

The PDF version of these slides might not make much sense without the accompanying narrative.

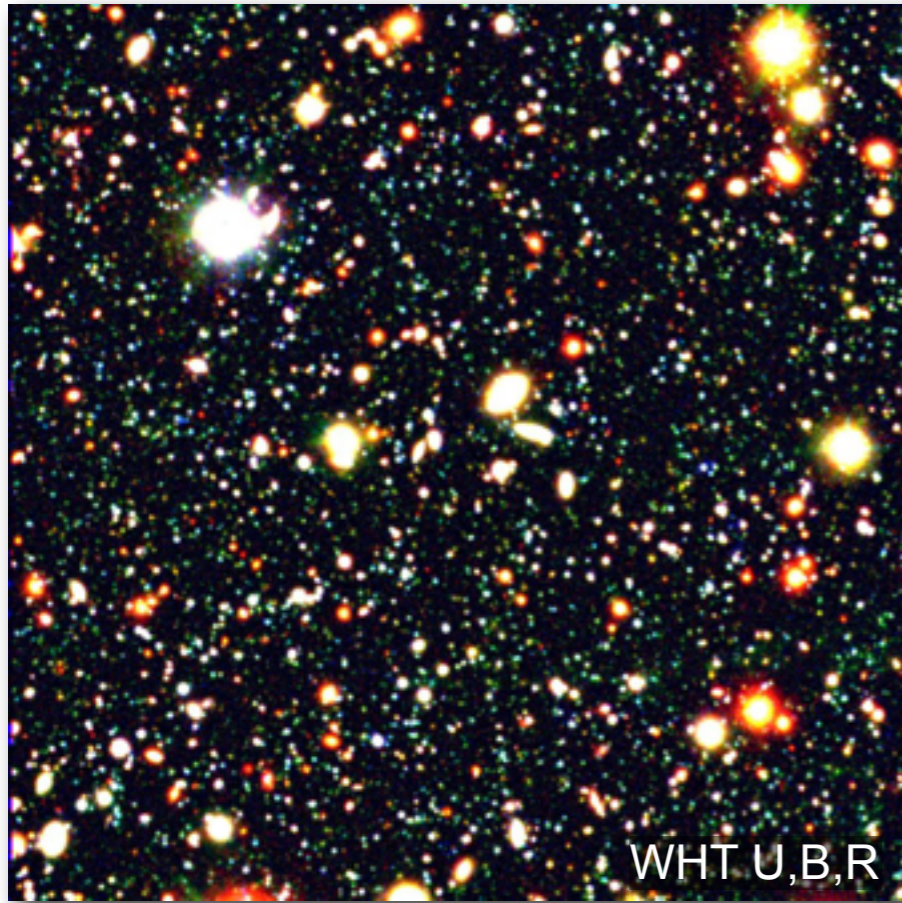
Please email me with any questions: ianh@astro.ox.ac.uk



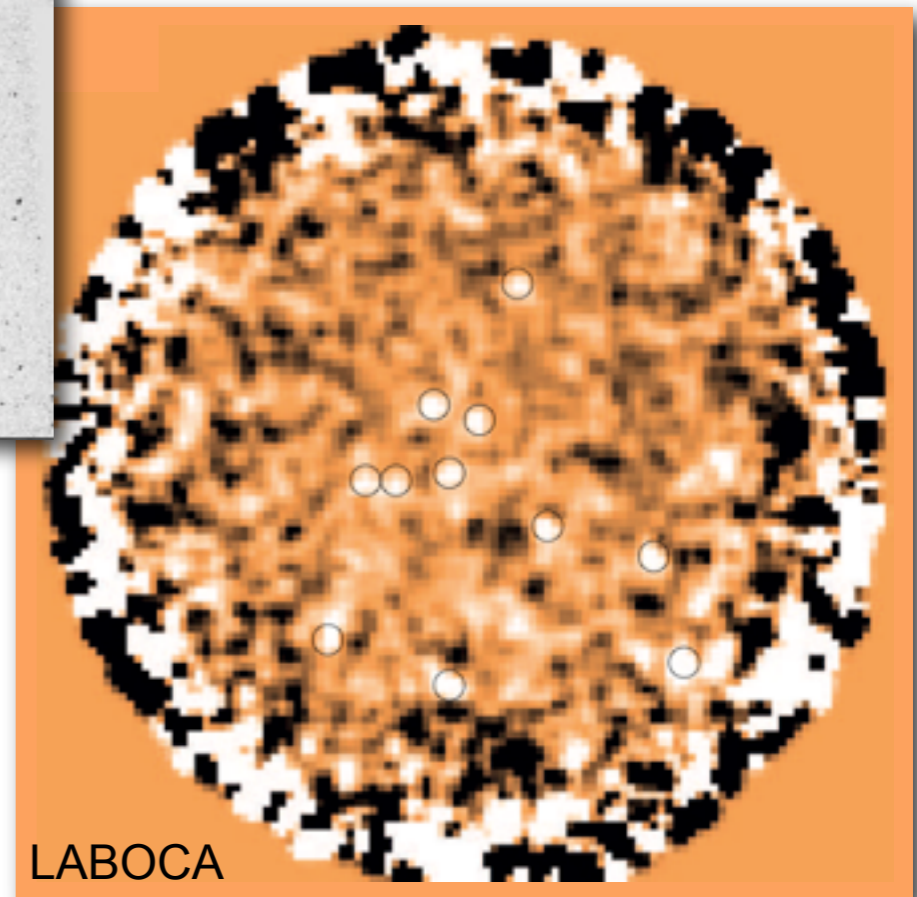
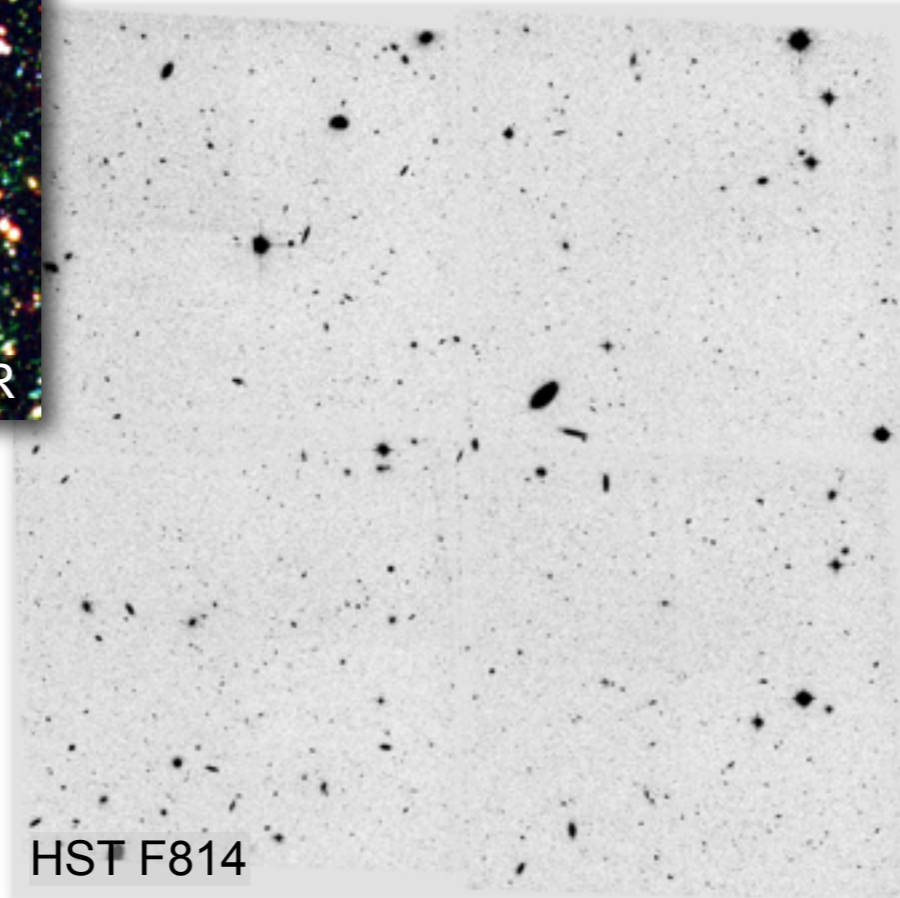
A self-imposed rule (as much as it pains me...)



Context: sub-mm galaxies and QSOs in the William Herschel Deep Field



WHT *U B R I Z* imaging ($B < 27.9$ mag)
UKIRT *H K* imaging
HST ACS High-resolution *I* band imaging



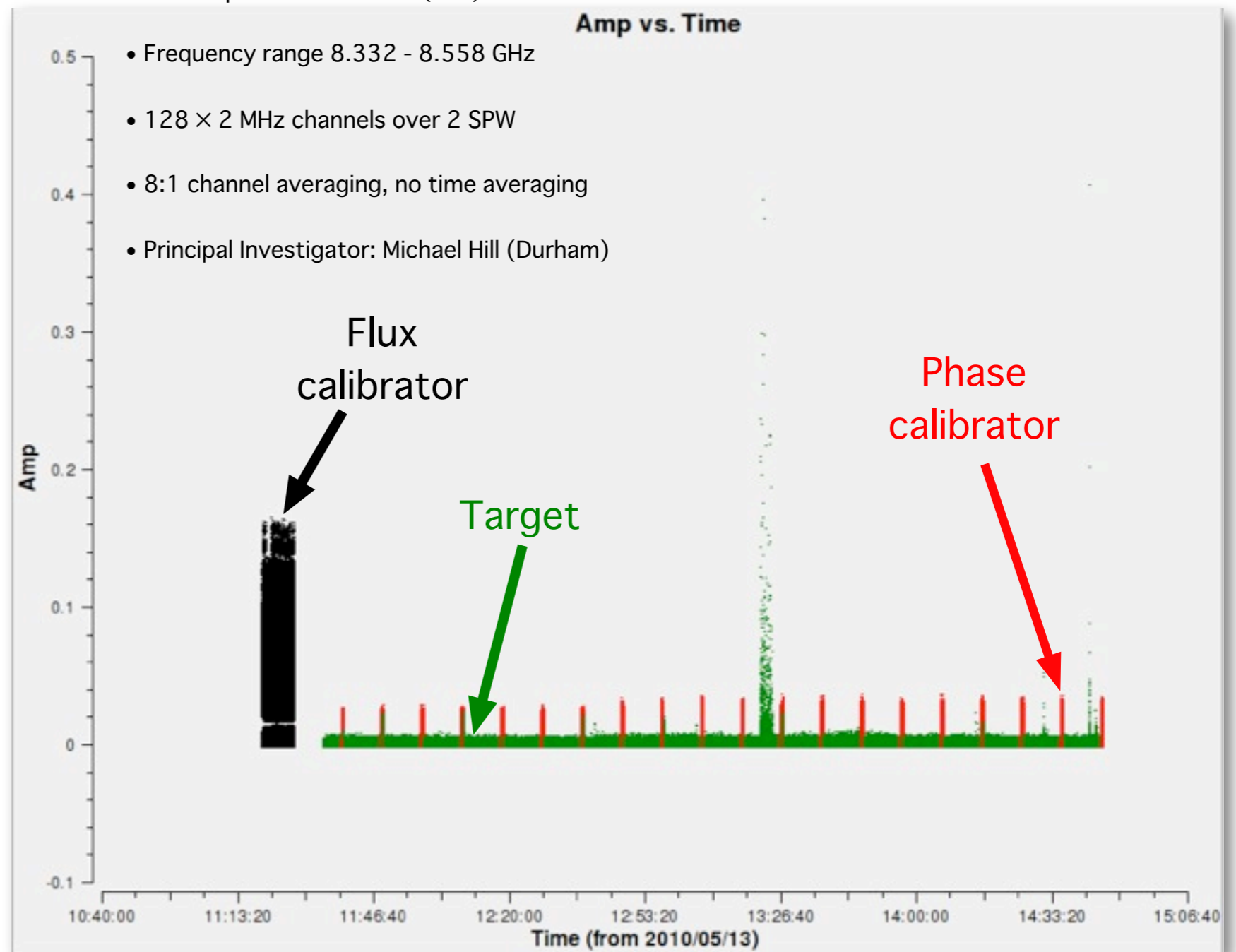
Chandra
LABOCA
EVLA

X-ray 10^{-15} erg s⁻¹ cm⁻² (70 ks)
870 μ m sub-mm survey (21 h)
Deep 8.4 GHz radio (35 h)

EVLA observations of the WHDF

- 35 hours with EVLA D-configuration
- 25 independent datasets (SBs) of 1.5 or 3.5 hours
- Frequency range 8.332 - 8.558 GHz
- 128 × 2 MHz channels over 2 SPW
- 8:1 channel averaging, no time averaging
- Principal Investigator: Michael Hill (Durham)

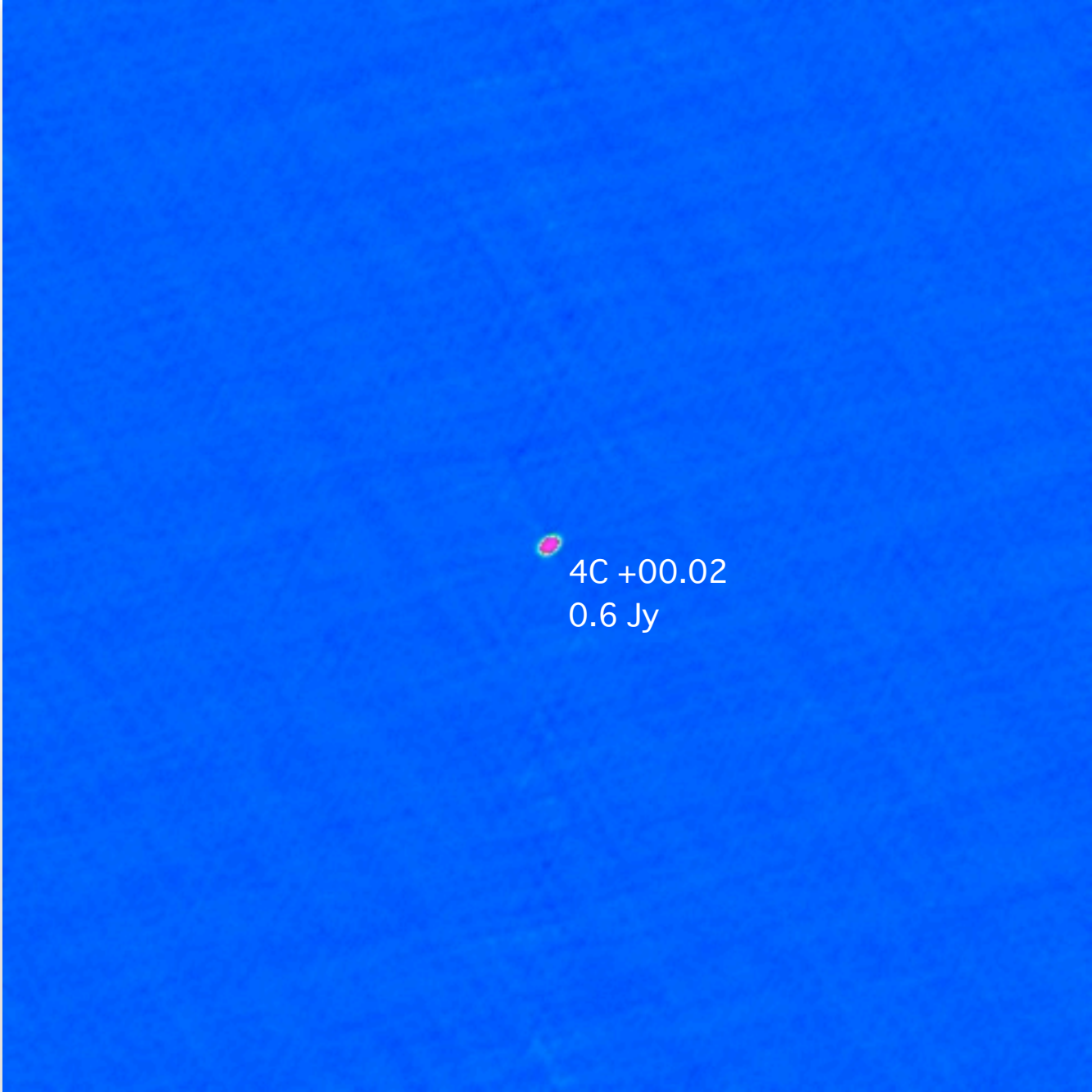
AS1008_sb1094913_1_000.55349.39414662037
AS1008_sb1094913_1.55326.477696724534
AS1008_sb1094913_1.55329.46954527778
AS1008_sb1094913_1.55344.4072031713
AS1008_sb1094913_1.55353.44451736111
AS1008_sb1094913_2.55355.37769755787
AS1008_sb1166741_1.55333.45861159722
AS1008_sb1166741_1.55343.43126916667
AS1008_sb1166809_1_000.55327.47497940972
AS1008_sb1166809_1_001.55328.451462557874
AS1008_sb1166809_1.55283.82364069445
AS1008_sb1166809_1.55311.49789672454
AS1008_sb1166809_1.55320.473294317126
AS1008_sb1166809_1.55324.69096299769
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AS1008_sb1349024_1.55336.5127268287
AS1008_sb1349024_1.55351.47178395833
AS1008_sb1349024_6_000.55358.53580408565
AS1008_sb1349024_6.55357.372279421295
AS1008_sb1349024_8.55362.35865112269
AS1008_sb1349024a_6_000.55357.448393287035



Post-flagging, post-averaging gain calibration performed with CASA
flux scale → bandpass → complex gain

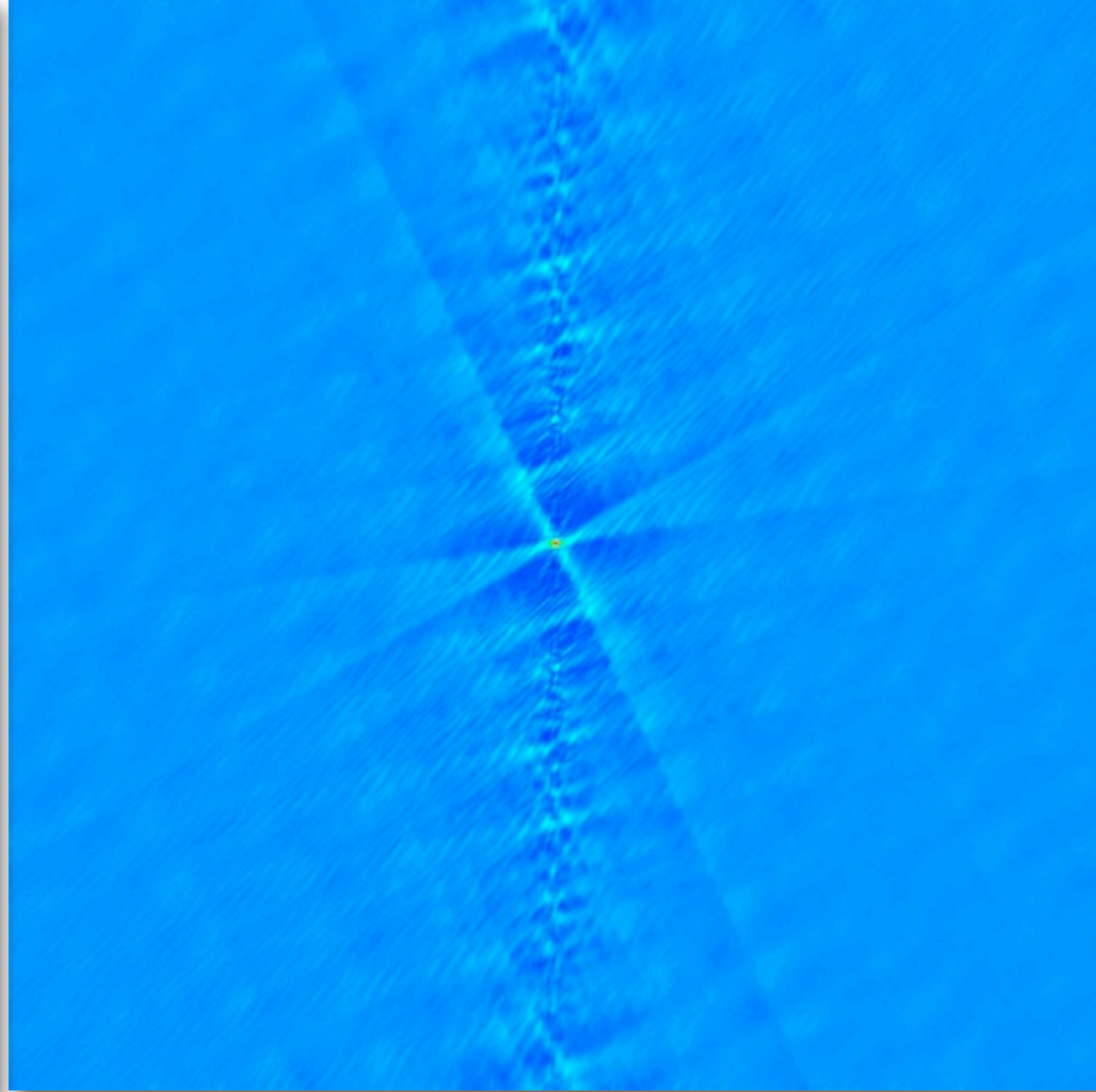
Two features of this target field that an estate agent would describe as 'quirky'

The phase calibrator

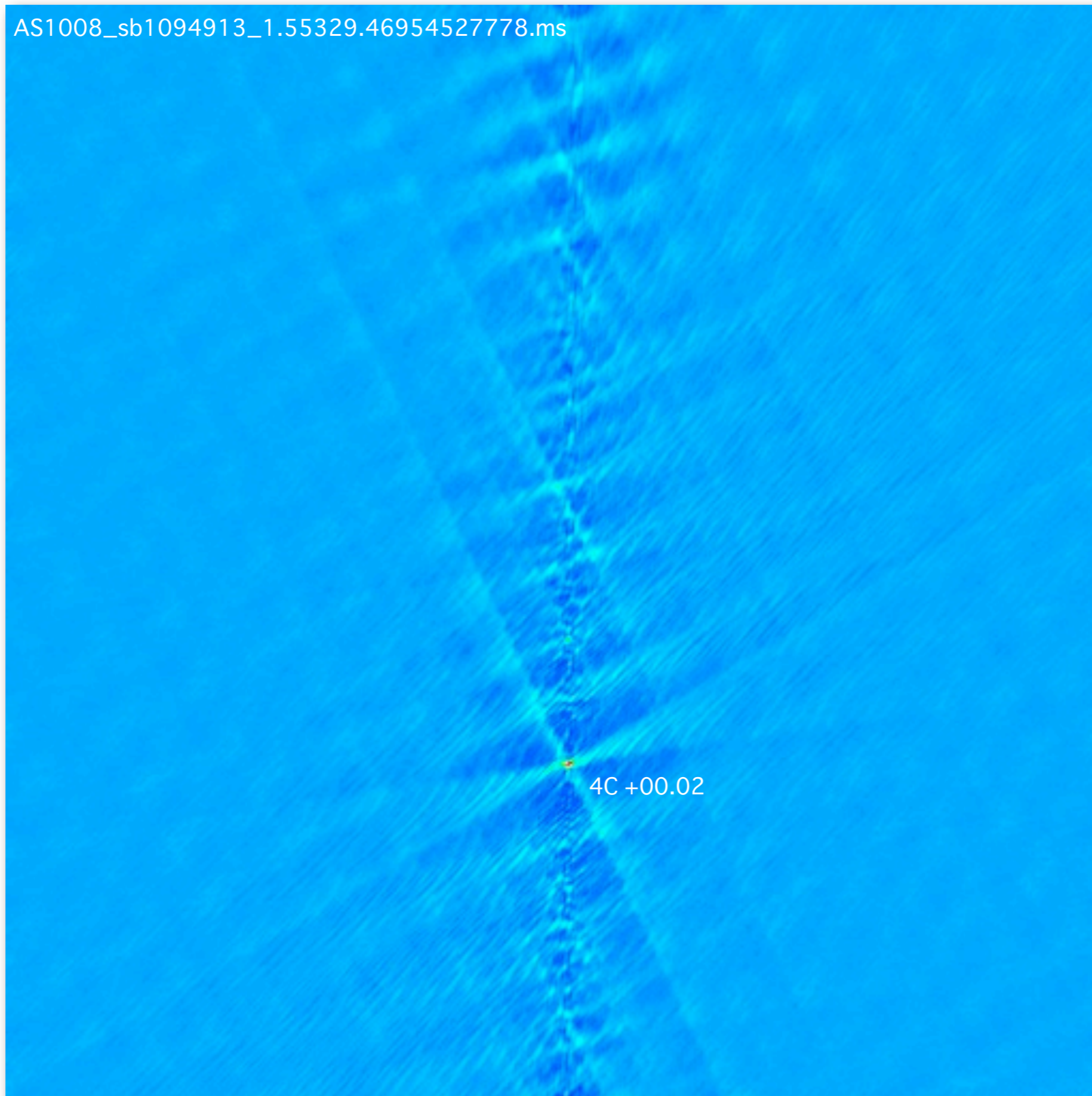


4C +00.02
0.6 Jy

The point-spread function

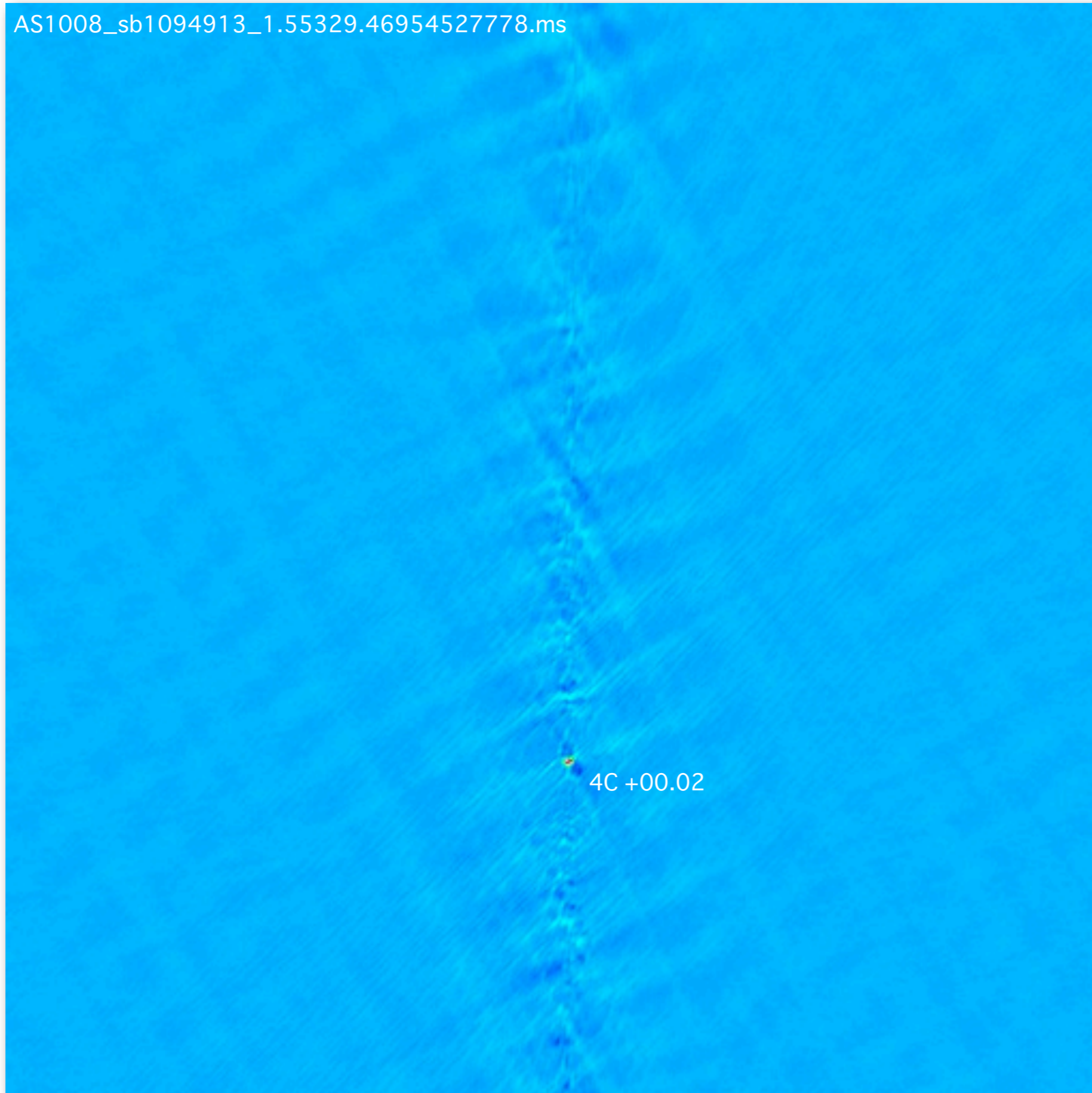


Wide-field dirty image of target



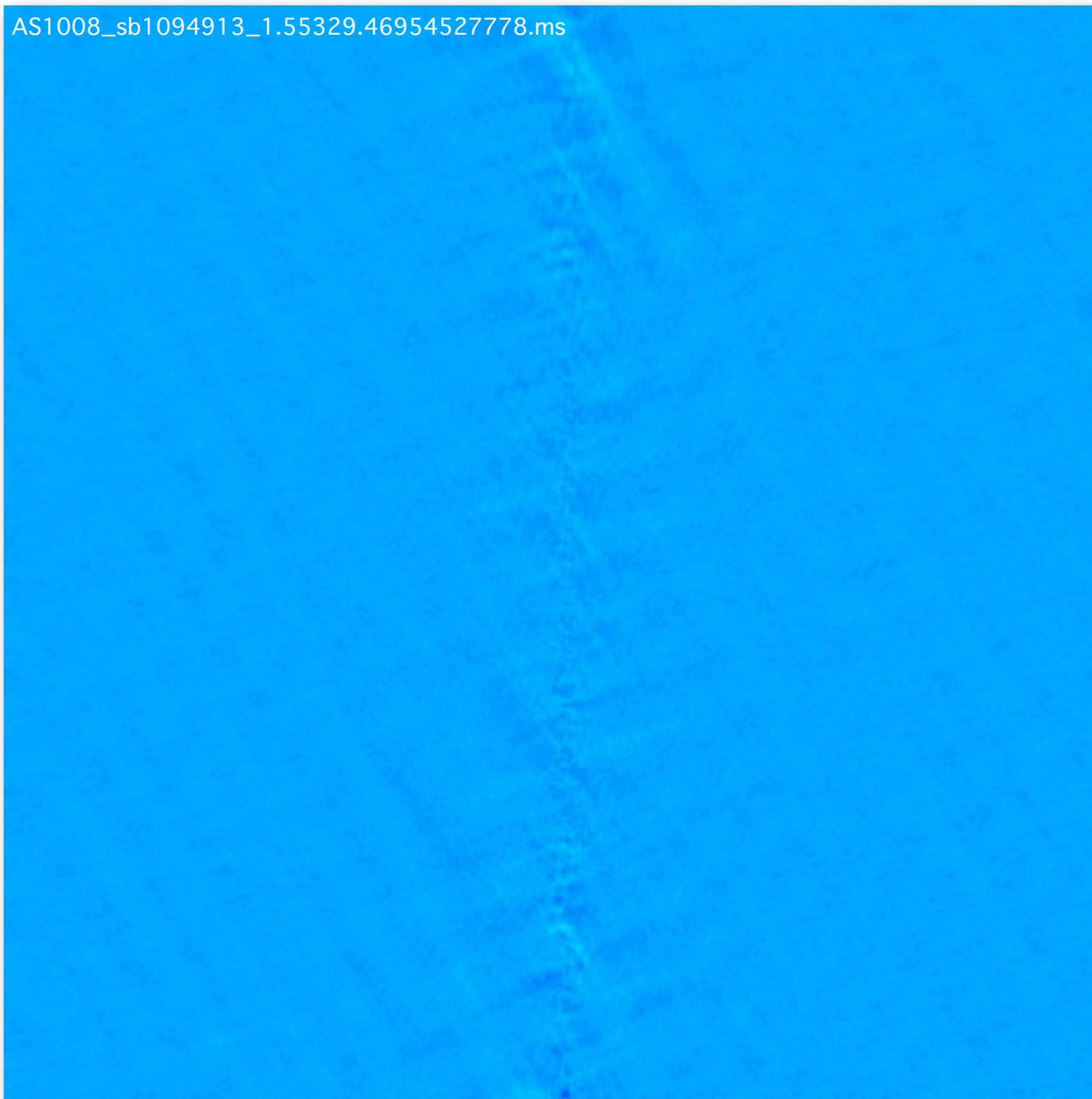
0.5 deg

Deconvolved image

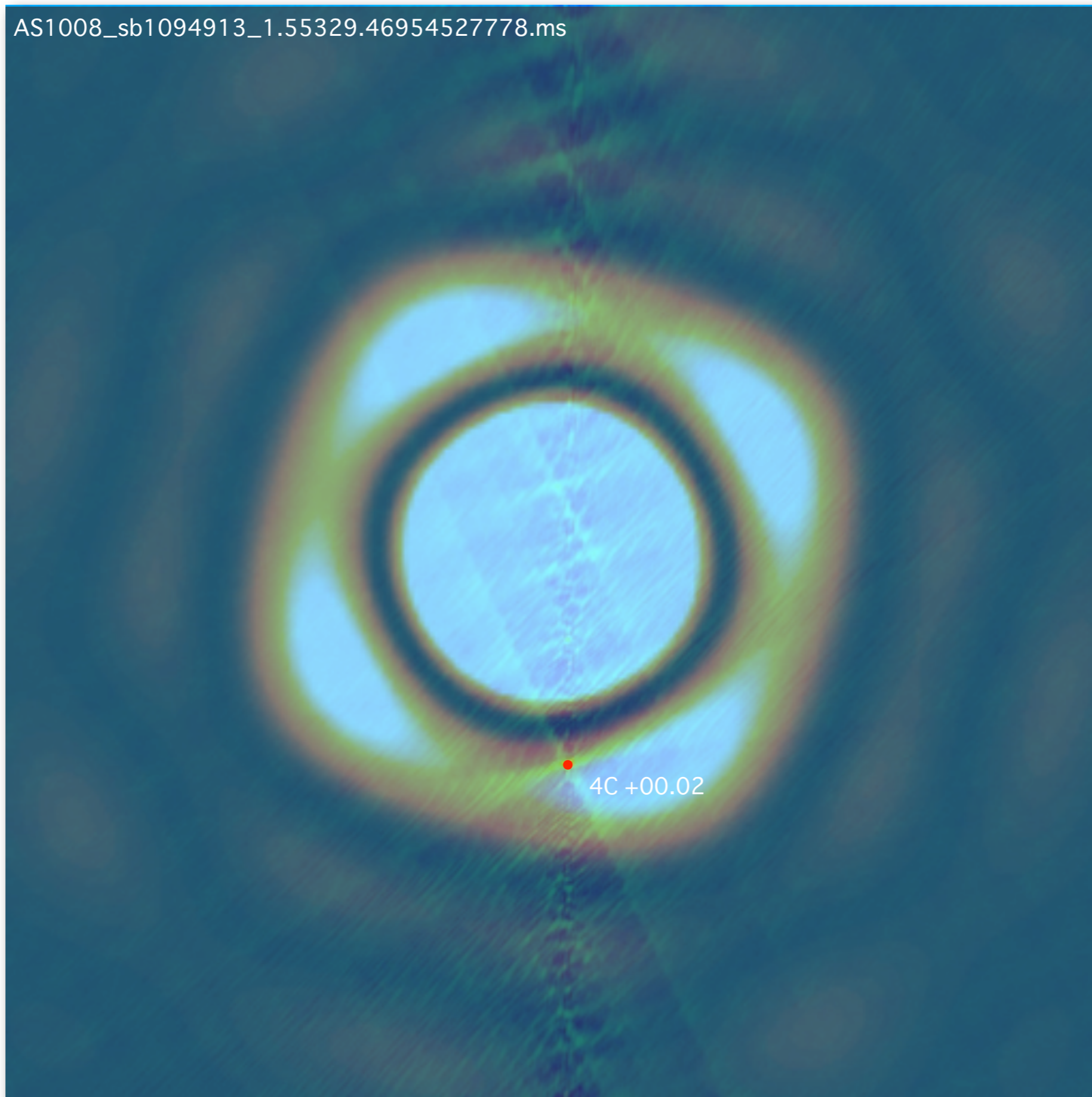


0.5 deg

Subtract MODEL_DATA column and image residuals



The EVLA primary beam

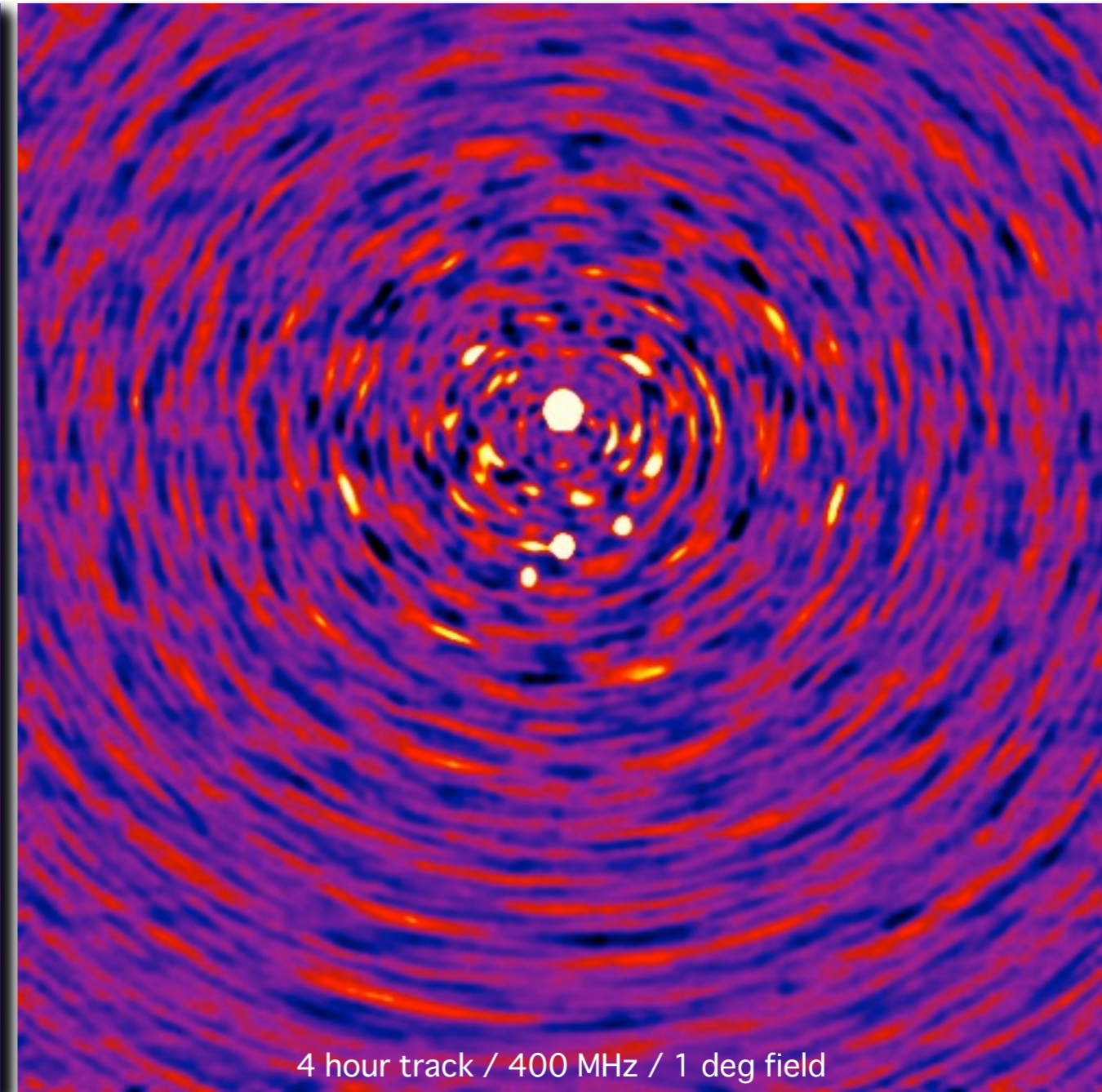
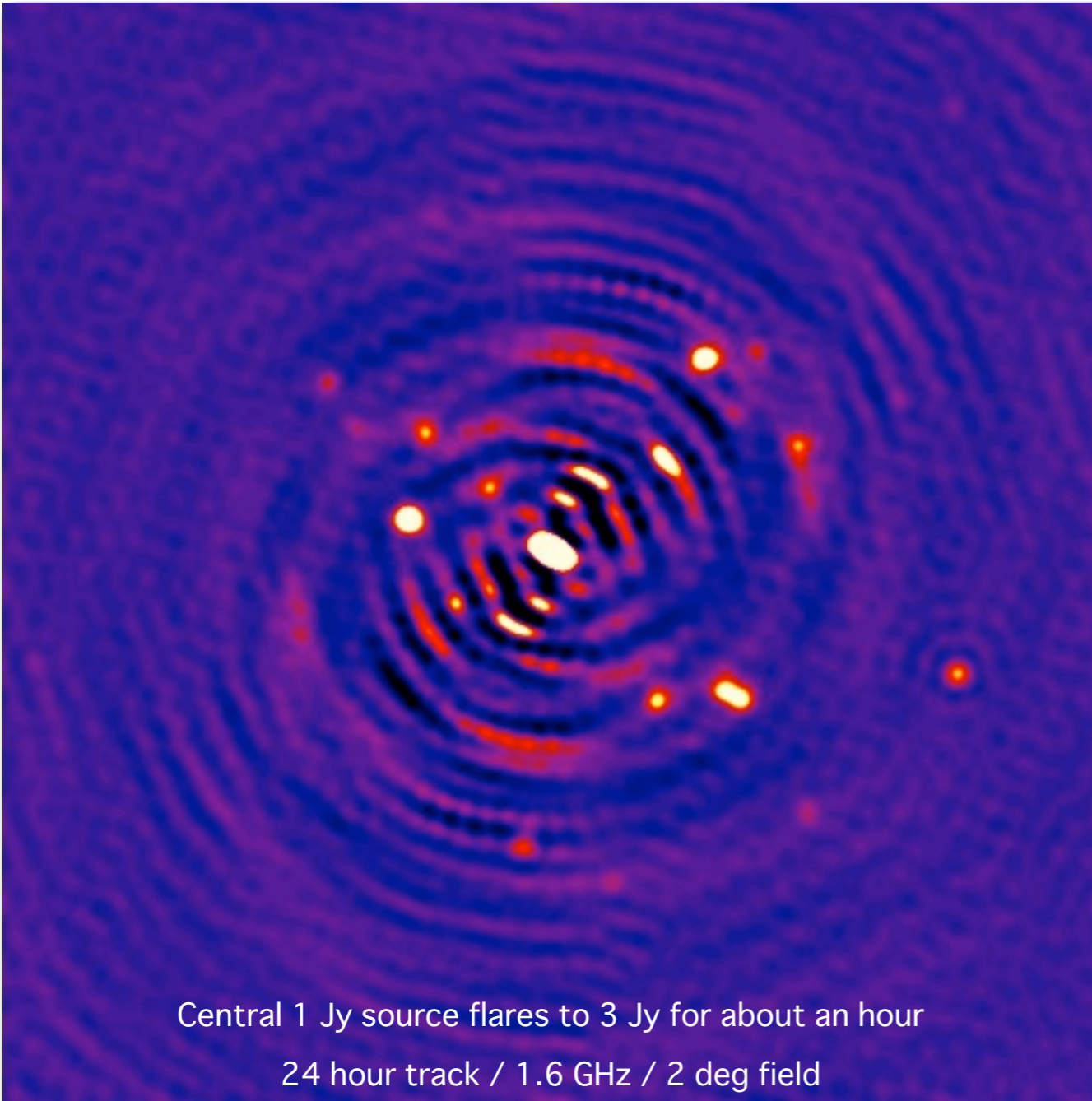


0.5 deg

Intrinsic or apparent transients? Either way your continuum map is a mess

MeqTrees KAT-7 simulation

OeRC SKA AA simulation (Dulwich, Mort, Salvini)



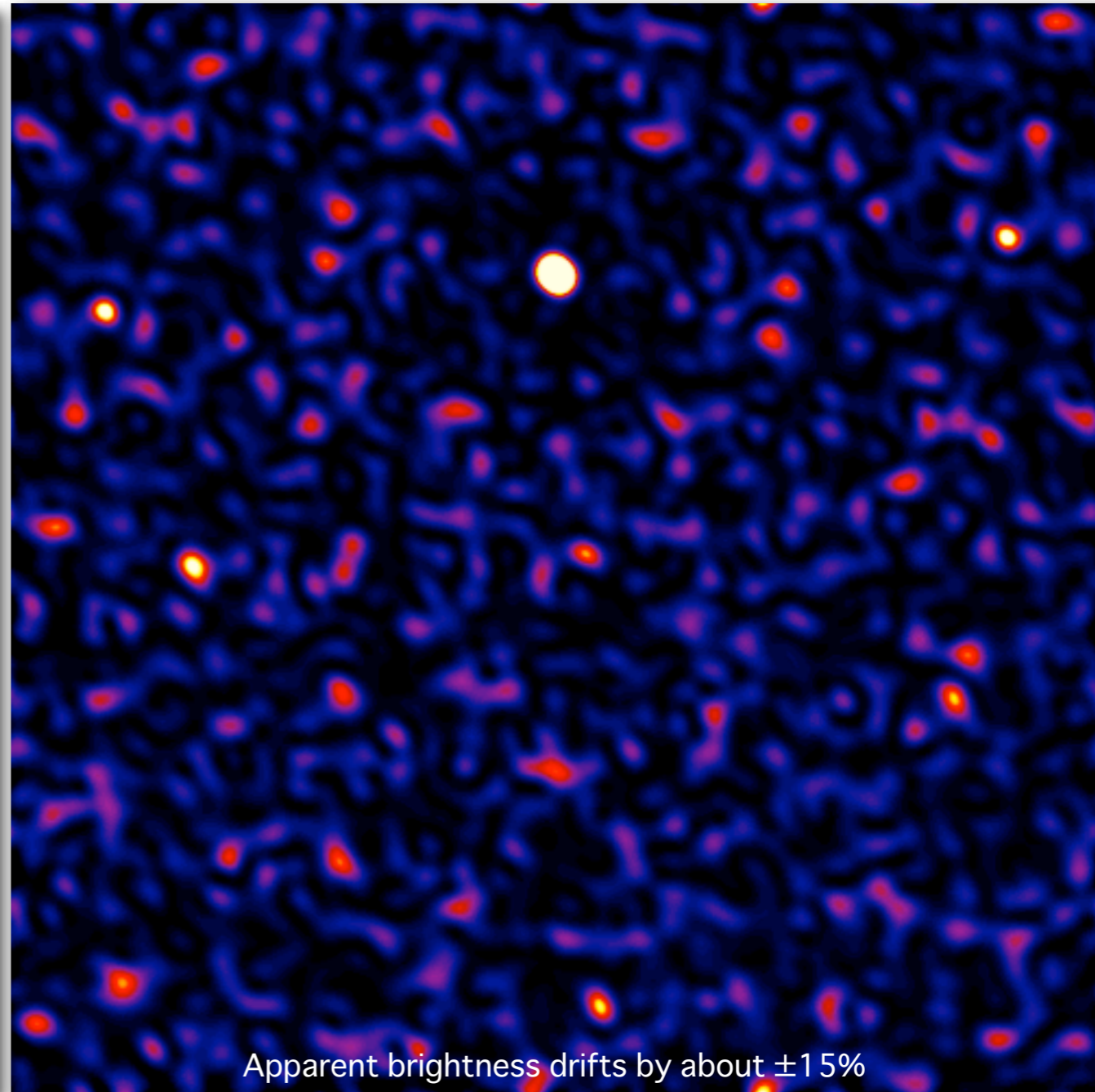
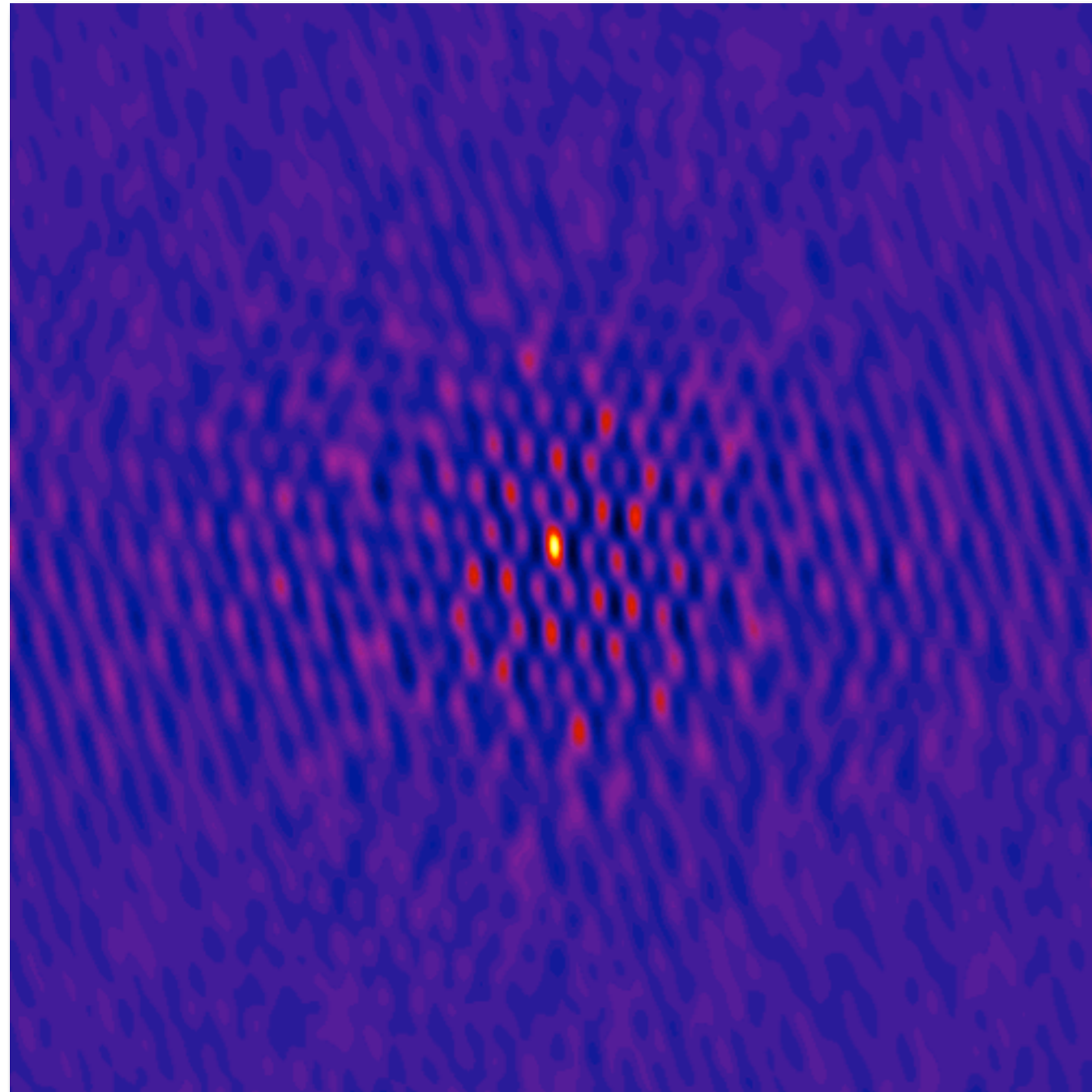
Deconvolved image, Briggs weighting

Deconvolved image, natural weighting

Intrinsic or apparent transients? Either way your continuum map is a mess

MeqTrees KAT-7 simulation

OeRC SKA AA simulation (Dulwich, Mort, Salvini)



Apparent brightness drifts by about $\pm 15\%$

48 \times 30-minute snapshot dirty images

48 \times 5-minute snapshot dirty images

Direction-dependent calibration to the rescue

Peeling





AIPS HELP file for PEELR in 31DEC11



As of Mon Jul 25 5:08:21 2011


PEELR: RUN PEELR for proc to calibrate interfering sources

INPUTS

INNAME			Input UV file name (name)
INCLASS			Input UV file name (class)
INSEQ	0.0	9999.0	Input UV file name (seq. #)
INDISK	0.0	9.0	Input UV file disk unit #
IN2NAME			Input image name (name)
IN2CLASS			Input image name (class)
IN2SEQ	0.0	9999.0	Input image name (seq. #)
IN2DISK	0.0	9.0	Input image disk unit #
OUTNAME			Output UV file name (name)
OUTCLASS			Output UV file name (class)
OUTSEQ	-1.0	9999.0	Output UV file name (seq. #)
OUTDISK	0.0	9.0	Output UV file disk unit #.
NFIELD	1.0	4096.0	Number facets in IN2NAME
NGAUSS	1.0	10.0	Number resolutions in IN2NAME
PPARM	0.0		List of <= 100 facets to peel
BCHAN	0.0	16384.0	Lowest channel number 0=>all
ECHAN	0.0	16384.0	Highest channel number
SOLINT			CALIB solution interval (min)
SOLTYPE			Soln type, ' ', 'L1', 'GCON', 'R', 'L1R', 'GCOR'
SOLMODE			'P' phase only, else 'A&P'
WEIGHTIT	0.0	3.0	Modify data weights function
APARM			General CALIB parameters 1=min. no. antennas 2 > 0 => data divided 3 > 0 => avg. RR,LL

AIPS HELP file (version 31DEC x) peel

← → ↻ casa.nrao.edu/docs/taskref/peel-task.html ☆ 🔒 🔧

 National Radio Astronomy Observatory Search NRAO

Monday, July 25, 2011

[NRAO Home](#) > [CASA](#) > TaskRef Search

[\[next\]](#) [\[prev\]](#) [\[prev-tail\]](#) [\[tail\]](#) [\[up\]](#)

0.1.57 peel

Requires:

Synopsis Do direction dependent selfcal(s) and optionally remove annoying sources. **Description**

Arguments

Inputs	
vis	Name of the input visibility set. allowed: string Default:
dirs	List of directions to peel. allowed: any Default: variant ""
remove	Subtract the selfcalibrated source(s) from the data. allowed: bool Default: True
calmode	Type of selfcal to do. (p: Phase only, a: Ampl only. ap: both allowed: string Default: p

Example

Peeling

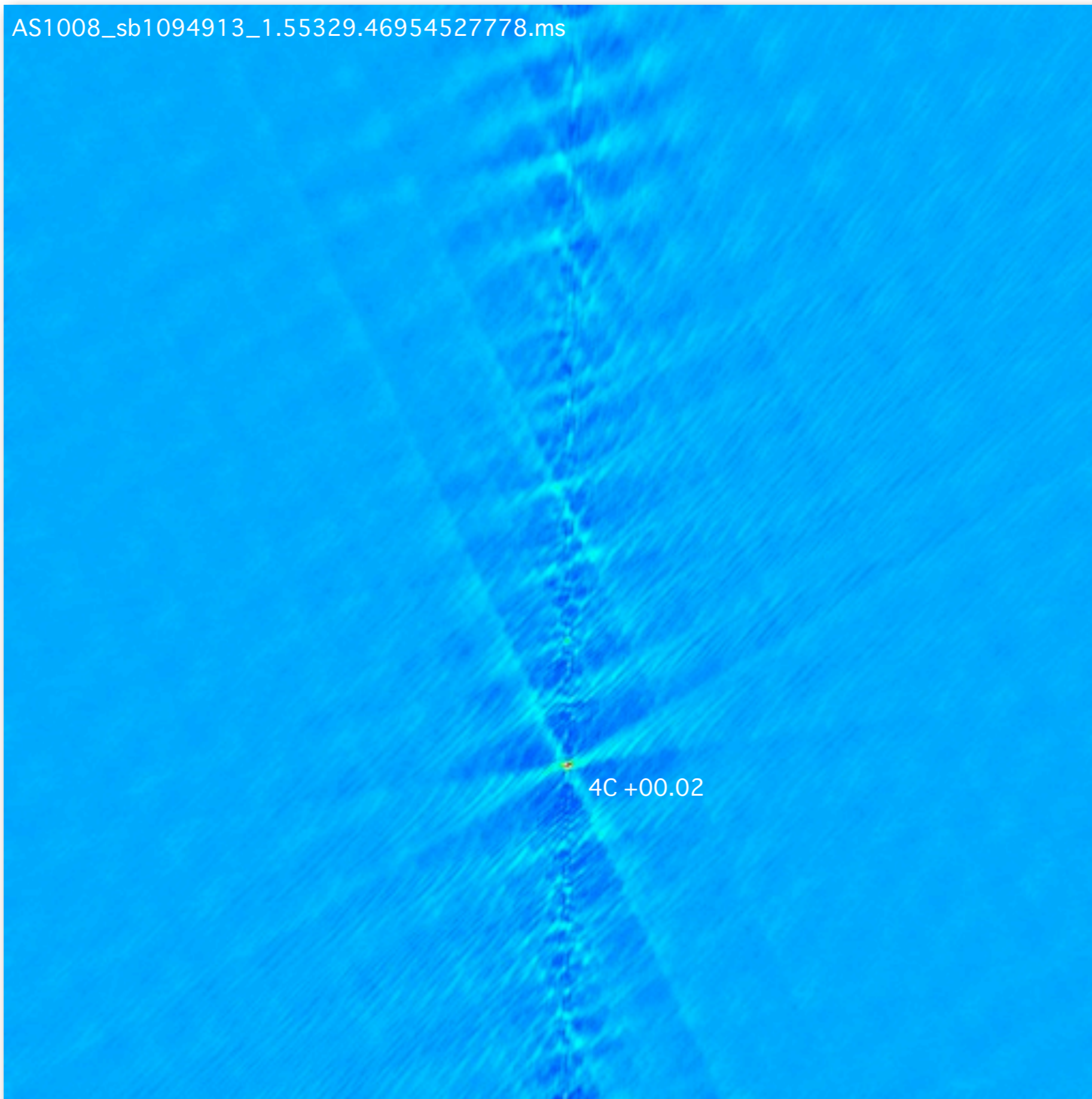
$$\mathbf{D}_{pq}^{(1)} = \mathbf{D}_{pq} - \tilde{\mathbf{G}}_p \mathbf{X}_{s_0 pq} \tilde{\mathbf{G}}_q^H$$

Smirnov, A&A, 572, 107, 2011 following Noordam, SPIE, 5489, 817, 2004

Solve for differential gains

$$\mathbf{V}_{pq} = \mathbf{G}_p \left(\sum_s \Delta \mathbf{E}_{sp} \mathbf{X}_{spq} \Delta \mathbf{E}_{sq}^H \right) \mathbf{G}_q^H$$

Dirty image



0.5 deg

Best 'traditional-cal' image



0.5 deg

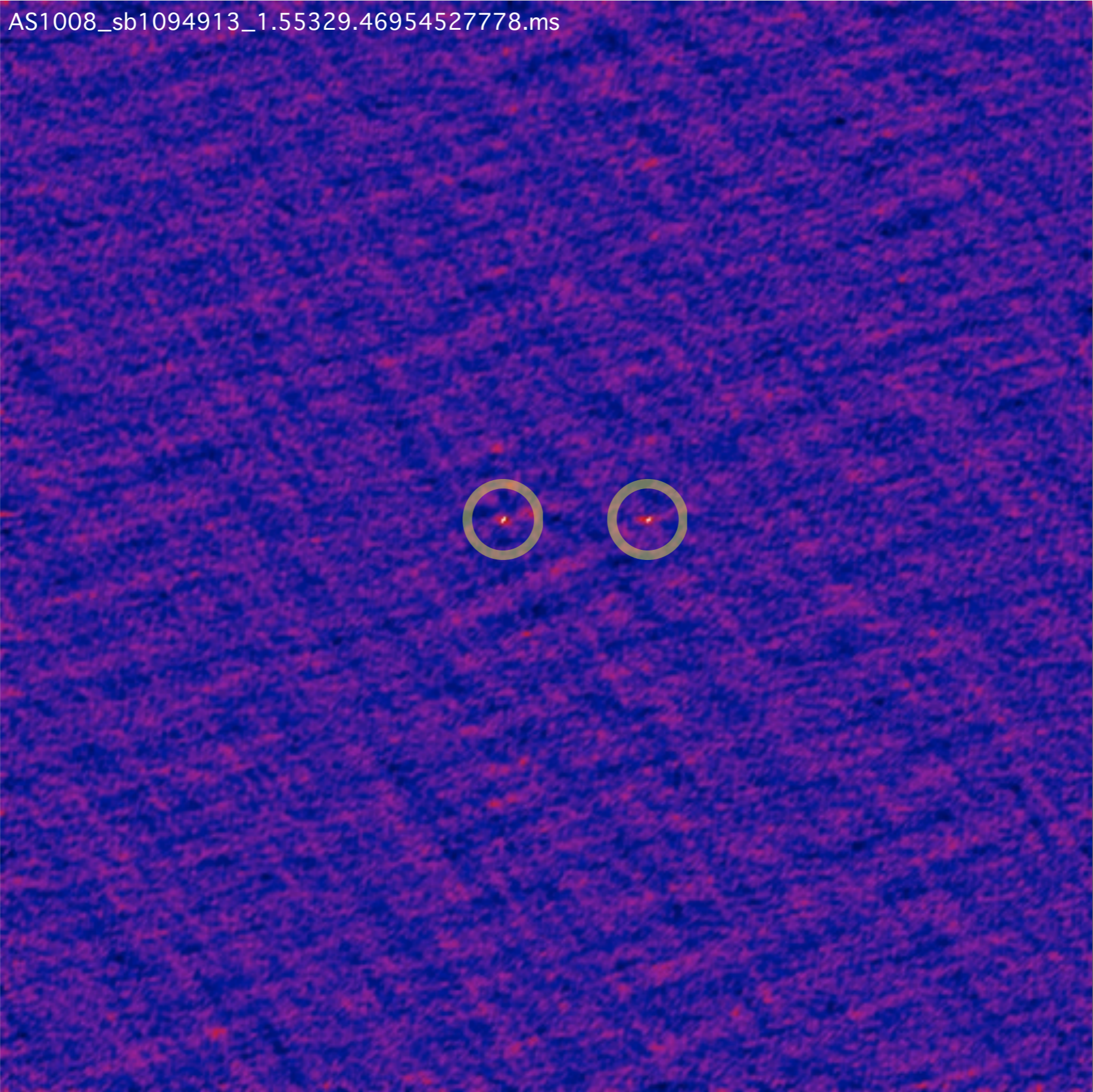
Solve for differential gains with MeqTrees, subtract model and image residuals



0.5 deg

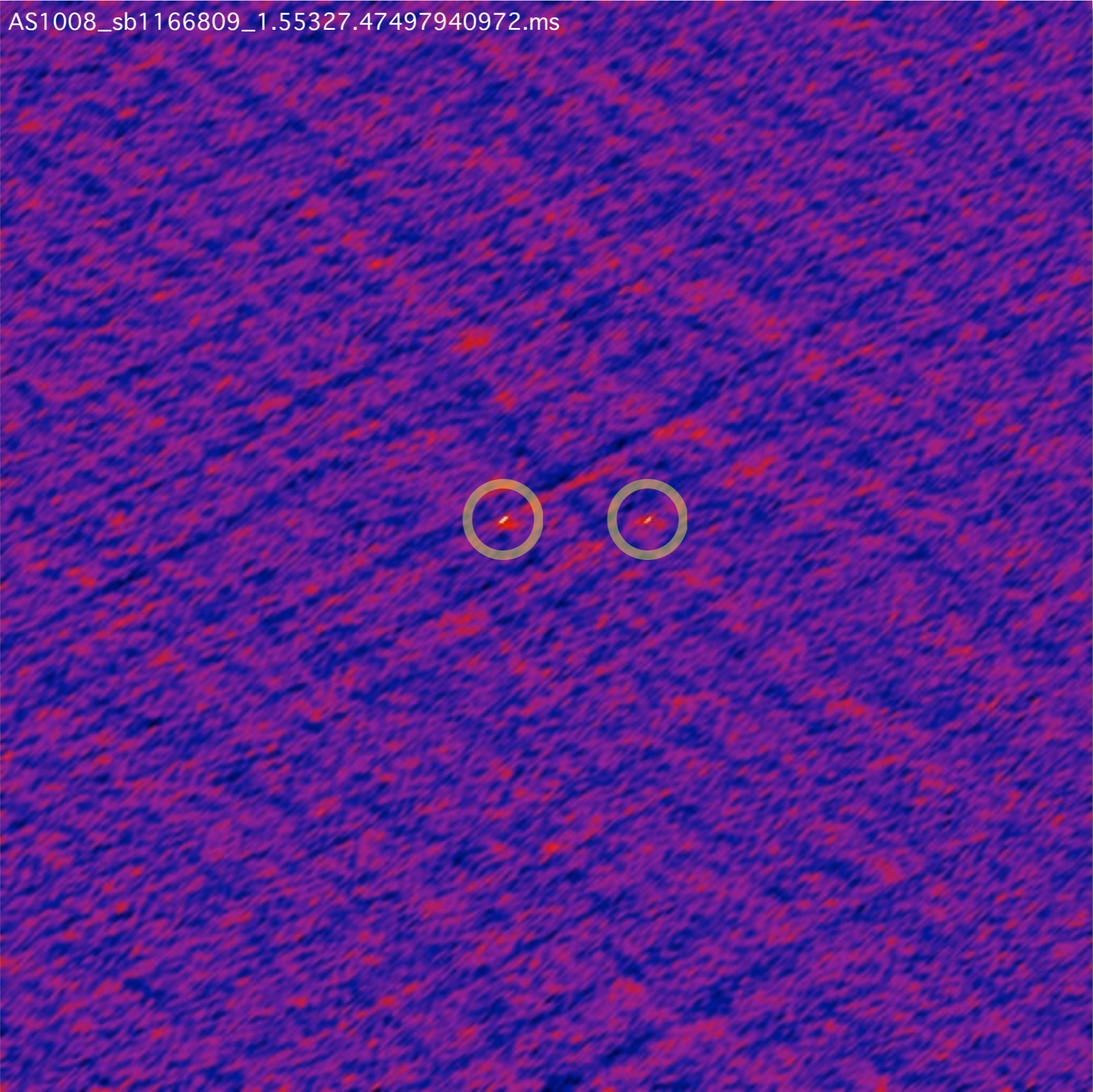
Smirnov, A&A, 572, 107, 2011
Noordam & Smirnov, ApJ, 524, 61, 2011

Solve for differential gains with MeqTrees, subtract model and image residuals



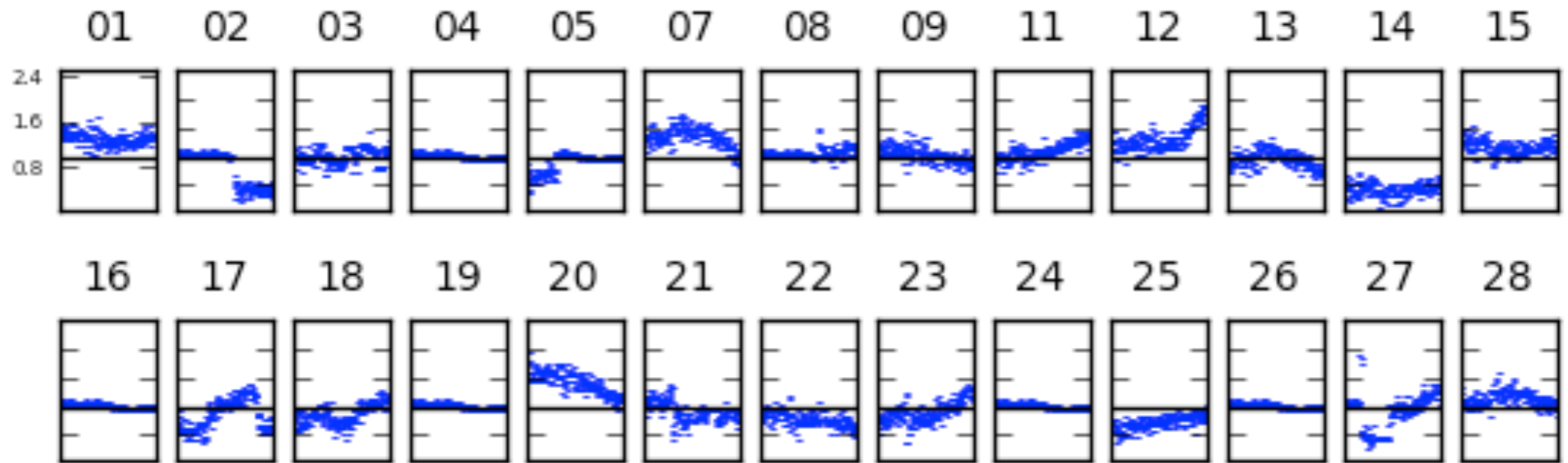
Smirnov, A&A, 572, 107, 2011
Noordam & Smirnov, ApJ, 524, 61, 2011

Solve for differential gains with MeqTrees, subtract model and image residuals

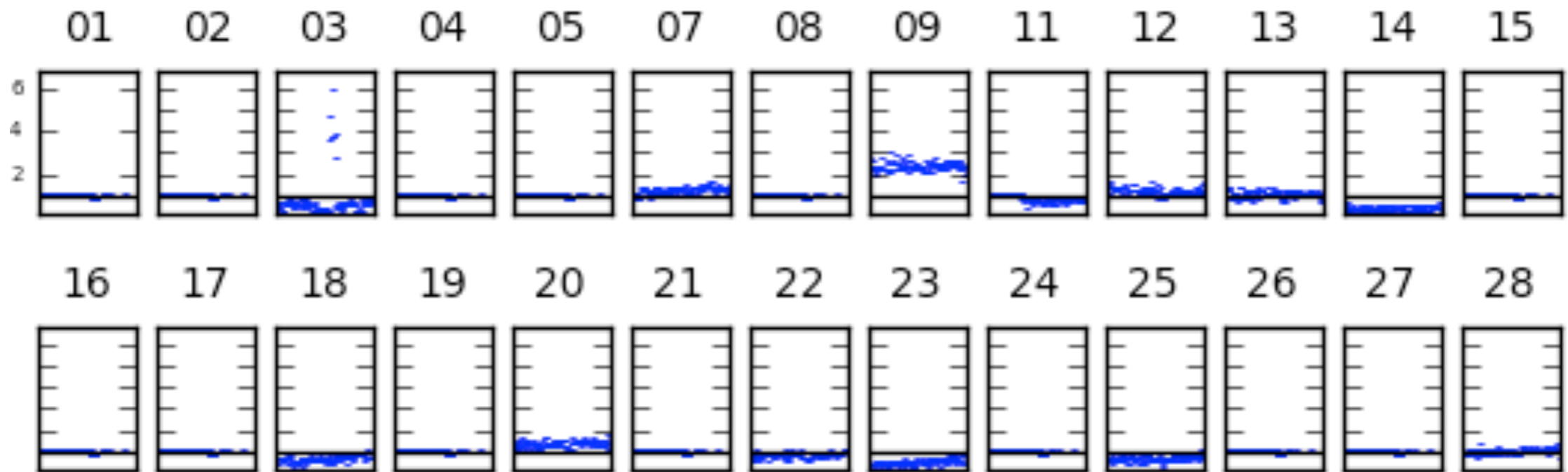


Smirnov, A&A, 572, 107, 2011
Noordam & Smirnov, ApJ, 524, 61, 2011

dE solutions per antenna



55329_55327_CONCAT.ms



AS1008_sb1166809_1.55311.49789672454.ms.SPLIT.WHDF1.ms

Solving for the 'variable' sources in our simulations

The image shows a screenshot of the Tigger software interface. On the left, a window titled 'Tigger - sumsslsm.lsm.html' displays a table of astronomical sources and a corresponding visibility plot. The table lists source names, RA, Dec, r, and type. The plot shows a blue field with a central bright spot and concentric rings, with a dashed box labeled 'no flare.fits' indicating a region of interest.

name	RA	Dec	r	type
22 J1930M72	19h05m26.21s	-73°50'02.40"	0.0'	Gau
43 J1930M76	19h15m54.44s	-74°39'36.90"	65.4'	Gau
21 J1930M76	19h04m34.79s	-74°51'56.50"	62.0'	Gau
52 J1930M76	19h19m50.42s	-74°35'58.50"	74.6'	Gau
12 J1845M76	19h00m20.34s	-74°10'48.00"	29.6'	Gau
64 J1930M76	19h31m55.52s	-74°34'17.40"	116.8'	Gau
13 J1845M76	19h01m04.48s	-74°29'25.10"	43.2'	Gau

On the right, the 'TDL Compile-time Options' dialog box is open, showing various settings for the simulation. The 'MS selection' section is set to 'KAT7.MS'. The 'Processing options' section includes 'Calibrate (fit corrupted model to data)' checked, with 'Calibrate on' set to 'complex visibilities' and 'using interferometers' set to 'all'. The 'Image-plane components' section includes 'Use TiggerSkyModel module' checked, with 'Tigger LSM file' set to 'sumsslsm.lsm.html' and 'Source subset' set to '=TRANSIENT'. Other options include 'Use dE Jones (differential gains)' checked and 'Use DiagReallmag module' checked.

MS selection

MS: KAT7.MS

Interferometers to use: all

Correlations to use: 2x2, diagonal terms only

Start Purr on this MS

Processing options

Read additional uv-model visibilities from MS

Calibrate (fit corrupted model to data)

Calibrate on: complex visibilities

...using interferometers: all

Output visibilities: corrected residuals

Flag output visibilities

Image-plane components

Use 'TiggerSkyModel' module

Tigger LSM file: sumsslsm.lsm.html

Source subset: =TRANSIENT

Make solvable source parameters

Use 'Calico.OMS.central_point_source' module

Use 'Siamese.OMS.fitsimage_sky' module

Use 'Siamese.OMS.gridded_sky' module

Export sky model as kvis annotations

Use E Jones (primary beam)

Use dE Jones (differential gains)

Use 'DiagReallmag' module

Matrix type: complex

Initial value, diagonal: 1

Initial value, off-diagonal: 0

Solve for each source independently

Use 'FullReallmag' module

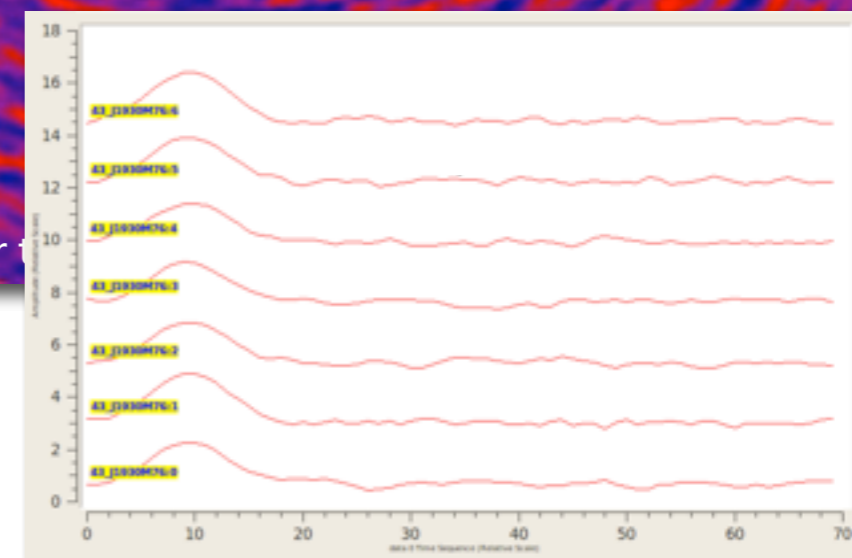
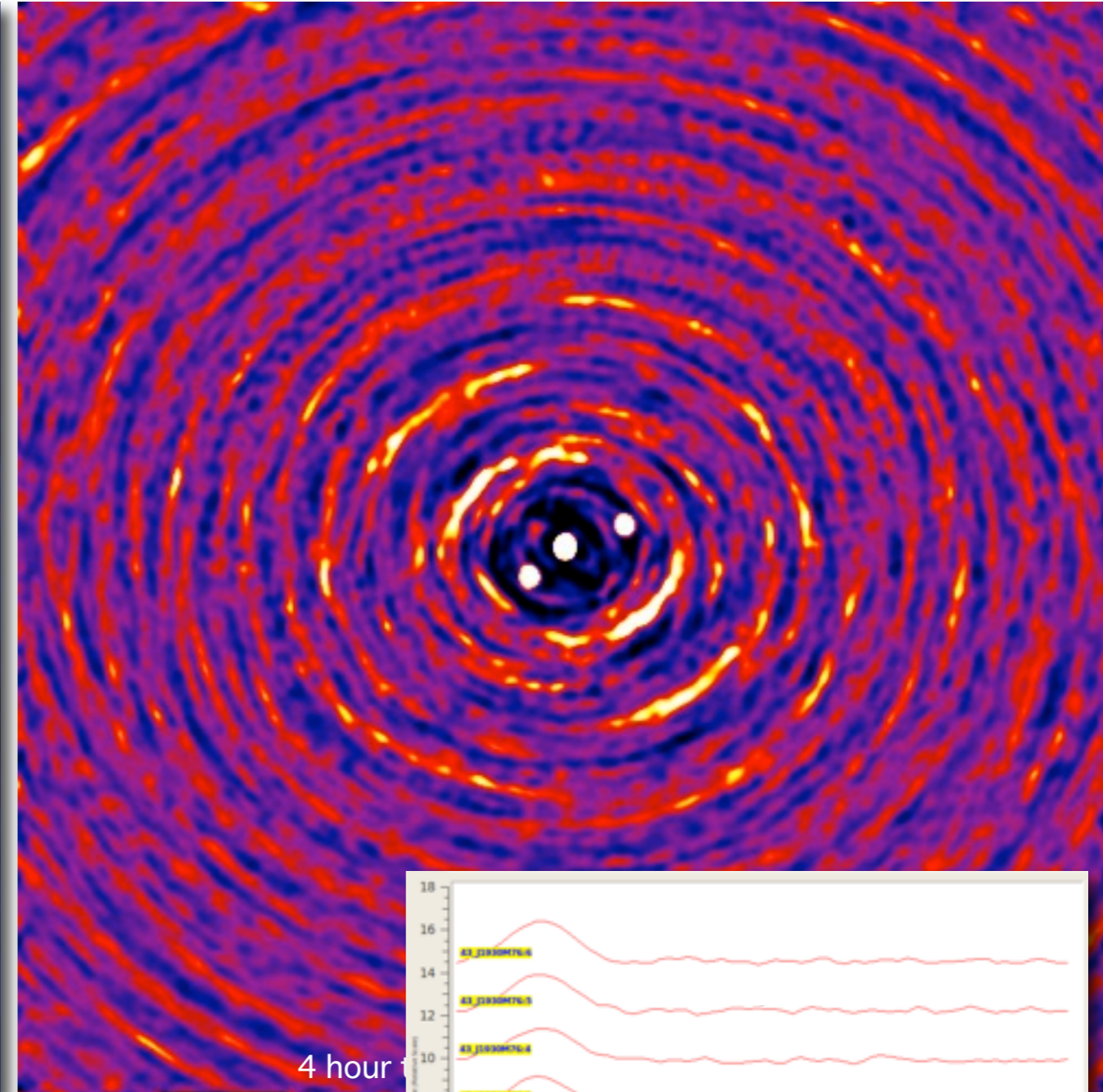
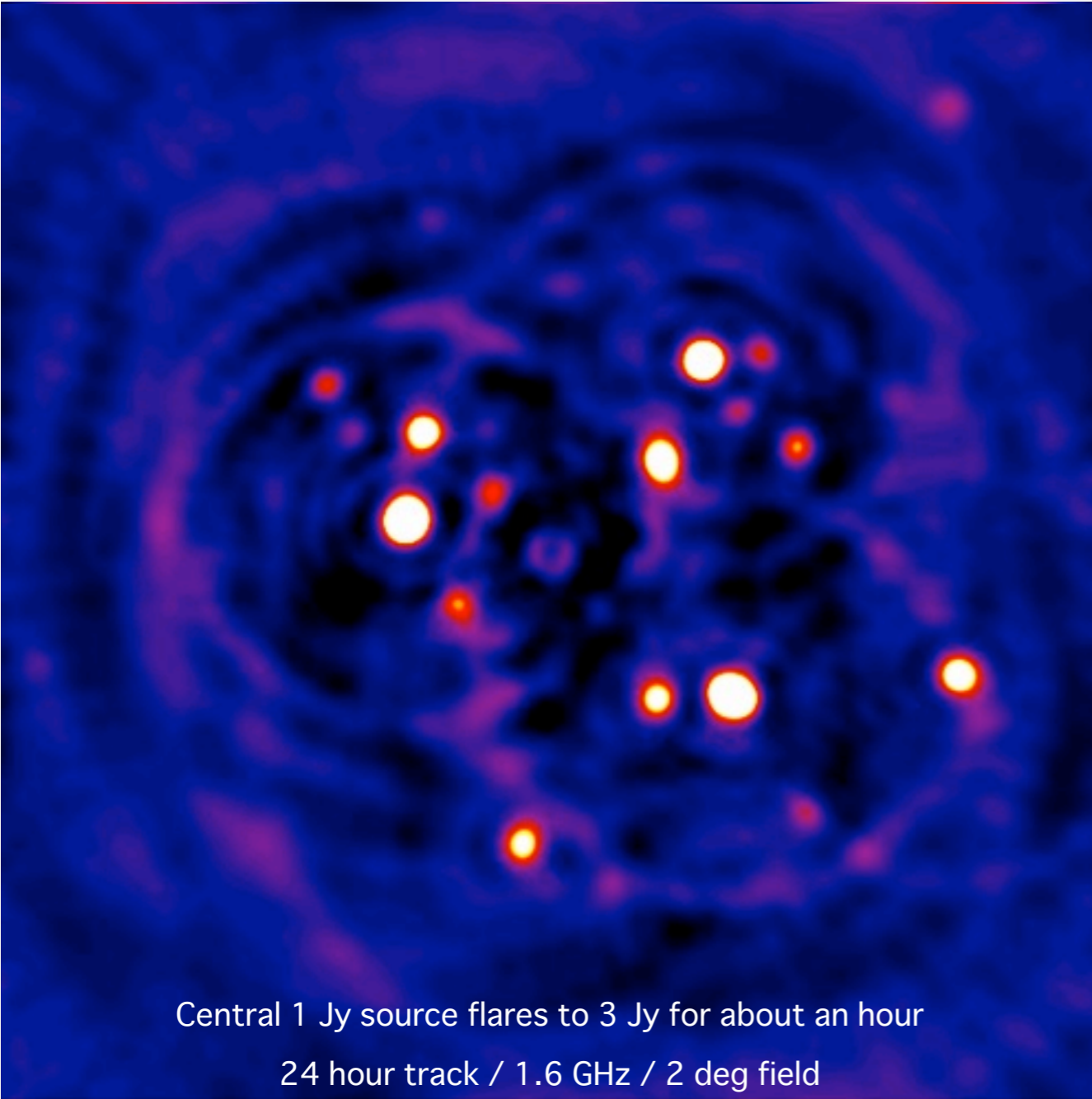
Use 'DiagAmplPhase' module

Buttons: Compile, Load, Save, Cancel

Solving for the 'variable' sources in our simulations

MeqTrees KAT-7 simulation

OeRC SKA AA simulation (Dulwich, Mort, Salvini)



Automating everything

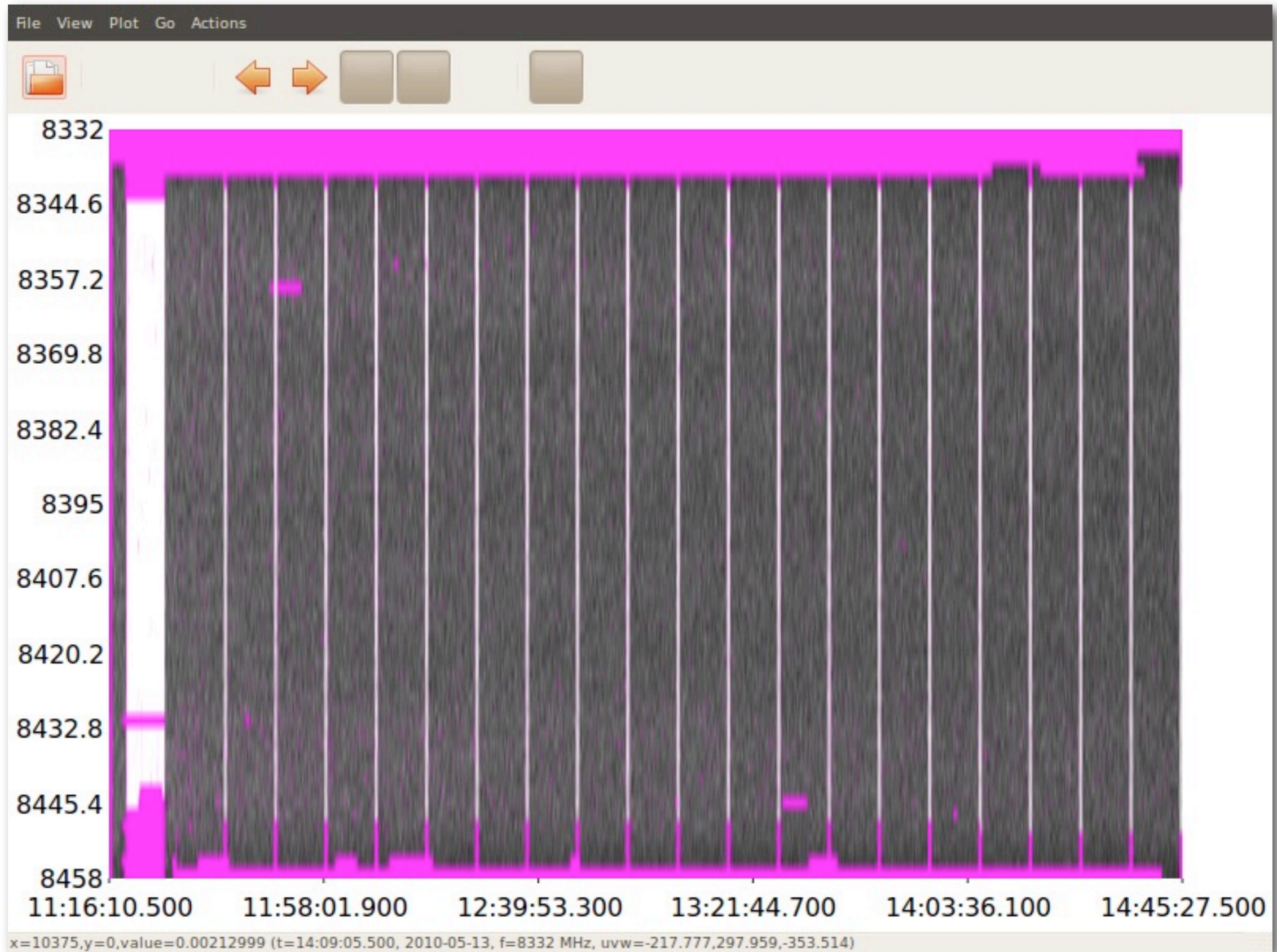
Flagging full spectral resolution data

The image is a composite of two scenes. On the left, a computer terminal window displays a configuration file for an interactive flagger. A dialog box titled "Progress" is overlaid on the terminal, showing a progress bar at 99% and the text "Drawing item 'Amp vs. Time'". The terminal text includes:

```
er/interactive flagger for visibility data.  
= 'AS1008_sb1094913_1.55326.477696724534.REMerged.ms' # input visibility data  
" # plot x-axis (blank for default/current)  
" # plot y-axis (blank for default/current)  
True # data selection parameters  
" # field names or field index numbers (blank for all)  
" # spectral windows:channels (blank for all)  
" # time range (blank for all)  
" # uv range (blank for all)  
" # antenna/baselines (blank for all)  
" # scan numbers (blank for all)  
" # correlations (blank for all)  
" # (sub)array numbers (blank for all)  
" # MS selection (blank for all)  
  
True # data averaging parameters  
" # average over channel? (blank = False, otherwi  
" # average over time? (blank = False, other value  
False # only valid if time averaging is turned on. aver.
```

On the right, a smartphone displays a stopwatch application. The time shown is 57:25.8. The screen also features a "Stop" button and a "Lap" button. The phone's dock at the bottom shows icons for World Clock, Alarm, Stopwatch, and Timer.

Automatic flagging with rficonsole



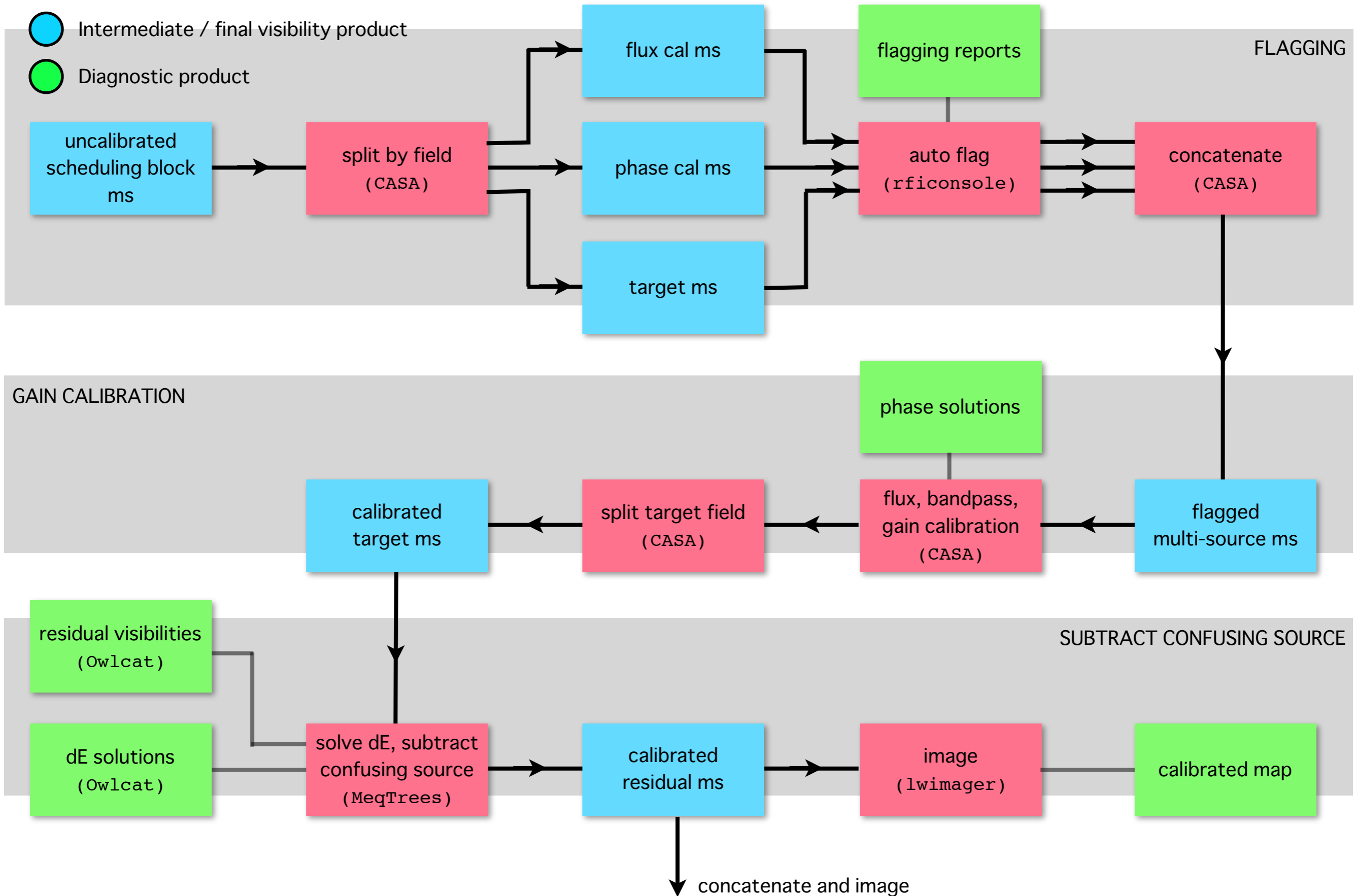
Offringa et al., MNRAS, 405, 155, 2010

Automated calibration scheme / software inventory: 7 MS test

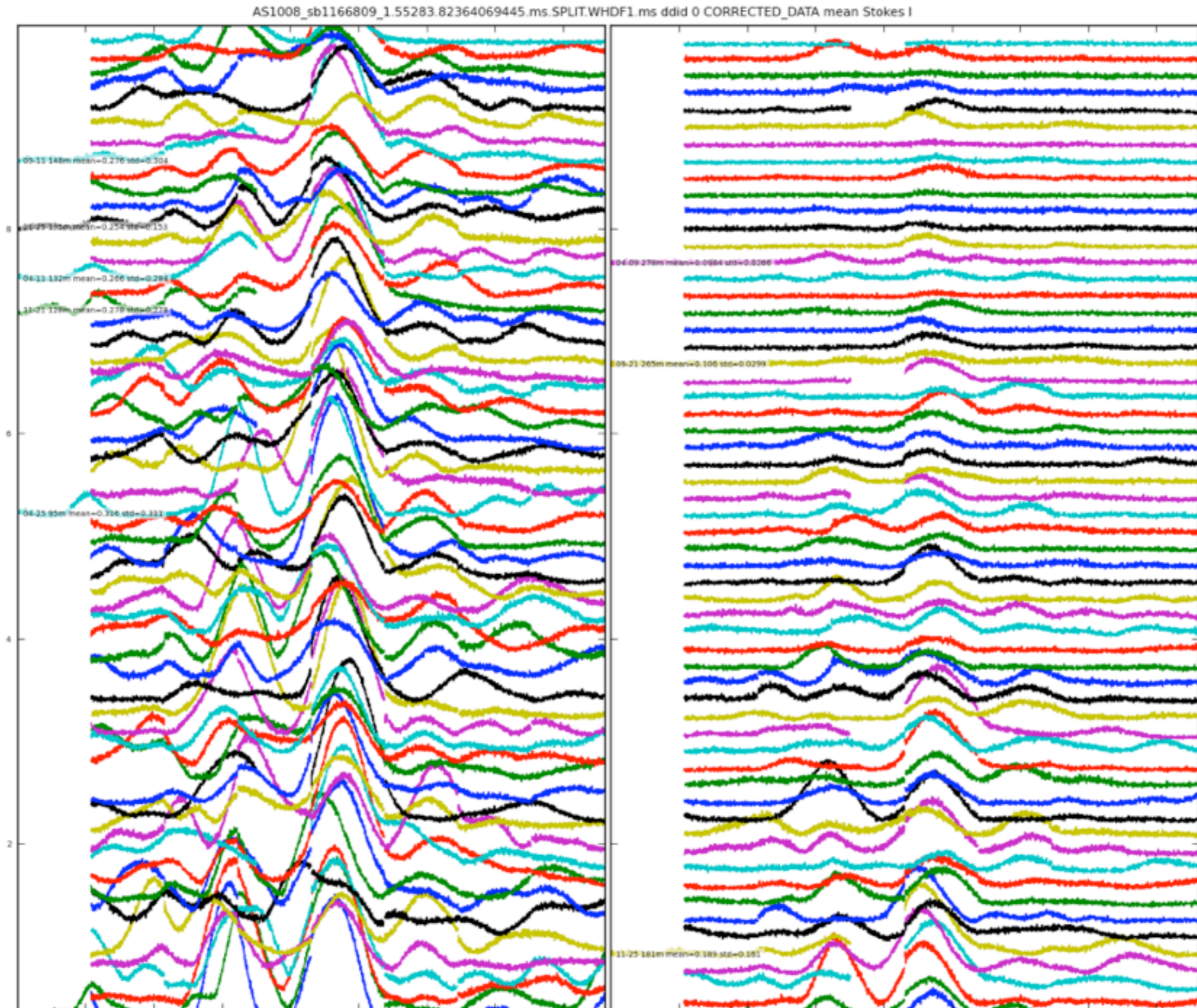
● Software

● Intermediate / final visibility product

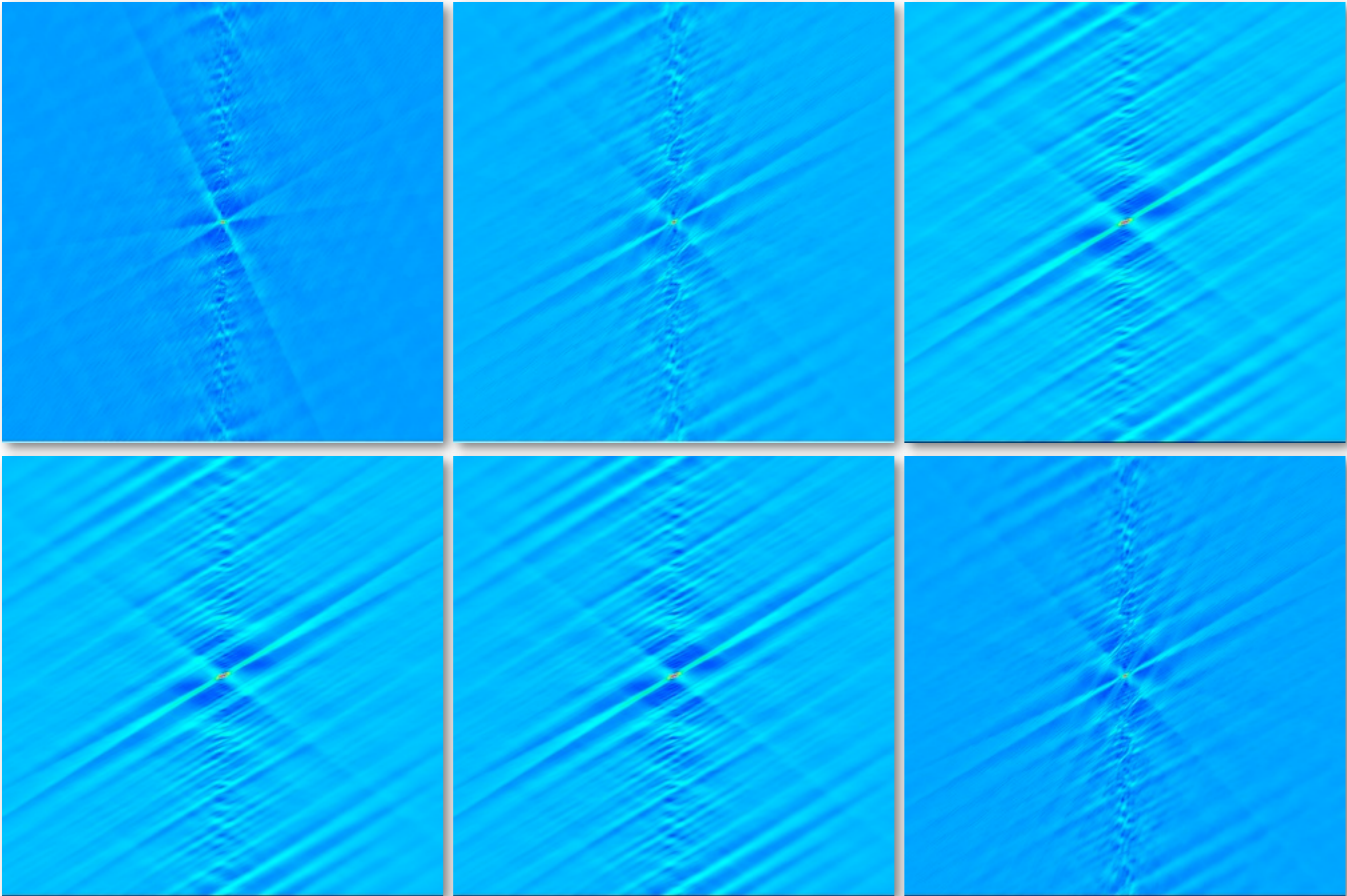
● Diagnostic product



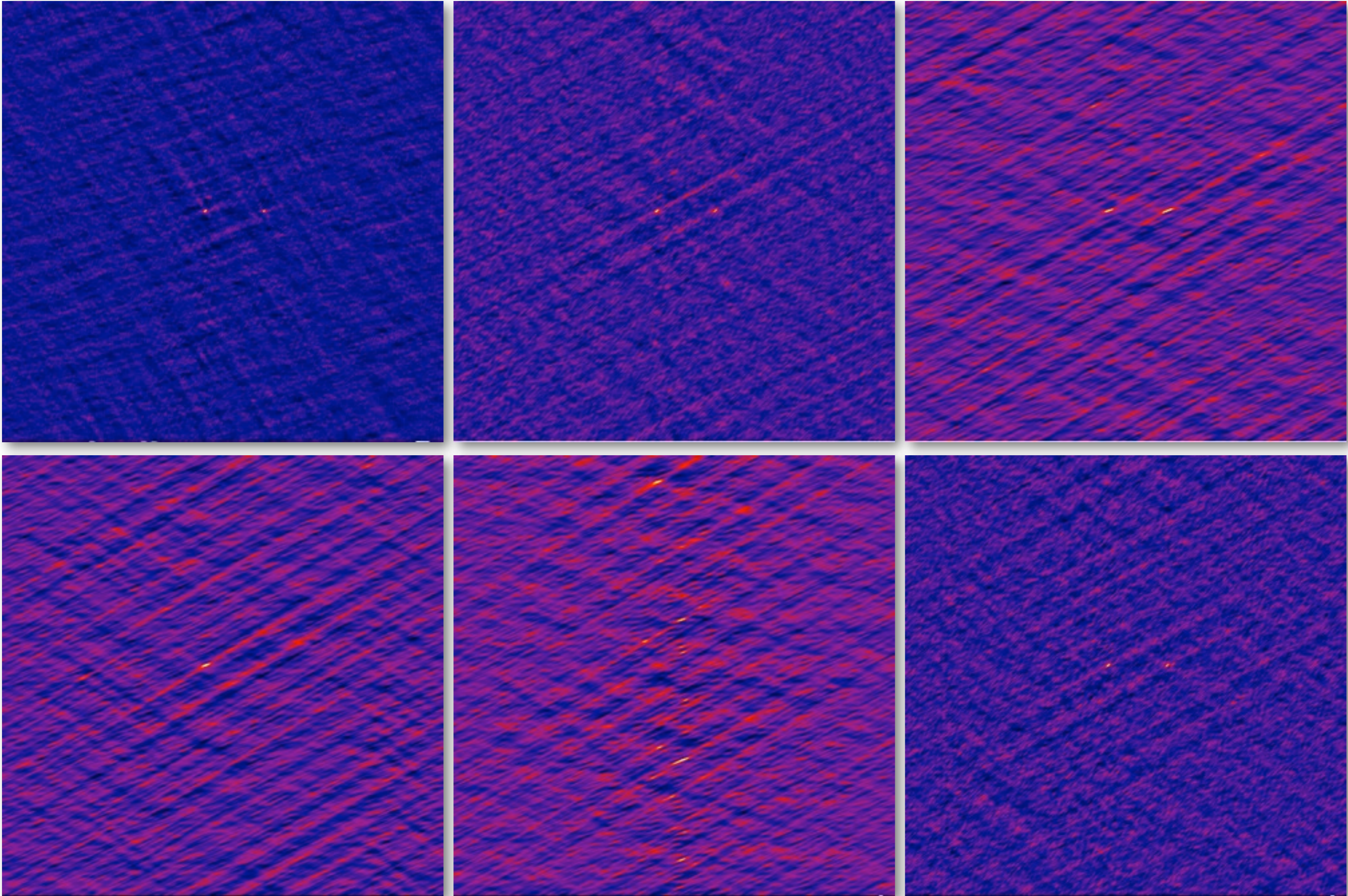
The importance of diagnostic data products: UFOs over New Mexico?



Automatically generate PSF images

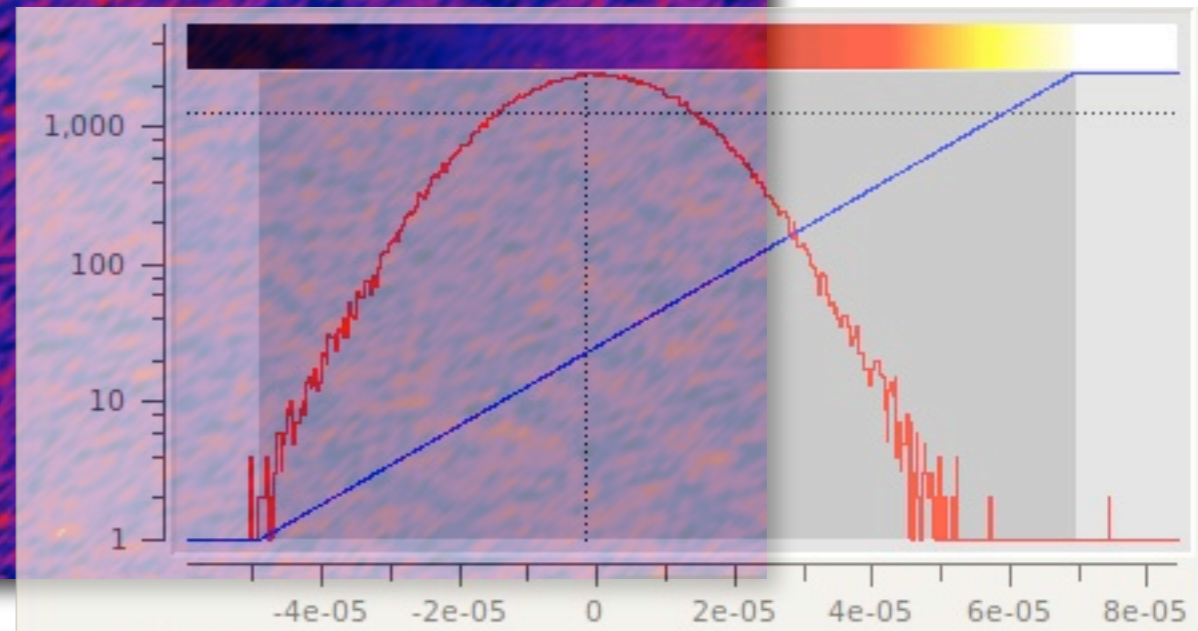
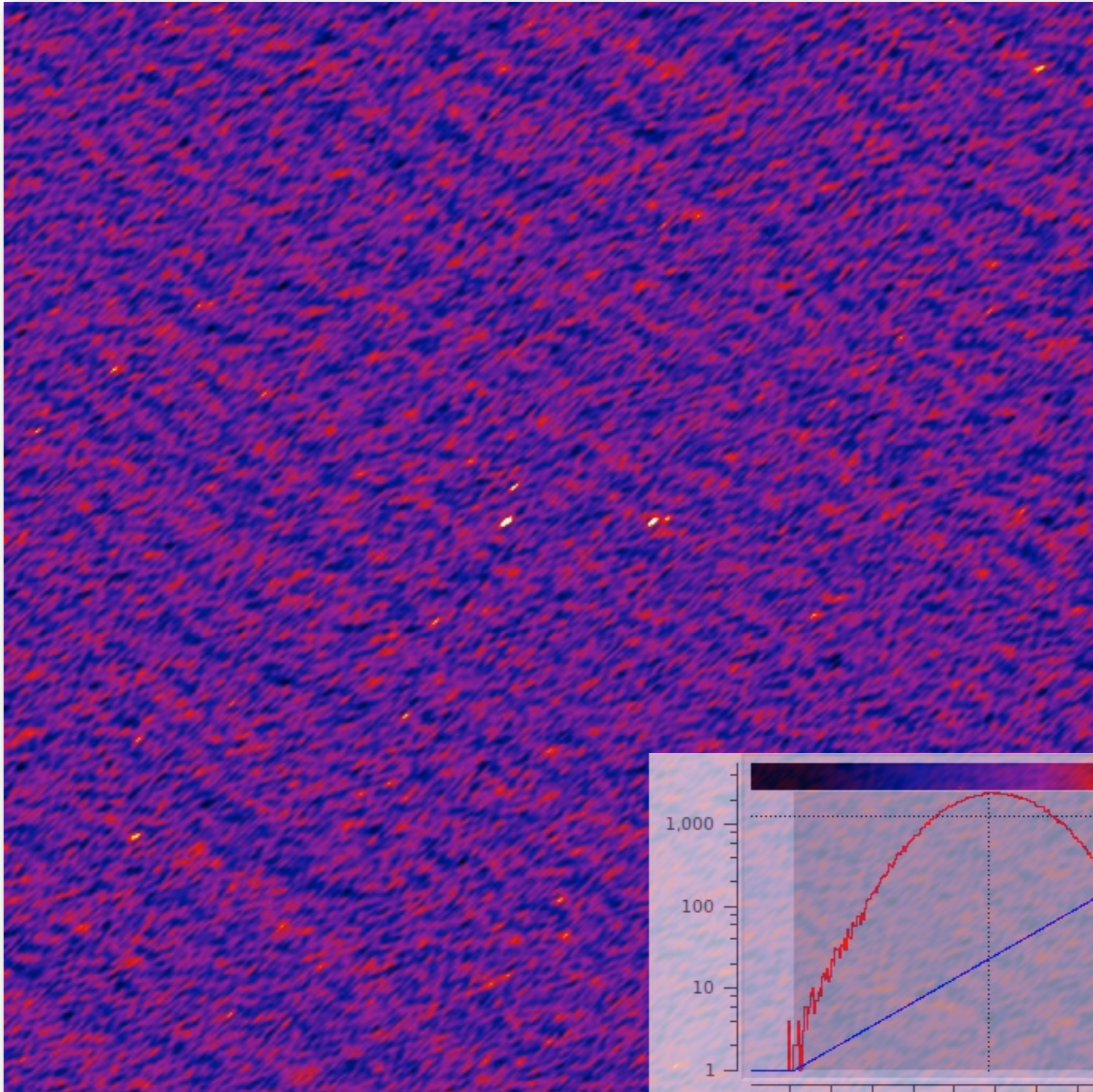


Automatically generate dirty maps

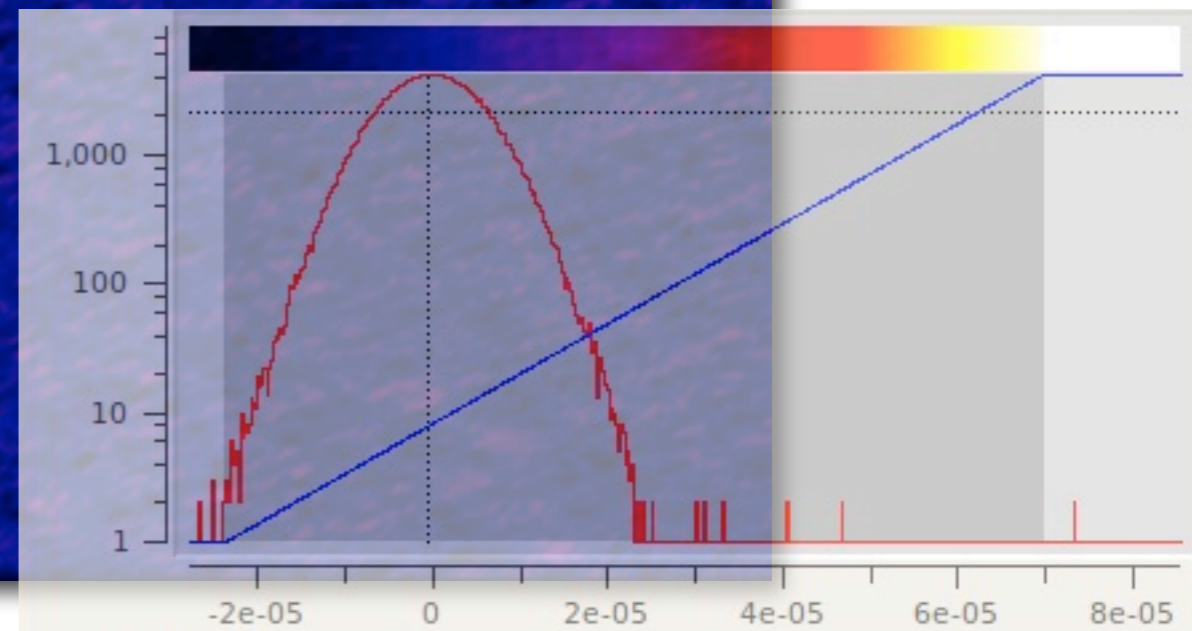
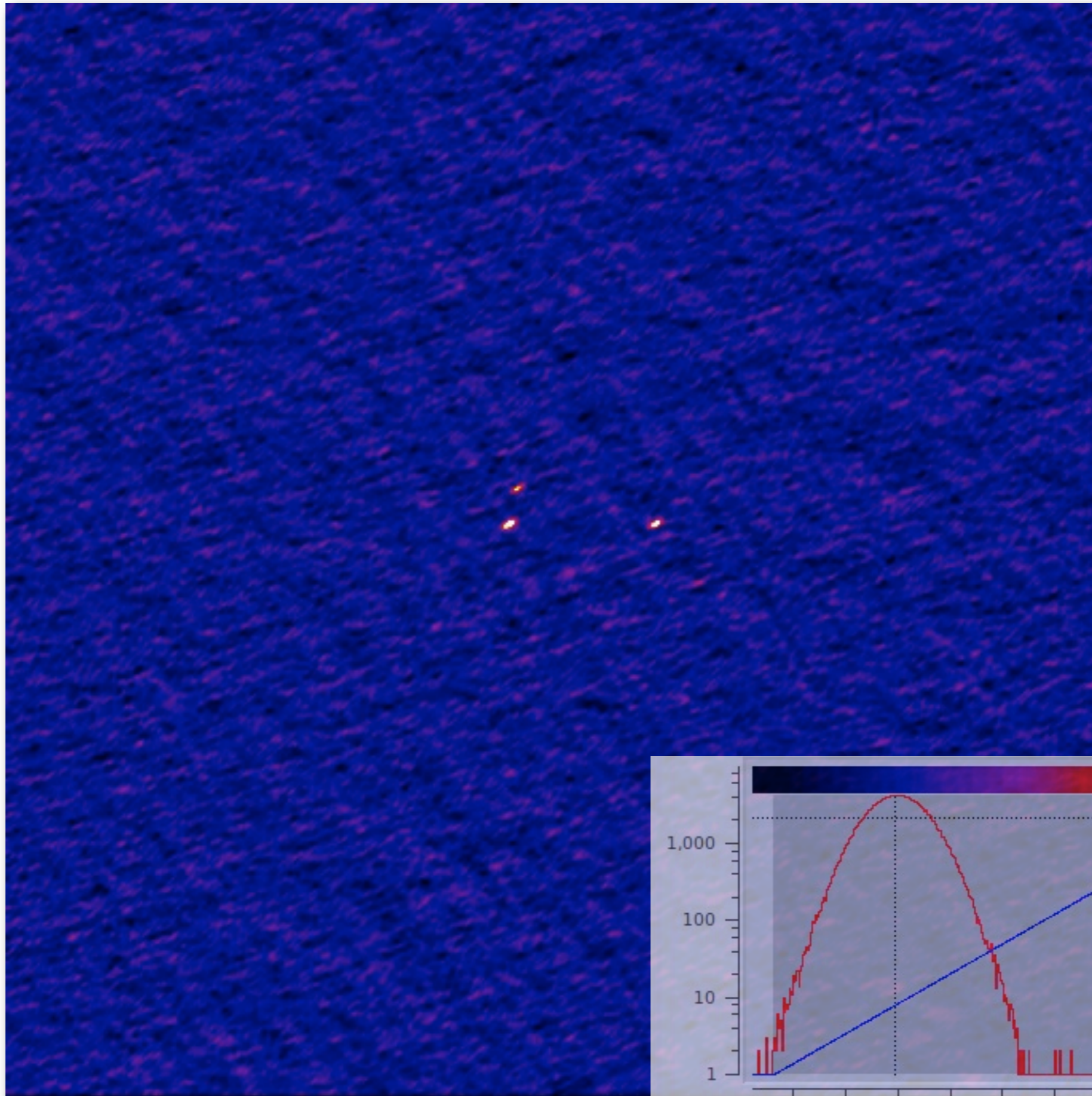


Map from 6 MS \times 2 SPW, 13 μ Jy RMS

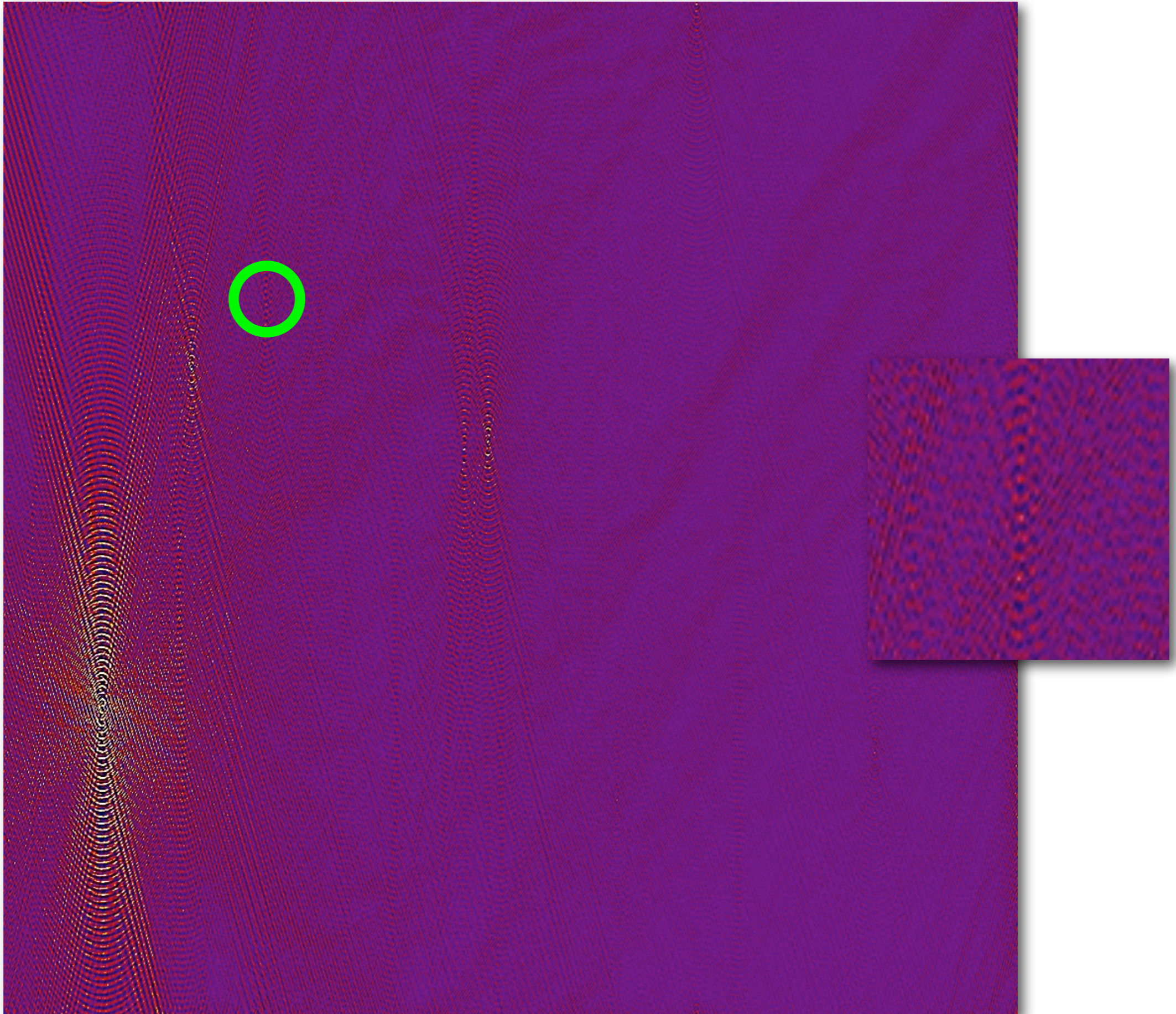
0.5 deg



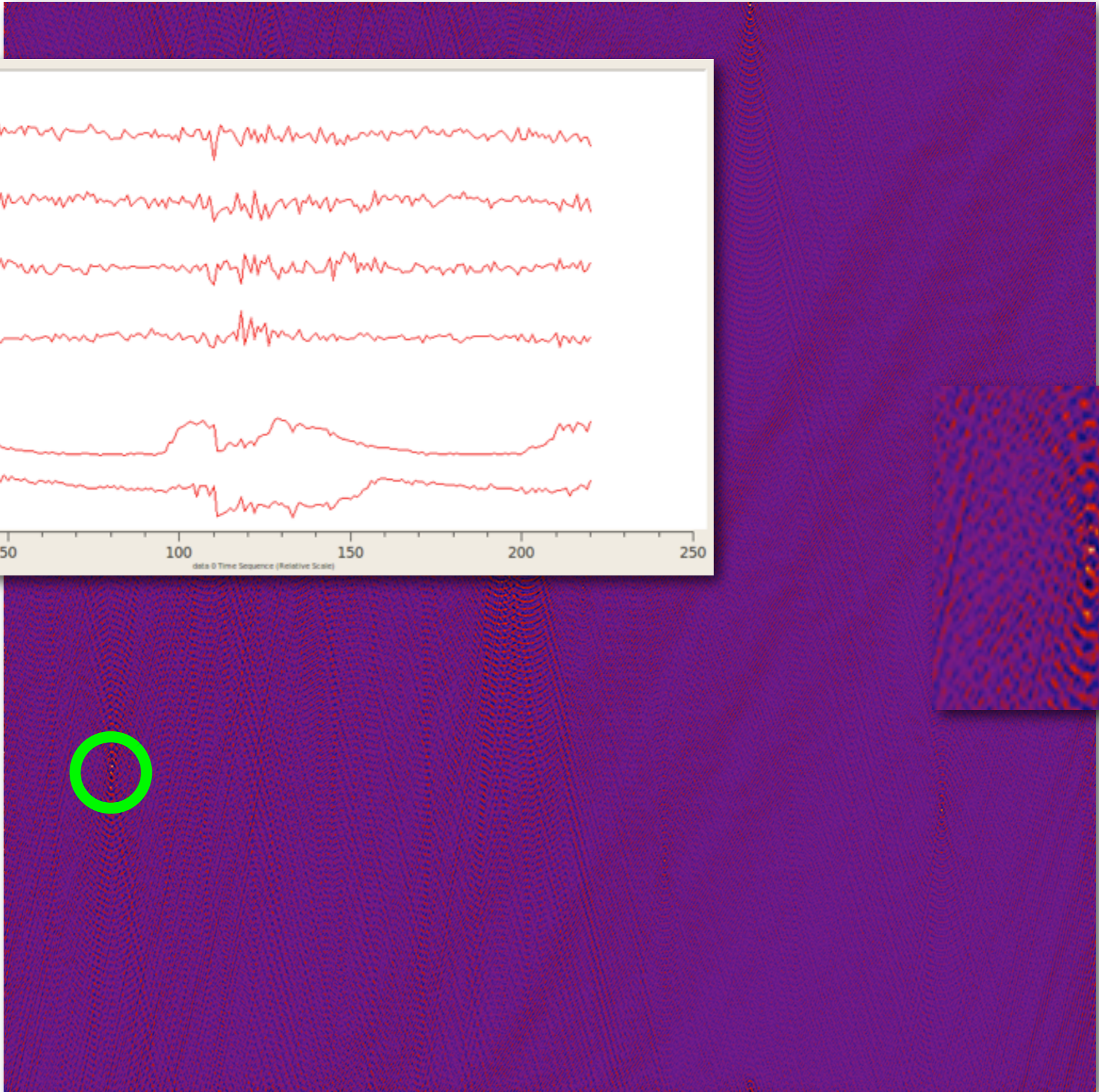
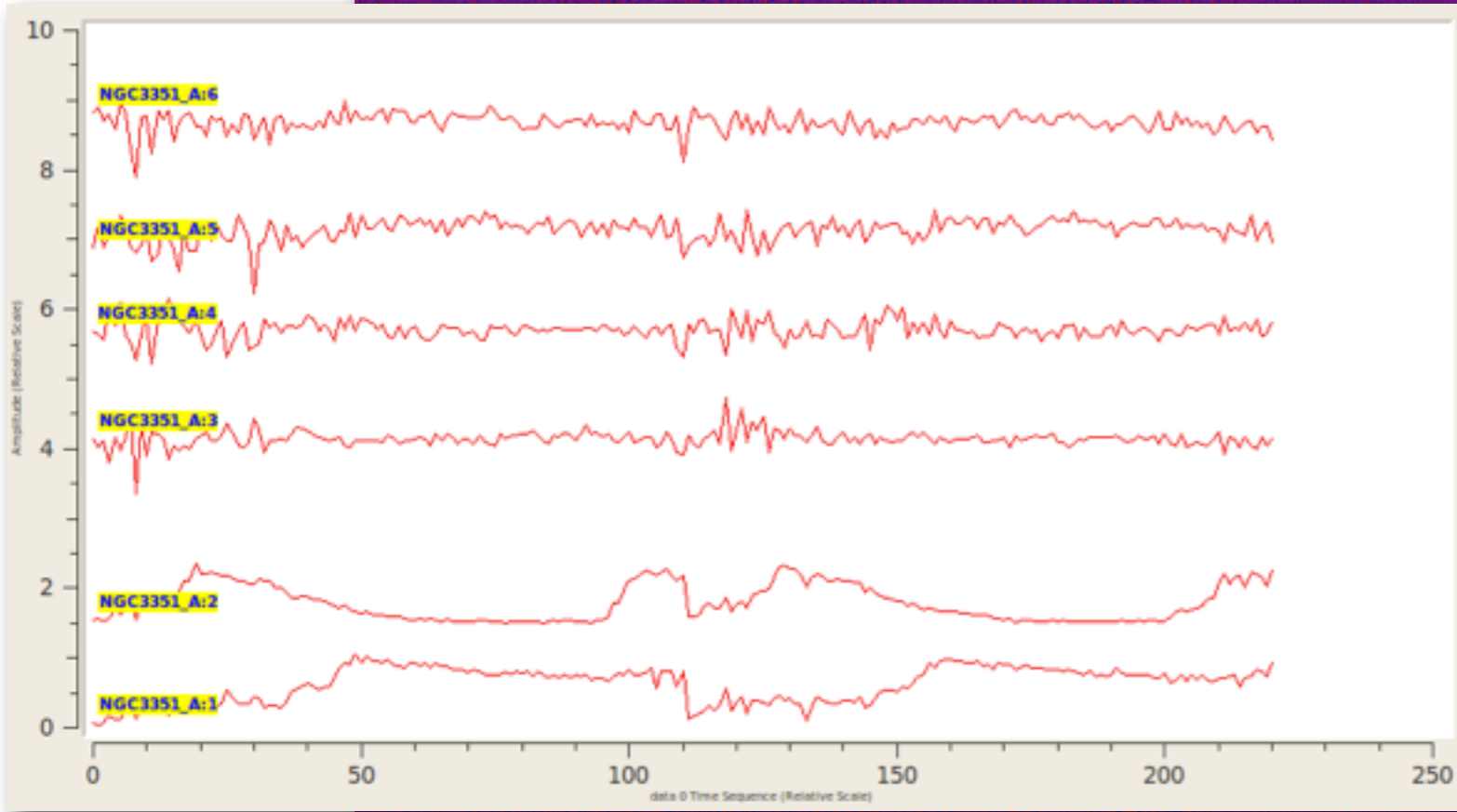
Less is more: 5 MS \times 2 SPW, 6 μ Jy RMS



MERLIN observations of NGC3351



MERLIN observations of NGC3351



Wide-band, wide-field e-MERLIN simulation with a toy primary beam model

