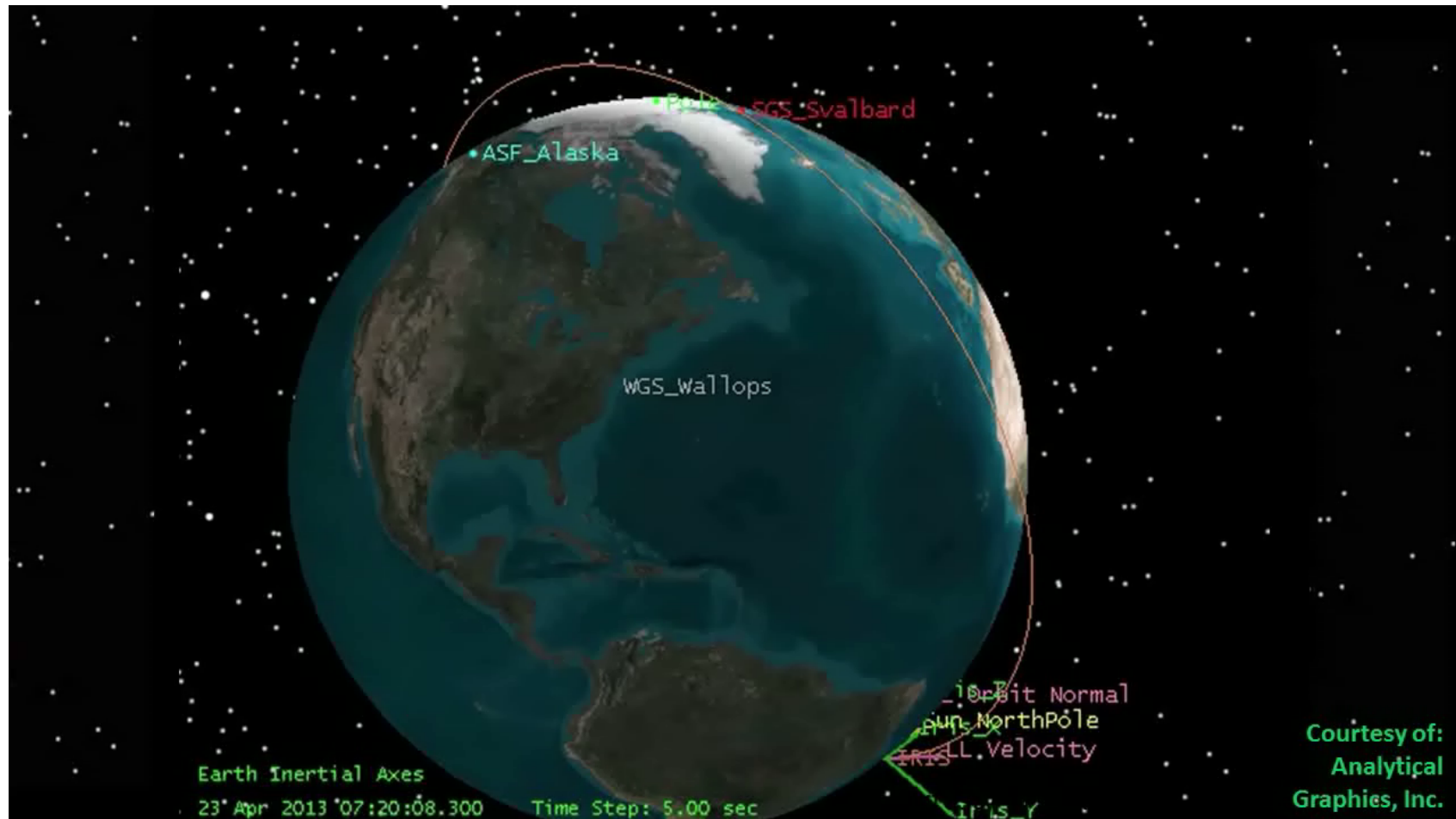


The Interface Region Imaging Spectrograph (IRIS)

Lucia Kleint

University of Applied Sciences and Arts Northwestern Switzerland

IRIS Orbit: nearly always daylight



IRIS Data: iris.lmsal.com

[Help](#)
[Export SSW](#)
INTERFACE REGION IMAGING SPECTROGRAPH
IRIS DATA SEARCH

Start: 2014-02-15T00:00
End: 2015-02-12T00:00

Raster
min max
FOV X
FOV Y
Count
Cdnce

Raster Step
Count
Size
Cdnce

Exposure Time
Min Exp
Exp Time

Spectral Lines

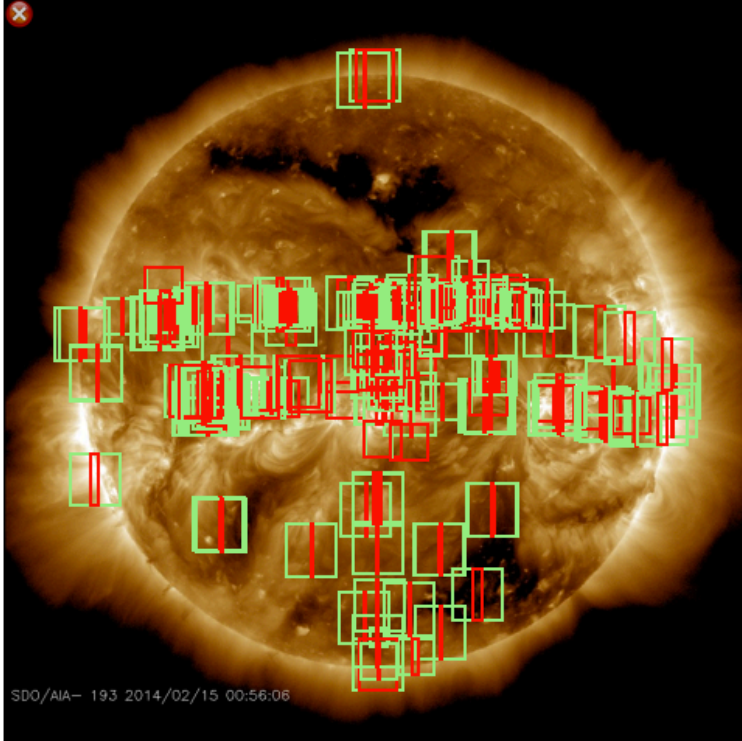
Desc:

SJI
min max
FOV X
FOV Y

Cadence
1330
1400
2796
2832

Target
XCEN
YCEN
Radius
OBSID:
Target:

Events



SDO/AIA- 193 2014/02/15 00:56:06

Time	Goal	OBS Desc.	X,Y	RX	RY
2015-01-25 20:33-21:15	flare watch AR12268	Very large sit-and-stare	-592",-126"	0"	175"
2015-01-25 21:51-22:53	flare watch AR12268	Very large sit-and-stare	-583",-126"	0"	175"
2015-01-25 23:29-00:30 +1d	flare watch AR12268	Very large sit-and-stare	-569",-126"	0"	175"
2015-01-26 01:06-02:08	flare watch AR12268	Very large sit-and-stare	-559",-127"	0"	175"
2015-01-26 02:44-03:45	flare watch AR12268	Very large sit-and-stare	-550",-127"	0"	175"
2015-01-26 04:21-05:20	flare watch AR12268	Very large sit-and-stare	-536",-124"	0"	175"
2015-01-26 05:59-06:17	A1: throughput monitoring, QS	Large coarse 64-step raster	136",25"	127"	119"
2015-01-26 07:37-07:54	focus calibration	Fine focus 2832, 1330, 2796, 1400; return to -131	113",-128"	0"	180"
2015-01-26 09:14-10:15	flare watch AR12268	Very large sit-and-stare	-524",-103"	0"	175"

start

end

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

IRIS Documentation

INTERFACE REGION IMAGING SPECTROGRAPH

Home Mission Operations Data Analysis Modeling **Documents** Software Team Press Contact

Online guide to IRIS data analysis [NEW]

Operations/Planning

- ITN 1 - IRIS Operations Overview
- ITN 2 - Manual for Table Creator
- ITN 3 - Manual for Timeline Tool
- ITN 4 - Manual for Synthetic Observations Tool
- ITN 5 - Operations Under Roll Conditions
- ITN 6 - AEC Operations
- ITN 7 - Compression Approach
- ITN 8 - Checklist for IRIS planner
- ITN 9 - Periodic Calibration Activities

Data Flow

- ITN 10 - General Approach to Data Flow and Archiving
- ITN 11 - Definition of Data Levels
- ITN 12 - Definition of Keywords
- ITN 13 - VSO and IRIS Level 2 keywords

Calibration

IRIS mission/instrument paper

Data Analysis

- ITN 26 - User Guide To Data Analysis
- ITN 27 - Quicklook Tools Manual
- ITN 28 - IRIS IDL Data Structure
- ITN 29 - Deconvolution Approach
- ITN 30 - 60 Day Observing Plan
- ITN 31 - IRIS science planning: tables, linelists, targets
- SolarSoft Tree and UVSP Database
- Data analysis tutorial at AAS 2014
- List of Flares observed with IRIS

Numerical Modeling

- ITN 33 - General Overview of Numerical Simulations
- ITN 34 - Numerical Simulations Quicklook Tools
- ITN 35 - Numerical Simulations Synthetic Observables
- ITN 36 - RH 1.5 D Manual
- ITN 37 - How to Derive Physical Information from Mg II h/k

IRIS Technical Notes List (ITN)

OBSID, downlinks, ...

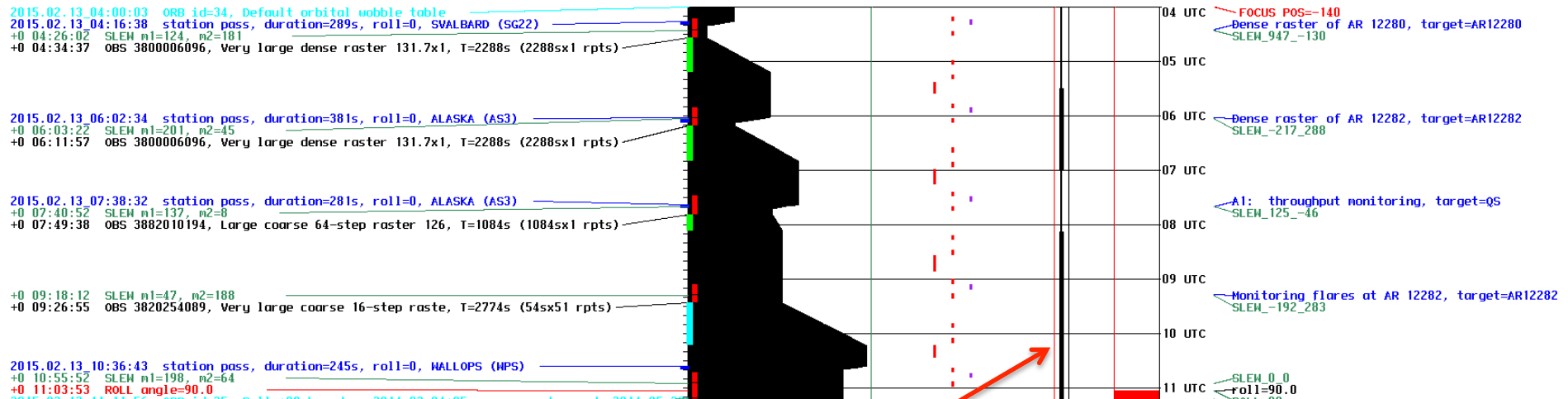
IRIS Timelines

SAA

short summary



Automatic Exposure Control (AEC)



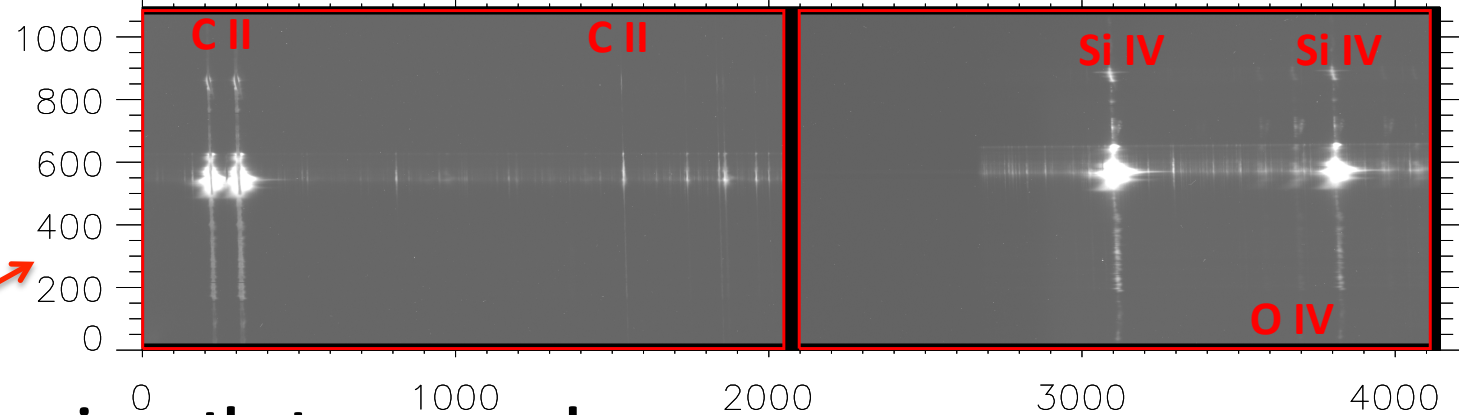
Exposure time decreases if AEC enabled and histogram has n pixels above a threshold

requires 1330 SJI for FUV spectra
requires 2796 SJI for NUV spectra

IRIS Spectral line selection: linelists

FSN: 2749320, CRS:00025, FUV, sumsptr: 8, sumspat: 4

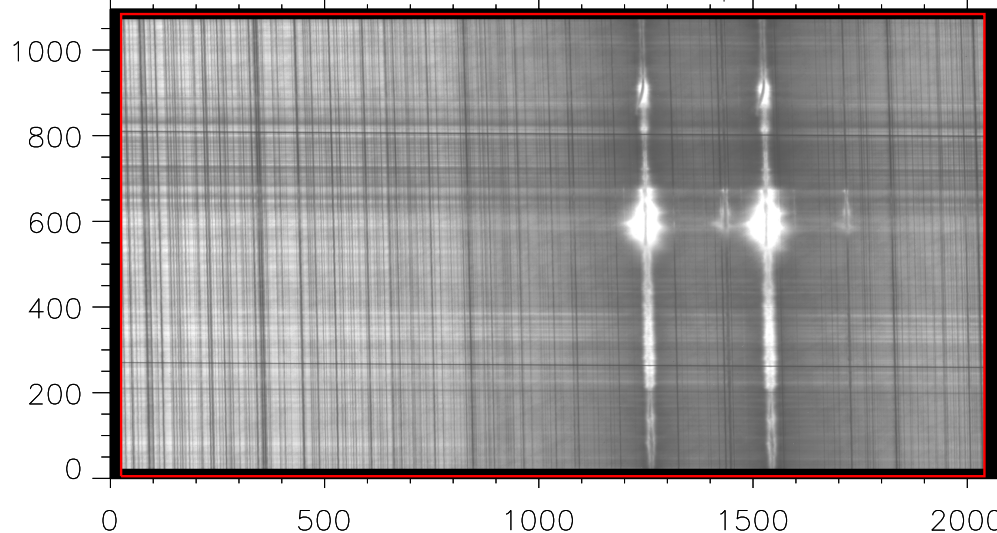
FUV



red boxes: regions that are saved

FSN: 2749319, CRS:00022, NUV, sumsptr: 8, sumspat: 4

NUV
(Level 0: λ
flipped!)



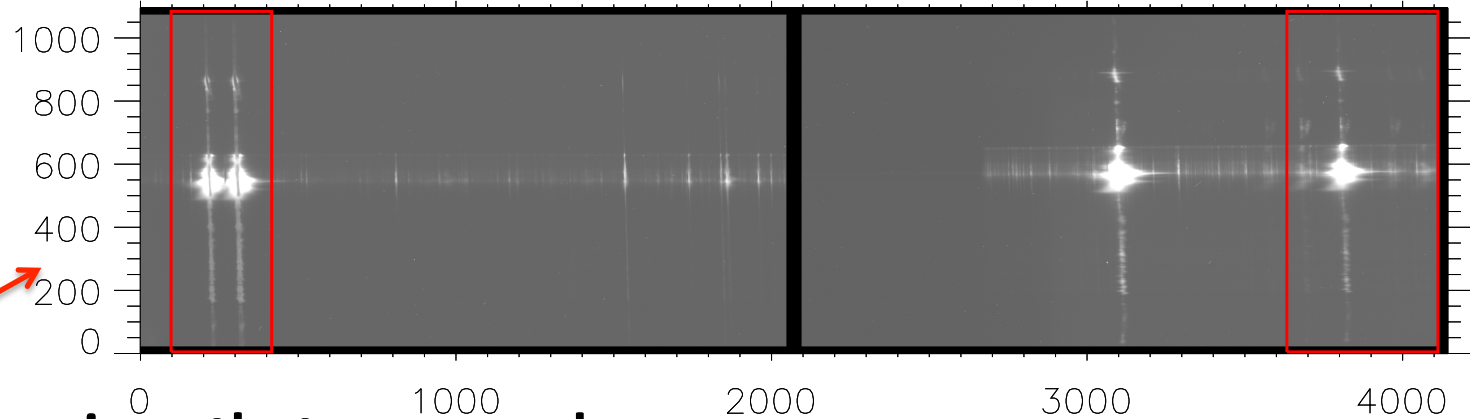
Full readout

not used often
due to telemetry

IRIS Spectral line selection: 5 linelists

FSN: 2749320, CRS:00316, FUV, sumsptr: 8, sumspat: 4

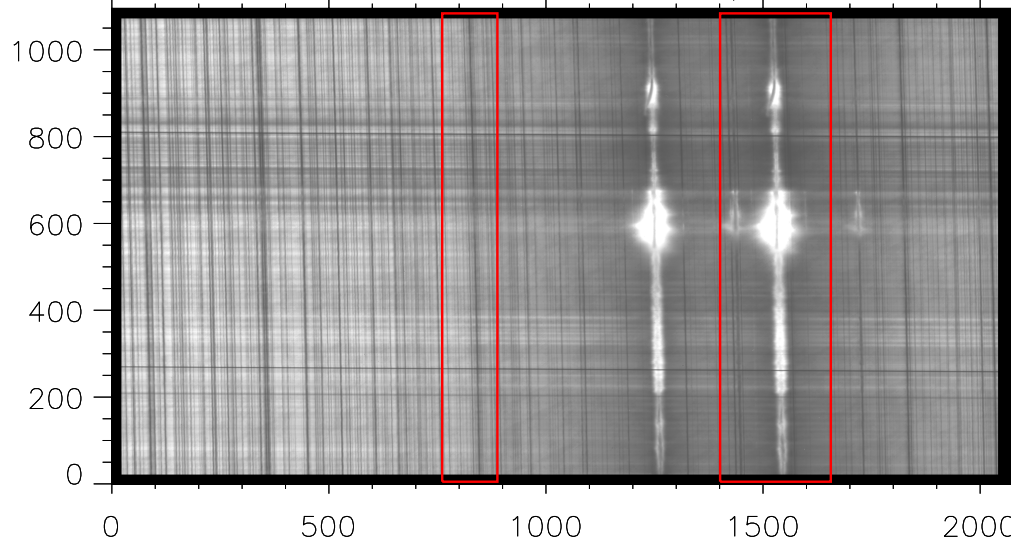
FUV



red boxes: regions that are saved

FSN: 2749319, CRS:00320, NUV, sumsptr: 8, sumspat: 4

NUV

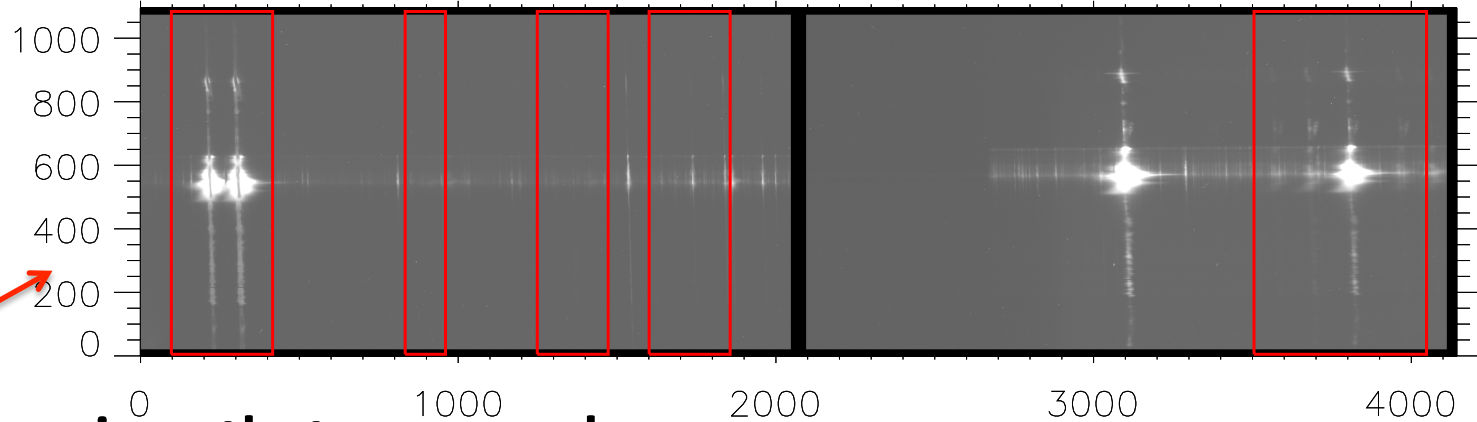


Small
linelist

IRIS Spectral line selection: 5 linelists

FSN: 2749320, CRS:00325, FUV, sumsptr1: 8, sumspat: 4

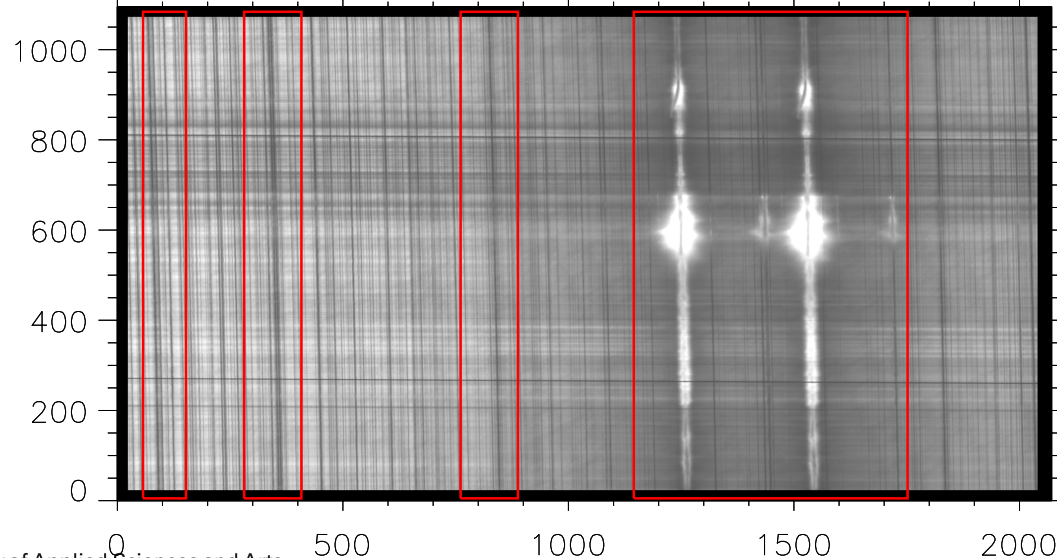
FUV



red boxes: regions that are saved

FSN: 2749319, CRS:00322, NUV, sumsptr1: 8, sumspat: 4

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 $\text{erg/s/cm}^2/\text{sr}/\text{A}$)
 - 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 ($\text{erg s}^{-1} \text{cm}^{-2} \text{sr}^{-1} \text{\AA}^{-1}$) 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

see also TN 24

$$I_{abs} = I_m \times \frac{hc}{\lambda} \frac{1}{A_{eff} d sa}$$

DN/s

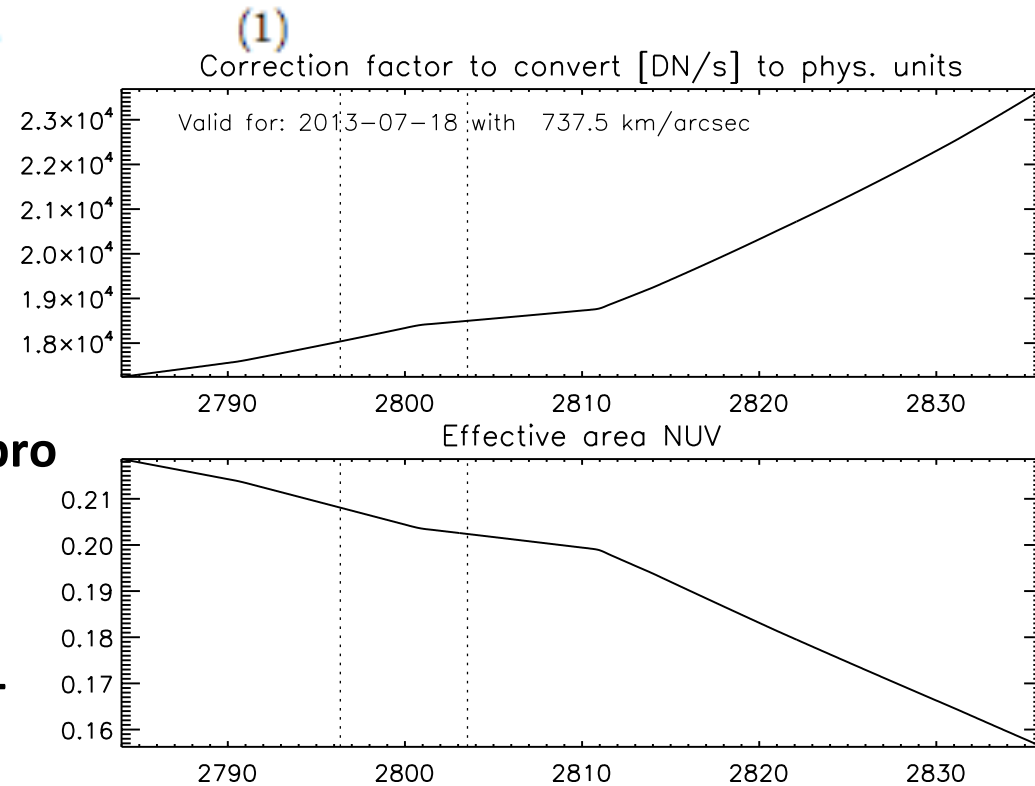
18 = photons/DN for NUV (SG and SJI).

4 = FUV SG

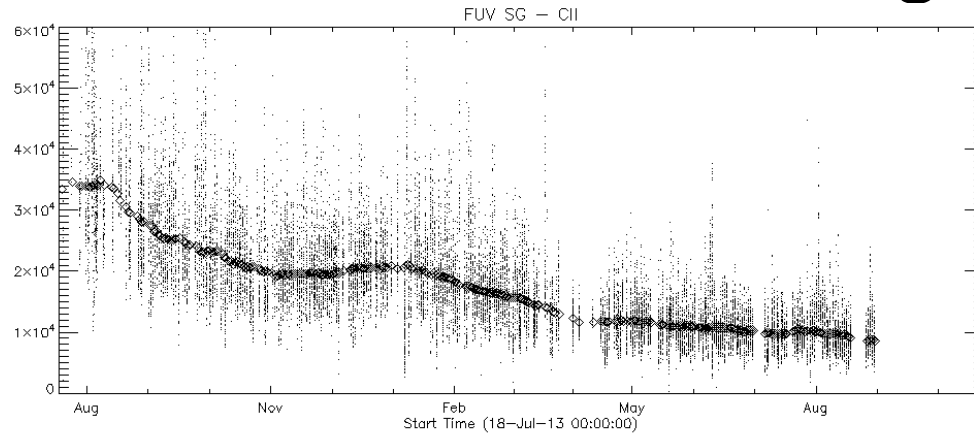
12 = FUV SJI

`iris_get_response.pro`

varies during the year (Earth-Sun distance)

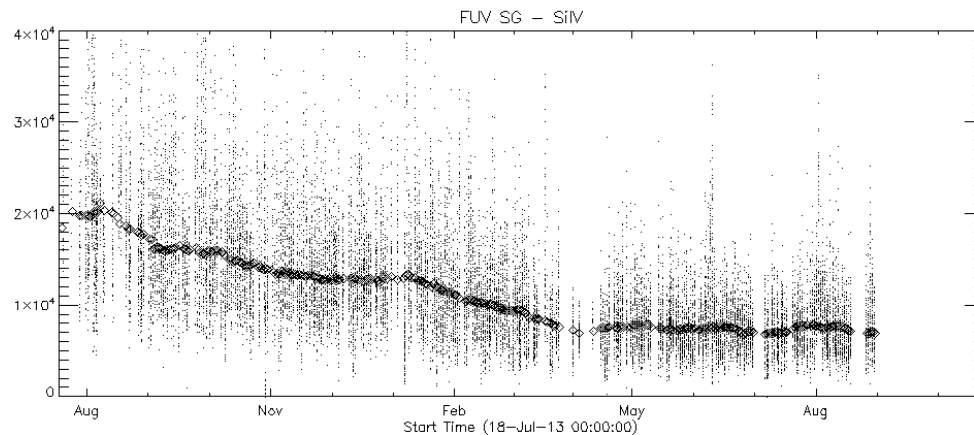


Absolute calibration: degradation since launch



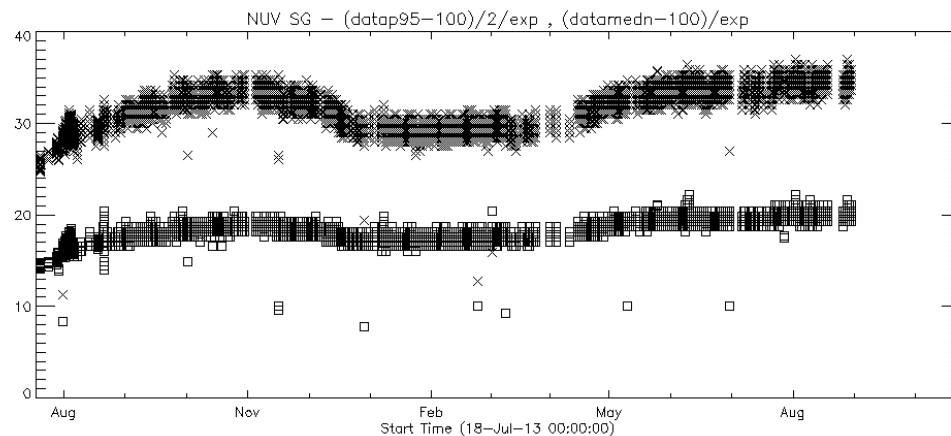
**daily quiet Sun measurements
to create these plots.**

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

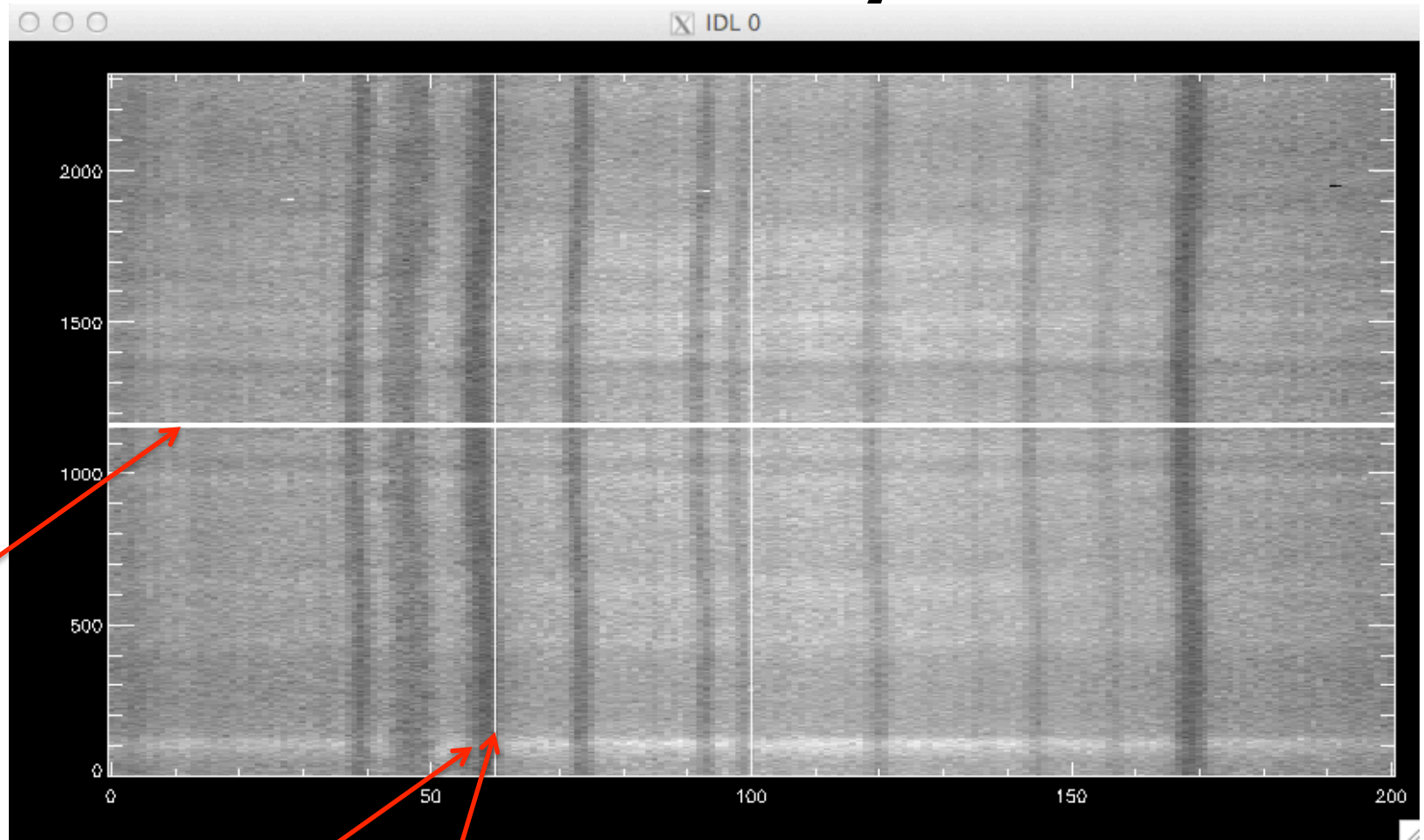
```
IDL> help,hdr,/str
** Structure <2a28a08>, 405 tags, length=4336, data length=4276, refs=1:
SIMPLE          INT          1
BITPIX          LONG         16
NAXIS           LONG         0
EXTEND          INT          1
DATE            STRING      '2013-11-02'
TELESCOP        STRING      'IRIS'
INSTRUME        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



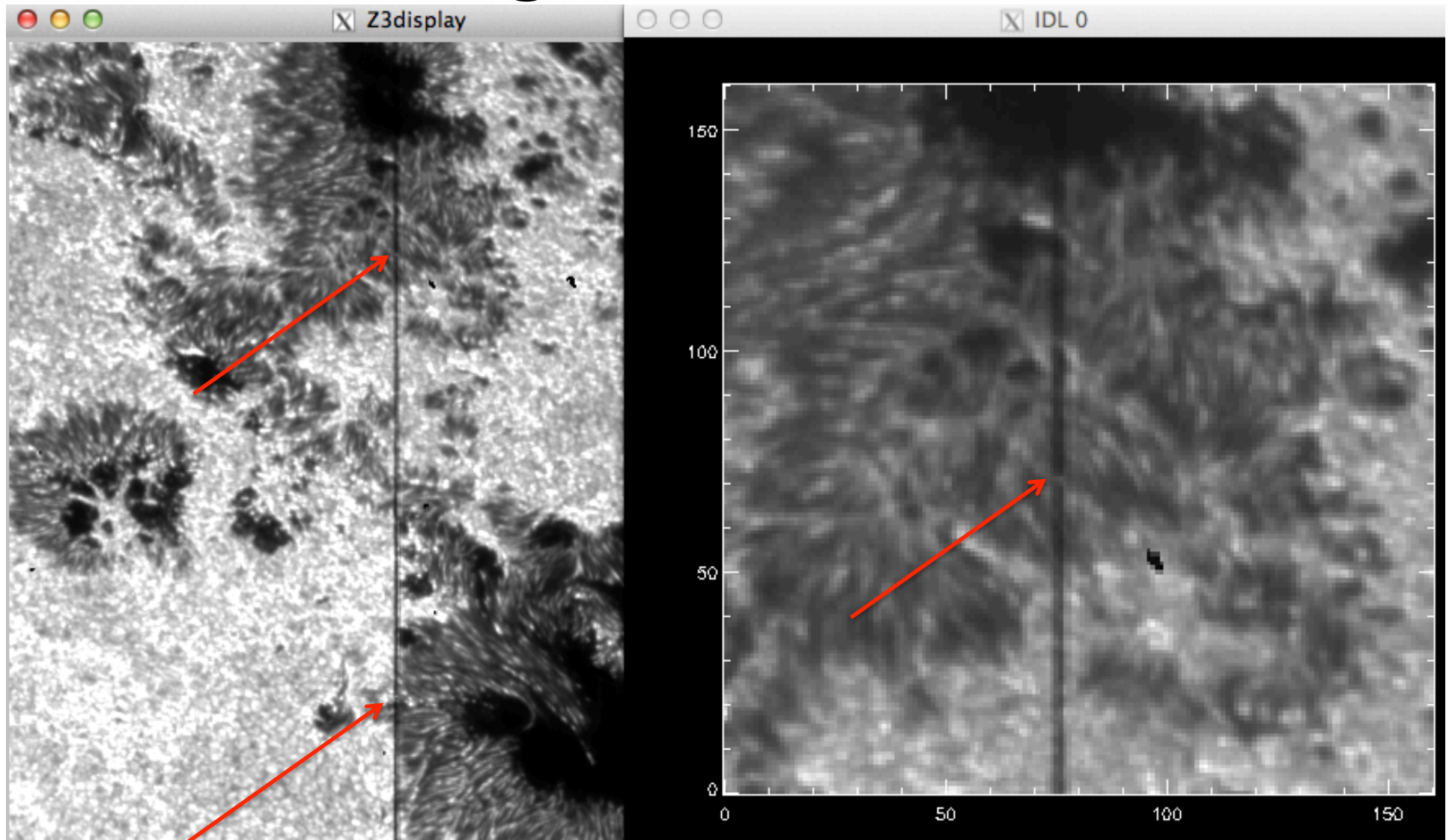
lost frames

lines "curved"

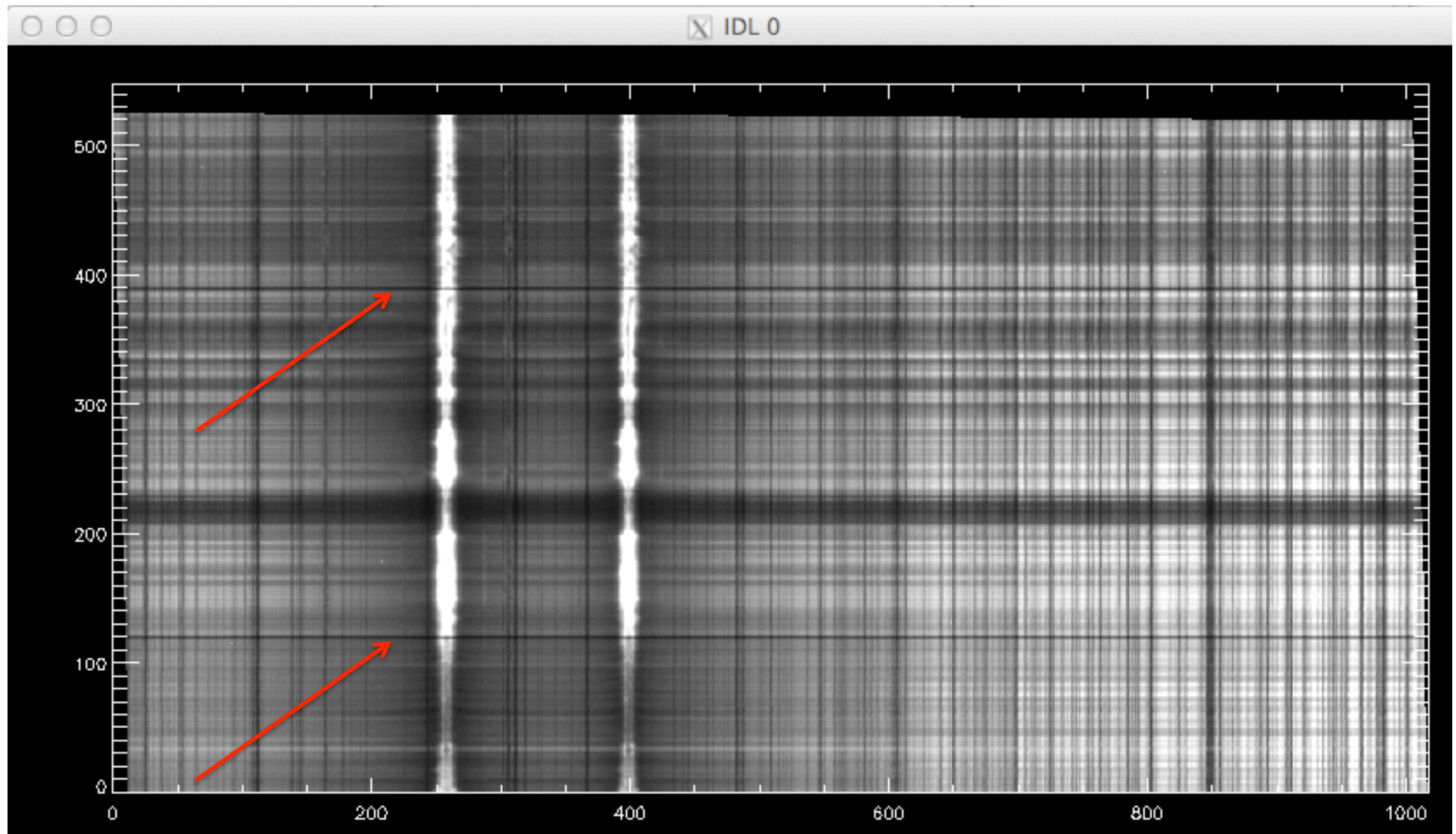
white line=reference

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)

Exit [EIS] 

Select data source: IRIS EIS/CCSDS EIS/FITS EIS/HK

Start/Stop for file search, Time Units: [D]D-MON-[YR]YR HH:MM:SS[.MS] Recent time-windows: 17-Jun-2013 - 25-Feb-2015 ignore times (only if no tree structure)

Start Time: 17-Jun-13 18:14:05 Stop Time: 25-Feb-2015 09:18:01

Set search filter: iris 12*

Search Pattern: local

Search Directory: /Users/kleintl/Data/work/irisdata/

STARTOBS	OBSID	OBS_DESC	XCEN	YCEN	SAT_ROT
2013-09-01T16:09:35.000	4000255147	Medium sit-and-stare 0.3"x60" 1s C II Si IV Mg II h	-119.8	67.3	0.0
2013-10-11T23:54:49.000	3880013646	Very large dense raster 131.7x175 400s Si IV Deep x 30	-152.0	-287.1	0.0
2014-01-28T07:30:21.810	3860259280	Large coarse 8-step raster 14x120 8s C II Si IV Deep x 8 FUV spe	-917.0	-192.5	-0.0
2014-03-29T14:09:38.830	3860258481	Very large coarse 8-step raster 14x175 8s Si IV Mg II h	490.0	281.7	-0.0
2014-10-26T13:12:25.760	3824005253	Large sit-and-stare 0.3x120 1s C II Si IV Deep x 2 SJI cadence	525.9	-300.0	55.0
2014-10-26T15:16:01.590	3880356995	Very large coarse 64-step raster 126x175 64s C II Mg II h	584.4	-306.9	90.0

/Users/kleintl/Data/work/irisdata/iris_12_20141026_151601_3880356995_SJI_2832_t000.fits
 /Users/kleintl/Data/work/irisdata/iris_12_20141026_151601_3880356995_raster_t000_r000000.fits

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_r000000.fits',hdr,data,wave='Si IV'  
read_iris_l2,path+'iris_l2_20141026_151601_3880356995_raster_t000_r000000.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 ;
```

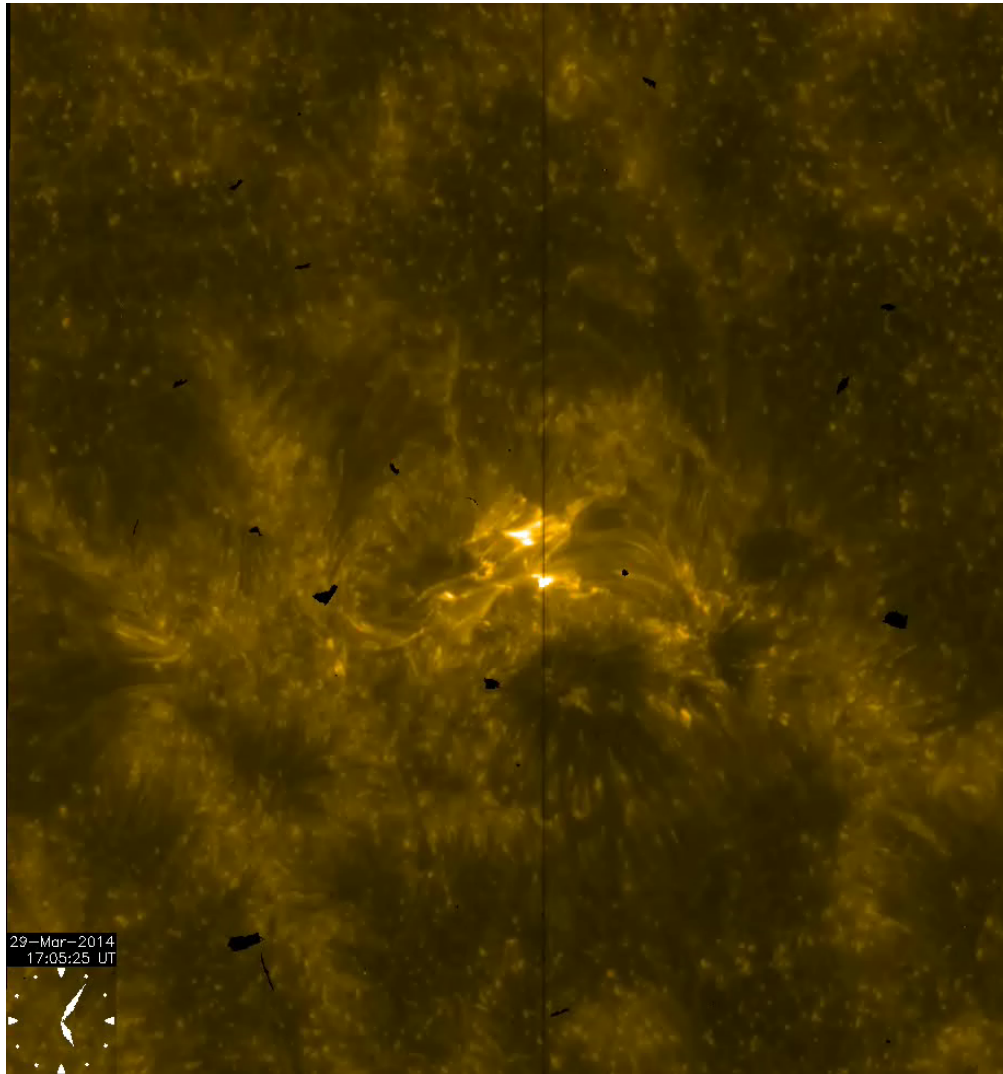
`iris_get_mg_features_lev2,'filename',iwin,[-40,40],lc,rp,bp`

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