The polSALT software (beta version)

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polSALT software:

Download at: **https://github.com/saltastro/polsalt**

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Outline (6 steps):

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(1) Basic image reductions (imred.py)

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(2) Wavelength calibrations (specpolwavmap.py)

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(2) Wavelength calibrations (specpolwavmap.py)

(3) Background subtr. and spectra extraction (specpolextract_sc.py)

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----------Polarimetry steps:----------

(4) Raw stokes calculation (specpolrawstokes.py)

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(4) Raw stokes calculation (specpolrawstokes.py)

(5) Final stokes calculation (specpolfinalstokes.py)

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----------Polarimetry steps:----------

(4) Raw stokes calculation (specpolrawstokes.py)

(5) Final stokes calculation (specpolfinalstokes.py)

(6) Visualisation of results (specpolview.py)

polSALT software:

Original:

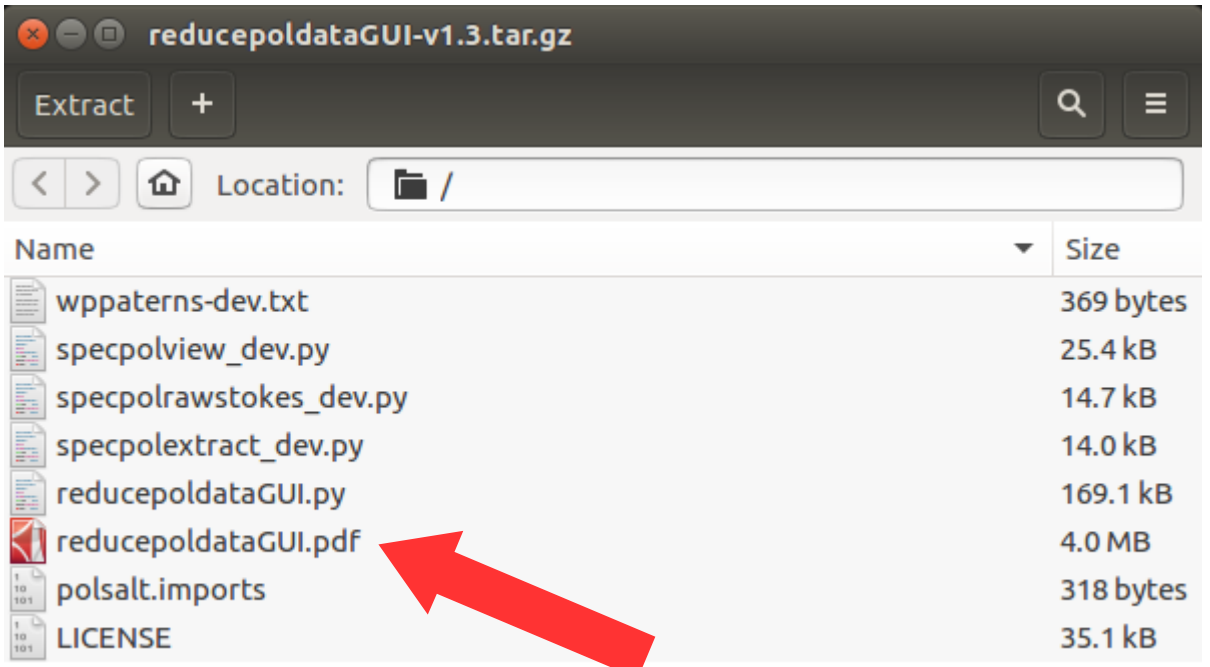
- Developed and support by Ken Nordsieck.
- Single master script:
  - “reducepoldata_sc.py”
  - Run via command line.
- 'All-in-one' approach.
- Limited user interaction.

New tools:

- Graphical user interface (GUI) – developed and support by Enrico Kotze.
- 'Step-by-step' approach
  - Evaluate each reduction step before proceeding (and redo if necessary).
  - Visualises the extraction of target spectrum with interactive settings to select appropriate extraction and background windows.

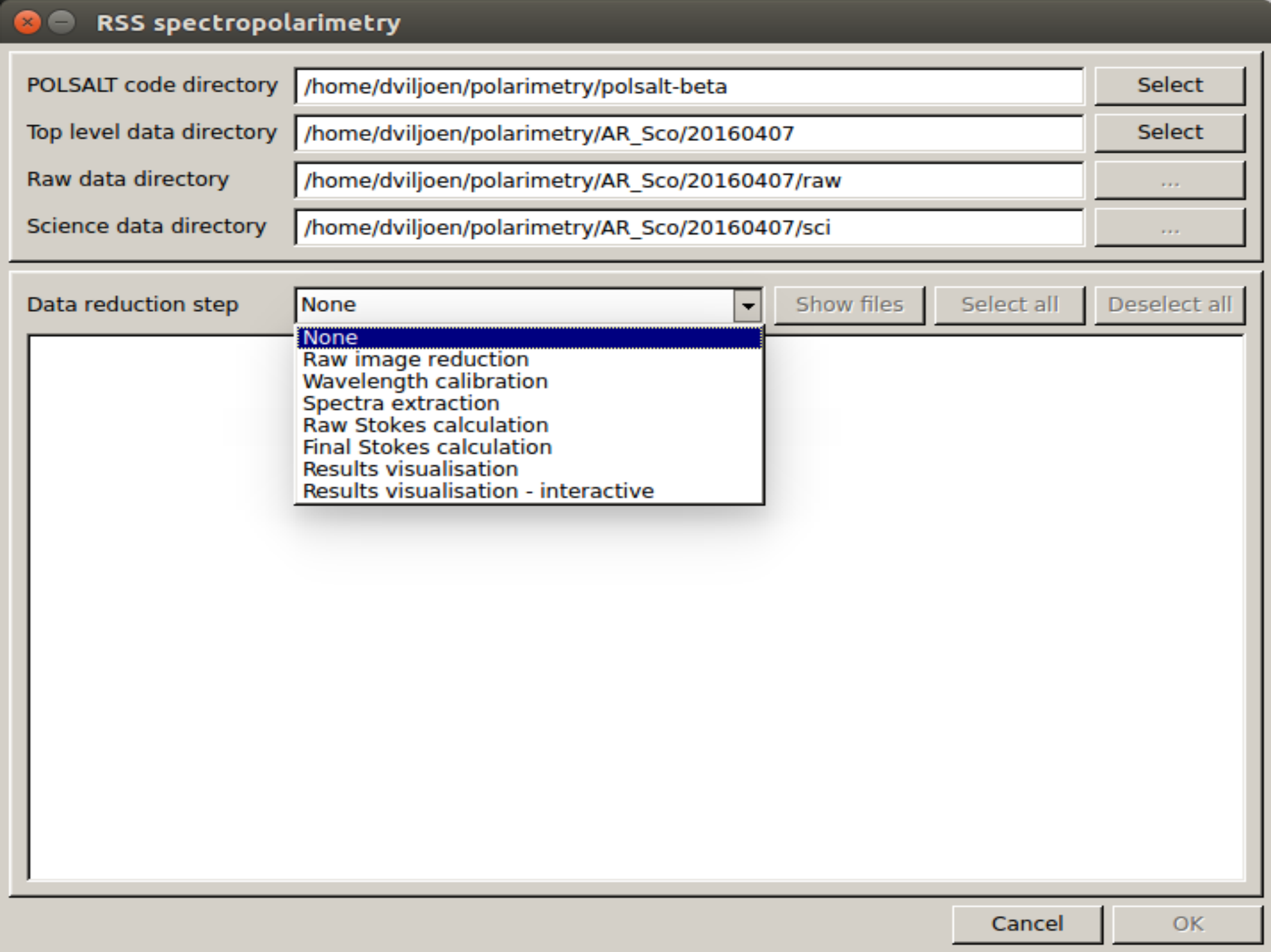
polSALT GUI:

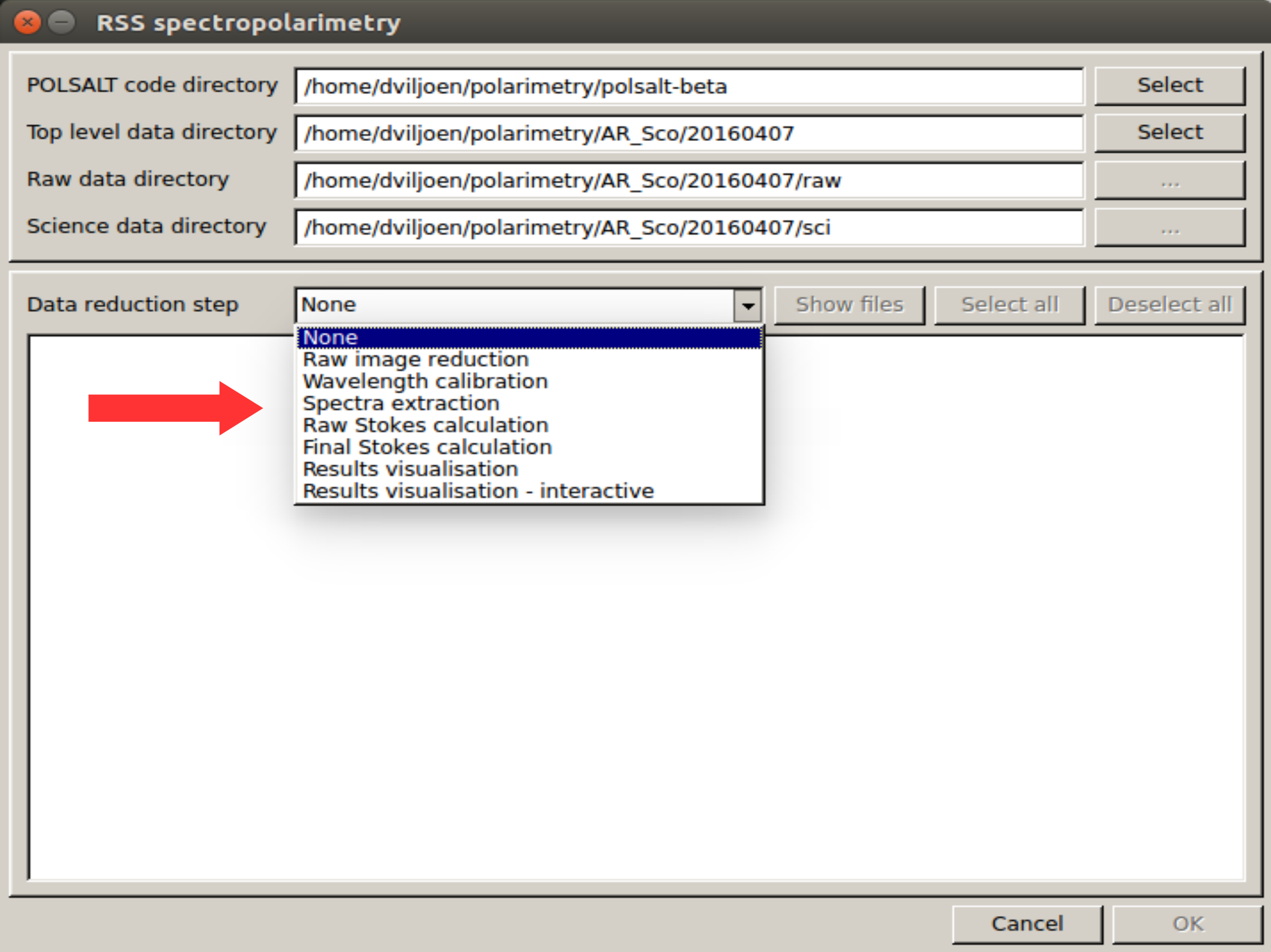
- Download at: http://www.saao.ac.za/~ejk/polsalt/code/reducepoldataGUI-v1.3.tar.gz
- Tarball:



Setup instructions

- python -W ignore reducepoldataGUI.py &


RSS spectropolarimetry
POLSALT code directory
/home/dviljoen/polarimetry/polsalt-beta
Select
Top level data directory
/home/dviljoen/polarimetry/AR_Sco/20160407
Select
Raw data directory
/home/dviljoen/polarimetry/AR_Sco/20160407/raw
...
Science data directory
/home/dviljoen/polarimetry/AR_Sco/20160407/sci
...
Data reduction step
None
Show files
Select all
Deselect all
None
Raw image reduction
Wavelength calibration
Spectra extraction
Raw Stokes calculation
Final Stokes calculation
Results visualisation
Results visualisation - interactive
Cancel
OK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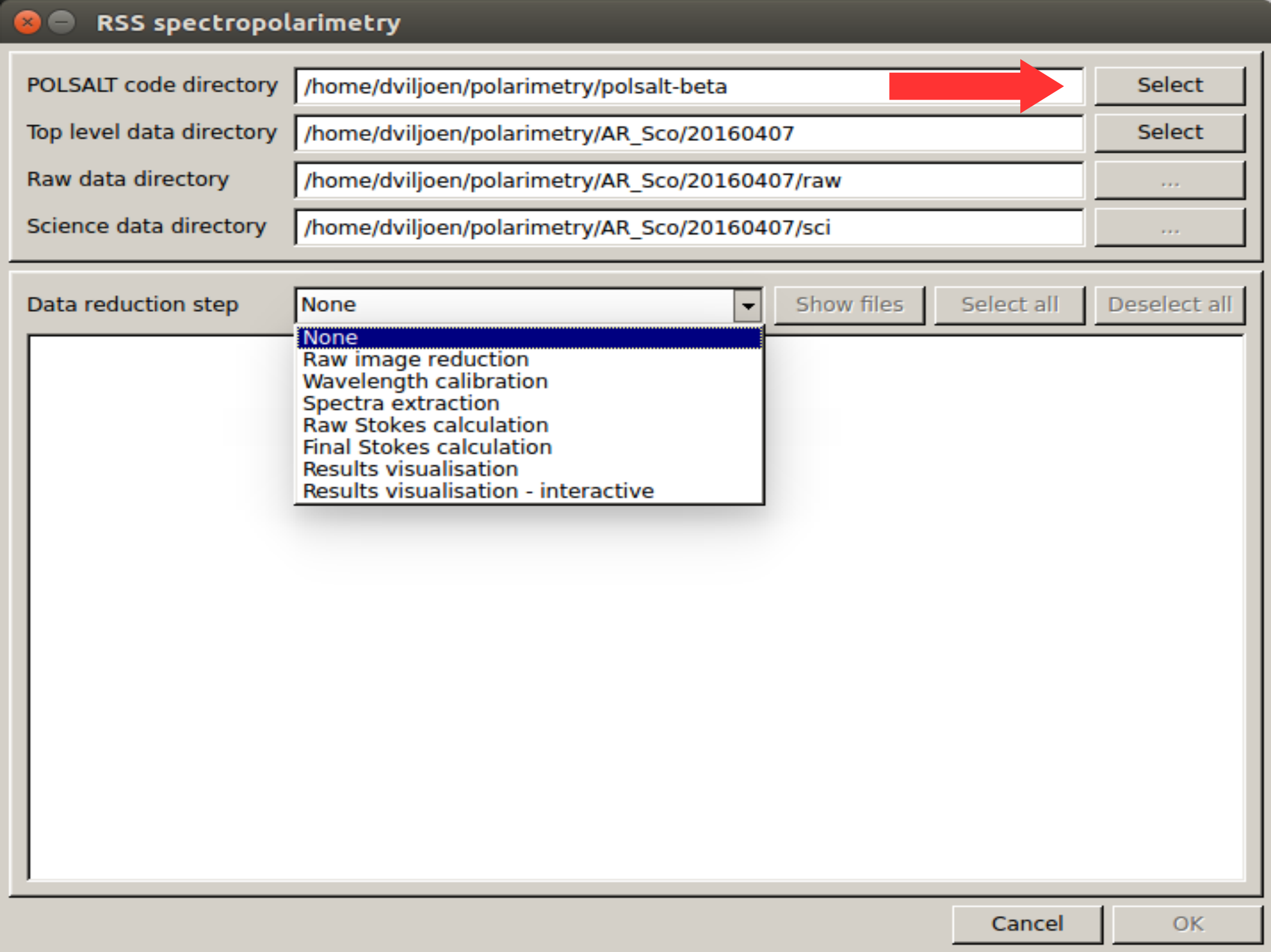
Cancel
OK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Show files
Select all
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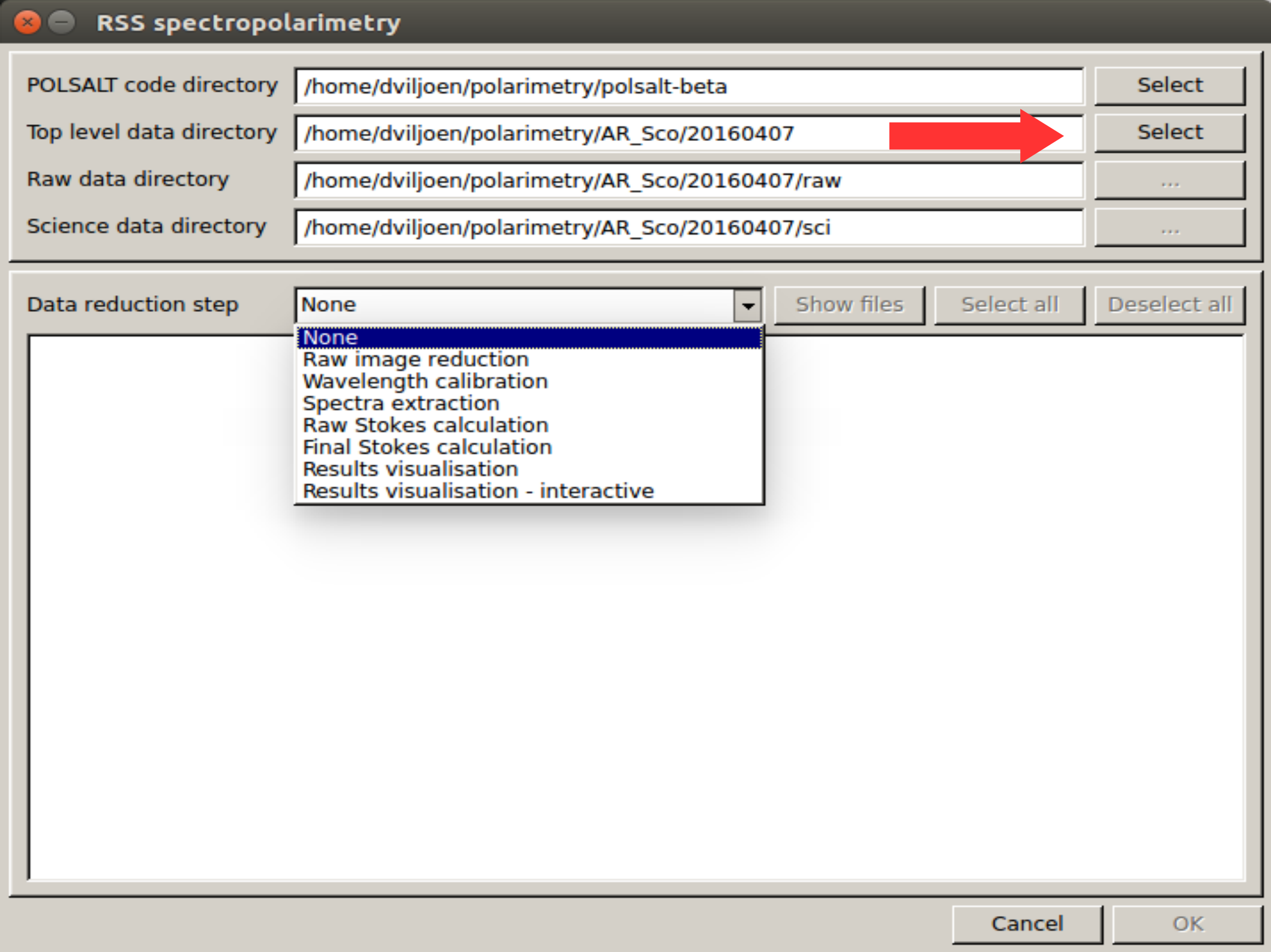
Results visualisation
Results visualisation - interactive
Cancel
OK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Select
Top level data directory
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Raw data directory
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Data reduction step
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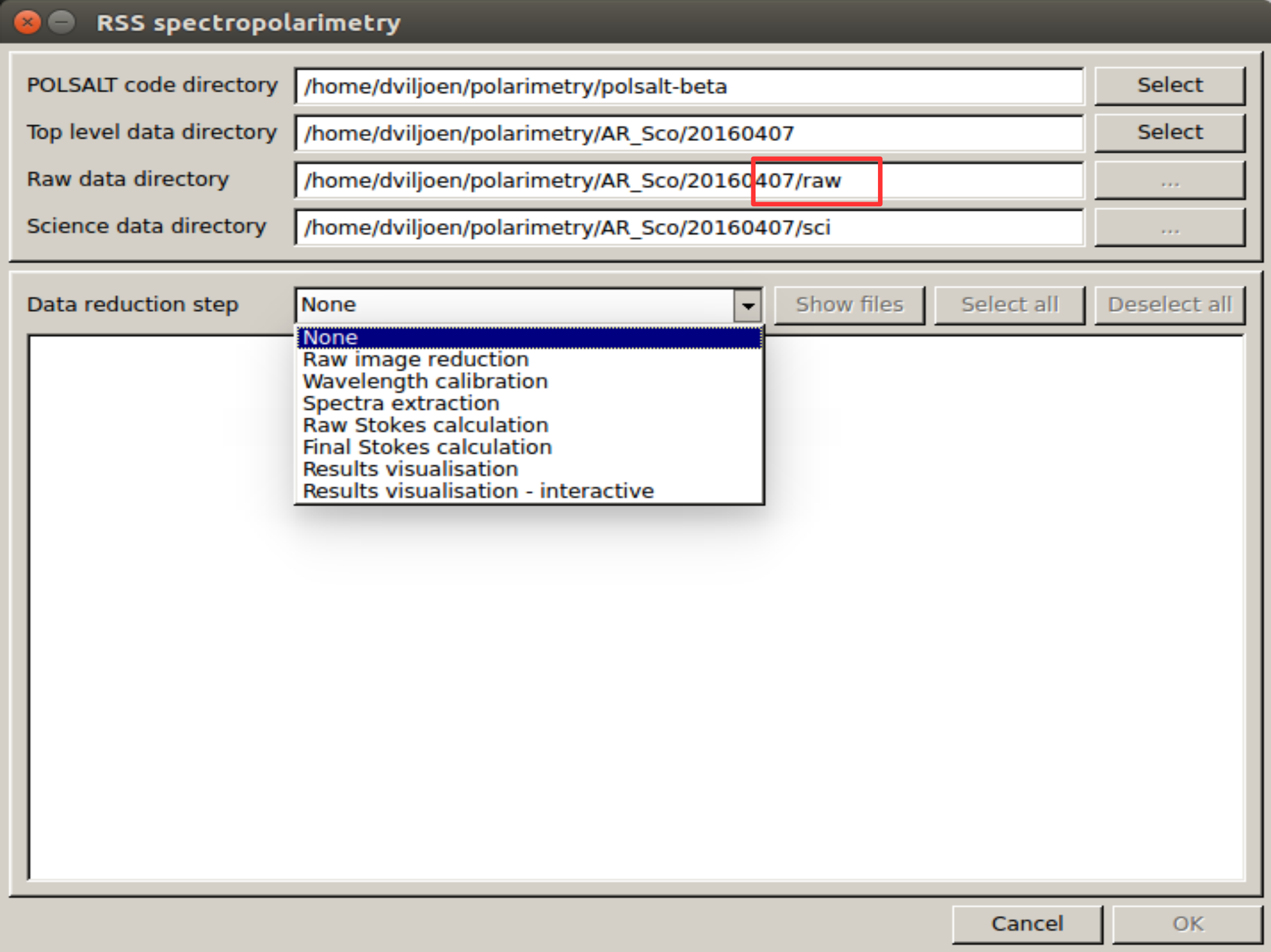
Cancel
OK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Top level data directory
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Raw image reduction
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Raw Stokes calculation
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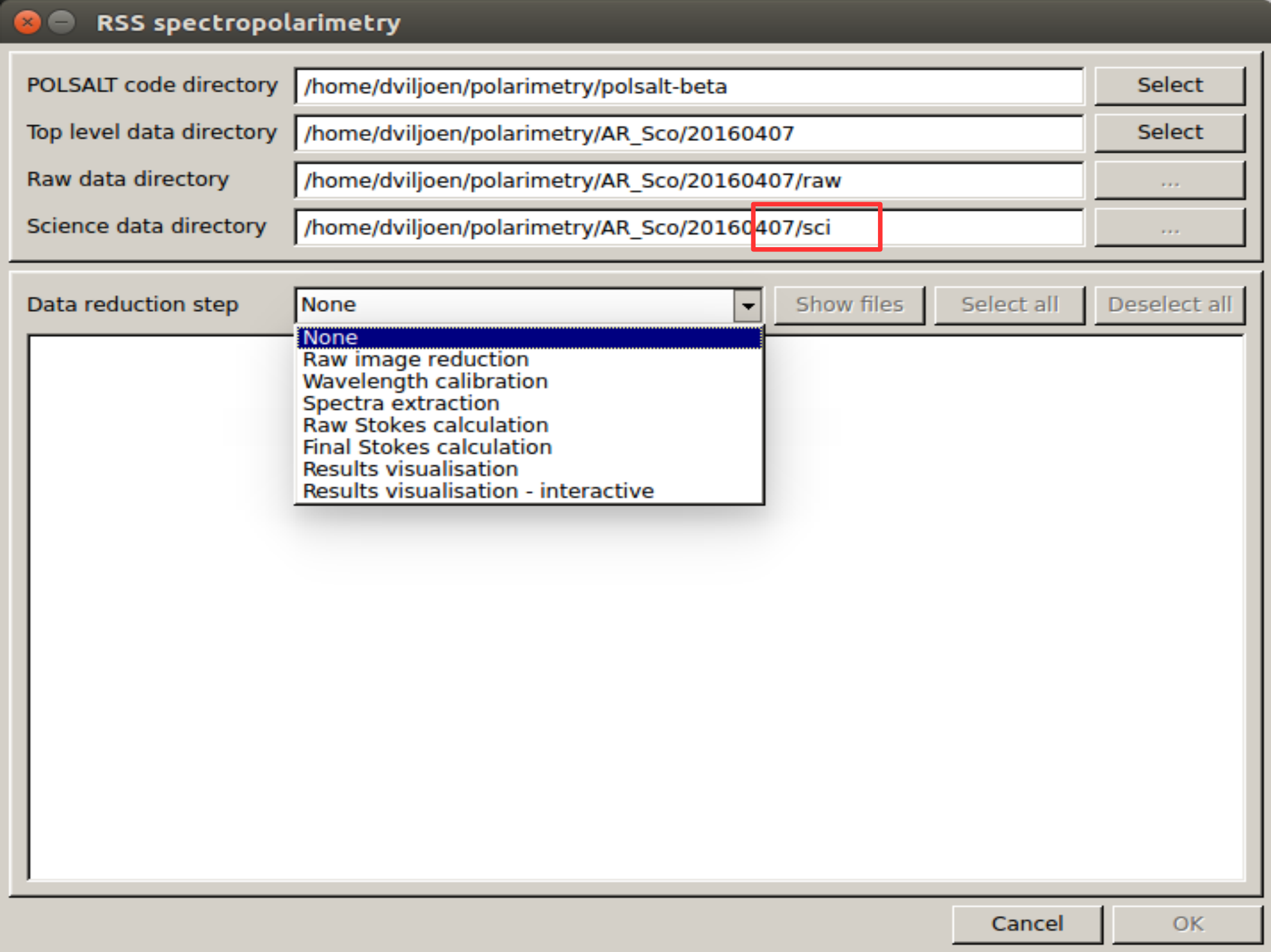
Cancel
OK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Cancel
OK

Step 1:
Basic image reductions

Script used: imred.py

Basic CCD reductions:

- Overscan subtraction.
- Gain correction.
- Crosstalk correction.
- Mosaicing.
- Produces "mxgbPp..." fits files.

RSS spectropolarimetry

POLSALT code directory: /home/dviljoen/polarimetry/polsalt-beta [Select]

Top level data directory: /home/dviljoen/polarimetry/AR_Sco/20160407 [Select]

Raw data directory: /home/dviljoen/polarimetry/AR_Sco/20160407/raw [...]

Science data directory: /home/dviljoen/polarimetry/AR_Sco/20160407/sci [...]

Data reduction step: Raw image reduction [Show files] [Select all] [Deselect all]

	File	Wave plate pattern	Half wave plate	Quarter wave plate	Image
1	P201604070037.fits	LINEAR-HI	0 - 0 deg	0 - 0 deg	OBJECT
2	P201604070038.fits	LINEAR-HI	4 - 45.00 deg	0 - 0 deg	OBJECT
3	P201604070039.fits	LINEAR-HI	2 - 22.50 deg	0 - 0 deg	OBJECT
4	P201604070040.fits	LINEAR-HI	6 - 67.50 deg	0 - 0 deg	OBJECT
5	P201604070041.fits	LINEAR-HI	1 - 11.25 deg	0 - 0 deg	OBJECT
6	P201604070042.fits	LINEAR-HI	5 - 56.25 deg	0 - 0 deg	OBJECT
7	P201604070043.fits	LINEAR-HI	3 - 33.75 deg	0 - 0 deg	OBJECT
8	P201604070044.fits	LINEAR-HI	7 - 78.75 deg	0 - 0 deg	OBJECT
9	P201604070045.fits	LINEAR-HI	0 - 0 deg	0 - 0 deg	OBJECT
10	P201604070046.fits	LINEAR-HI	4 - 45.00 deg	0 - 0 deg	OBJECT
11	P201604070047.fits	LINEAR-HI	2 - 22.50 deg	0 - 0 deg	OBJECT
12	P201604070048.fits	LINEAR-HI	6 - 67.50 deg	0 - 0 deg	OBJECT
13	P201604070049.fits	LINEAR-HI	1 - 11.25 deg	0 - 0 deg	OBJECT
14	P201604070050.fits	LINEAR-HI	5 - 56.25 deg	0 - 0 deg	OBJECT
15	P201604070051.fits	LINEAR-HI	3 - 33.75 deg	0 - 0 deg	OBJECT

[Cancel] [OK]

```
2018-10-31 13:15:49 MESSAGE ----------------------------------------

SALTMOSAIC -- geotran ./tmpfPOOO8tile.fits[3] ./tmpwXEuPntran.fits "" "" xshift=-2.03 yshift=0
.0575 xrotation=-0.02495 yrotation=-0.0998 xmag=1 ymag=1 xmin='INDEF'xmax='INDEF' ymin='INDEF'
 ymax='INDEF' ncols='INDEF' nlines='INDEF' verbose='no' fluxconserve='yes' nxblock=2048 nybloc
k=2048 interpolant='linear' boundary='constant' constant=0

2018-10-31 13:15:49 MESSAGE ----------------------------------------

xgbpP201604090056.fits[1][1:512,1:1026] --> tmpRPA1Fftile.fits[1][1:512,1:1026]
xgbpP201604090056.fits[2][1:512,1:1026] --> tmpRPA1Fftile.fits[1][513:1024,1:1026]
xgbpP201604090056.fits[3][1:512,1:1026] --> tmpRPA1Fftile.fits[2][1:512,1:1026]
xgbpP201604090056.fits[4][1:512,1:1026] --> tmpRPA1Fftile.fits[2][513:1024,1:1026]
xgbpP201604090056.fits[5][1:512,1:1026] --> tmpRPA1Fftile.fits[3][1:512,1:1026]
xgbpP201604090056.fits[6][1:512,1:1026] --> tmpRPA1Fftile.fits[3][513:1024,1:1026]

2018-10-31 13:15:50 MESSAGE ----------------------------------------

SALTMOSAIC -- geotran ./tmpRPA1Fftile.fits[1] ./tmpdRSsvEtran.fits "" "" xshift=-4.215 yshift=
0.5825 xrotation=0.03575 yrotation=0.143 xmag=1 ymag=1 xmin='INDEF'xmax='INDEF' ymin='INDEF' y
max='INDEF' ncols='INDEF' nlines='INDEF' verbose='no' fluxconserve='yes' nxblock=2048 nyblock=
2048 interpolant='linear' boundary='constant' constant=0
Transform CCD #2 using dx=0, dy=0, rot=0

2018-10-31 13:15:50 MESSAGE ----------------------------------------

SALTMOSAIC -- geotran ./tmpRPA1Fftile.fits[3] ./tmp027A3gtran.fits "" "" xshift=-2.03 yshift=0
.0575 xrotation=-0.02495 yrotation=-0.0998 xmag=1 ymag=1 xmin='INDEF'xmax='INDEF' ymin='INDEF'
 ymax='INDEF' ncols='INDEF' nlines='INDEF' verbose='no' fluxconserve='yes' nxblock=2048 nybloc
k=2048 interpolant='linear' boundary='constant' constant=0

2018-10-31 13:15:51 MESSAGE ----------------------------------------
saltmosaic completed
```

Step 2:
Wavelength calibrations

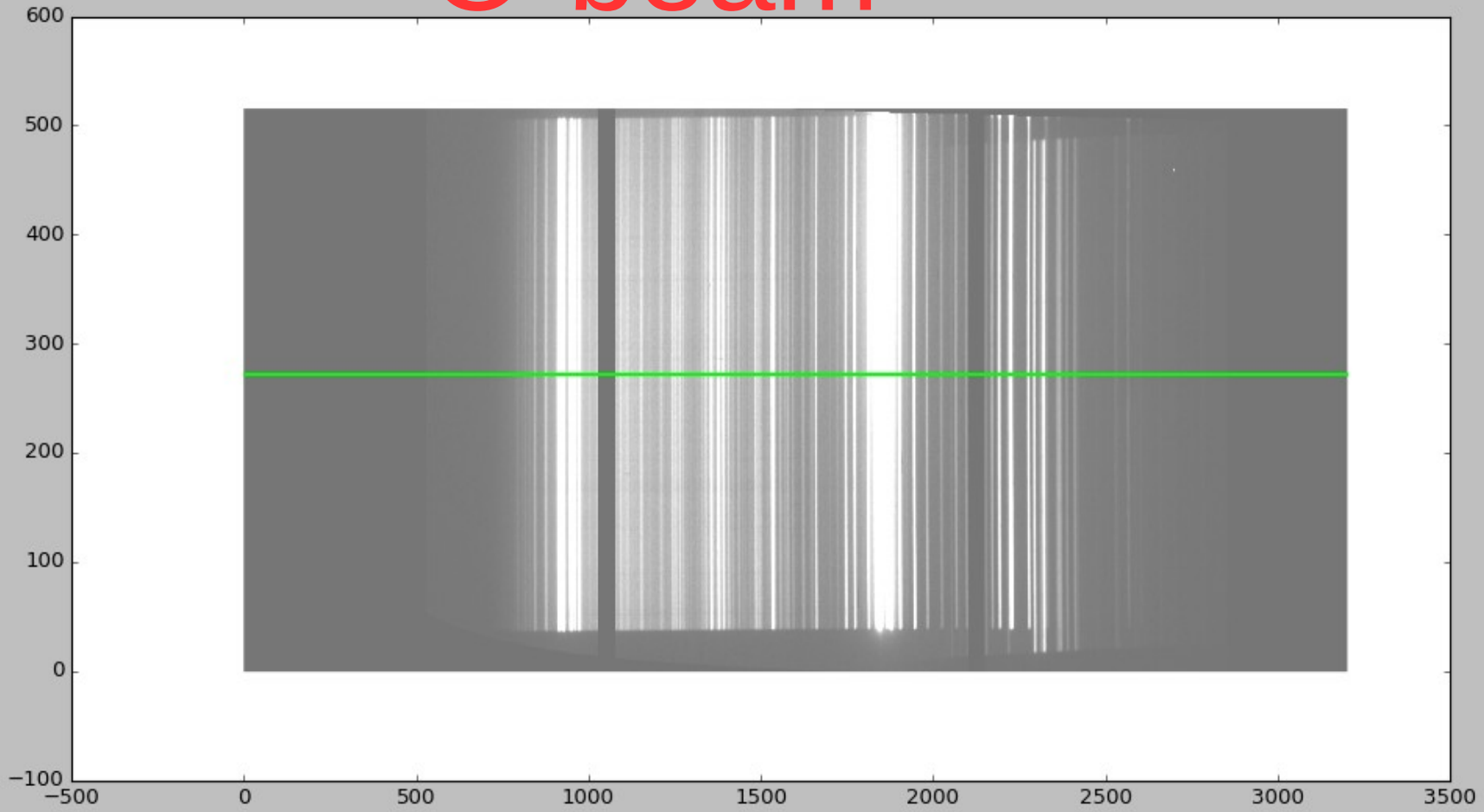
Script used: specpolwavmap.py

- O (bottom) and E (top) beamsplitter beams are split apart.
- The “specidentify” interface will appear for you to identify lines.
- We suggest manual line identification (as opposed to “auto-identify”).
- Wavelength calibration step occurs twice (once for O-beam and once for E-beam).
- Cosmic-ray rejection now done.
- Produces "wmxgbPp..." fits files - which has the beams split (saved in different extensions) and a wavelength map plane added.

InterIdentify

Image | Arc | Residual

O-beam



x=-201.797 y=545.406

Filename: arc_55_0.fits

Y1: 272 Y2: 273 Update

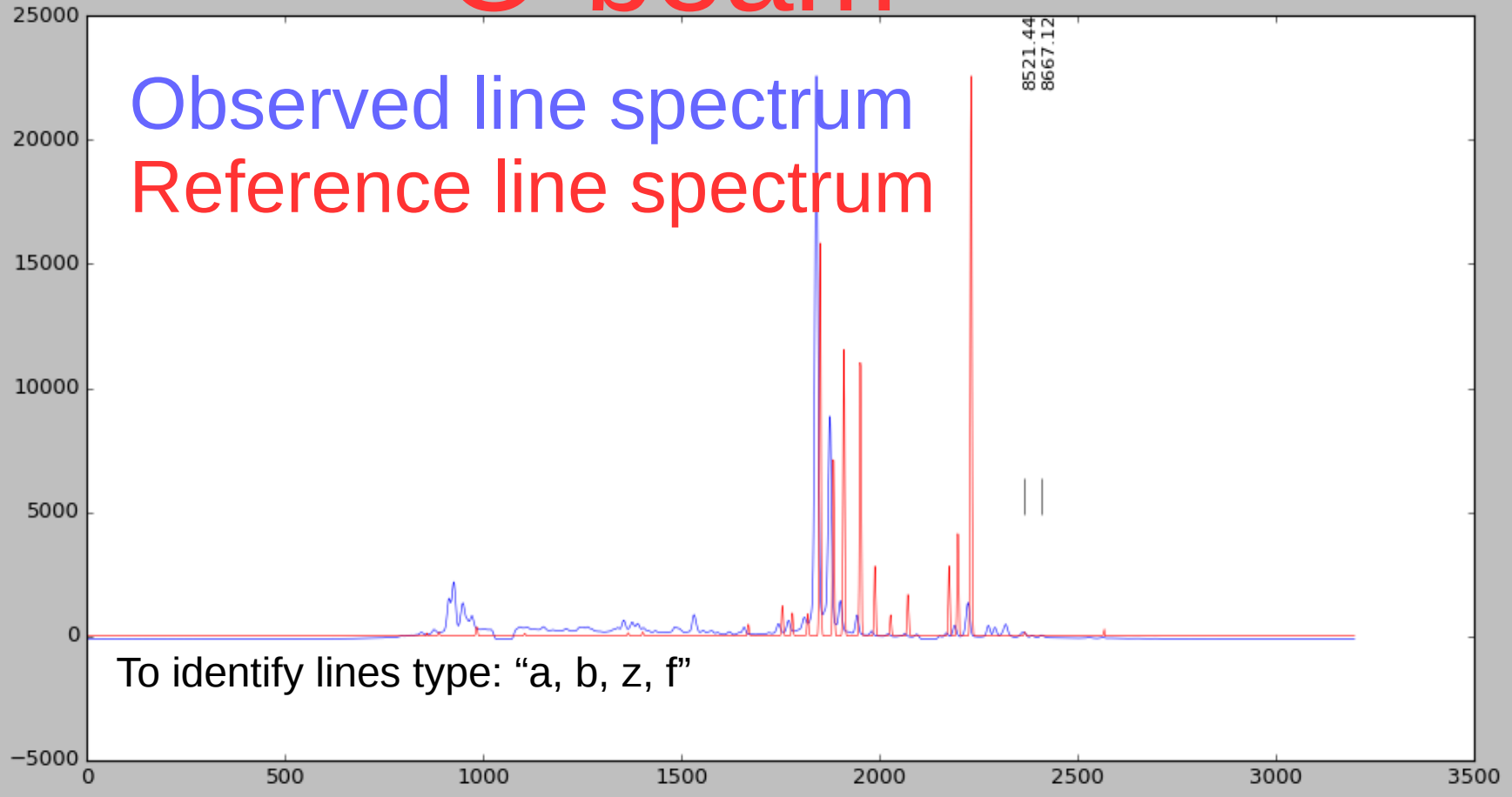
nrows: 1 rstep: 20 Next

Auto-Identify

InterIdentify

Image | Arc | Residual

O-beam



x=911.758 y=6503.11

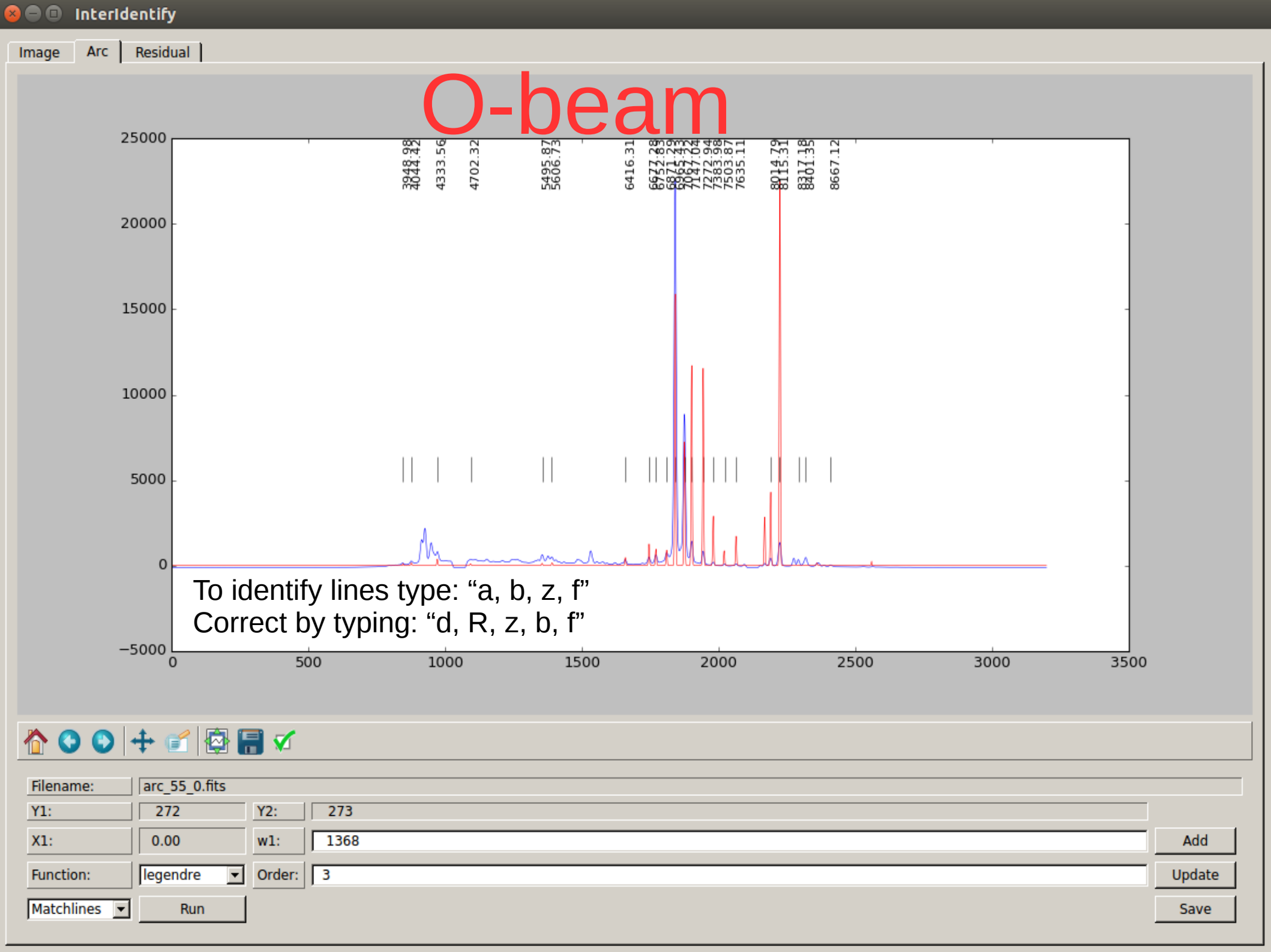
Filename: arc_55_0.fits

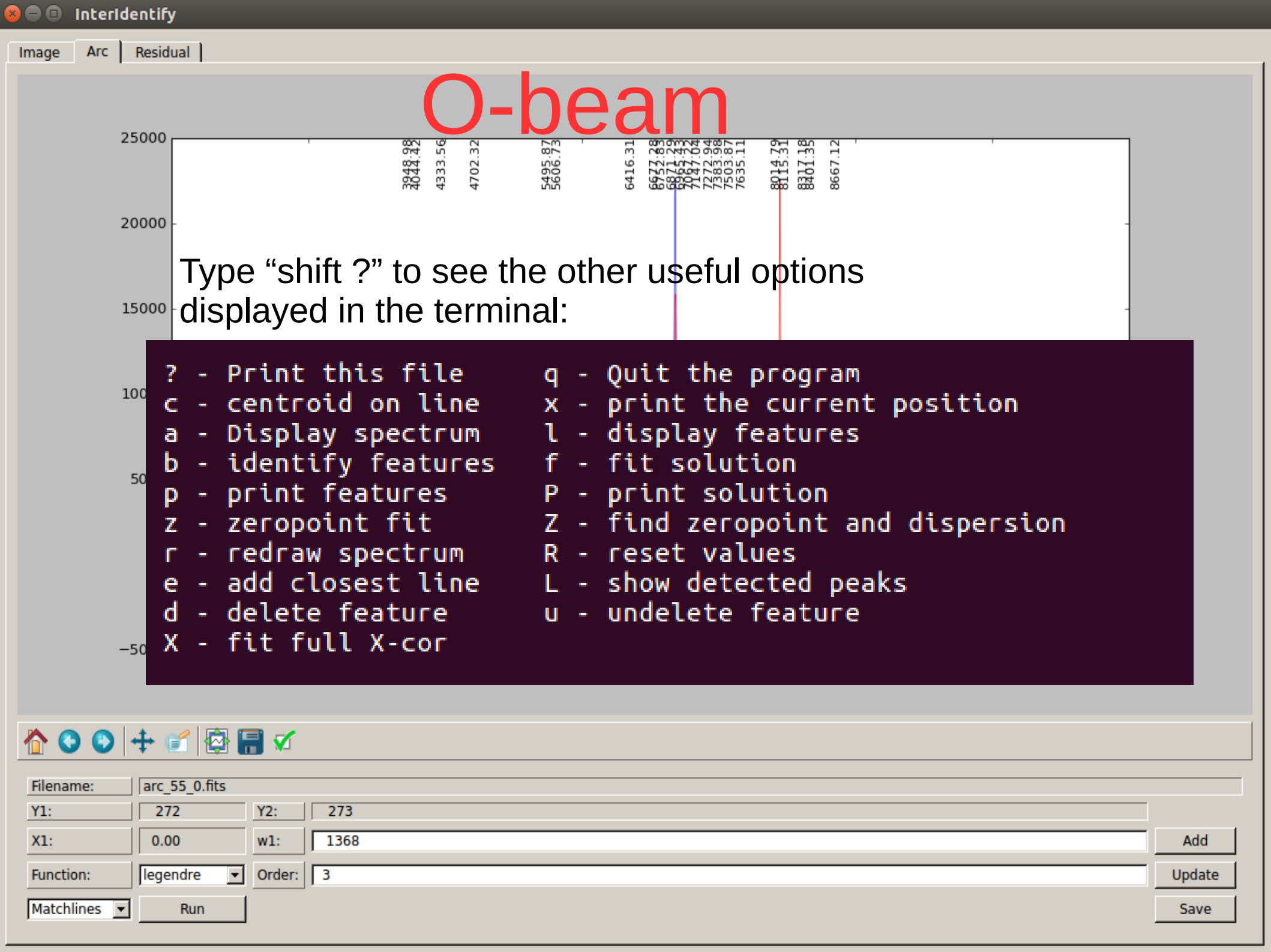
Y1: 272 Y2: 273

X1: 0.00 w1: 1368 Add

Function: legendre Order: 3 Update

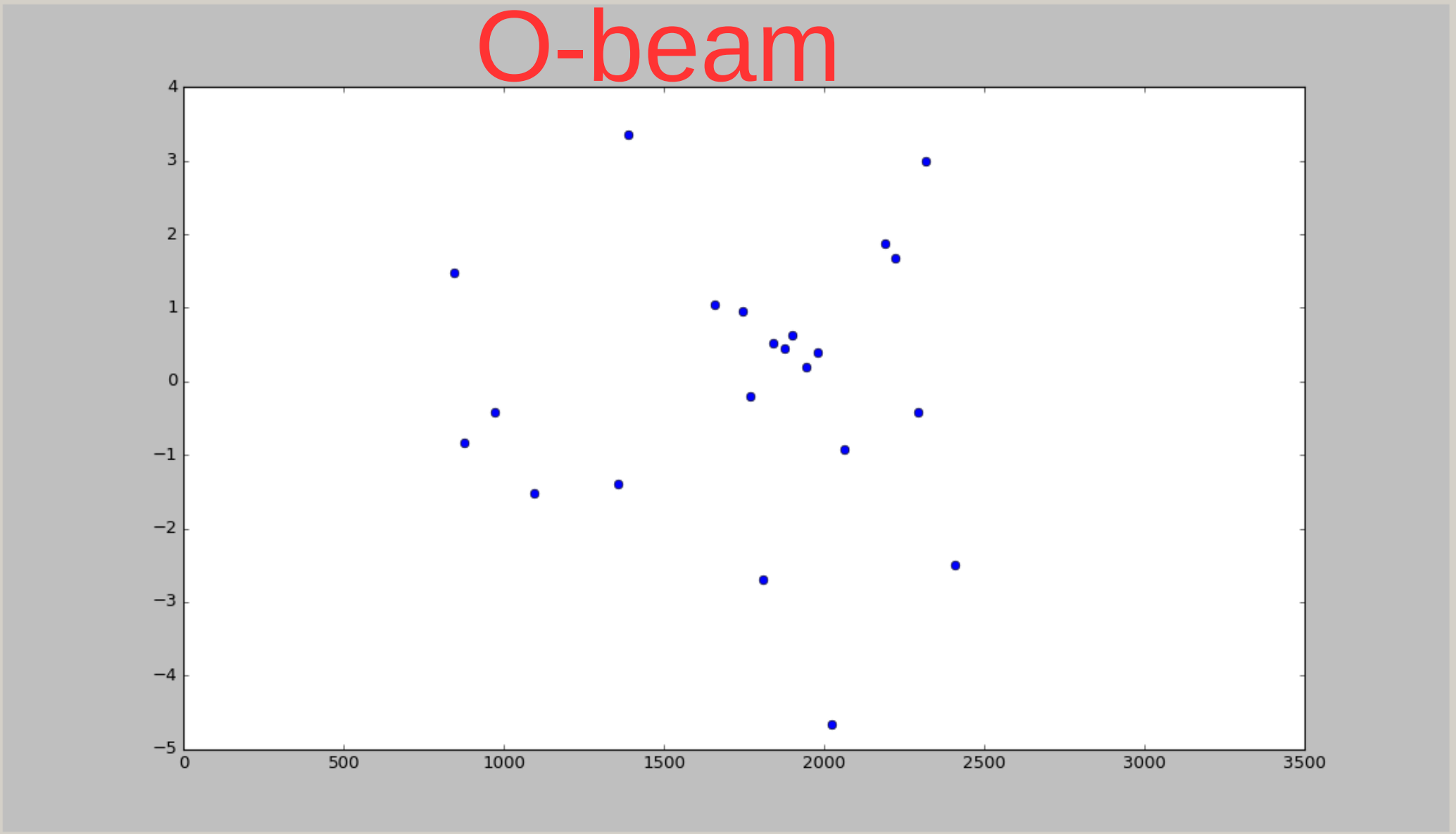
Matchlines Run Save


InterIdentify
Image
Arc
Residual
O-beam
3948.98
4044.42
4333.56
4702.32
5495.87
5606.73
6416.31
6677.28
6752.83
6871.29
6965.43
7067.04
7147.04
7272.94
7383.98
7503.87
7635.11
8014.79
8115.31
8317.18
8401.35
8667.12
25000
20000
15000
10000
5000
0
−5000
0
500
1000
1500
2000
2500
3000
3500
To identify lines type: “a, b, z, f”
Correct by typing: “d, R, z, b, f”
Filename:
arc_55_0.fits
Y1:
272
Y2:
273
X1:
0.00
w1:
1368
Add
Function:
legendre
Order:
3
Update
Matchlines
Run
Save


InterIdentify
Image
Arc
Residual
O-beam
25000
20000
15000
100
50
−50
3948.98
4044.42
4333.56
4702.32
5495.87
5606.73
6416.31
6677.28
6871.29
7147.04
7272.94
7383.98
7503.87
7635.11
8014.79
8115.31
8317.18
8401.35
8667.12
Type “shift ?” to see the other useful options displayed in the terminal:
? - Print this file
c - centroid on line
a - Display spectrum
b - identify features
p - print features
z - zeropoint fit
r - redraw spectrum
e - add closest line
d - delete feature
X - fit full X-cor
q - Quit the program
x - print the current position
l - display features
f - fit solution
P - print solution
Z - find zeropoint and dispersion
R - reset values
L - show detected peaks
u - undelete feature
Filename:
arc_55_0.fits
Y1:
272
Y2:
273
X1:
0.00
w1:
1368
Add
Function:
legendre
Order:
3
Update
Matchlines
Run
Save

InterIdentify

Image | Arc | Residual



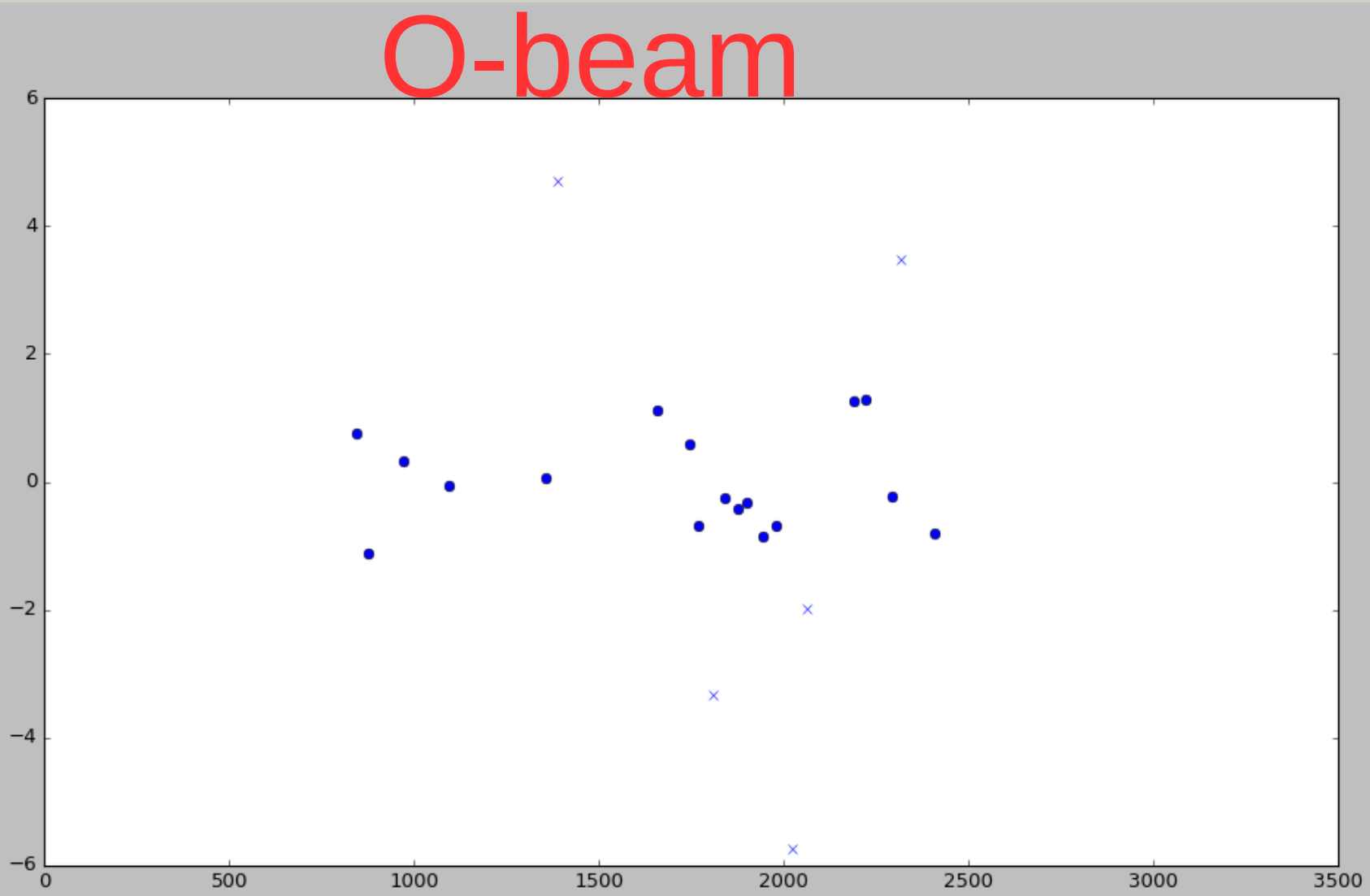
Filename: None

Average: 3.9e-12 Std(A): 1.8

Sigma: 3.0 Niter: 5 Reject

InterIdentify

Image | Arc | Residual

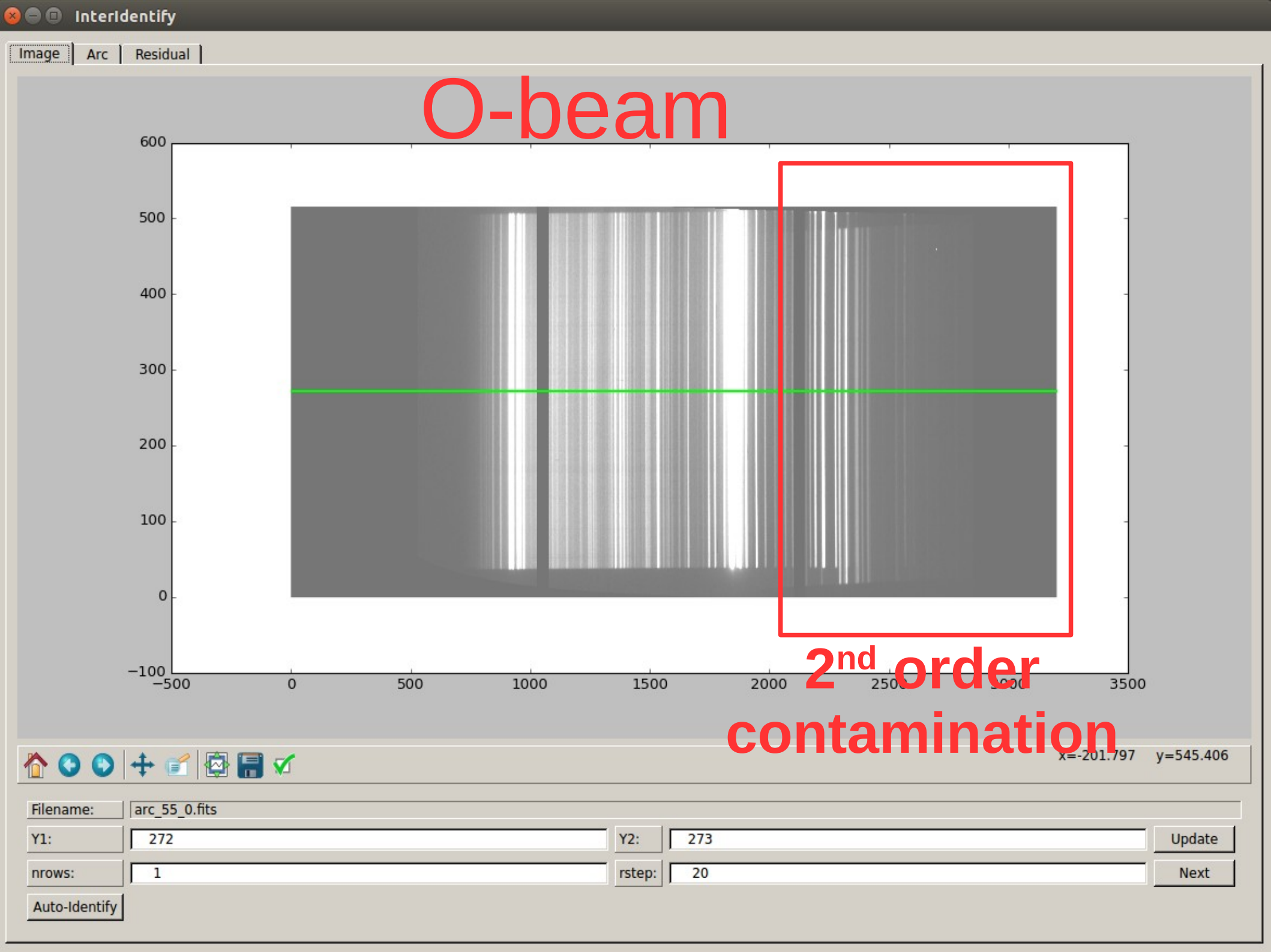


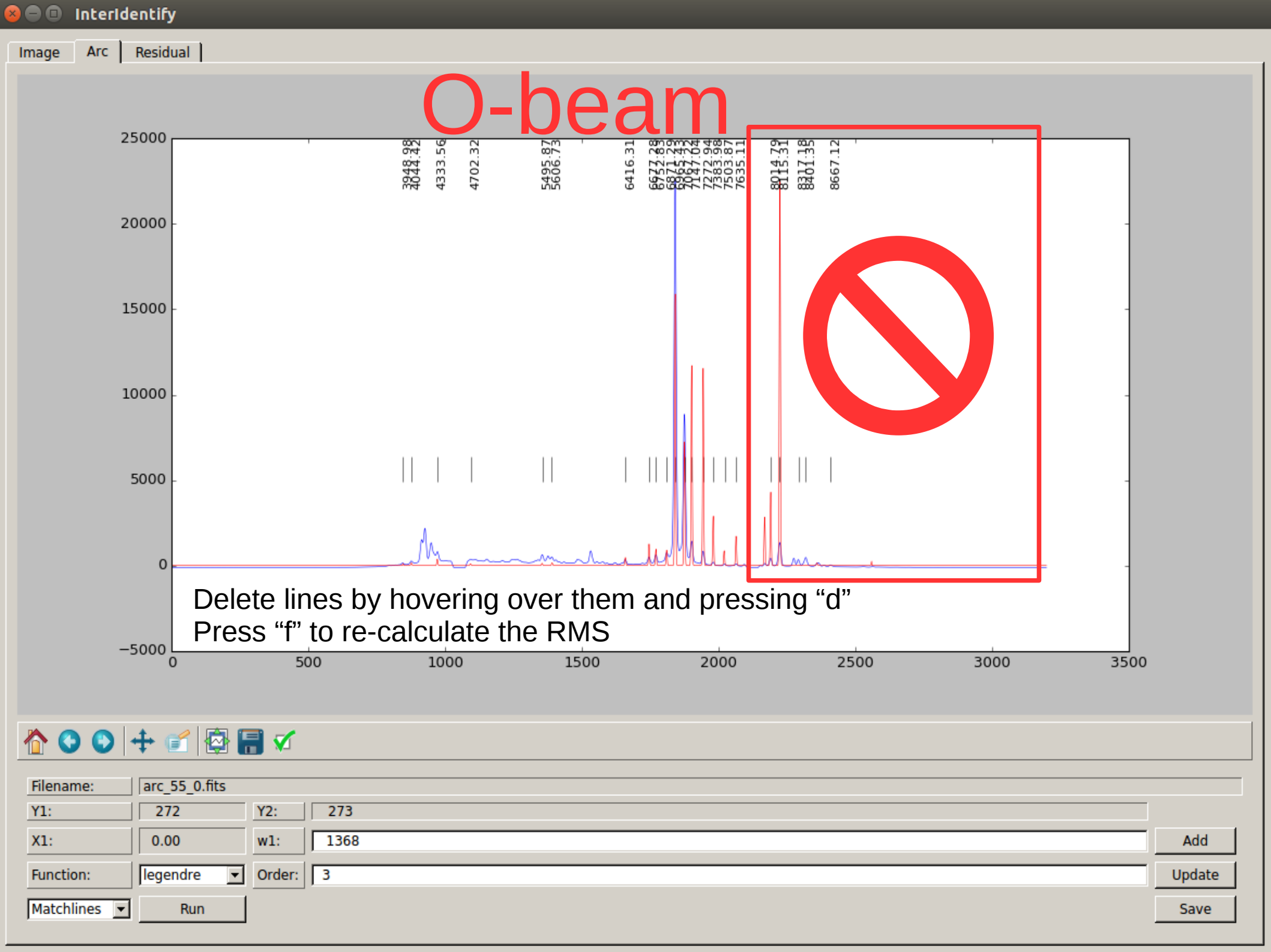
Filename: None

Average: 2.2e-12 Std(A): 0.75

Sigma: 1.5 Niter: 5 Reject

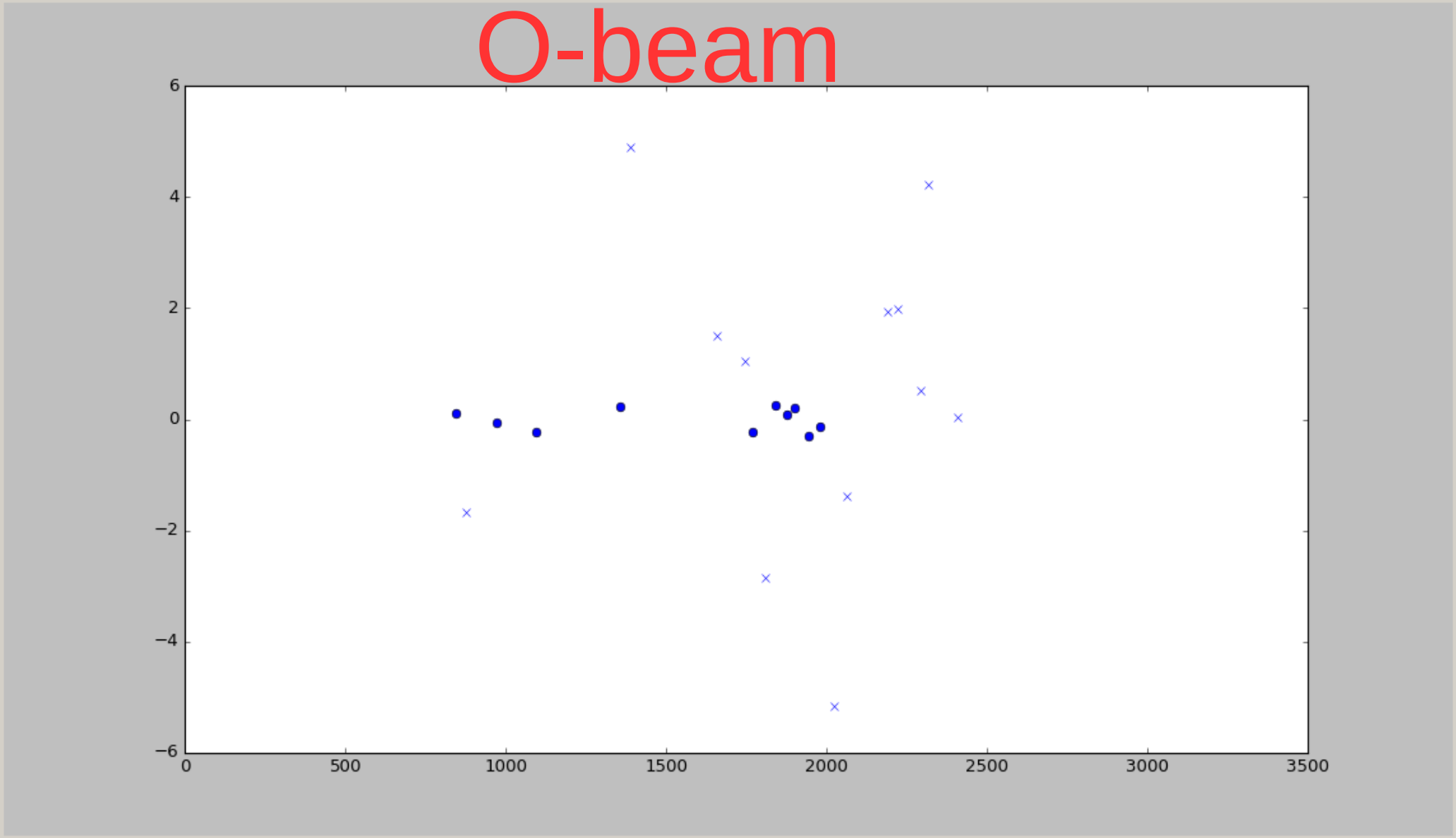
Be aware of the following in PG300 grating observations


InterIdentify
Image
Arc
Residual
O-beam
600
500
400
300
200
100
0
−100
−500
0
500
1000
1500
2000
3500
2nd order
contamination
x=-201.797
y=545.406
Filename:
arc_55_0.fits
Y1:
272
Y2:
273
Update
nrows:
1
rstep:
20
Next
Auto-Identify


InterIdentify
Image
Arc
Residual
O-beam
3948.98
4044.42
4333.56
4702.32
5495.87
5606.73
6416.31
6677.28
6752.83
6871.29
6965.43
7032.41
7147.04
7272.94
7383.98
7503.87
7635.11
8014.79
8115.31
8317.18
8401.35
8667.12
25000
20000
15000
10000
5000
0
−5000
0
500
1000
1500
2000
2500
3000
3500
Delete lines by hovering over them and pressing “d”
Press “f” to re-calculate the RMS
Filename:
arc_55_0.fits
Y1:
272
Y2:
273
X1:
0.00
w1:
1368
Add
Function:
legendre
Order:
3
Update
Matchlines
Run
Save

InterIdentify

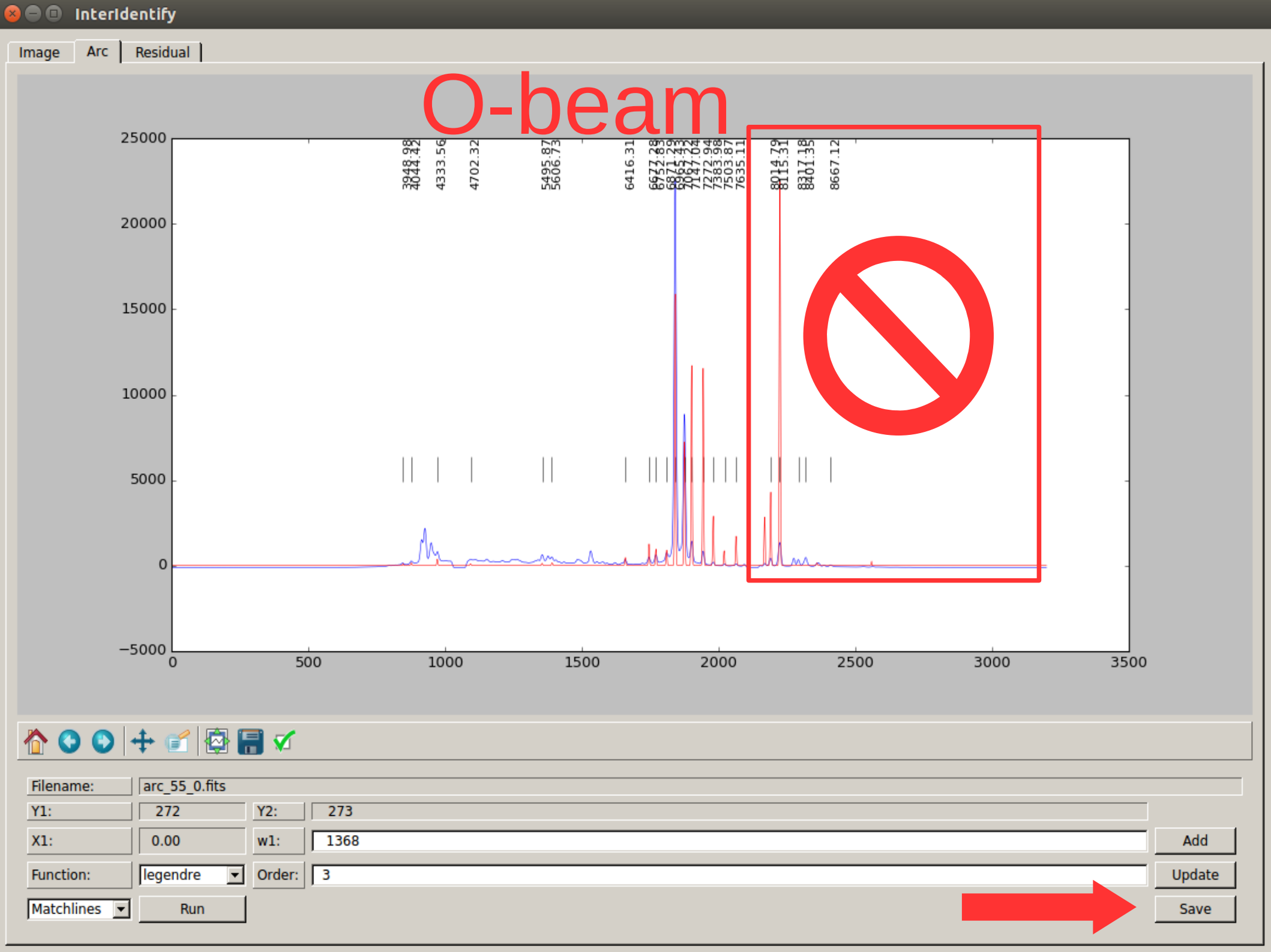
Image | Arc | Residual

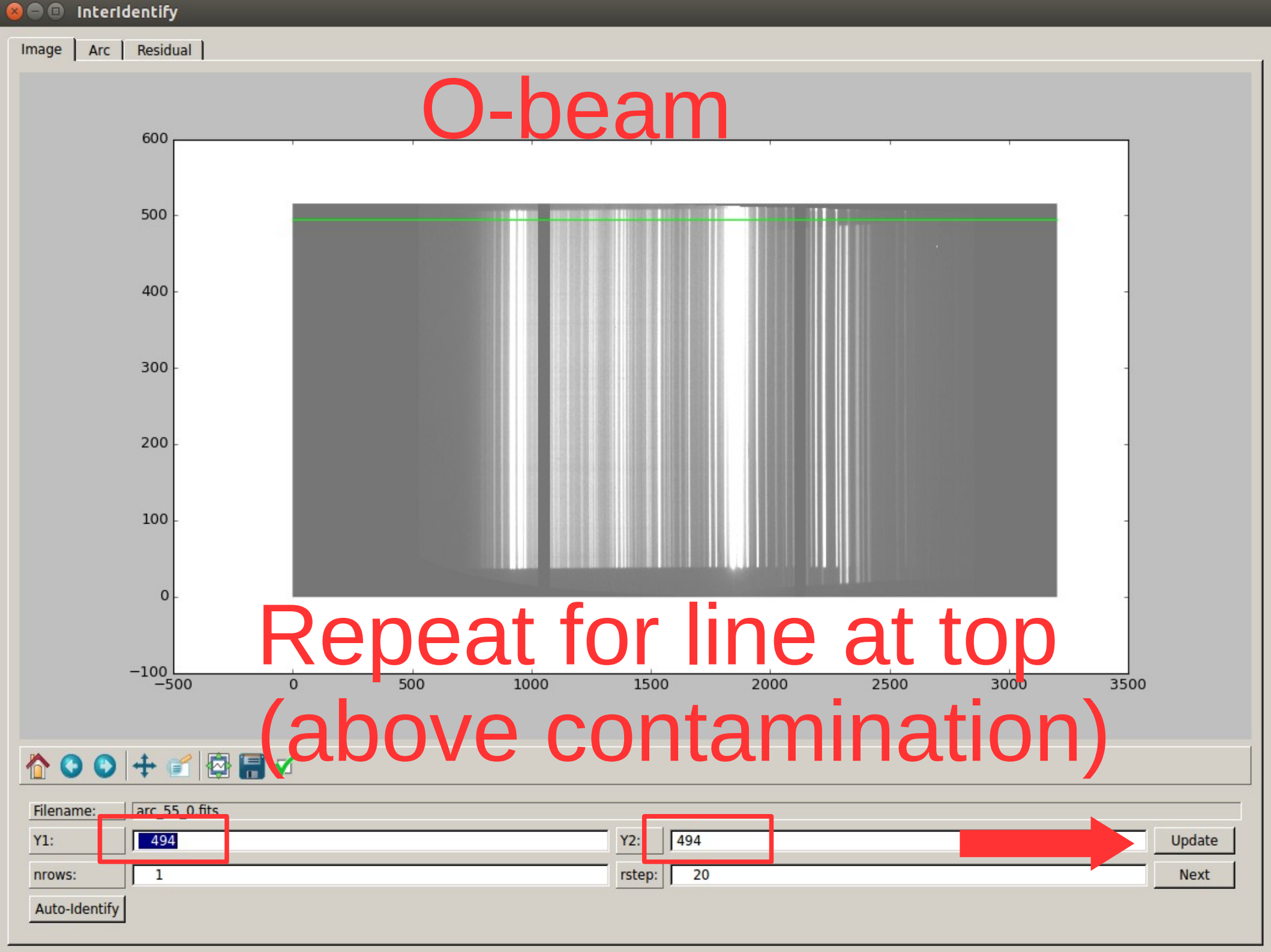


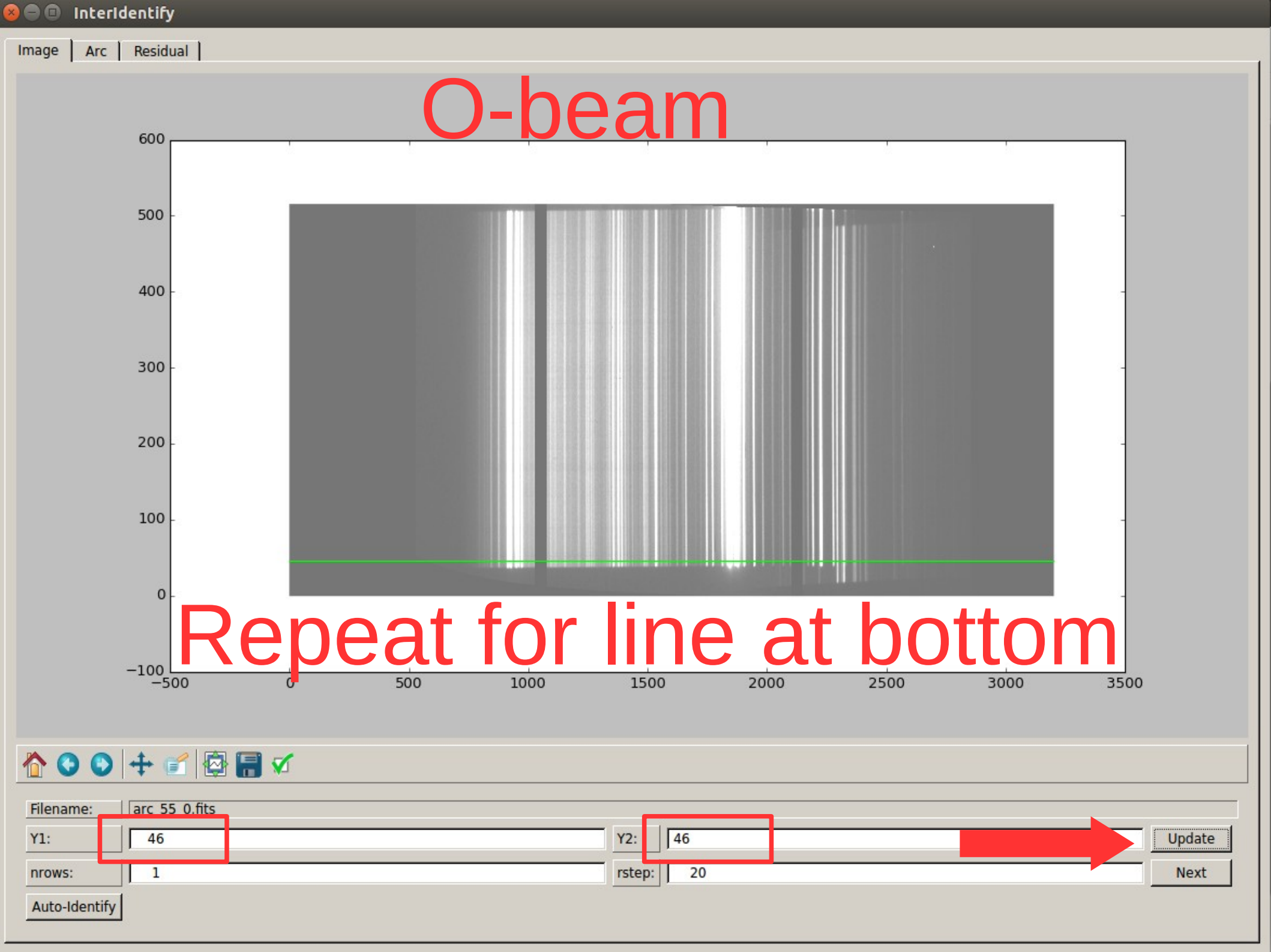
Filename: None

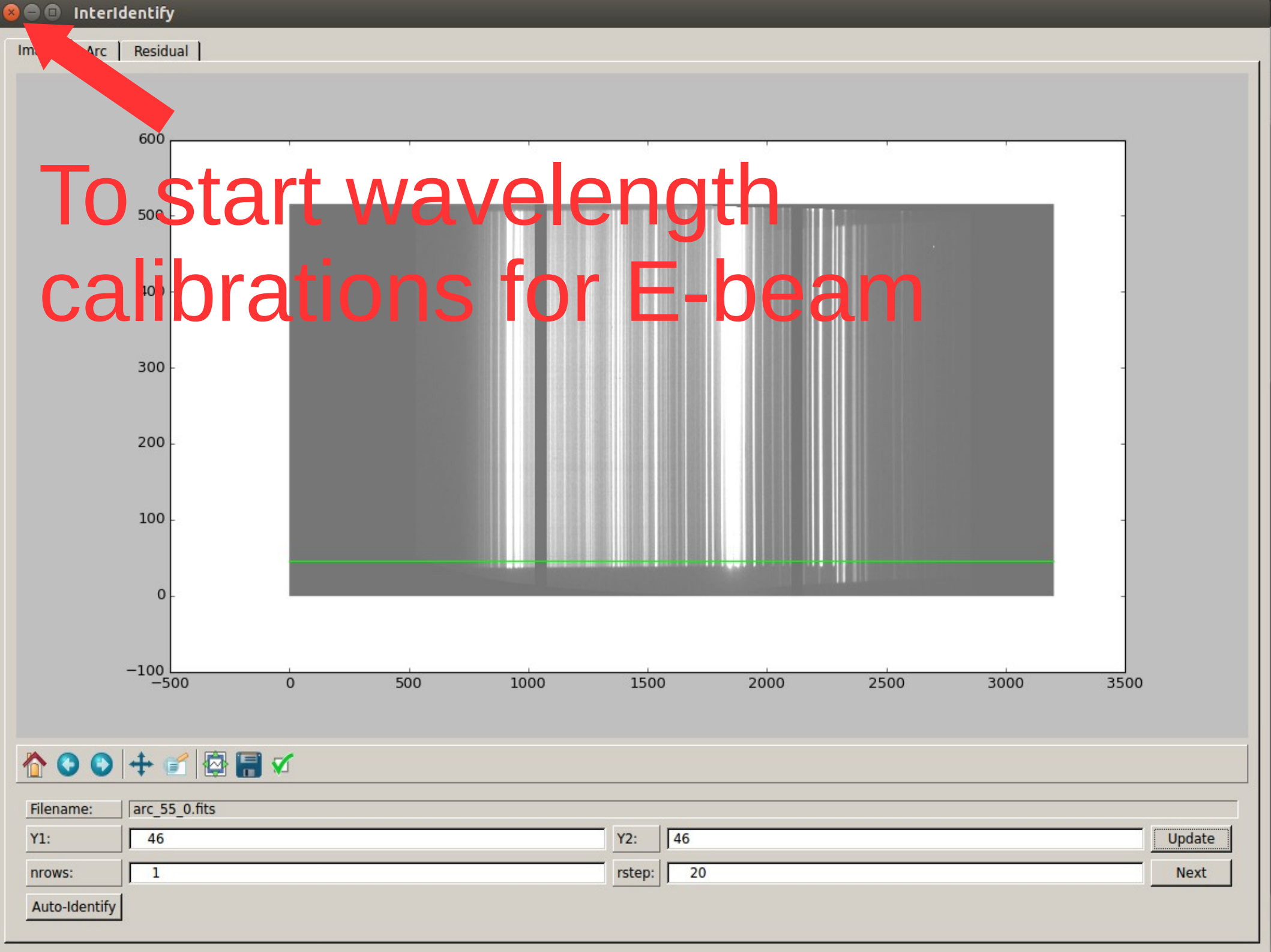
Average: -0.0033 Std(A): 0.2

Sigma: 1.5 Niter: 5 Reject


InterIdentify
Image
Arc
Residual
O-beam
25000
20000
15000
10000
5000
0
−5000
0
500
1000
1500
2000
2500
3000
3500
3948.98
4044.42
4333.56
4702.32
5495.87
5606.73
6416.31
6677.28
6752.83
6871.29
6965.43
7032.41
7147.04
7272.94
7383.98
7503.87
7635.11
8014.79
8115.31
8317.18
8401.35
8667.12
Filename:
arc_55_0.fits
Y1:
272
Y2:
273
X1:
0.00
w1:
1368
Add
Function:
legendre
Order:
3
Update
Matchlines
Run
Save


InterIdentify
Image
Arc
Residual
O-beam
600
500
400
300
200
100
0
−100
−500
0
500
1000
1500
2000
2500
3000
3500
Repeat for line at top
(above contamination)
Filename:
arc_55_0.fits
Y1:
494
Y2:
494
Update
nrows:
1
rstep:
20
Next
Auto-Identify


InterIdentify
Image
Arc
Residual
O-beam
600
500
400
300
200
100
0
−100
−500
0
500
1000
1500
2000
2500
3000
3500
Repeat for line at bottom
Filename:
arc_55_0.fits
Y1:
46
Y2:
46
Update
nrows:
1
rstep:
20
Next
Auto-Identify


InterIdentify
Im
Arc
Residual
To start wavelength calibrations for E-beam
600
500
400
300
200
100
0
−100
−500
0
500
1000
1500
2000
2500
3000
3500
Filename:
arc_55_0.fits
Y1:
46
Y2:
46
Update
nrows:
1
rstep:
20
Next
Auto-Identify

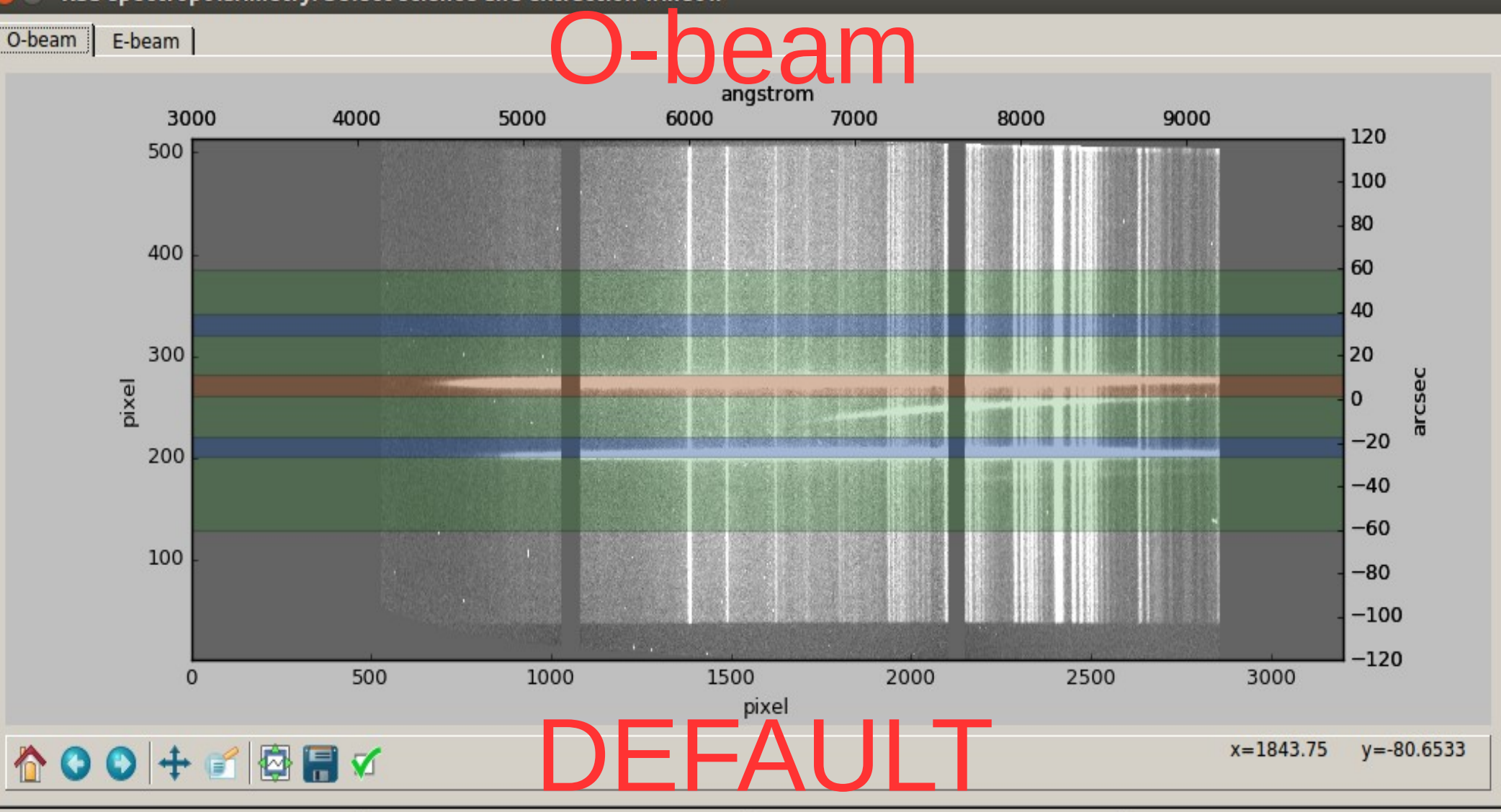
Step 3:
Background subtraction
and
spectra extraction

Script used: specpolextract_sc.py (specpolextract_dev.py*)

- In each image, beams are corrected for beamsplitter distortion and tilt using brightest spectrum in the image.
- Produces "cwmxgbPp.." fits files
- Next sky and spectrum is extracted vs wavelength, extracted O and E spectra stored as a 1D "image".
- Produces "ecwmxgbPp.." fits file.

RSS spectropolarimetry: Select science and extraction window

O-beam E-beam



x=1843.75 y=-80.6533

Science locate window: GREEN	arcsec	pixel
width	120	257
top	60	385
bottom	-60	128

Extraction window: RED	arcsec	pixel
width	10	20
top	12	281
bottom	2	261

Background window - above: BLUE	arcsec	pixel
width	10	20
top	40	341
bottom	30	321

Background window - below: BLUE	arcsec	pixel
width	10	20
top	-16	221
bottom	-26	201

Fits wmxgbpP201604070037.fits

Update tilt correction and windows

Update background windows

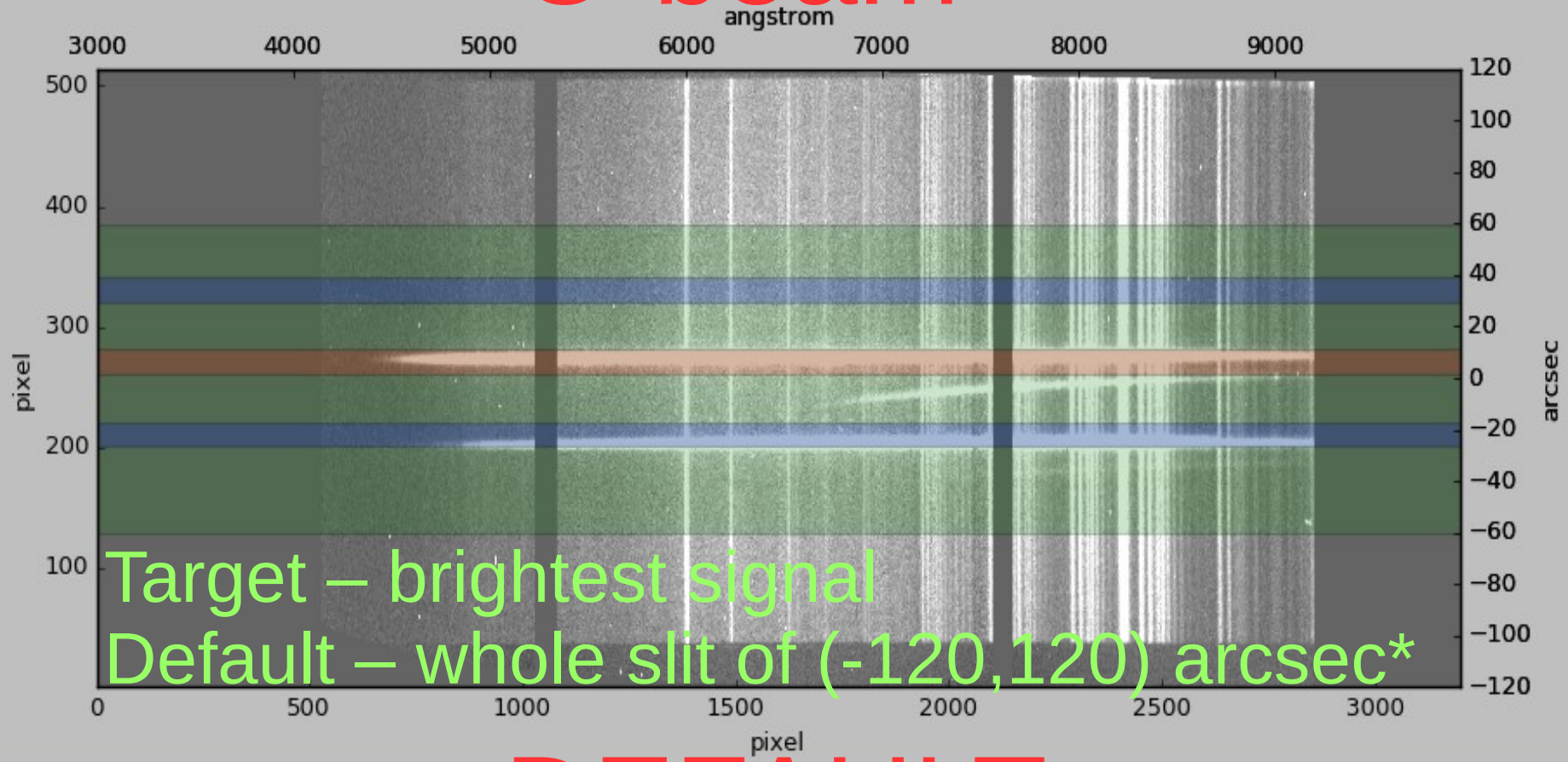
Cancel OK

RSS spectropolarimetry: Select science and extraction window

O-beam

O-beam

E-beam



Target – brightest signal

Default – whole slit of (-120,120) arcsec*

DEFAULT

x=1843.75 y=-80.6533

Science locate window: GREEN	arcsec	pixel
width	120	257
top	60	385
bottom	-60	128

Extraction window: RED	arcsec	pixel
width	10	20
top	12	281
bottom	2	261

Background window - above: BLUE	arcsec	pixel
width	10	20
top	40	341
bottom	30	321

Background window - below: BLUE	arcsec	pixel
width	10	20
top	-16	221
bottom	-26	201

Fits wmxgbpP201604070037.fits

Update tilt correction and windows

Update background windows

Cancel

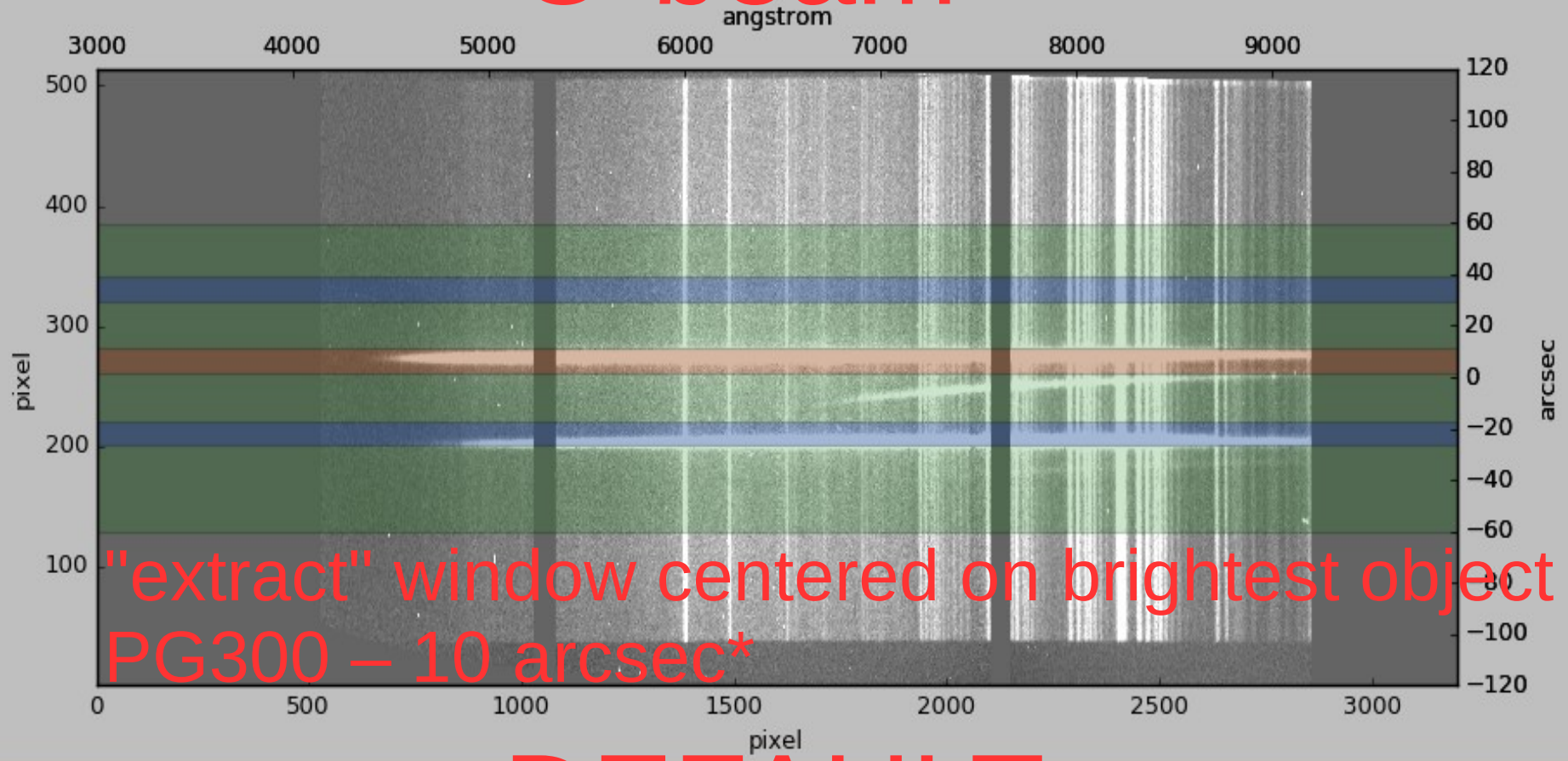
OK

RSS spectropolarimetry: Select science and extraction window

O-beam

O-beam

E-beam



"extract" window centered on brightest object

PG300 – 10 arcsec*

DEFAULT

x=1843.75 y=-80.6533

Science locate window: GREEN	arcsec	pixel
width	120	257
top	60	385
bottom	-60	128

Extraction window: RED	arcsec	pixel
width	10	20
top	12	281
bottom	2	261

Background window - above: BLUE	arcsec	pixel
width	10	20
top	40	341
bottom	30	321

Background window - below: BLUE	arcsec	pixel
width	10	20
top	-16	221
bottom	-26	201

Fits wmxgbpP201604070037.fits

Update tilt correction and windows

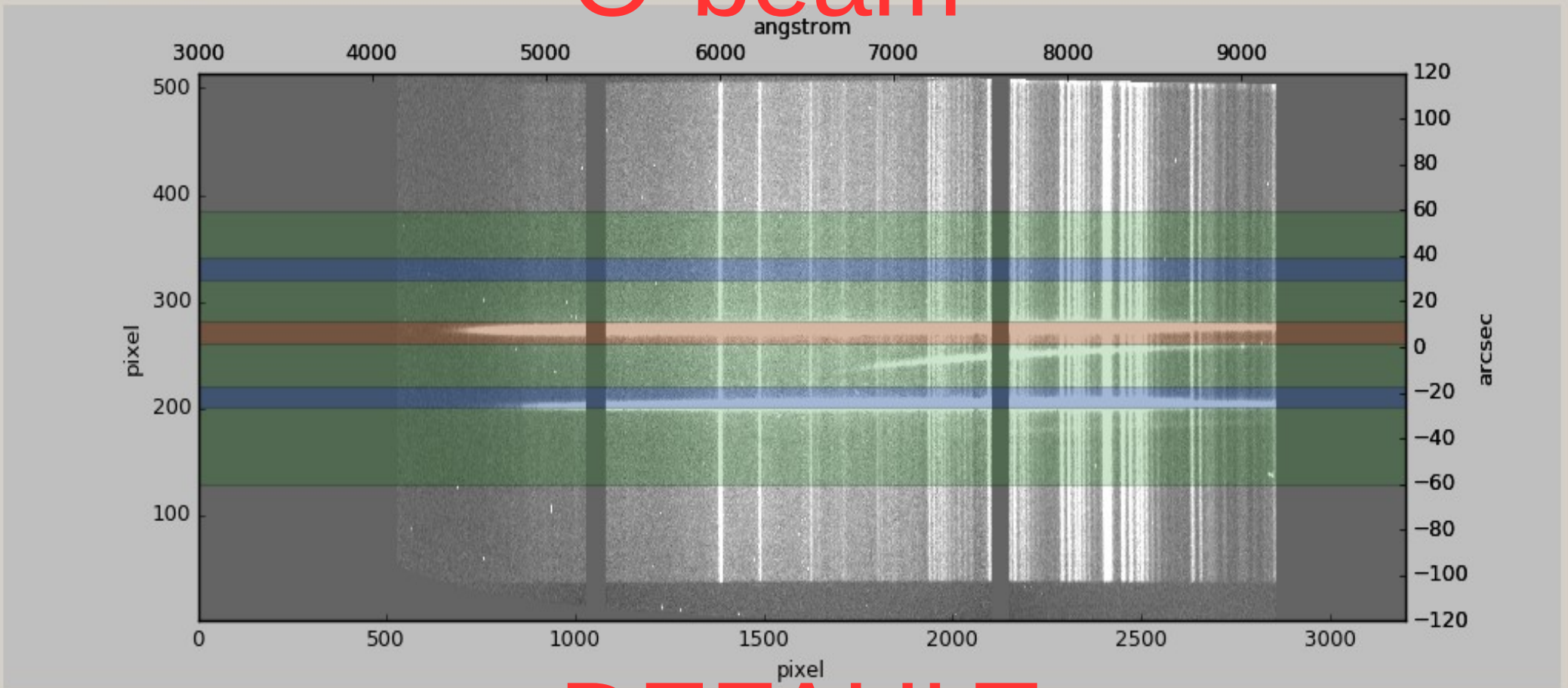
Update background windows

Cancel OK

RSS spectropolarimetry: Select science and extraction window

O-beam E-beam

O-beam



DEFAULT

x=1843.75 y=-80.6533

Science locate window: GREEN	arcsec	pixel
width	120	257
top	60	385
bottom	-60	128

Extraction window: RED	arcsec	pixel
width	10	20
top	12	281
bottom	2	261

Background window - above: BLUE	arcsec	pixel
width	10	20
top	40	341
bottom	30	321

Background window - below: BLUE	arcsec	pixel
width	10	20
top	-16	221
bottom	-26	201

Fits wmxgbpP201604070037.fits

Update tilt correction and windows

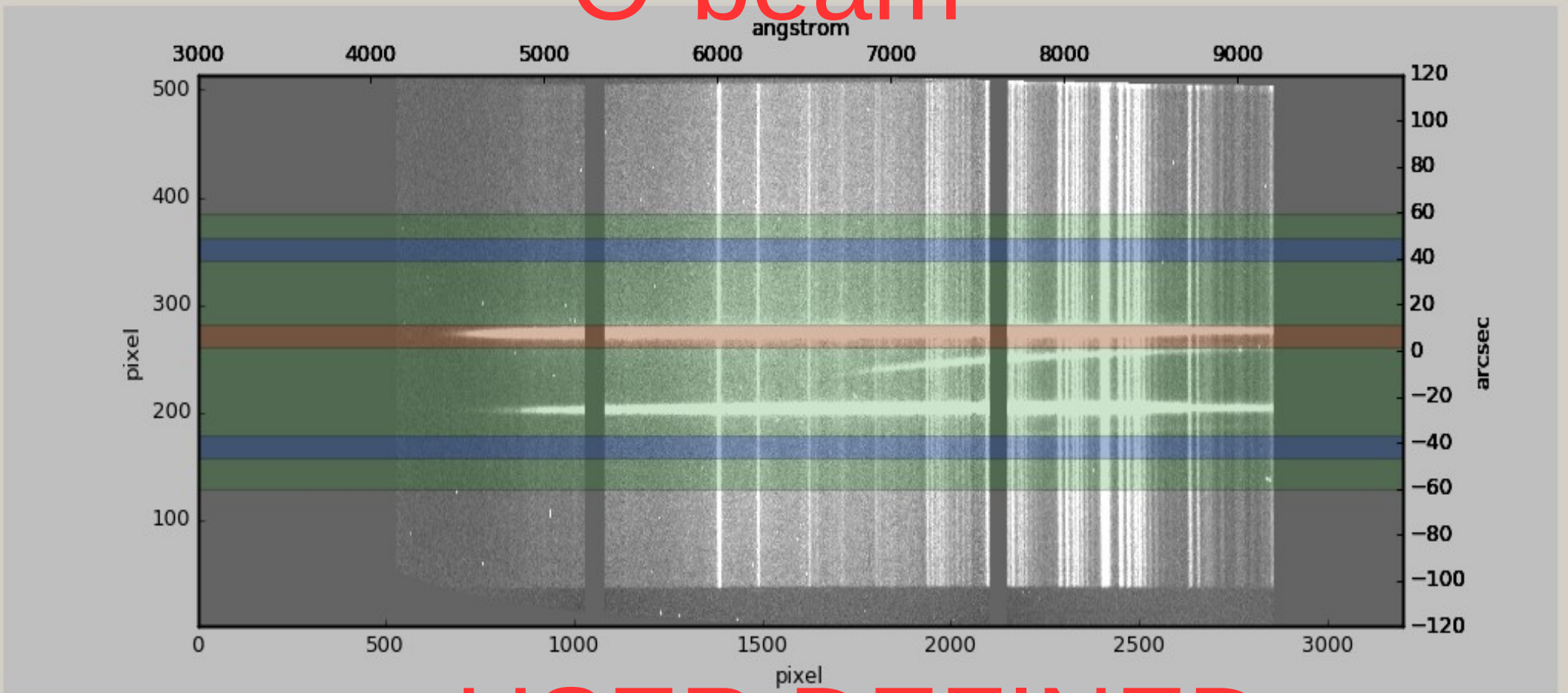
Update background windows

Cancel OK

RSS spectropolarimetry: Select science and extraction window

O-beam

E-beam



x=927.211 y=-10.5528

Science locate window: GREEN	arcsec	pixel
width	120	257
top	60	385
bottom	-60	128

Extraction window: RED	arcsec	pixel
width	10	20
top	12	281
bottom	2	2[illegible]

Background window - above: BLUE	arcsec	pixel
width	10	21
top	50	362
bottom	40	341

Background window - below: BLUE	arcsec	pixel
width	10	21
top	-36	179
bottom	-46	158

Fits wmxgbpP201604070037.fits

Update tilt correction and windows

Update background windows

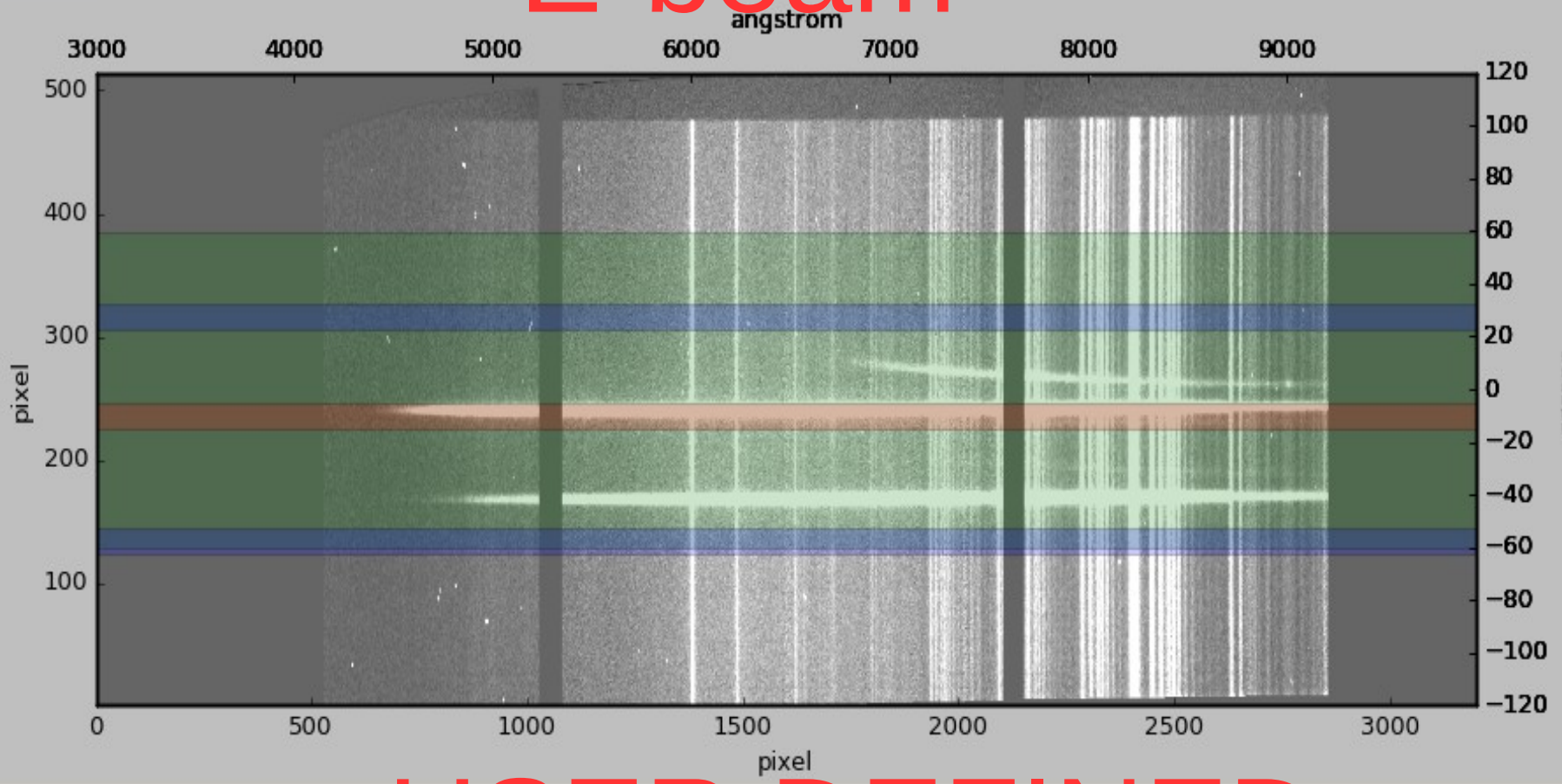
Cancel

OK

RSS spectropolarimetry: Select science and extraction window

O-beam | E-beam

E-beam



USER DEFINED

x=1432.32 y=-33.9196

Science locate window: GREEN	arcsec	pixel
width	120	257
top	60	385
bottom	-60	128

Extraction window: RED	arcsec	pixel
width	10	20
top	-5	246
bottom	-15	2

Background window - above: BLUE	arcsec	pixel
width	10	21
top	33	327
bottom	23	306

Background window - below: BLUE	arcsec	pixel
width	10	21
top	-53	144
bottom	-63	123

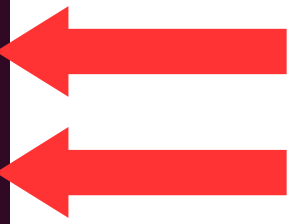
Fits wmxgbpP201604070037.fits | Update tilt correction and windows | Update background windows | Cancel | OK

Another problem to take note of:

```
specpolextract_dev version: 20180524
wmxgbpP201604070037.fits : brtest object at    1.0 arcsec,
wmxgbpP201604070038.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070039.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070040.fits : brtest object at    1.0 arcsec,
wmxgbpP201604070041.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070042.fits : brtest object at    1.0 arcsec,
wmxgbpP201604070043.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070044.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070045.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070046.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070047.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070048.fits : brtest object at  -34.5 arcsec,
wmxgbpP201604070049.fits : brtest object at  -34.5 arcsec,
wmxgbpP201604070050.fits : brtest object at  -34.5 arcsec,
wmxgbpP201604070051.fits : brtest object at  -34.5 arcsec,
wmxgbpP201604070052.fits : brtest object at  -34.5 arcsec,
```

Another problem to take note of:

```
specpolextract_dev version: 20180524
wmxgbpP201604070037.fits : brtest object at    1.0 arcsec,
wmxgbpP201604070038.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070039.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070040.fits : brtest object at    1.0 arcsec,
wmxgbpP201604070041.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070042.fits : brtest object at    1.0 arcsec,
wmxgbpP201604070043.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070044.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070045.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070046.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070047.fits : brtest object at  -35.0 arcsec,
wmxgbpP201604070048.fits : brtest object at  -34.5 arcsec,
wmxgbpP201604070049.fits : brtest object at  -34.5 arcsec,
wmxgbpP201604070050.fits : brtest object at  -34.5 arcsec,
wmxgbpP201604070051.fits : brtest object at  -34.5 arcsec,
wmxgbpP201604070052.fits : brtest object at  -34.5 arcsec,
```



Step 4:
Raw stokes calculations

Script used: specpolrawstokes.py (specpolrawstokes_dev.py*)

- “Waveplate position pairs” identified – (4 waveplate positions stations, 45 degrees apart).
- Taken together – result in linear polarization signal swapping between the O and E beams.
- Combined into "raw stokes" fits files – basically single stokes parameters (unnormalized “I” plane and an “S” plane, the stokes degree of polarization being S/I).
- Rawstokes files are named <object>_<config>_h<12>_<cycle>.fits, for instance WR113_c0_h26_02.fits for object WR113, first configuration, waveplate position pair 2 and 6, second cycle of waveplate pattern.

RSS spectropolarimetry

POLSALT code directory: /home/dviljoen/polarimetry/polsalt-beta [Select]

Top level data directory: /home/dviljoen/polarimetry/AR_Sco/20160407 [Select]

Raw data directory: /home/dviljoen/polarimetry/AR_Sco/20160407/raw [...]

Science data directory: /home/dviljoen/polarimetry/AR_Sco/20160407/sci [...]

Data reduction step: Raw Stokes calculation [Show files] [Select all] [Deselect all]

	File	Wave plate pattern	Half wave plate	Quarter wave plate	Ima
1	☑ ecwmxgbpP201604070037.fits	LINEAR-HI	0 - 0 deg	0 - 0 deg	OBJE
2	☑ ecwmxgbpP201604070038.fits	LINEAR-HI	4 - 45.00 deg	0 - 0 deg	OBJE
3	☑ ecwmxgbpP201604070039.fits	LINEAR-HI	2 - 22.50 deg	0 - 0 deg	OBJE
4	☑ ecwmxgbpP201604070040.fits	LINEAR-HI	6 - 67.50 deg	0 - 0 deg	OBJE
5	☑ ecwmxgbpP201604070041.fits	LINEAR-HI	1 - 11.25 deg	0 - 0 deg	OBJE
6	☑ ecwmxgbpP201604070042.fits	LINEAR-HI	5 - 56.25 deg	0 - 0 deg	OBJE
7	☑ ecwmxgbpP201604070043.fits	LINEAR-HI	3 - 33.75 deg	0 - 0 deg	OBJE
8	☑ ecwmxgbpP201604070044.fits	LINEAR-HI	7 - 78.75 deg	0 - 0 deg	OBJE
9	☑ ecwmxgbpP201604070045.fits	LINEAR-HI	0 - 0 deg	0 - 0 deg	OBJE
10	☑ ecwmxgbpP201604070046.fits	LINEAR-HI	4 - 45.00 deg	0 - 0 deg	OBJE
11	☑ ecwmxgbpP201604070047.fits	LINEAR-HI	2 - 22.50 deg	0 - 0 deg	OBJE
12	☑ ecwmxgbpP201604070048.fits	LINEAR-HI	6 - 67.50 deg	0 - 0 deg	OBJE
13	☑ ecwmxgbpP201604070049.fits	LINEAR-HI	1 - 11.25 deg	0 - 0 deg	OBJE
14	☑ ecwmxgbpP201604070050.fits	LINEAR-HI	5 - 56.25 deg	0 - 0 deg	OBJE

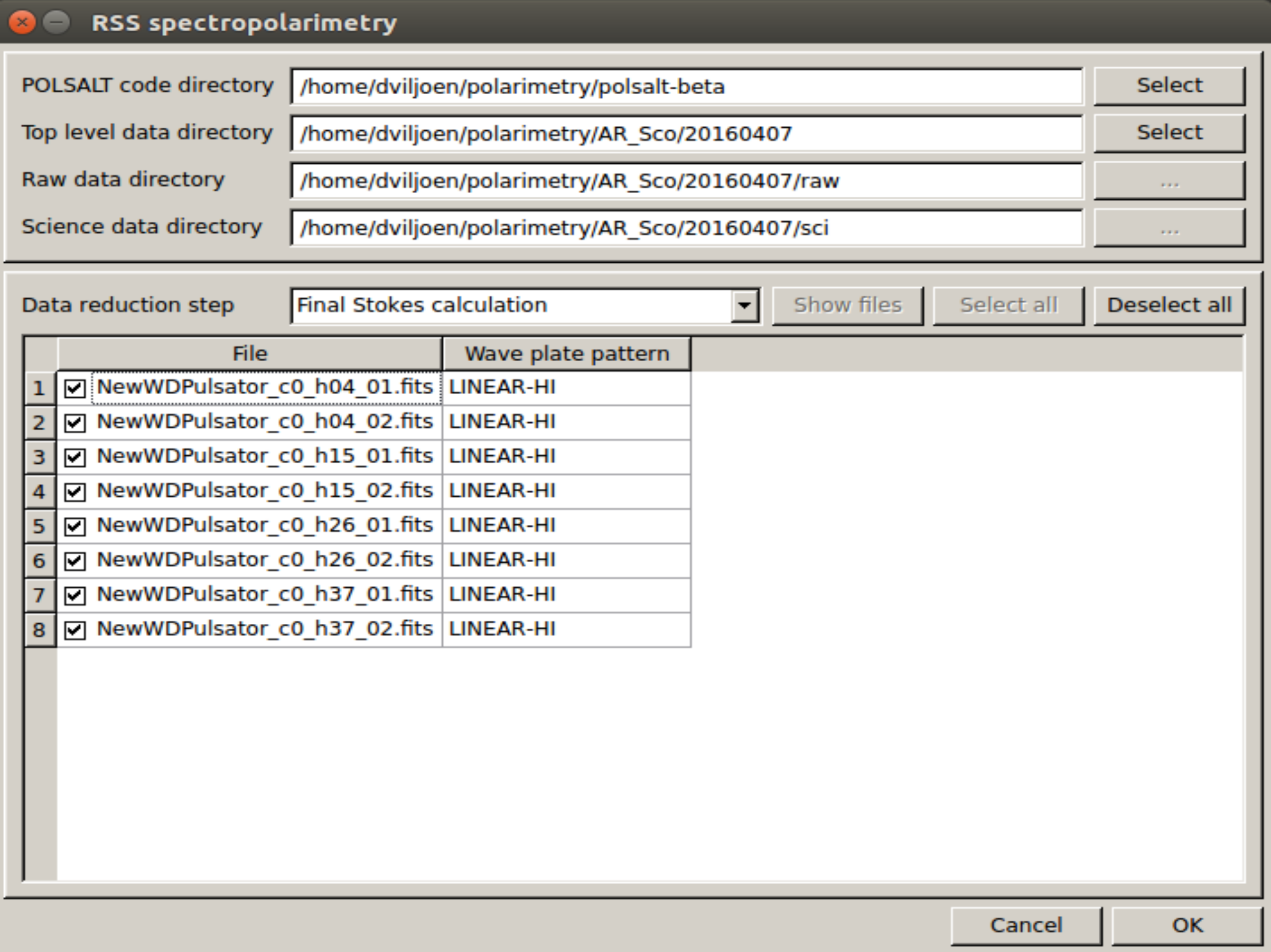
[Cancel] [OK]

```
SPECPOLRAWSTOKES
infilelist=['ecwmxgbpP201604070037.fits', 'ecwmxgbpP201604070038.fits', 'ecwmxgbpP201604070039.fits', 'ecwmxgbpP201604070040.fits',
'ecwmxgbpP201604070041.fits', 'ecwmxgbpP201604070042.fits', 'ecwmxgbpP201604070043.fits', 'ecwmxgbpP201604070044.fits', 'ecwmxgbpP20
1604070045.fits', 'ecwmxgbpP201604070046.fits', 'ecwmxgbpP201604070047.fits', 'ecwmxgbpP201604070048.fits', 'ecwmxgbpP201604070049.f
its', 'ecwmxgbpP201604070050.fits', 'ecwmxgbpP201604070051.fits', 'ecwmxgbpP201604070052.fits']
logfile=specpolrawstokes.log debug=False



2018-11-02 12:29:31 MESSAGE ---------------------------------------
Starting specpolrawstokes

specpolrawstokes version: 20171226
Raw Stokes File     OBS CCDSUM GRATING  GR-ANGLE  CAMANG    WPPATERN
NewWDPulsator_c0_h04_01  0  4 2   PG0300     5.38    10.75    LINEAR-HI
NewWDPulsator_c0_h26_01  0  4 2   PG0300     5.38    10.75    LINEAR-HI
NewWDPulsator_c0_h15_01  0  4 2   PG0300     5.38    10.75    LINEAR-HI
NewWDPulsator_c0_h37_01  0  4 2   PG0300     5.38    10.75    LINEAR-HI
NewWDPulsator_c0_h04_02  0  4 2   PG0300     5.38    10.75    LINEAR-HI
NewWDPulsator_c0_h26_02  0  4 2   PG0300     5.38    10.75    LINEAR-HI
NewWDPulsator_c0_h15_02  0  4 2   PG0300     5.38    10.75    LINEAR-HI
NewWDPulsator_c0_h37_02  0  4 2   PG0300     5.38    10.75    LINEAR-HI

2018-11-02 12:29:33 MESSAGE ---------------------------------------
specpolrawstokes completed
```

Step 5:
Final stokes calculations

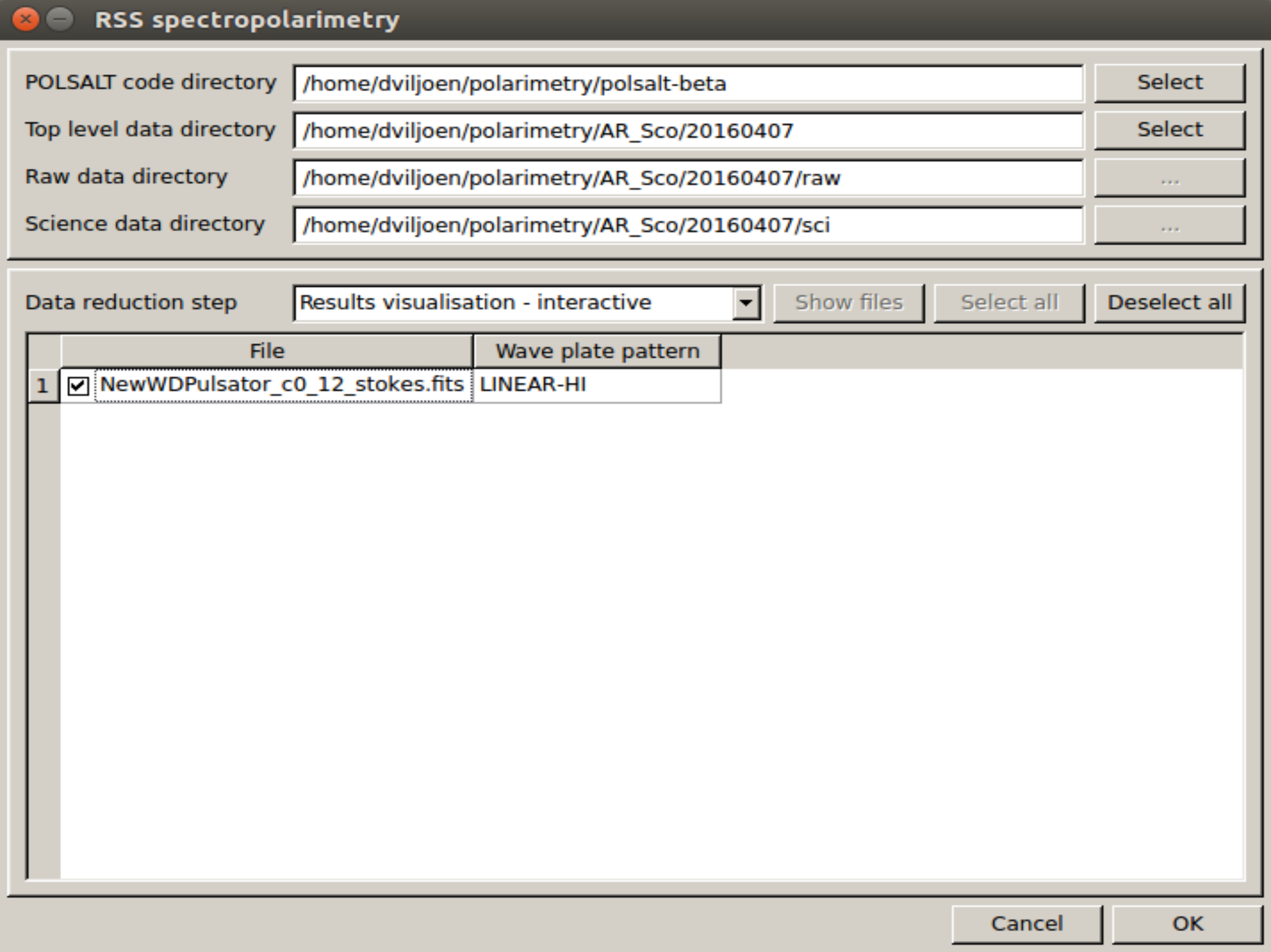
Sript used: specpolfinalstokes.py

- Evaluates full pattern to determine Q and U.
- Applies polarimetric zero-point and the waveplate efficiency calibrations along with axis calibrations to give the final stokes parameters.
- Saved as <object>_<config>_<cycles>_stokes.fits files, i.e. WR113_c0_1_stokes.fits for cycle #1, first configuration of WR113.
- Stored in this file is unnormalized stokes parameters I,Q,U, with degree of polarization being Q/I and U/I.


RSS spectropolarimetry
POLSALT code directory
/home/dviljoen/polarimetry/polsalt-beta
Select
Top level data directory
/home/dviljoen/polarimetry/AR_Sco/20160407
Select
Raw data directory
/home/dviljoen/polarimetry/AR_Sco/20160407/raw
...
Science data directory
/home/dviljoen/polarimetry/AR_Sco/20160407/sci
...
Data reduction step
Final Stokes calculation
Show files
Select all
Deselect all
File
Wave plate pattern
1 NewWDPulsator_c0_h04_01.fits LINEAR-HI
2 NewWDPulsator_c0_h04_02.fits LINEAR-HI
3 NewWDPulsator_c0_h15_01.fits LINEAR-HI
4 NewWDPulsator_c0_h15_02.fits LINEAR-HI
5 NewWDPulsator_c0_h26_01.fits LINEAR-HI
6 NewWDPulsator_c0_h26_02.fits LINEAR-HI
7 NewWDPulsator_c0_h37_01.fits LINEAR-HI
8 NewWDPulsator_c0_h37_02.fits LINEAR-HI
Cancel
OK

```
SPECPOLFINALSTOKES
infilelist=['NewWDPulsator_c0_h04_01.fits', 'NewWDPulsator_c0_h04_02.fits', 'NewWDPulsator_c0_h15_01.fits', 'NewWDPulsator_c0_h15_02
.fits', 'NewWDPulsator_c0_h26_01.fits', 'NewWDPulsator_c0_h26_02.fits', 'NewWDPulsator_c0_h37_01.fits', 'NewWDPulsator_c0_h37_02.fit
s']
logfile=specpolextract.log debug=False HW_Cal_override=False
Linear_PolZeropoint_override=False PAZeropoint_override=False


2018-11-02 13:23:17 MESSAGE ----------------------------------------
Starting specpolfinalstokes

specpolfinalstokes version: 20171226
  PA type: Equatorial
  PolCal Model: 20170429
  HWCal: RSSpol_HW_Calibration_20061030_v04.txt
  PolZeropoint: RSSpol_Linear_TelZeropoint_20061030_v01.txt
  PAZeropoint: RSSpol_Linear_PAZeropoint.txt 20061030_v00 0.0

Configuration: c0

  Observation: NewWDPulsator_c0_12  Date: 20160407

                   culled                   sys %err                   mean chisq
       HW    04   15   26   37      04      15      26      37    04    15    26    37
    net    :   17 1047    7  747   0.303   0.715   0.377   0.465  6.60  3.45  1.27  2.89

                   culled                   sys %err                   mean chisq
       HW          all             04      15      26      37    04    15    26    37
     Linhi:         18          -2.582   0.626   1.704  -3.030 10.95  3.87  8.24 12.37

  Estimated sys %error: 1.585%   Mean Chisq:   6.21

    NewWDPulsator_c0_12_stokes.fits Stokes I,Q,U

    No fluxdb data available

   Wavelen     % Q      % U     % Q Err  % U Err    % P      PA     % P Err  PA  Err
    6571.71    1.9772  -3.4102   0.0241   0.0212   3.9419  150.052  0.0241    0.154


2018-11-02 13:23:18 MESSAGE ----------------------------------------
specpolfinalstokes completed
```

Step 6: Visualisation


RSS spectropolarimetry
POLSALT code directory
/home/dviljoen/polarimetry/polsalt-beta
Select
Top level data directory
/home/dviljoen/polarimetry/AR_Sco/20160407
Select
Raw data directory
/home/dviljoen/polarimetry/AR_Sco/20160407/raw
...
Science data directory
/home/dviljoen/polarimetry/AR_Sco/20160407/sci
...
Data reduction step
Results visualisation - interactive
Show files
Select all
Deselect all
File
Wave plate pattern
1
NewWDPulsator_c0_12_stokes.fits
LINEAR-HI
Cancel
OK

RSS spectropolarimetry: Visualise results

Plotting options | Plotting parameters

Standard plotting:

- (•) Intensity, Polarisation, Position angle
- ( ) Intensity, Stokes Q, Stokes U

Binning:

- (•) Unbinned
- ( ) Binned
  - 0 angstrom bin width
  - [ ] Show error bars

Custom plotting:

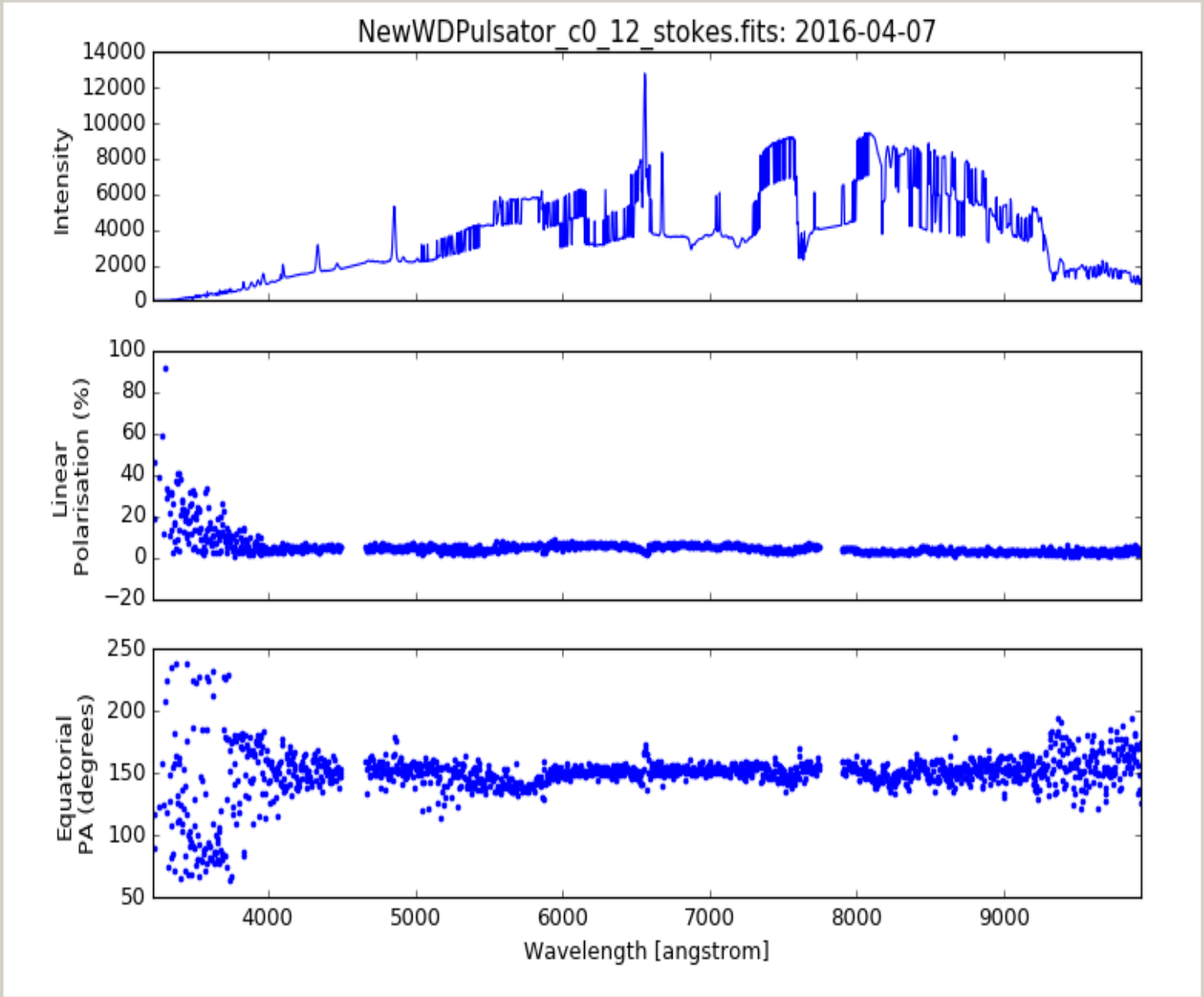
- [ ] Create custom plot
  - x-axis
  - y-axis

Output to .pdf:

- [x] Overview
- [ ] Intensity
- [ ] Polarisation / Stokes Q
- [ ] Position angle / Stokes U
- [ ] Custom

Plot results | Save .pdf | Clear plots

Overview | Intensity | Polarisation / Stokes Q | Position angle / Stokes U | Custom



x= y=95.2727

File: NewWDPulsator_c0_12_stokes.fits

Cancel | OK

RSS spectropolarimetry: Visualise results

Plotting options | Plotting parameters

Standard plotting:

- (•) Intensity, Polarisation, Position angle
- ( ) Intensity, Stokes Q, Stokes U

Binning:

- (•) Unbinned
- ( ) Binned
  - 0 angstrom bin width
  - [ ] Show error bars

Custom plotting:

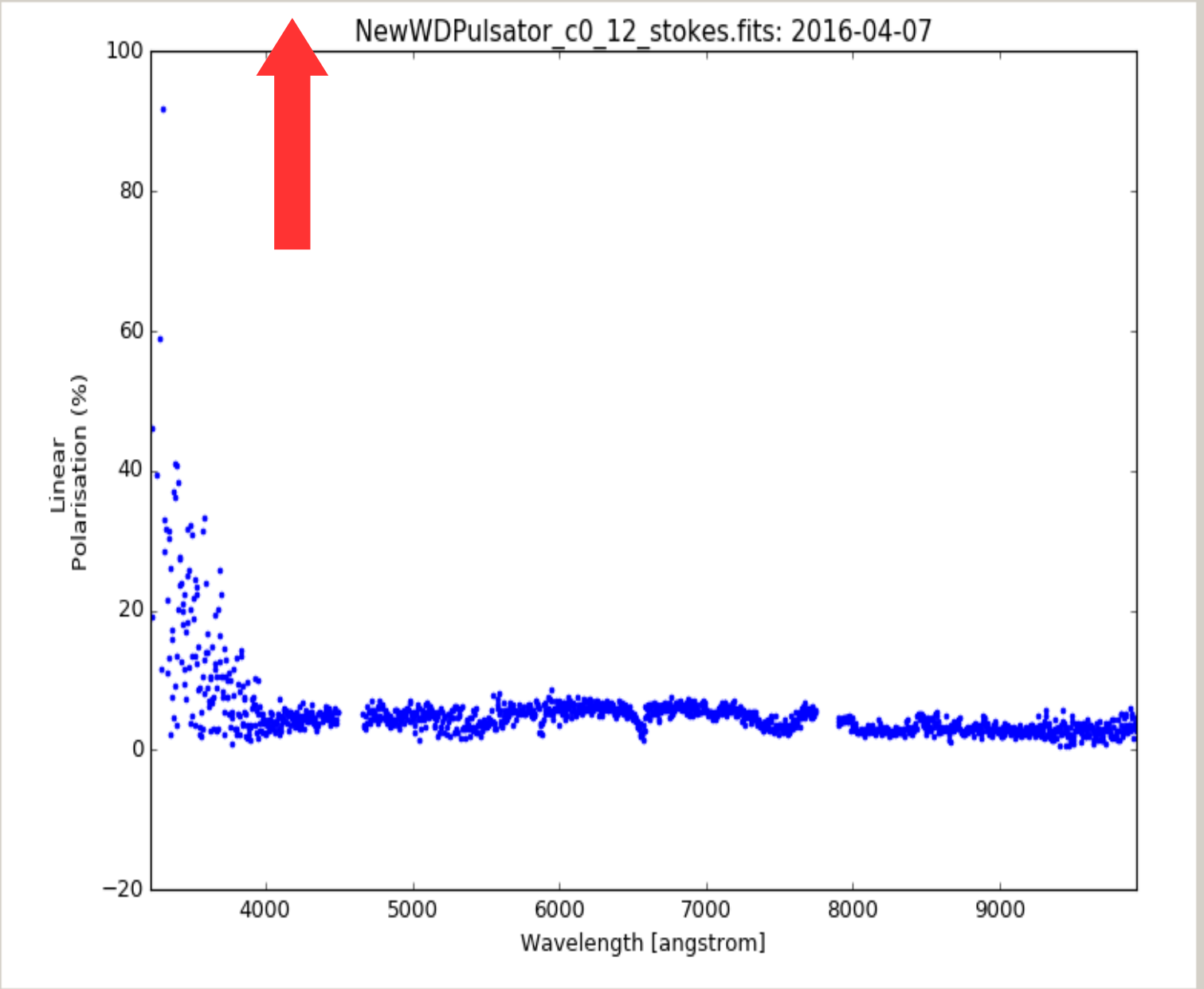
- [ ] Create custom plot
  - x-axis
  - y-axis

Output to .pdf:

- [x] Overview
- [ ] Intensity
- [ ] Polarisation / Stokes Q
- [ ] Position angle / Stokes U
- [ ] Custom

Plot results | Save .pdf | Clear plots

Overview | Intensity | Polarisation / Stokes Q | Position angle / Stokes U | Custom



x=3353.29 y=30.0535

File NewWDPulsator_c0_12_stokes.fits

Cancel | OK

RSS spectropolarimetry: Visualise results

Plotting options | Plotting parameters

Standard plotting:

- (•) Intensity, Polarisation, Position angle
- ( ) Intensity, Stokes Q, Stokes U

Binning:

- (•) Unbinned
- ( ) Binned
  - 0 angstrom bin width
  - [ ] Show error bars

Custom plotting:

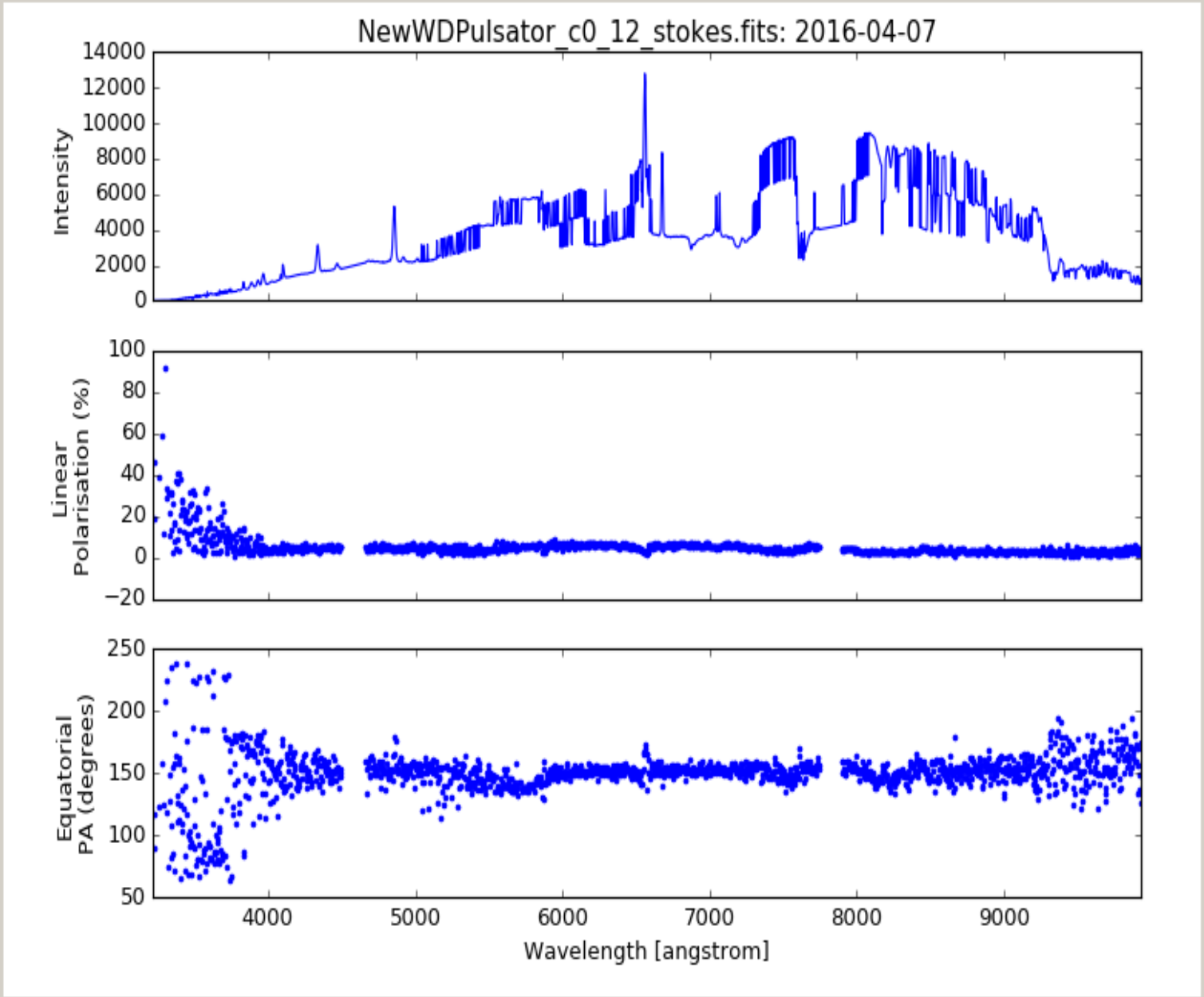
- [ ] Create custom plot
  - x-axis
  - y-axis

Output to .pdf:

- [x] Overview
- [ ] Intensity
- [ ] Polarisation / Stokes Q
- [ ] Position angle / Stokes U
- [ ] Custom

Plot results | Save .pdf | Clear plots

Overview | Intensity | Polarisation / Stokes Q | Position angle / Stokes U | Custom



x= y=95.2727

File: NewWDPulsator_c0_12_stokes.fits

Cancel | OK

RSS spectropolarimetry: Visualise results

Plotting options | Plotting parameters

Standard plotting:

- (•) Intensity, Polarisation, Position angle
- ( ) Intensity, Stokes Q, Stokes U

Binning:

- (•) Unbinned
- ( ) Binned
  - 0 angstrom bin width
  - [ ] Show error bars

Custom plotting:

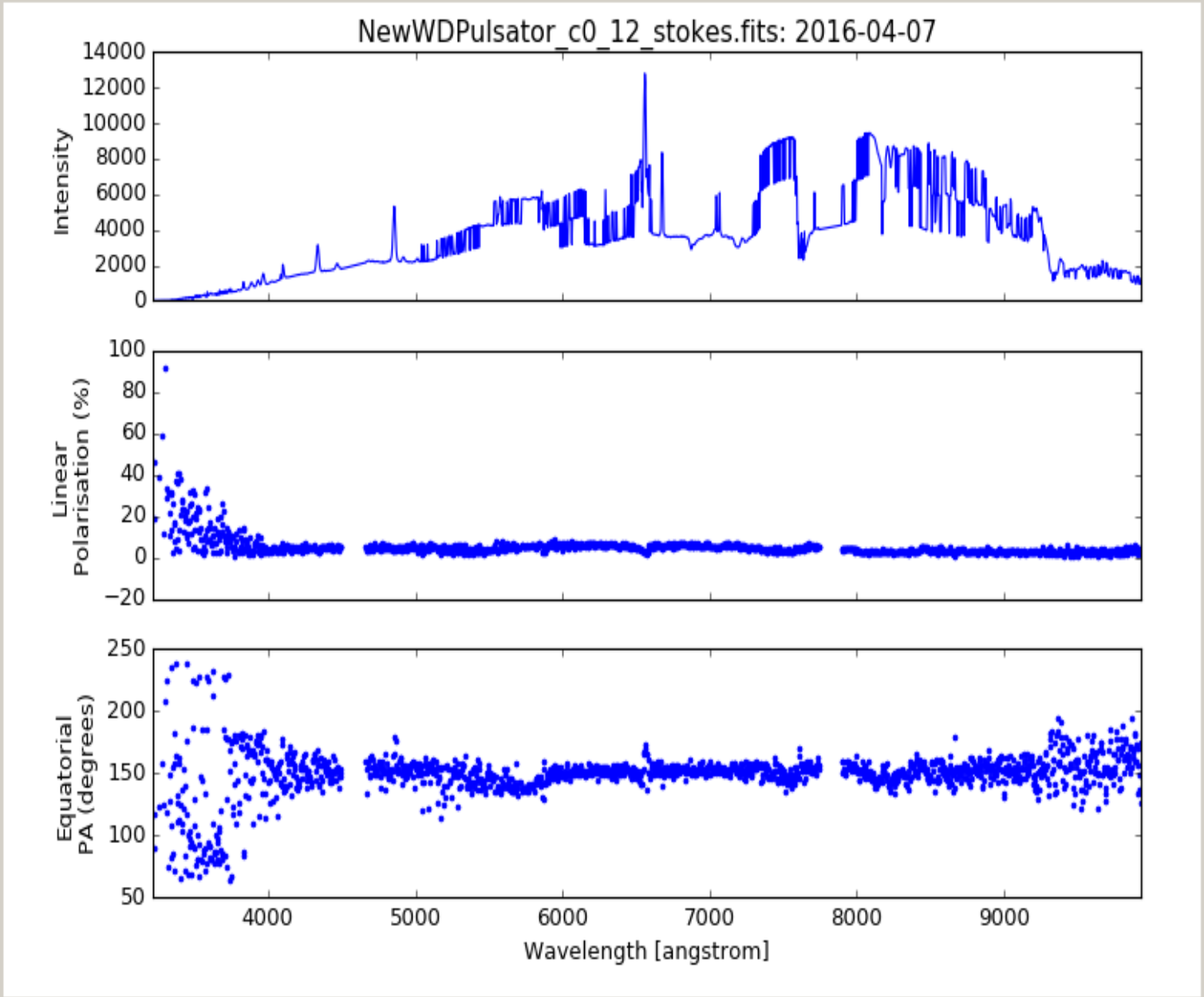
- [ ] Create custom plot
  - x-axis
  - y-axis

Output to .pdf:

- [x] Overview
- [ ] Intensity
- [ ] Polarisation / Stokes Q
- [ ] Position angle / Stokes U
- [ ] Custom

Plot results | Save .pdf | Clear plots

Overview | Intensity | Polarisation / Stokes Q | Position angle / Stokes U | Custom



x= y=95.2727

File: NewWDPulsator_c0_12_stokes.fits

Cancel | OK

RSS spectropolarimetry: Visualise results

Plotting options | Plotting parameters

Standard plotting:

- (•) Intensity, Polarisation, Position angle
- ( ) Intensity, Stokes Q, Stokes U

Binning:

- (•) Unbinned
- ( ) Binned
  - 0 angstrom bin width
  - [ ] Show error bars

Custom plotting:

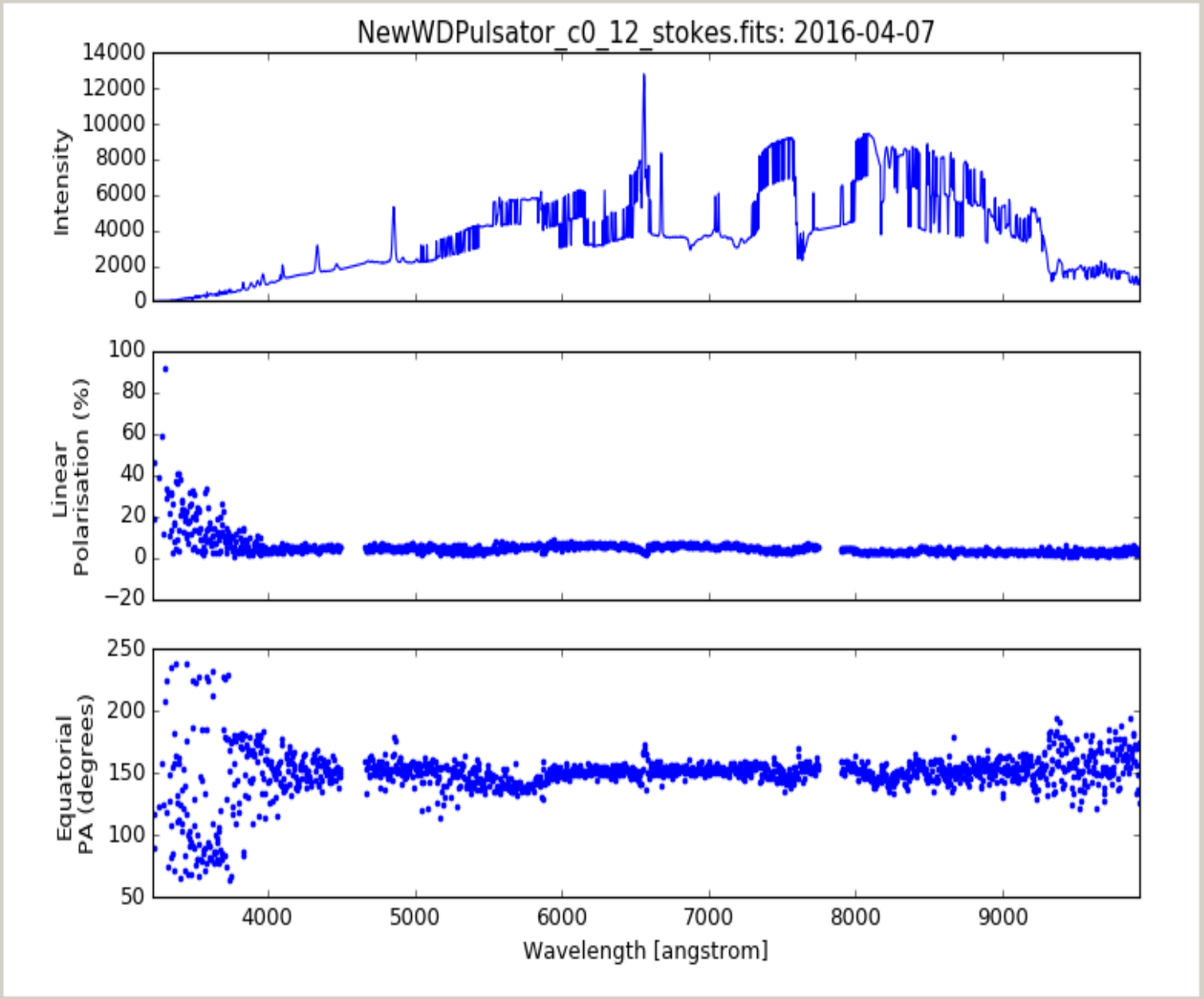
- [ ] Create custom plot
  - x-axis
  - y-axis

Output to .pdf:

- [x] Overview
- [ ] Intensity
- [ ] Polarisation / Stokes Q
- [ ] Position angle / Stokes U
- [ ] Custom

Plot results | Save .pdf | Cl...

Overview | Intensity | Polarisation / Stokes Q | Position angle / Stokes U | Custom



x= y=95.2727

File: NewWDPulsator_c0_12_stokes.fits

Cancel | OK

Work in progress:

- RSS able to observe both linear and circular polarization.

- Currently developing tools to reduce circular polarized data.
  - PolSALT can be used up to (and including) spectra extraction step.
  - Thereafter it fails.