The Interface Region Imaging Spectrograph (IRIS)

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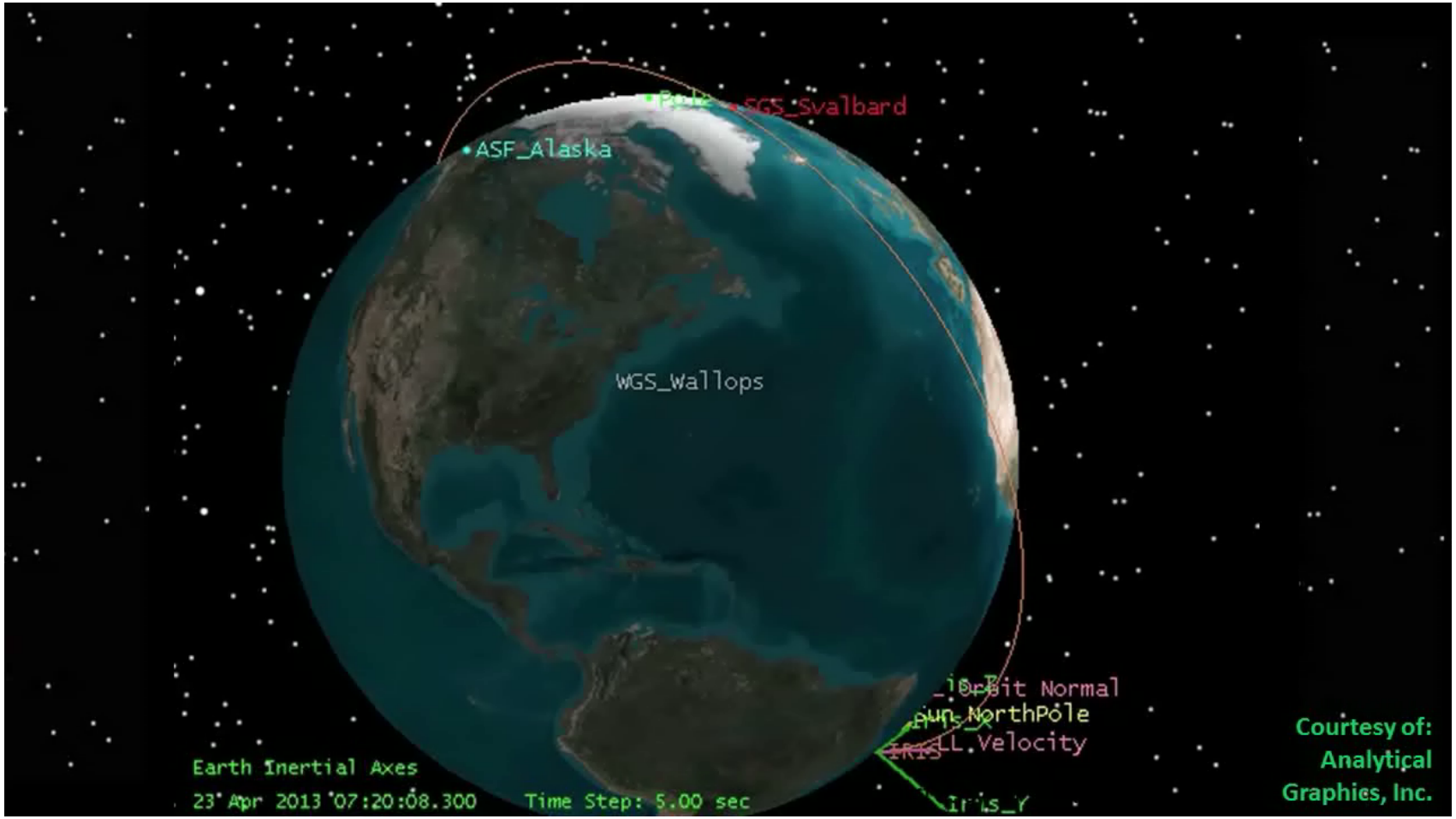
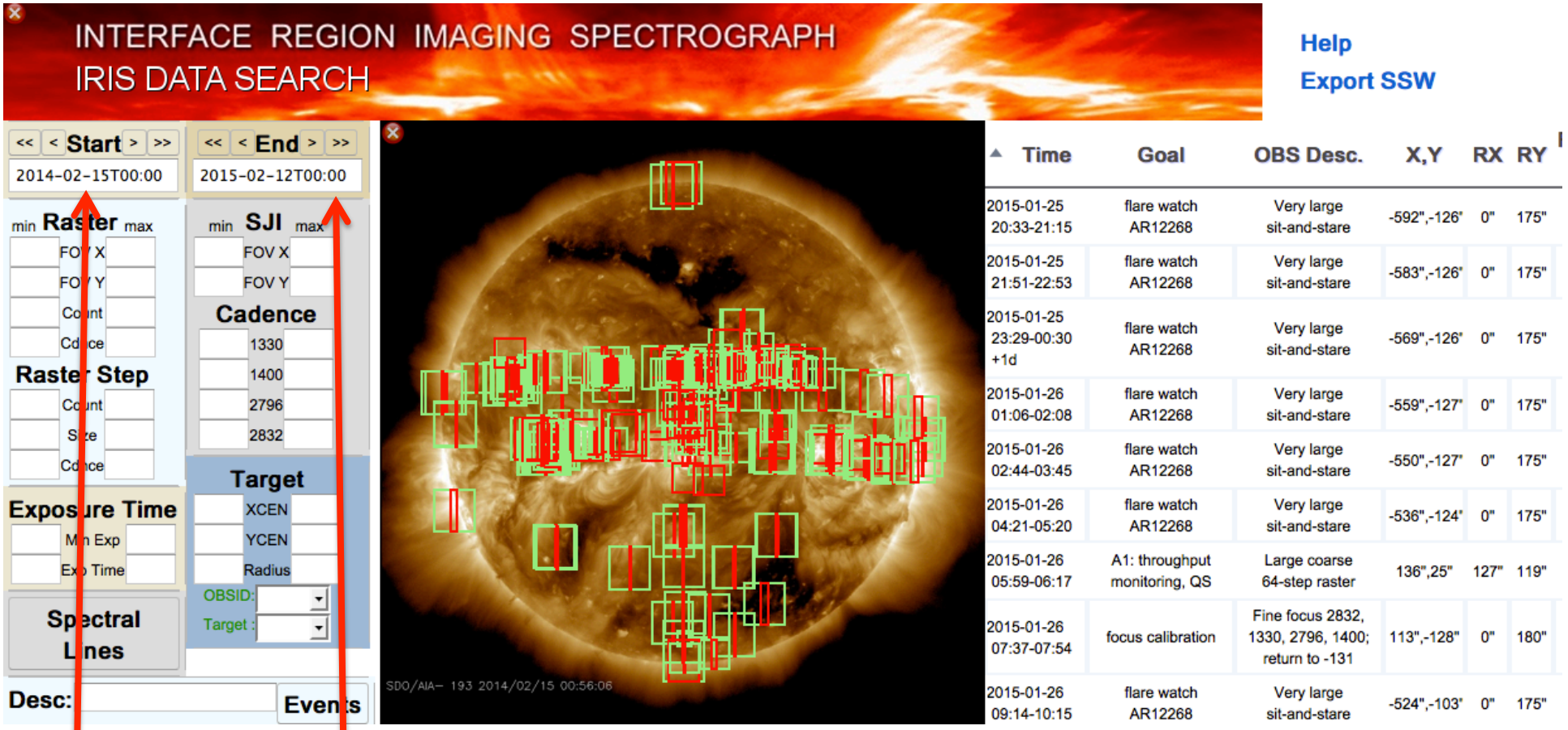
IRIS Orbit: nearly always daylight



IRIS Data: iris.lmsal.com

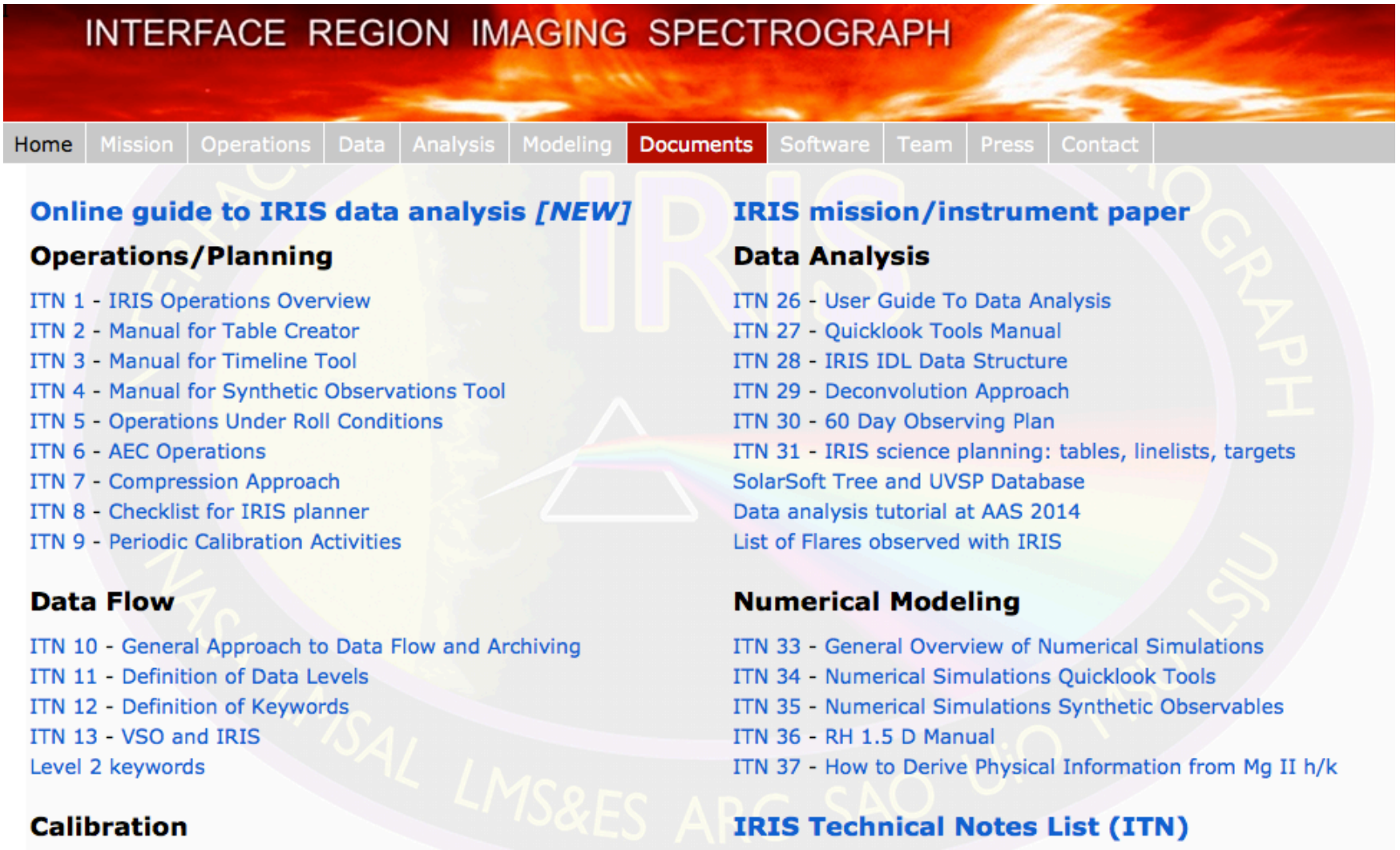


start

end

Observations found (green=FOV of slitjaws, red=FOV of raster)

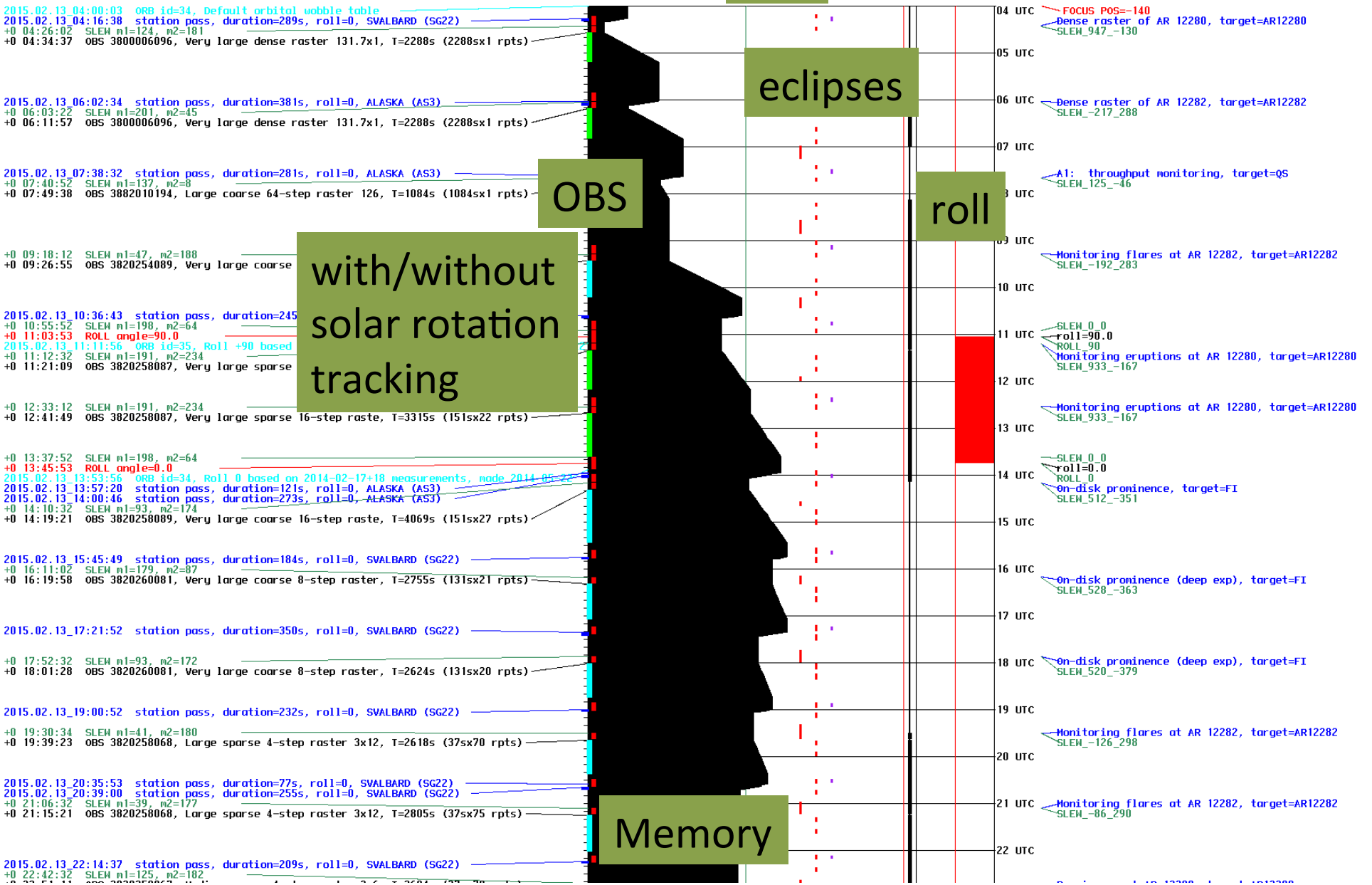
IRIS Documentation



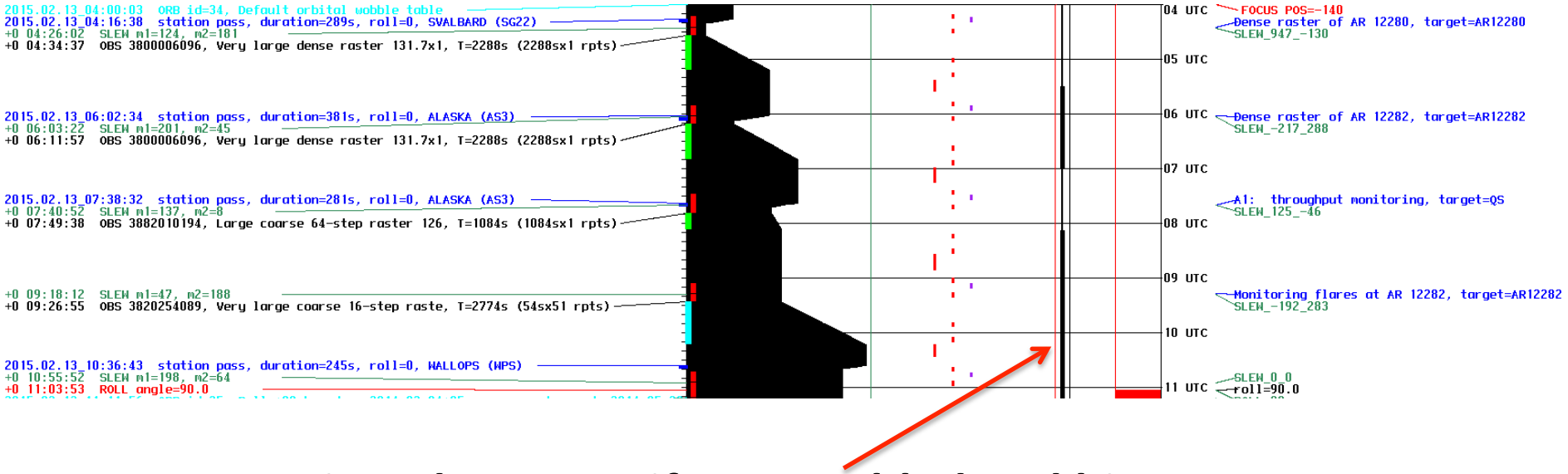
IRIS Timelines

OBSID, downlinks, …

short summary



Automatic Exposure Control (AEC)



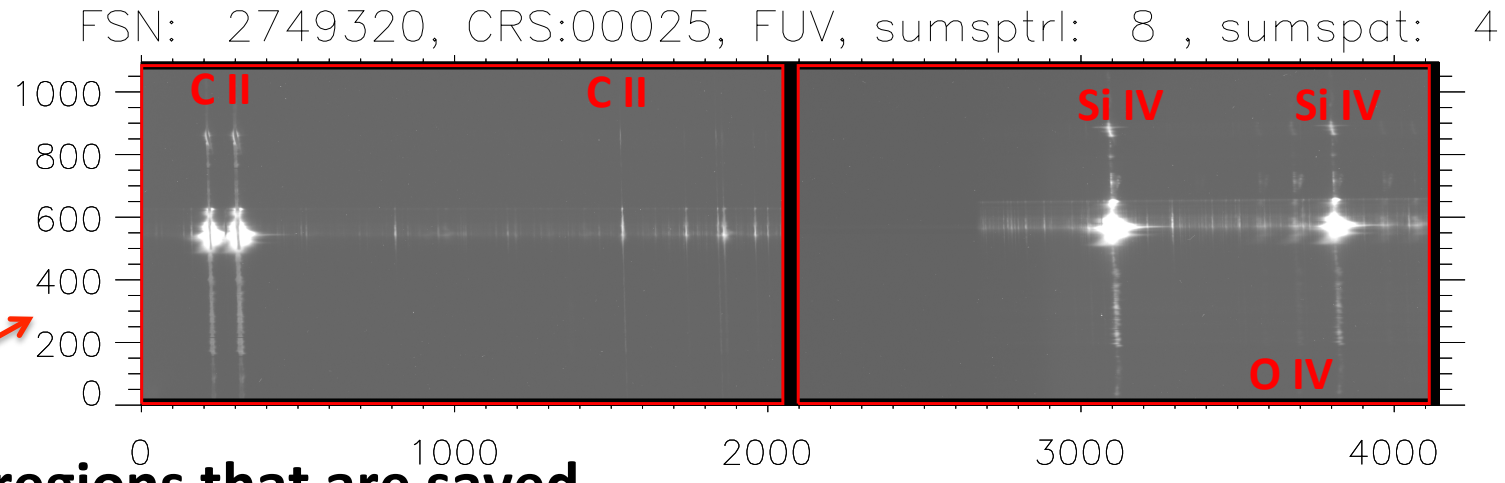
Exposure time decreases if AEC enabled and histogram has n pixels above a threshold

requires 1330 SJI for FUV spectra

requires 2796 SJI for NUV spectra

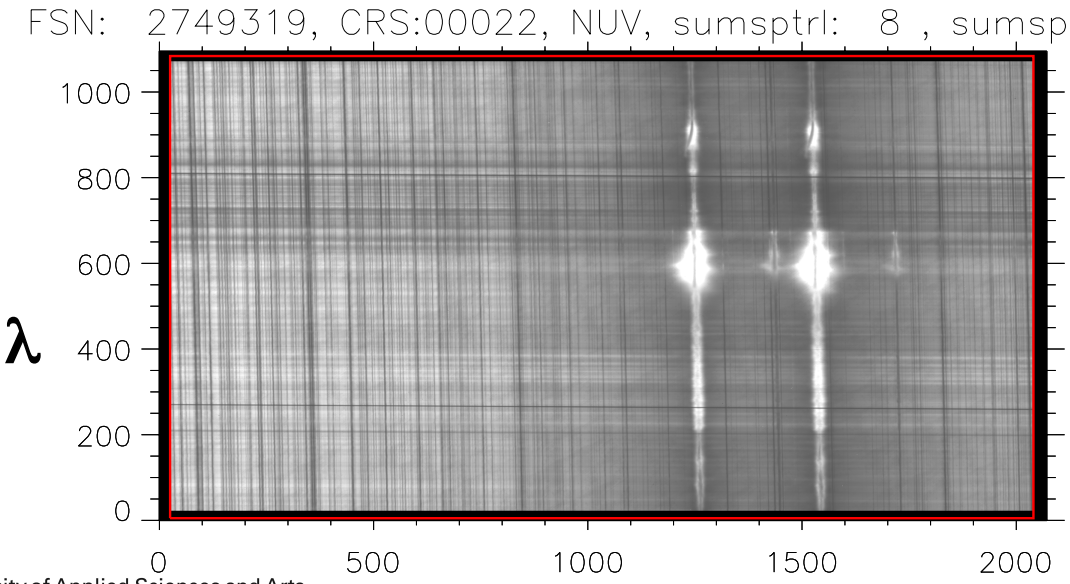
IRIS Spectral line selection: linelists

FUV



red boxes: regions that are saved

NUV
(Level 0: λ flipped!)

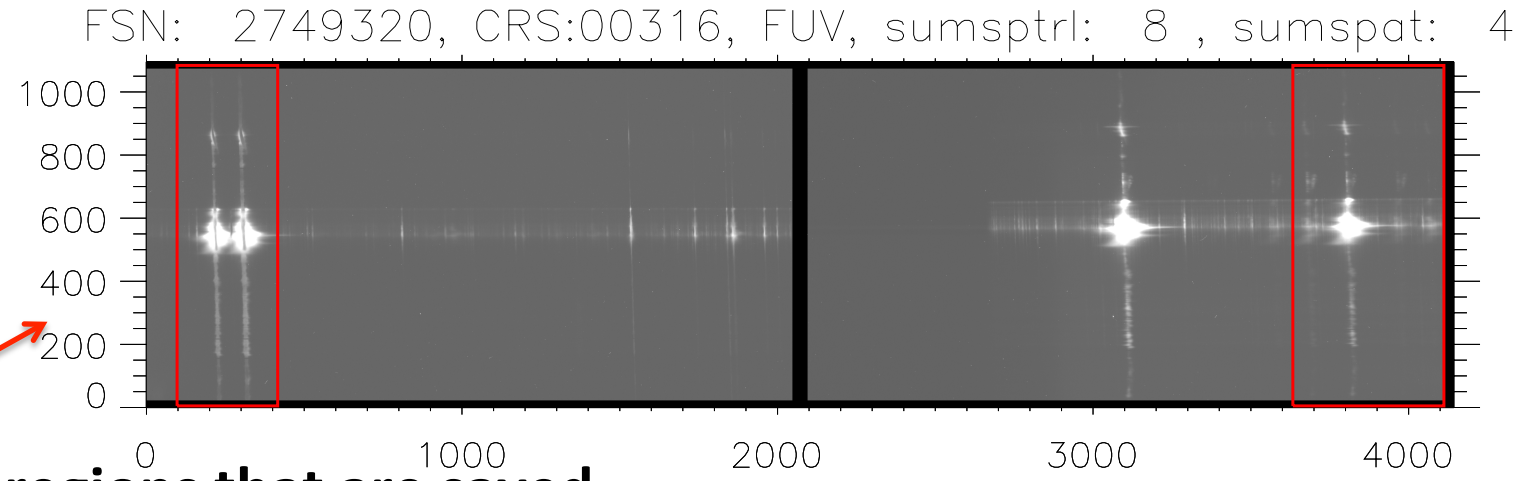


Full readout

not used often
due to telemetry

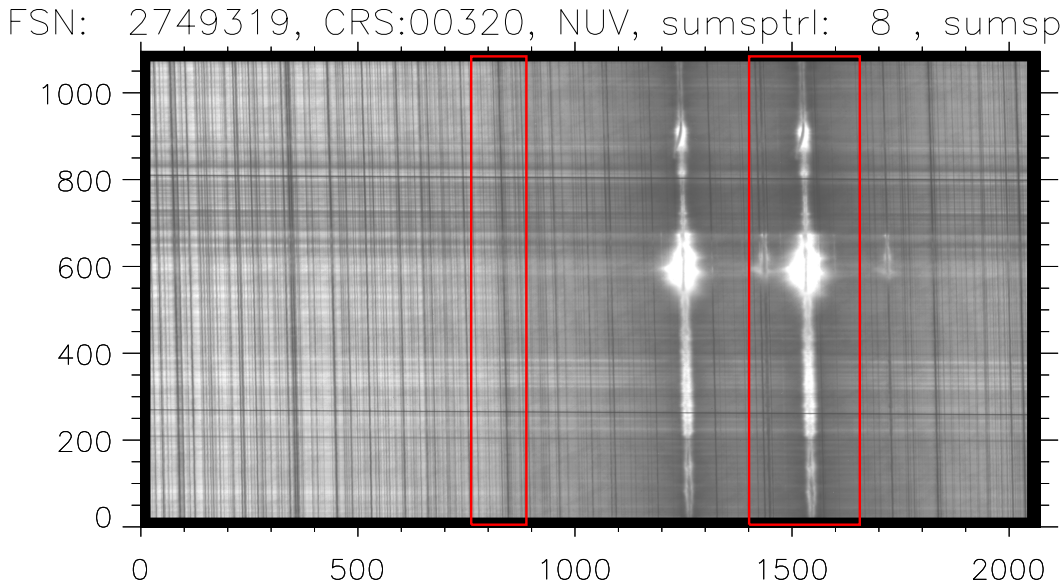
IRIS Spectral line selection: 5 linelists

FUV



red boxes: regions that are saved

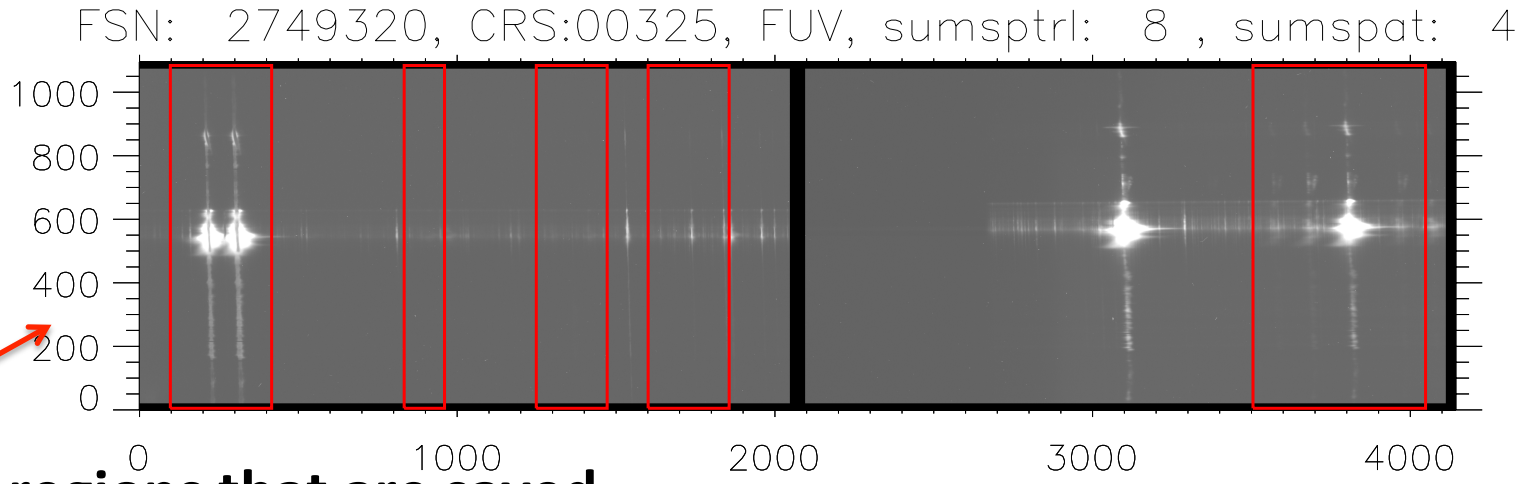
NUV



Small linelist

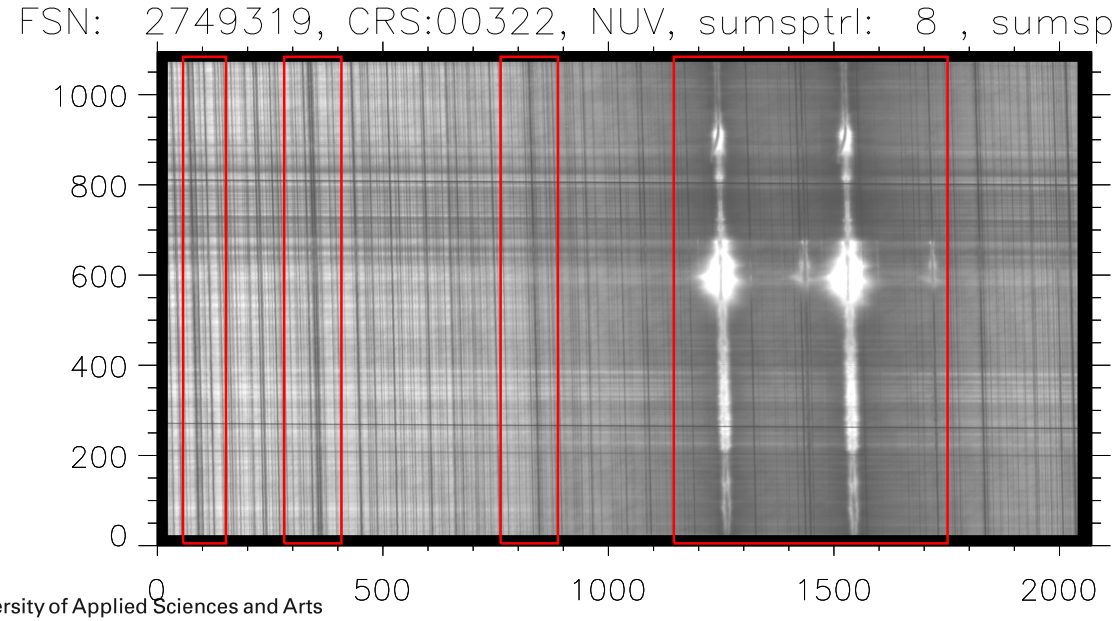
IRIS Spectral line selection: 5 linelists

FUV



red boxes: regions that are saved

NUV



Flare linelist

IRIS Level 2

- Level 1: only flipped, nearly raw data.
- Level 1.5 = level 1 + iris_prep
  i.e. dark, flat, spikes, geometry, wavelength, alignment
- Level 2 = Level 1.5, saved in a better format
  i.e. calibrated data, download as compressed fits files
- Level 3 = same as level 2, but for Crispex

- things to know:
  - no absolute radiometric calibration (to erg/s/cm^2/sr/A)
  - line ratios require dividing by the effective area (iris_get_response)
  - sometimes the orbital velocity is not corrected for (for older data)
  - one can use photospheric lines to check wavelength calibration
  - coalignment between SJI and FUV and NUV: fiducials

Absolute calibration

2.1.1. *IRIS Absolute Calibration*

We convert the measured counts per second into absolute units (erg s^{-1} cm^{-2} sr^{-1} $Å^{-1}$) by applying the pre-launch calibration developed by J. P. Wuelser and H. Tian. It converts the measured intensity I_m ([DN/s]) into absolute intensity I_{abs} by

$$I_{abs} = I_m \; x \; \frac{hc}{\lambda} \frac{1}{A_{\rm eff} \; d \; sa}. \qquad (1)$$

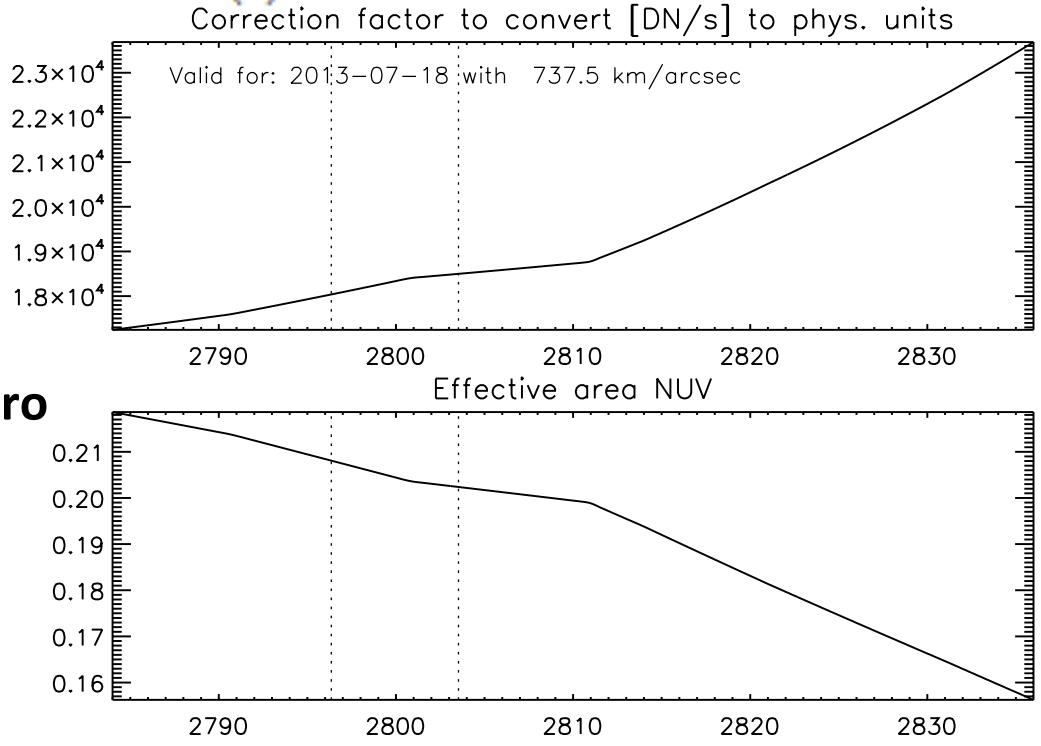
see also TN 24

DN/s

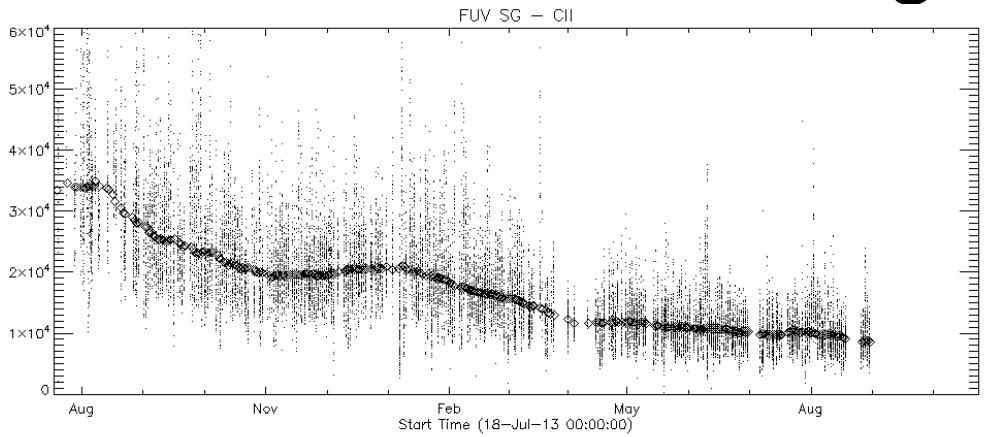
18 = photons/DN for NUV (SG and SJI).
4 = FUV SG
12 = FUV SJI

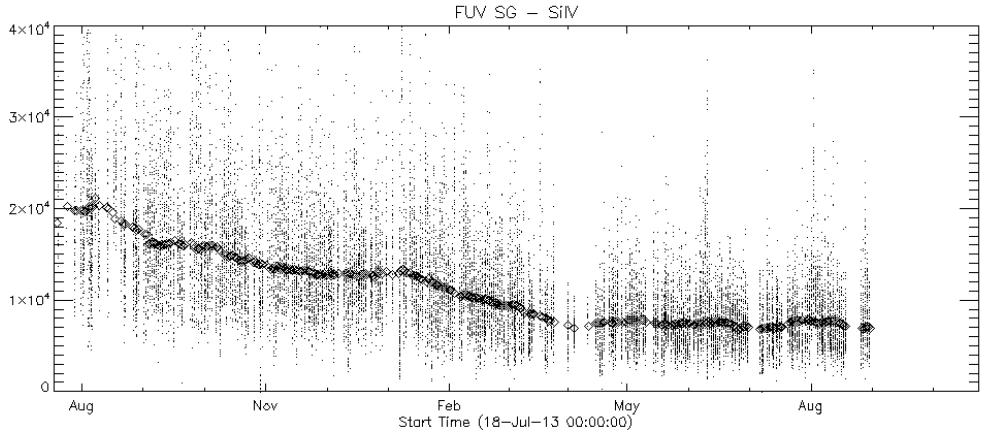
iris_get_response.pro

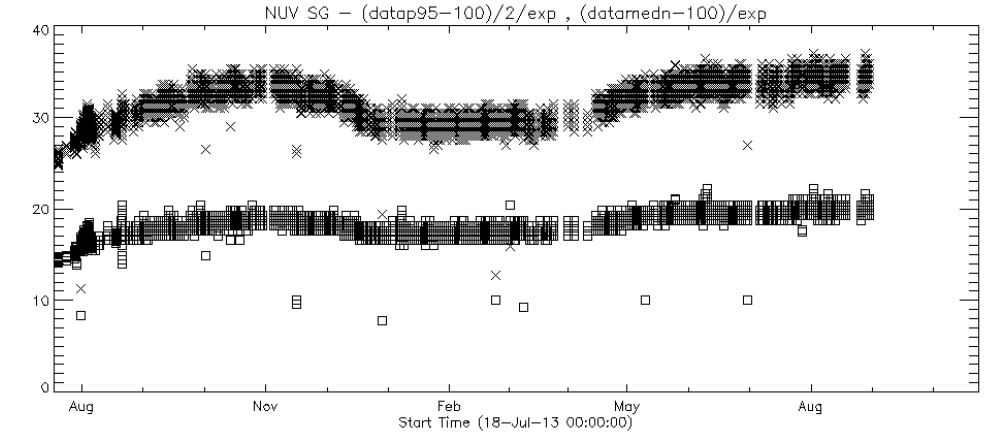
varies during the year (Earth-Sun distance)



Absolute calibration: degradation since launch







daily quiet Sun measurements to create these plots.

Decrease is significant.

NUV increased!

Annealing in late 2014 (not plotted) led to improvements in FUV.

Courtesy of JP Wuelser

Orbital velocity

spacecraft velocity and thermal effects, generally at 97-min periods

should be corrected in May 2014 pipeline. Pipeline is listed in header

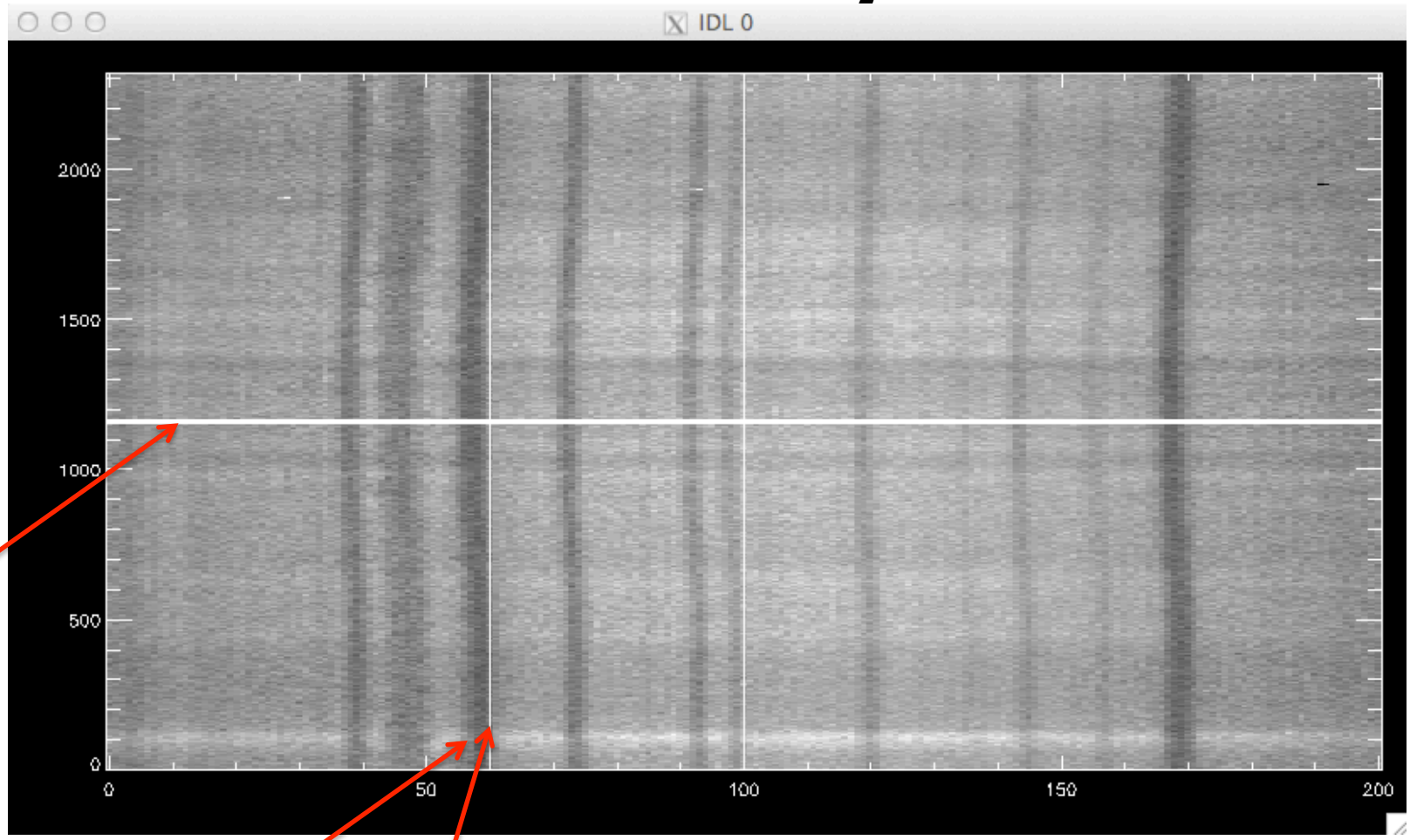
```
IDL> help,hdr,/str
** Structure <2a28a08>, 405 tags, length=4336, data length=4276, refs=1:
   SIMPLE          INT               1
   BITPIX          LONG                16
   NAXIS           LONG                 0
   EXTEND          INT               1
   DATE            STRING    '2013-11-02'
   TELESCOP        STRING    'IRIS'
   INSTRUME        STRING    'SPEC'
   DATA_LEV        DOUBLE          2.0000000
   LVL_NUM         DOUBLE          2.0000000
   VER_RF2         STRING    'L12-2013-10-30'
   DATE_RF2        STRING    '2013-11-02T04:44:57.426'
   DATA_SRC        DOUBLE          1.5000000
```

use Ni I 279.9474 nm (NUV) and O I 135.560 nm (FUV) for calibration

iris_orbitvar_corr_l2 .pro

Orbital velocity

Data from 130901

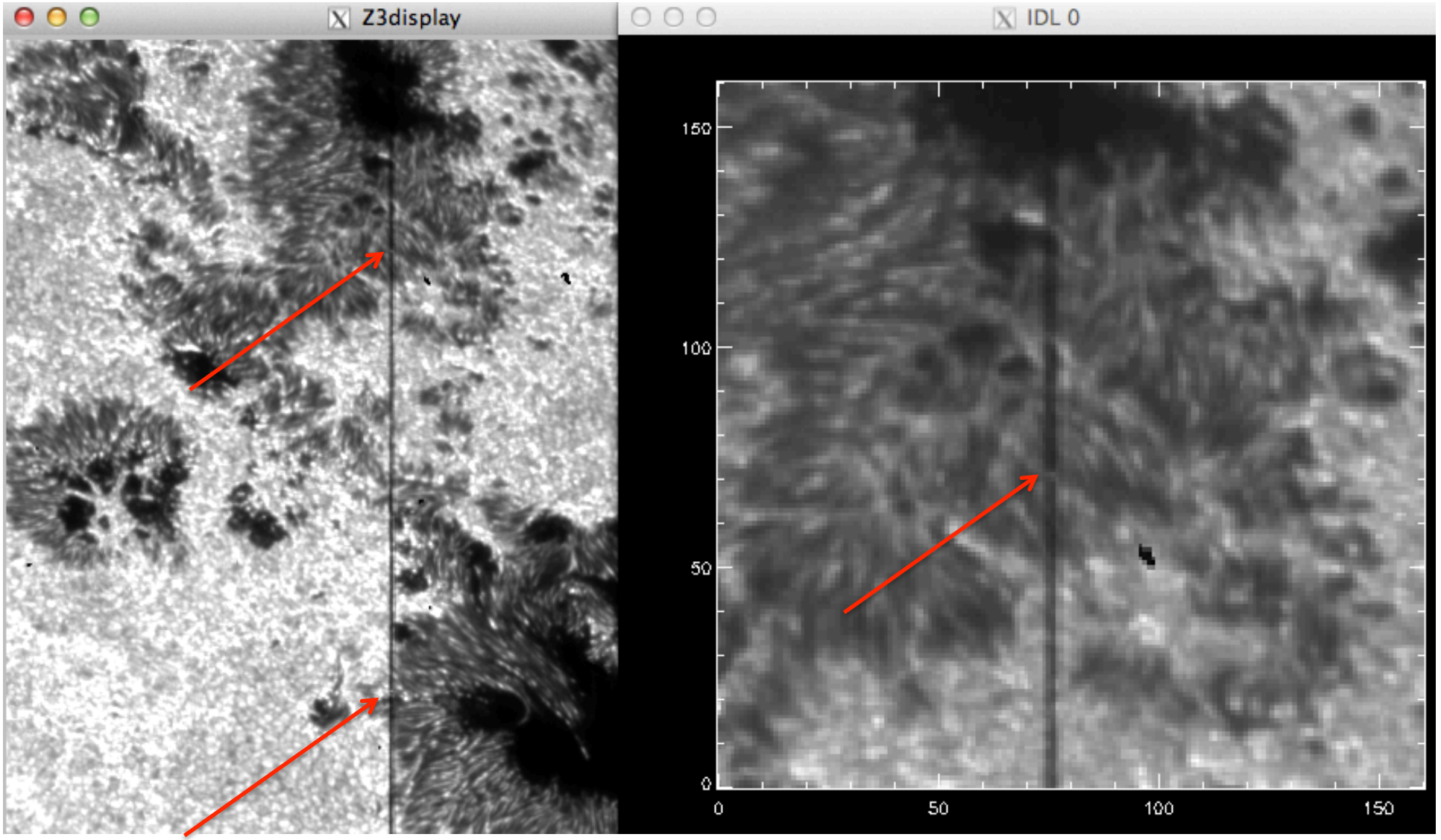


lost frames

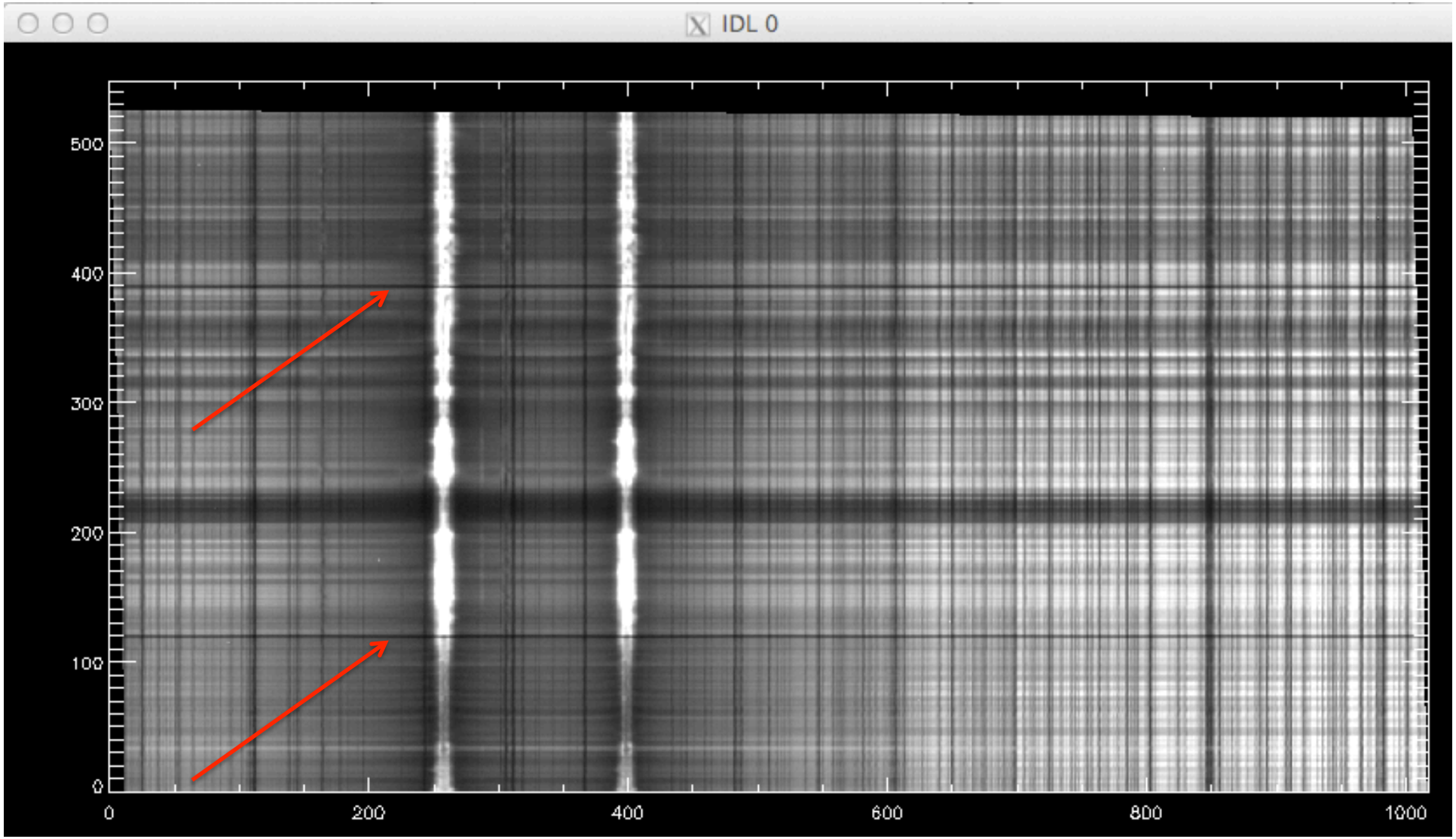
lines “curved”

white line=reference line that I drew

Co-alignment: Fiducials



Co-alignment



Horizontal black lines. Harder to see in FUV

Alignment with AIA

IRIS often has a ~0.5 deg roll compared to AIA (variable)

Sometimes the alignment is ok, sometimes it requires roll & few arcsec shift

Reading data

IDL> iris_xfiles ;Quicklook, basic Gaussian fitting

IDL> read_iris_l2,'file.fits',hdr,data,[wave='Mg']

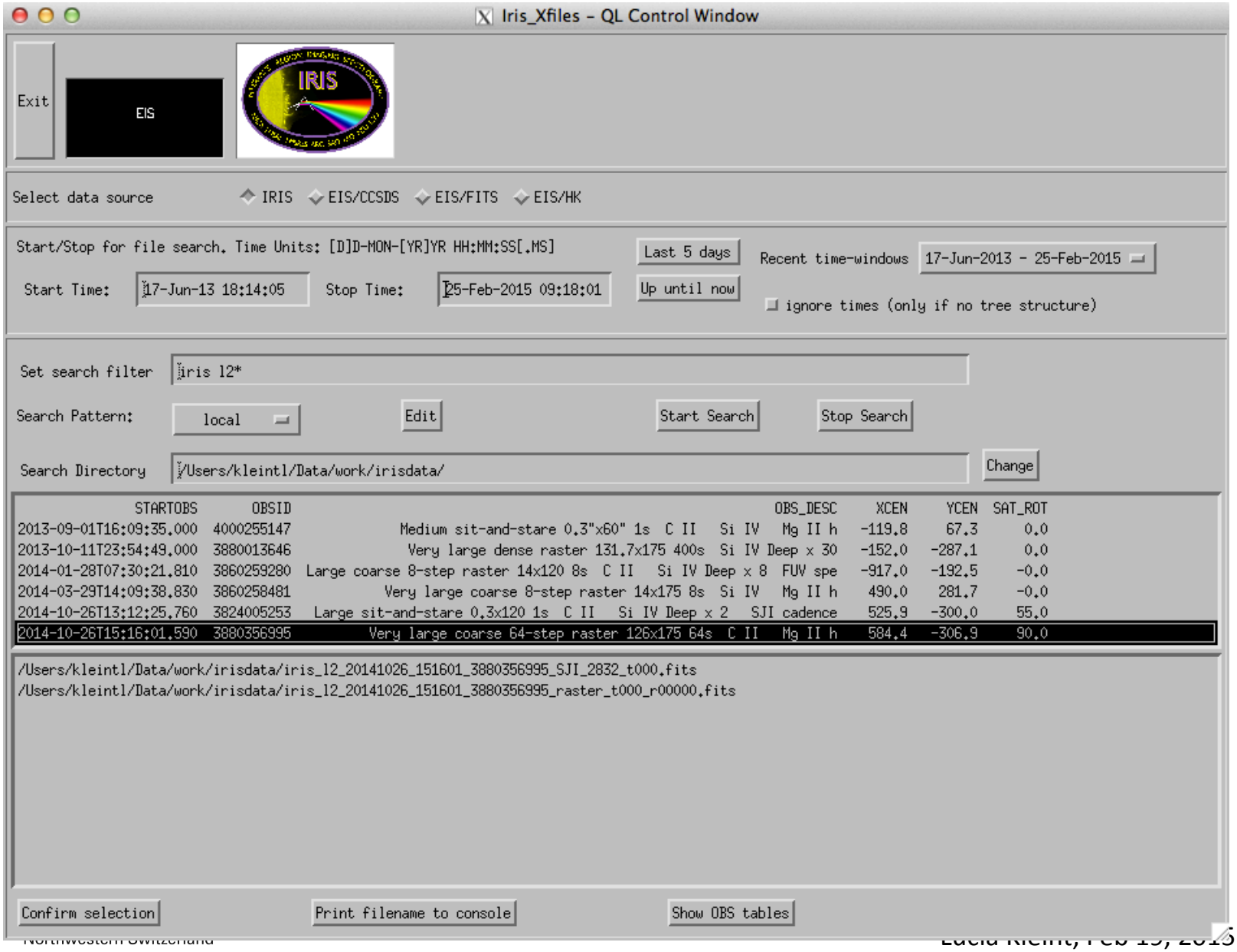
IDL-Objects -> see online documentation

Need more than 8 GB RAM in most cases (not for this example)

Upgrade solarsoft:

IDL> ssw_upgrade,/iris,/loud,/spawn[,/use_pass]

iris_xfiles (requires iris and eis in ssw)



Reading data

Example raster:

```
read_iris_l2,path+'iris_l2_20141026_151601_3880356995_SJI_2832_t000.fits',sjihdr,sjidata
read_iris_l2,path+'iris_l2_20141026_151601_3880356995_raster_t000_r00000.fits',hdr,data,wave='Si IV'
read_iris_l2,path+'iris_l2_20141026_151601_3880356995_raster_t000_r00000.fits',hdr2,data2,wave='Mg'
```

Display spectrum:

```
IDL> help,data2
DATA2           FLOAT     = Array[1018, 548, 64]
IDL> plot_image,reform(data2[*,*,50]>0)^.3,/nosq,min=0
```

scaling to ^0.3 usually gives good contrast

Step through spectral line:

```
IDL> for i=240,280 do begin plot_image,reform(data2[i,*,*]>0)^.3,/nosq,min=0 & wait,.3
```

Interpreting data

Automatic fitting for features in Mg (intensities and k and h peak positions):

```
IDL> .r -t iris_get_mg_features_lev2
     1 ;+
     2 ; NAME:
     3 ; IRIS_GET_MG_FEATURES_LEV2
     4 ;
     5 ; PURPOSE:
     6 ; Extract positions of Mg II spectral features from IRIS level 2 data.
     7 ;       Wrapper around IRIS_GET_MG_FEATURES for level2 data.
     8 ;       The algorithm is detailed in:
     9 ;       Pereira, T. M. D. , Leenarts, J., De Pontieu, B., Carlsson, M.,
    10 ;       Uitenbroek, H., 2013, ApJ, 778, 143, http://arxiv.org/abs/1310.1926
    11 ;
```

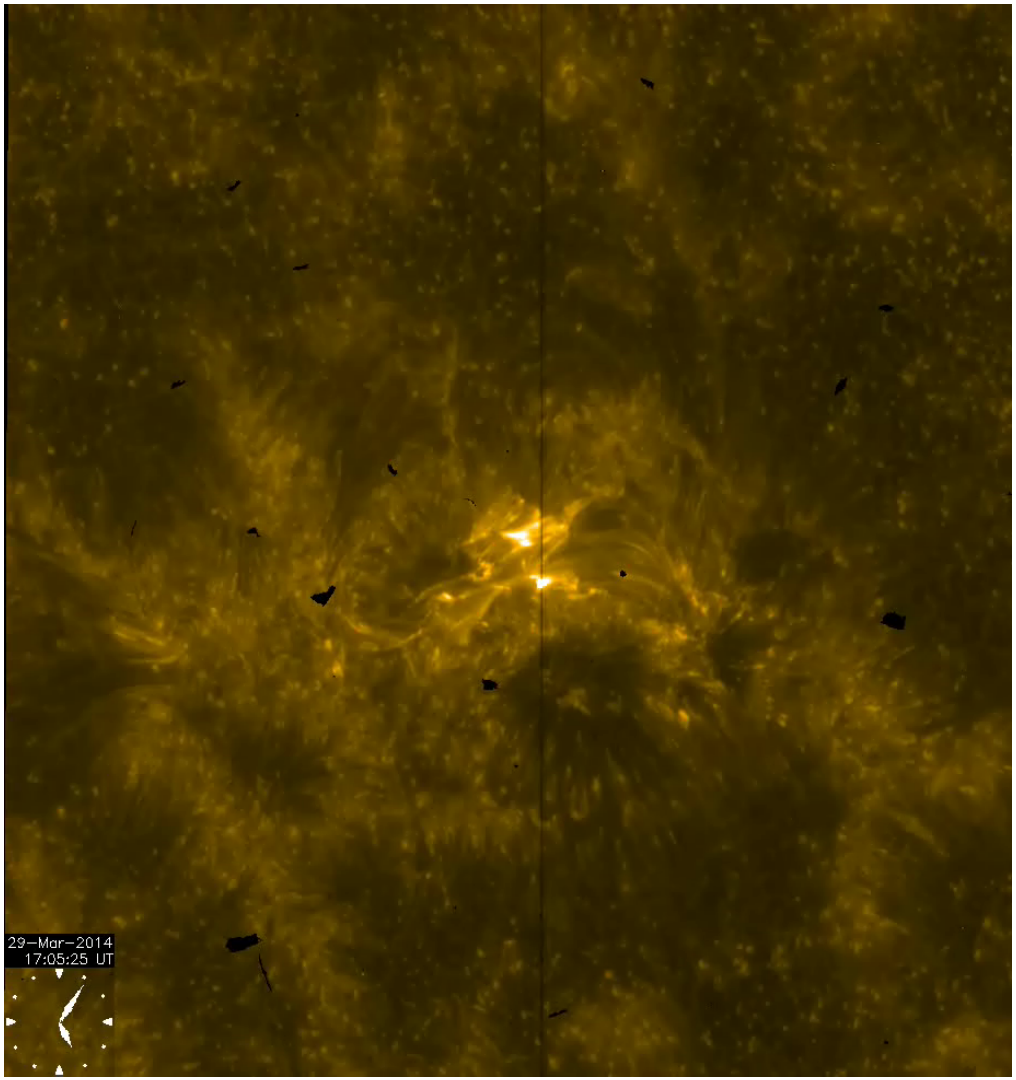
iris_get_mg_features_lev2,'filename',iwin,[-40,40], lc, rp, bp

number of Mg window (from header)

velocity range (km/s)

line center, red peak, blue peak wavelength and intensities

X1 flare – IRIS



First IRIS X-flare observation

dust on SJI visible