
3 - No 10830 data, Mk2 used for polar CH only;
4 - missing all CH data

FITS extensions header variables:

fullax1: number of pixels in extended image (horizontal)

fullax2: number of pixels in extended image (vertical)