

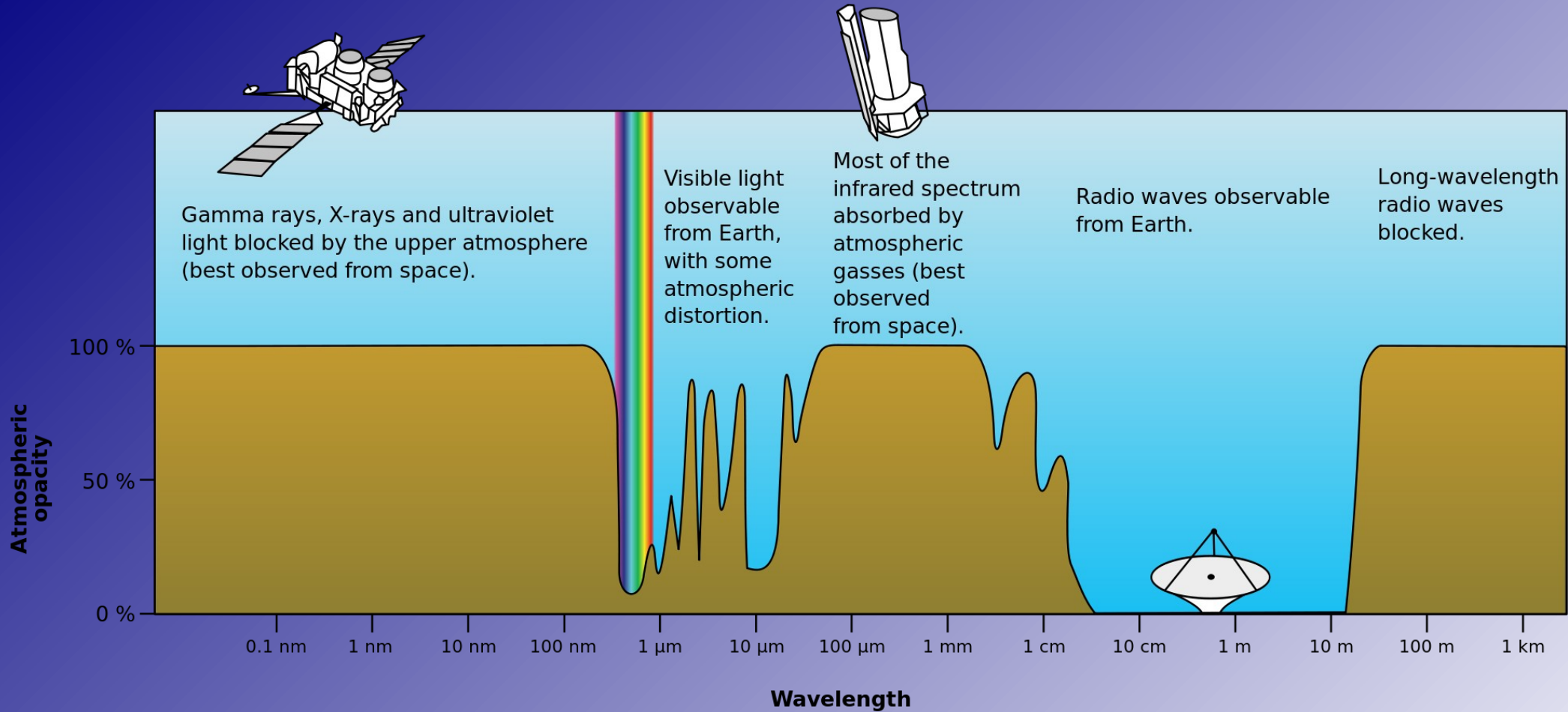
Principles of data reduction: infrared imaging

- NOTCam survival guide -

Erkki Kankare
15th October 2013
FINCA observing school



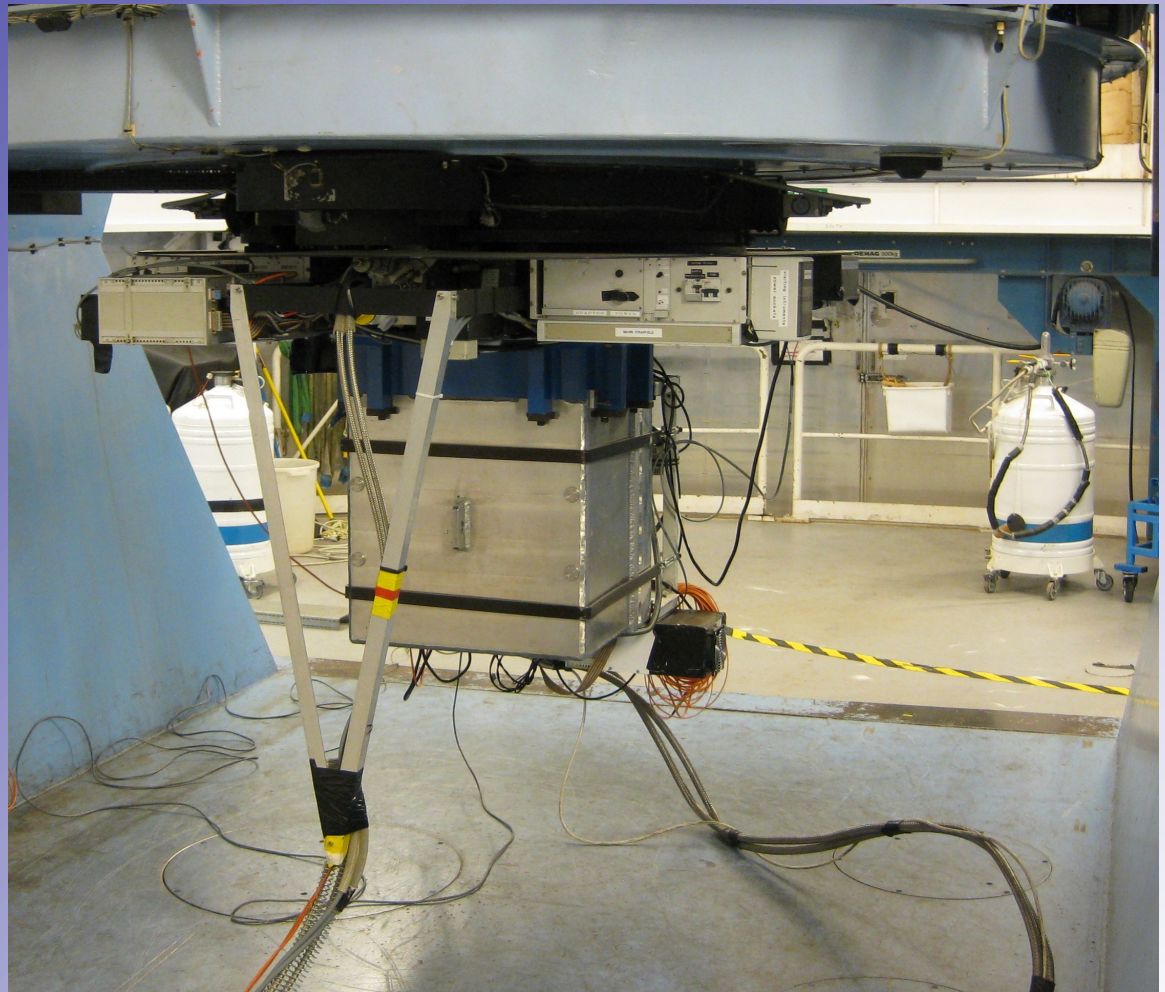
Near-infrared (near-IR)



- $\sim 7000 \text{ \AA} - 5 \text{ \mu m}$ (not visible for human eye)
- Atmosphere mostly transparent in near-IR (ground-based telescopes useful)

Nordic Optical Telescope near-infrared Camera and spectrograph (NOTCam)

- www.not.iac.es/instruments/notcam/
- Rockwell “HAWAII” HgCdTe array
- 1024x1024x18.5 μ m pixels
- Wide-field imaging
 - 4' x 4' (0.234"/pixel)
- High-resolution imaging
 - 80" x 80" (0.078"/pixel)
- Long-slit spectroscopy
- 0.8 - 2.5 μ m wavelength range
- 4 quadrants in the array

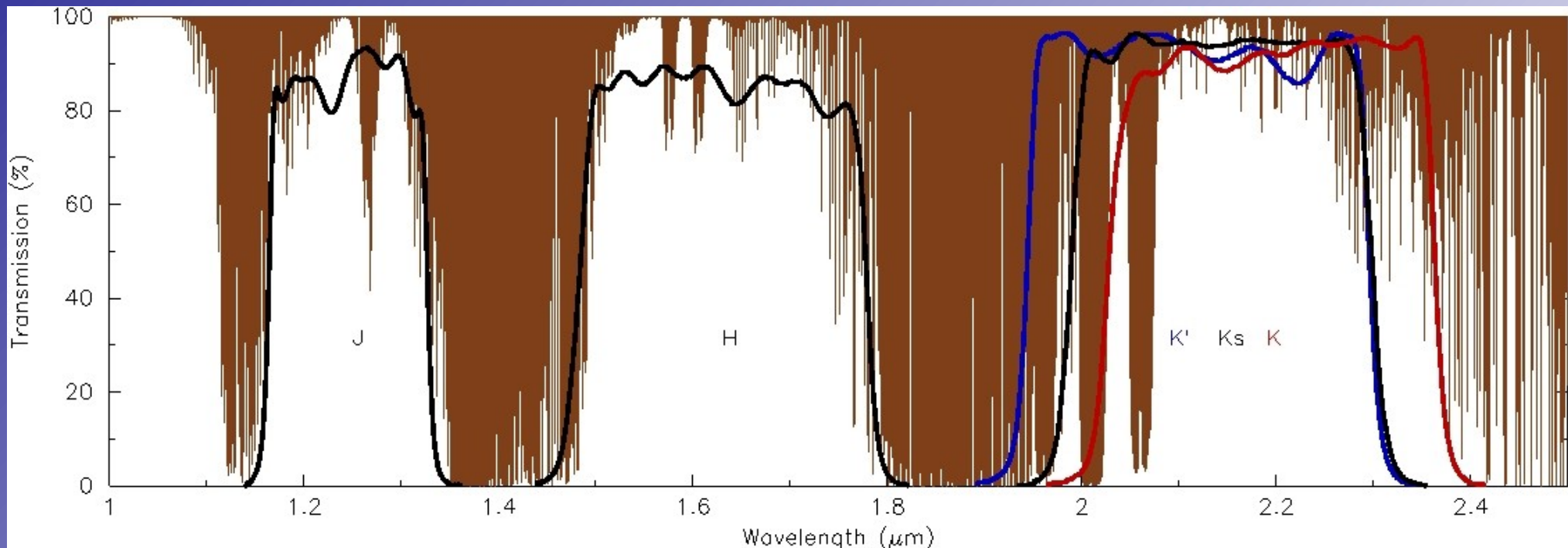


Optical elements

- Fixed setup
 - Broadband imaging JHKs
 - Selection of other filters
- All filters have their own focus offset (foc-del) compared to the WF K-band
- www.not.iac.es/instruments/notcam/filters/index.html

Imaging mode focus offsets found in good seeing (fwhm:0.3"-0.5").

	WF Camera	HR Camera	
	5650	20	Internal camera focus (fixed)
foc-pos	23450 *)	23450 *)	Telescope value for K,K',Ks
foc-del	0	110	K, K', Ks
foc-del	-45	70	H
foc-del	-100	30	J
foc-del	-160	-50	Y
foc-del	-200	-75	Z



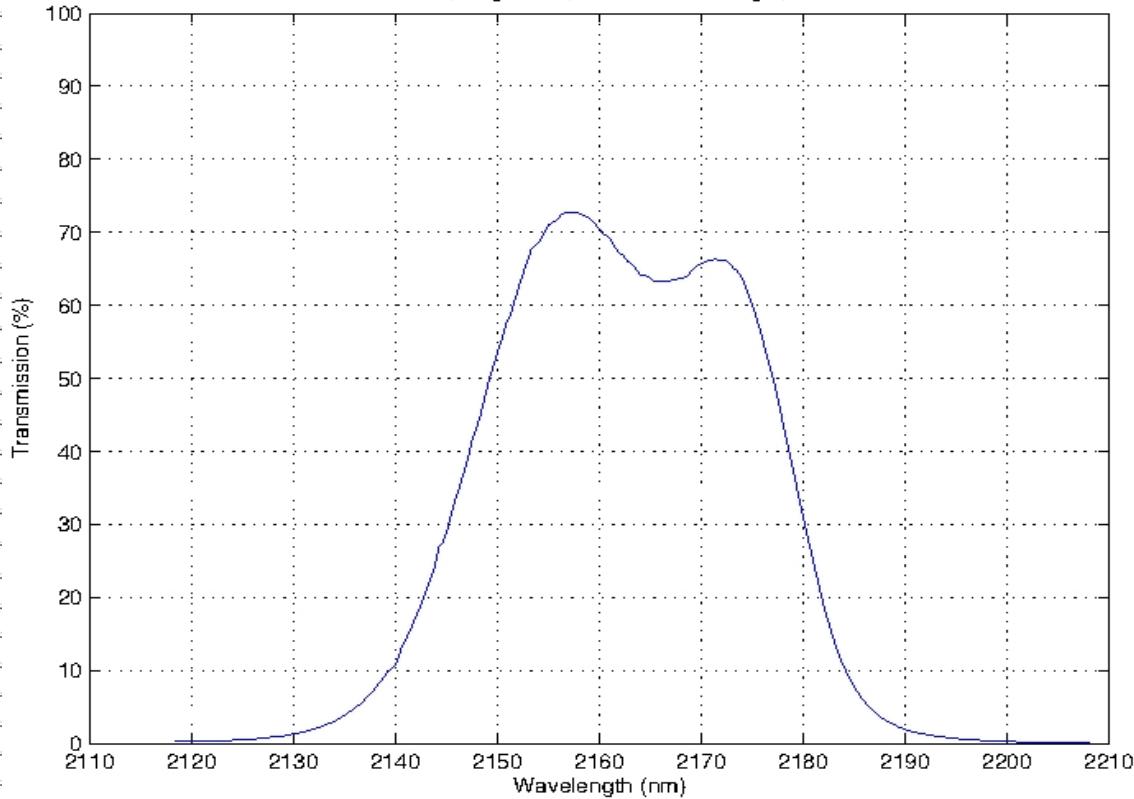
Optical elements

NOTCam Filter #	status	Name (click for details)	Bandpass (μm)			Transmission Curves	Comment
			λ_{on}	λ_{central}	λ_{off}		
201	Mounted	J	1.165	.	1.328	gif.ascii	NOTCam standard J
202	Mounted	J (spare)	1.167	1.250	1.334	gif.ascii	Mounted in the stop wheel
203	Mounted	H	1.484	.	1.780	gif.ascii	NOTCam standard H
204	Mounted	H (spare)	1.487	1.626	1.766	gif.ascii	Mounted in the stop wheel
205	Mounted	K	1.950	.	2.290	gif.ascii	
206	Mounted	K (spare)	1.950	2.115	2.280	gif.ascii	Mounted in the stop wheel
207	Mounted	K_s	1.999	2.140	2.282	gif.ascii	NOTCam standard K for imaging
208	Mounted	K	2.038	2.200	2.363	gif.ascii	NOTCam standard K for spectroscopy
209	Mounted	Br γ	2.147	2.163	2.179	ps.ascii	
210	Mounted	K continuum	2.251	2.267	2.284	ps.ascii	
211	Mounted	H continuum	1.562	1.574	1.586	ps.ascii	
212	Mounted	[Fe II]	1.632	1.645	1.657	ps.ascii	
213	Mounted	He I _A	1.070	1.079	1.089	png	
214	Mounted	Pa γ	1.086	1.094	1.102	.	
215	Mounted	J-continuum	1.201	1.211	1.221	ps.ascii	
216	Mounted	Pa β	1.277	1.287	1.296	ps.ascii	
217	Mounted	He I _B	2.056	2.071	2.086	ps.ascii	
218	Mounted	H ₂ v=1-0 S(1)	2.101	2.118	2.133	ps.ascii	
219	Mounted	He I _C	2.167	2.184	2.200	ps.ascii	
220	Mounted	H ₂ v=2-1 S(1)	2.233	2.251	2.268	ps.ascii	
221	Mounted	CO (2-0 bandhead)	2.271	2.288	2.305	ps.ascii	
222	Mounted	Y_n	1.004	1.028	1.053	png	Check note!
223	Mounted	CH ₄ s	1.543	1.599	1.655	ps.ascii	
224	Mounted	CH ₄ l	1.624	1.680	1.736	ps.ascii	
225	Order cancelled	Grism 1	1.000	1.300	1.600	.	
226	Stored	Grism 2	1.400	1.950	2.500	.	
227	Stored	[Fe II]	.	1.644	.	.	From Barr, use #212.
228	Mounted	[Fe II] Continuum	1.682	1.689	1.696	ps.ascii	From Barr.
229	Stored	H ₂ v=1-0 S(1)	.	2.122	.	.	From Barr, use #218.
230	Mounted	H ₂ v=1-0 S(1) Continuum	2.077	2.087	2.097	ps.ascii	From Barr.
231	Stored	1754/10	.	1.754	.	.	Belongs to B. Thomsen
232	Returned	1004/10	.	1.004	.	.	Belongs to G. Östlin
233	Returned	1012/10	.	1.012	.	.	Belongs to G. Östlin
234	Returned	1029/10	.	1.029	.	.	Belongs to G. Östlin
235	Returned	1020/10	.	1.020	.	.	Belongs to G. Östlin
236	Mounted	Y	0.944	1.020	1.097	png1 , png2 , png3 , ascii	From NDC Sep-2010.
237	Mounted	Z	0.830	0.889	0.949	jpg1 , jpg2 , jpg3 , ascii	From NDC Dec-2010.
238	Mounted	BK7	-	-	-	jpg , ascii	From Custom Scientific Mar-2012.
239	Mounted	KG4	-	-	-	jpg , ascii	From Custom Scientific Mar-2012.

Optical elements

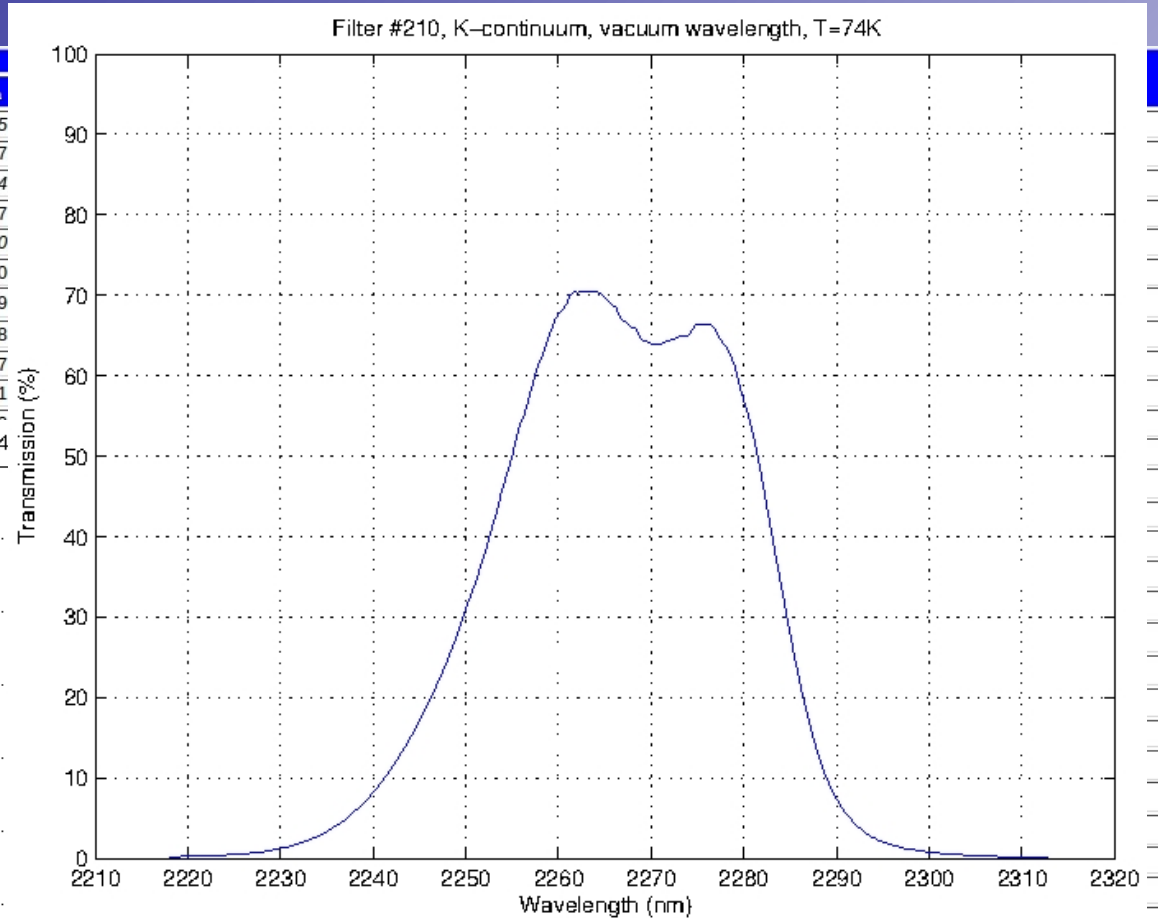
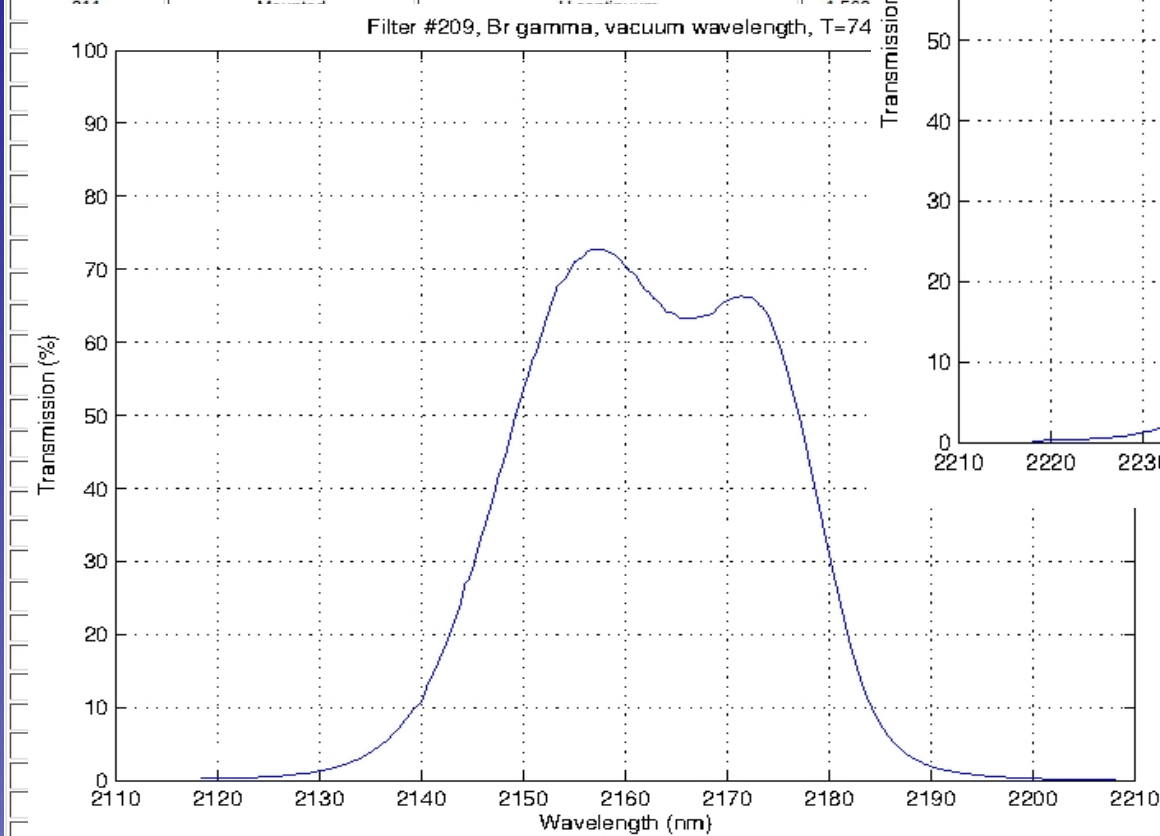
NOTCam Filter #	status	Name (click for details)	Bandpass (μm)			Transmission Curves	Comment
			λ_{on}	λ_{central}	λ_{off}		
201	Mounted	J	1.165	.	1.328	gif.ascii	NOTCam standard J
202	Mounted	J (spare)	1.167	1.250	1.334	gif.ascii	Mounted in the stop wheel
203	Mounted	H	1.484	.	1.780	gif.ascii	NOTCam standard H
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210	Mounted	K continuum	2.251	2.267	2.284	ps.ascii	
---	---	---	---	---	---	ps.ascii	
						ps.ascii	
						png	
						.	
						ps.ascii	
						ps.ascii	
						ps.ascii	
						ps.ascii	
						ps.ascii	
						ps.ascii	
						ps.ascii	
						png	Check note!
						ps.ascii	
						ps.ascii	
						.	
						.	
						.	From Barr, use #212.
						ps.ascii	From Barr.
						.	From Barr, use #218.
						ps.ascii	From Barr.
						.	Belongs to B. Thomsen
						.	Belongs to G. Östlin
						.	Belongs to G. Östlin
						.	Belongs to G. Östlin
						.	Belongs to G. Östlin
						png1.png2.png3.ascii	From NDC Sep-2010.
						jpg1.jpg2.jpg3.ascii	From NDC Dec-2010.
						jpg.ascii	From Custom Scientific Mar-2012.
239	Mounted	KG4	-	-	-	jpg.ascii	From Custom Scientific Mar-2012.

Filter #209, Br gamma, vacuum wavelength, T=74K



Optical elements

NOTCam Filter #	status	Name (click for details)	λ_{mid}
201	Mounted	J	1.165
202	Mounted	J (spare)	1.167
203	Mounted	H	1.484
204	Mounted	H (spare)	1.487
205	Mounted	K	1.950
206	Mounted	K (spare)	1.950
207	Mounted	K_s	1.999
208	Mounted	K	2.038
209	Mounted	Br γ	2.147
210	Mounted	K continuum	2.251

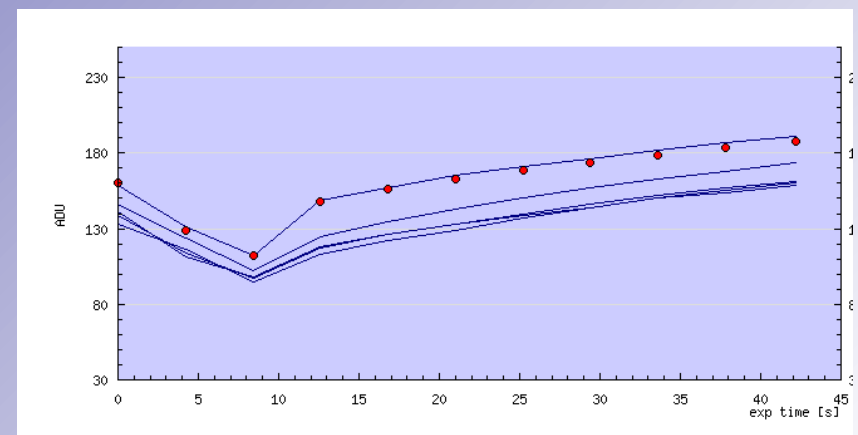
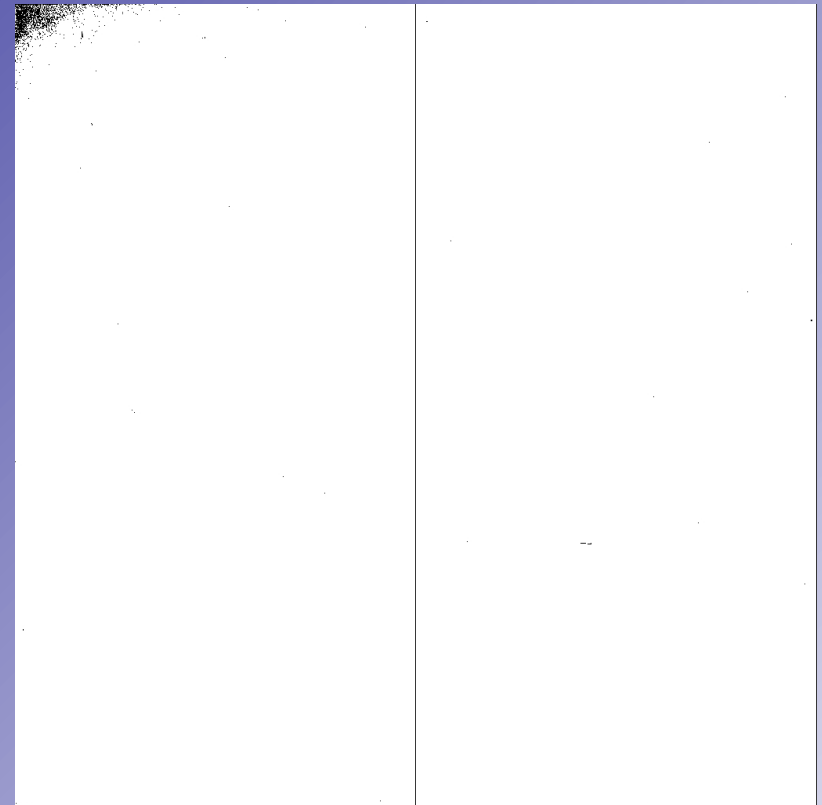


ps.ascii	From Barr.
.	From Barr, use #218.
ps.ascii	From Barr.
.	Belongs to B. Thomsen
.	Belongs to G. Östlin
.	Belongs to G. Östlin
.	Belongs to G. Östlin
.	Belongs to G. Östlin
png1.png2.png3.ascii	From NDC Sep-2010.
jpg1.jpg2.jpg3.ascii	From NDC Dec-2010.
jpg.ascii	From Custom Scientific Mar-2012.
jpg.ascii	From Custom Scientific Mar-2012.

239	Mounted	KG4	-	-	-
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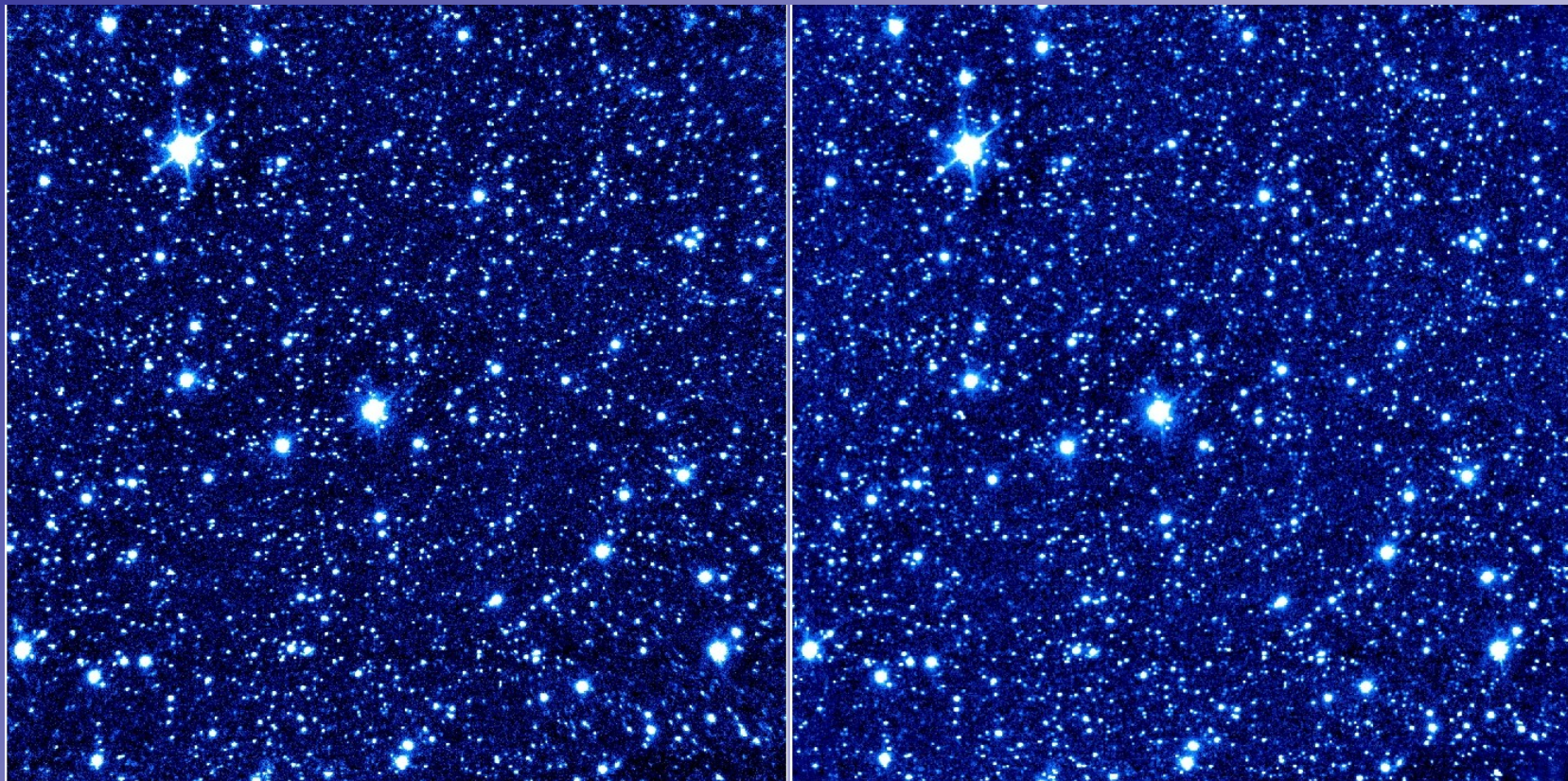
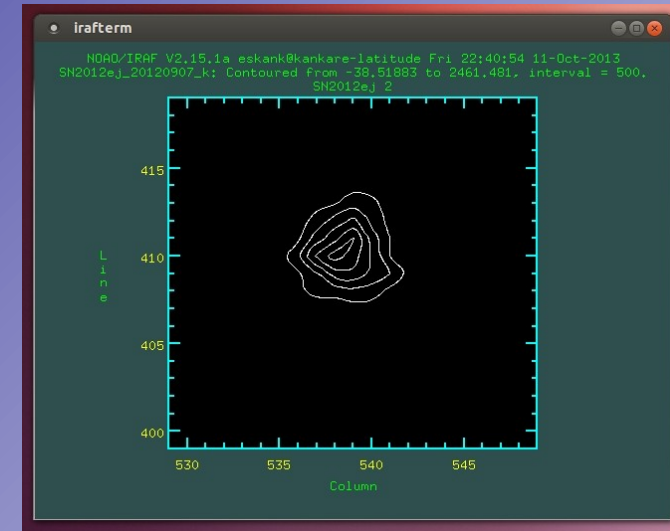
Bad pixels & Calibration

- www.not.iac.es/instruments/qc/
- Dead column in the centre of the array due to the readout 'feature'.
 - Also many cold pixels
- The only calibrations required for NOTCam near-IR imaging are differential (bright and faint) sky flats. Faint frames are used to subtract the thermal emission (independent of the sky intensity) from the bright frames.
- No bias subtraction
- Darks can be used to make a bad pixel mask (this is also available on the NOT web pages)
- No dark subtraction – NOTCam dark current is un-stable (and sky subtraction is done anyway)
- Dark exposures can be used to reset memory effects on a saturated array
 - clean3



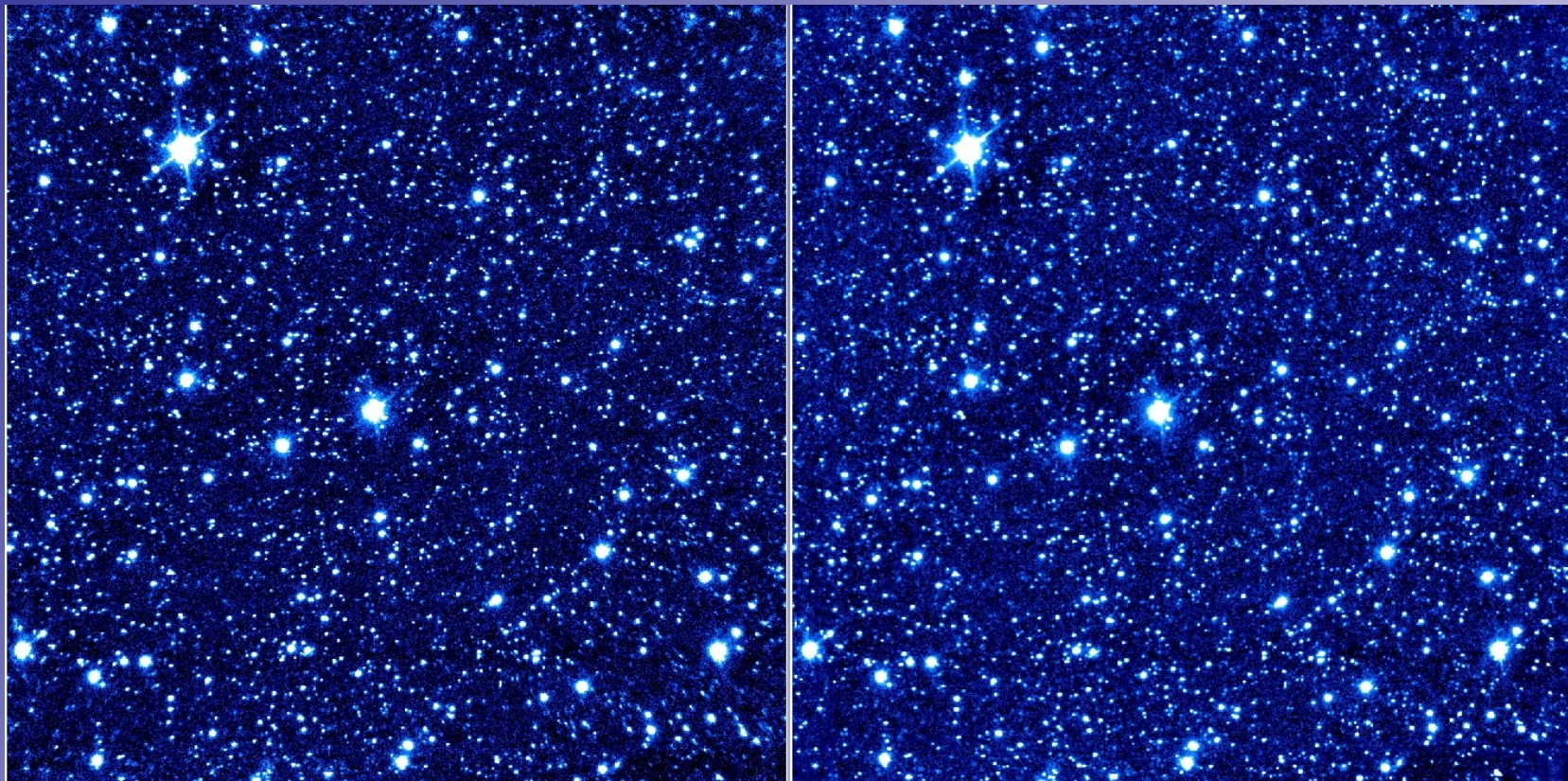
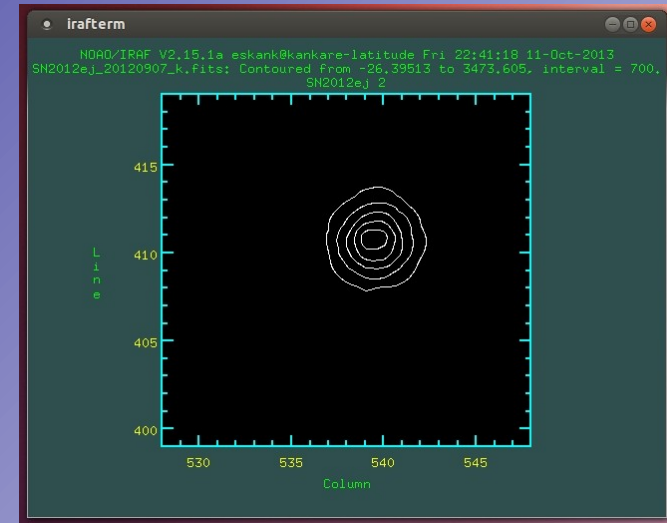
Distortion

- www.not.iac.es/instruments/notcam/calibration.html
- WF camera suffers from optical distortion
- Distortion correction model available
- Uncorrected (left) and distortion corrected (right) H-band images of the field used to make the model

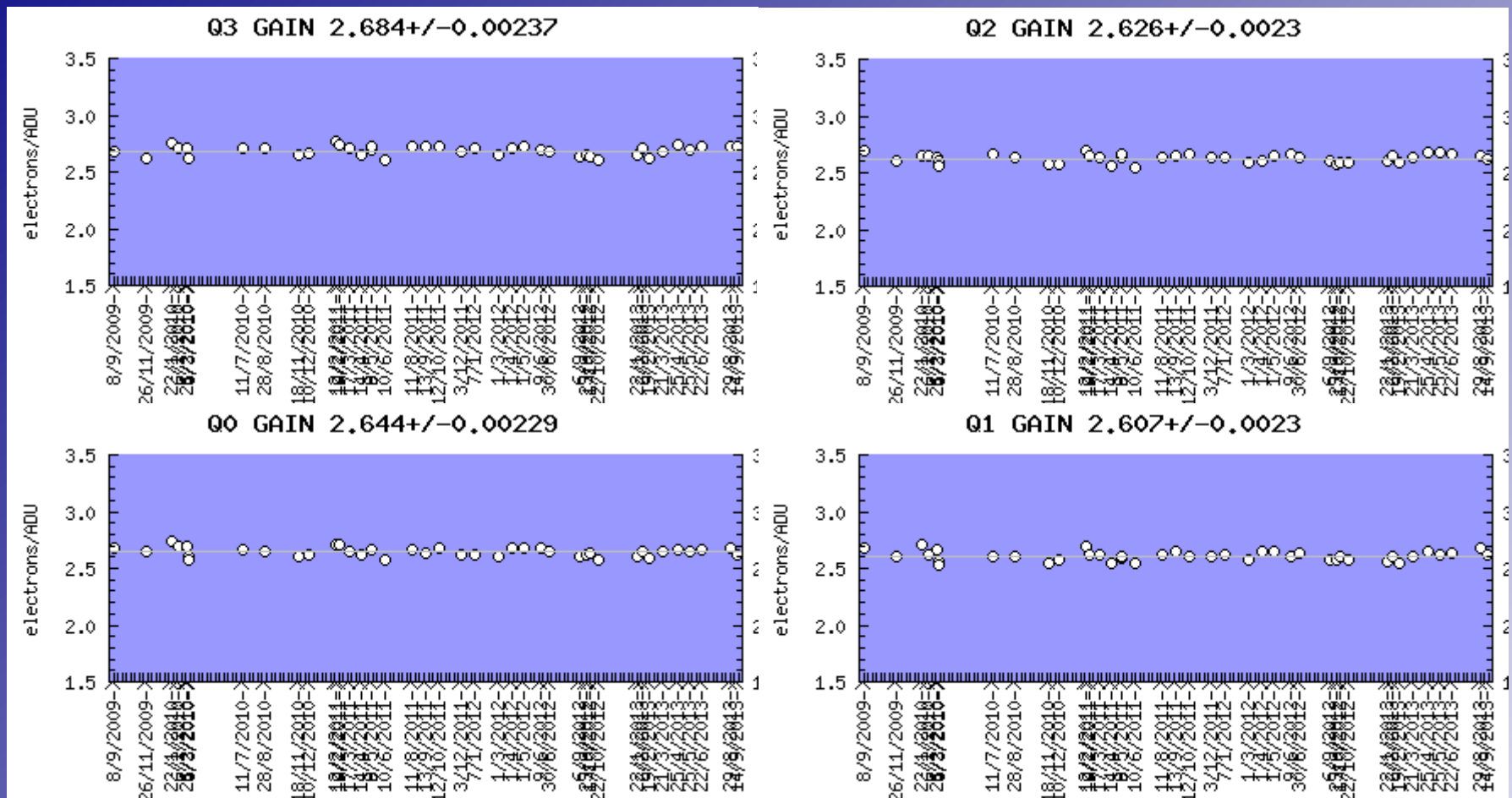


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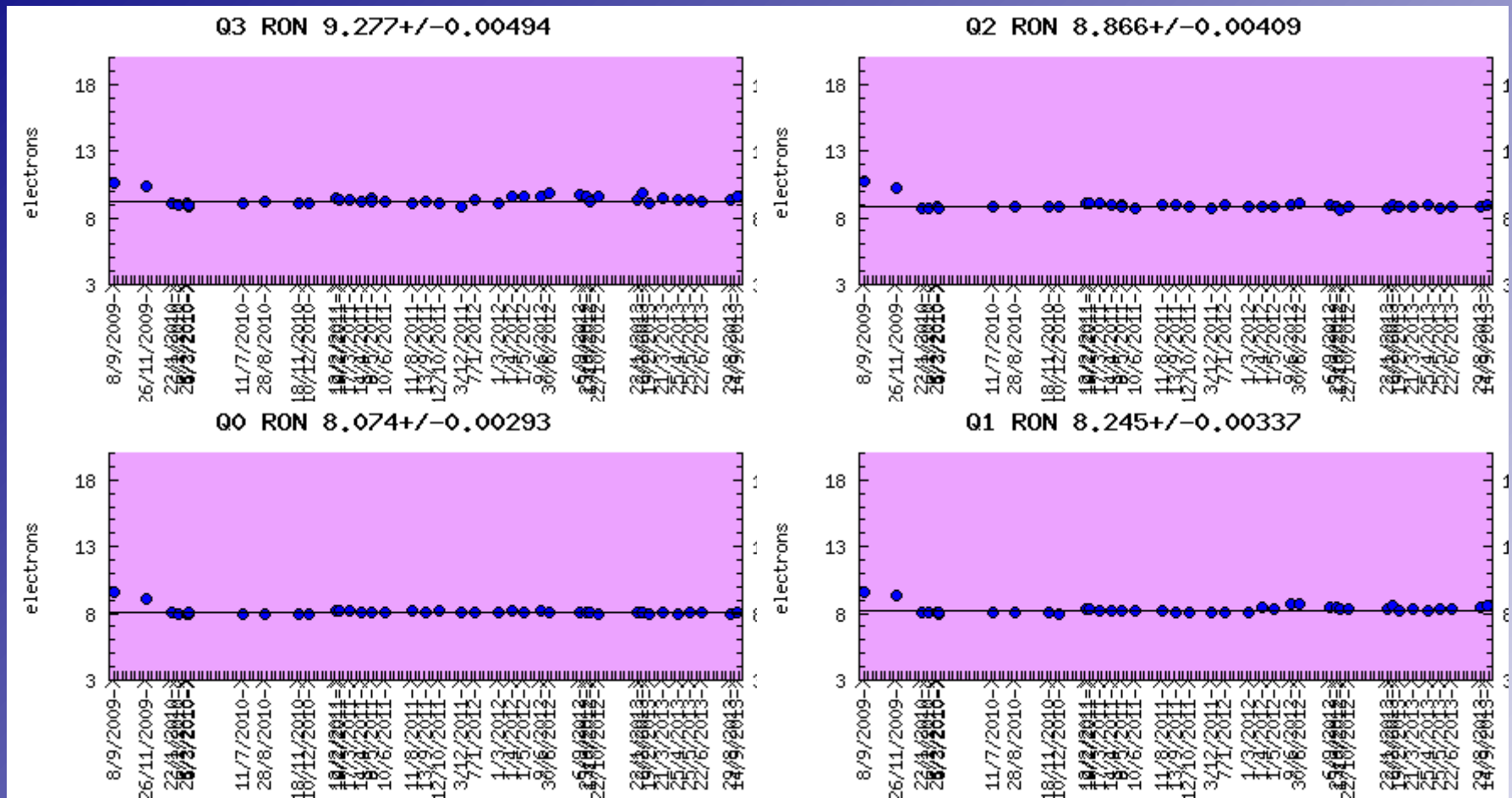


GAIN & RON



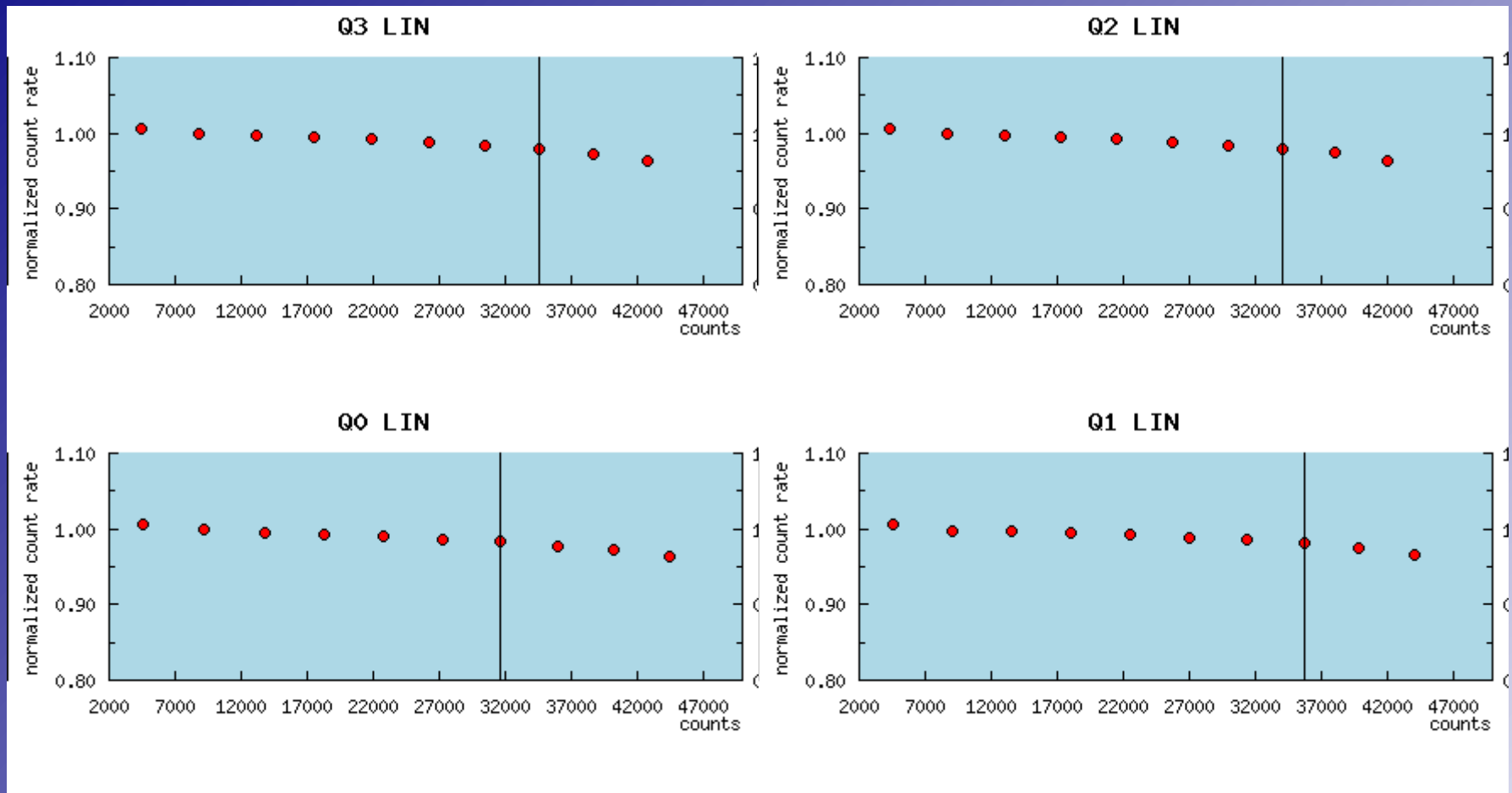
- www.not.iac.es/instruments/qc/
- Gain, relation between photons/electrons and ADUs/counts: e^-/ADU (ADU = Analogue-to-Digital Unit)
- Ramp-sampling mode (frame mode), gain $\sim 2.6 e^-/\text{ADU}$

GAIN & RON



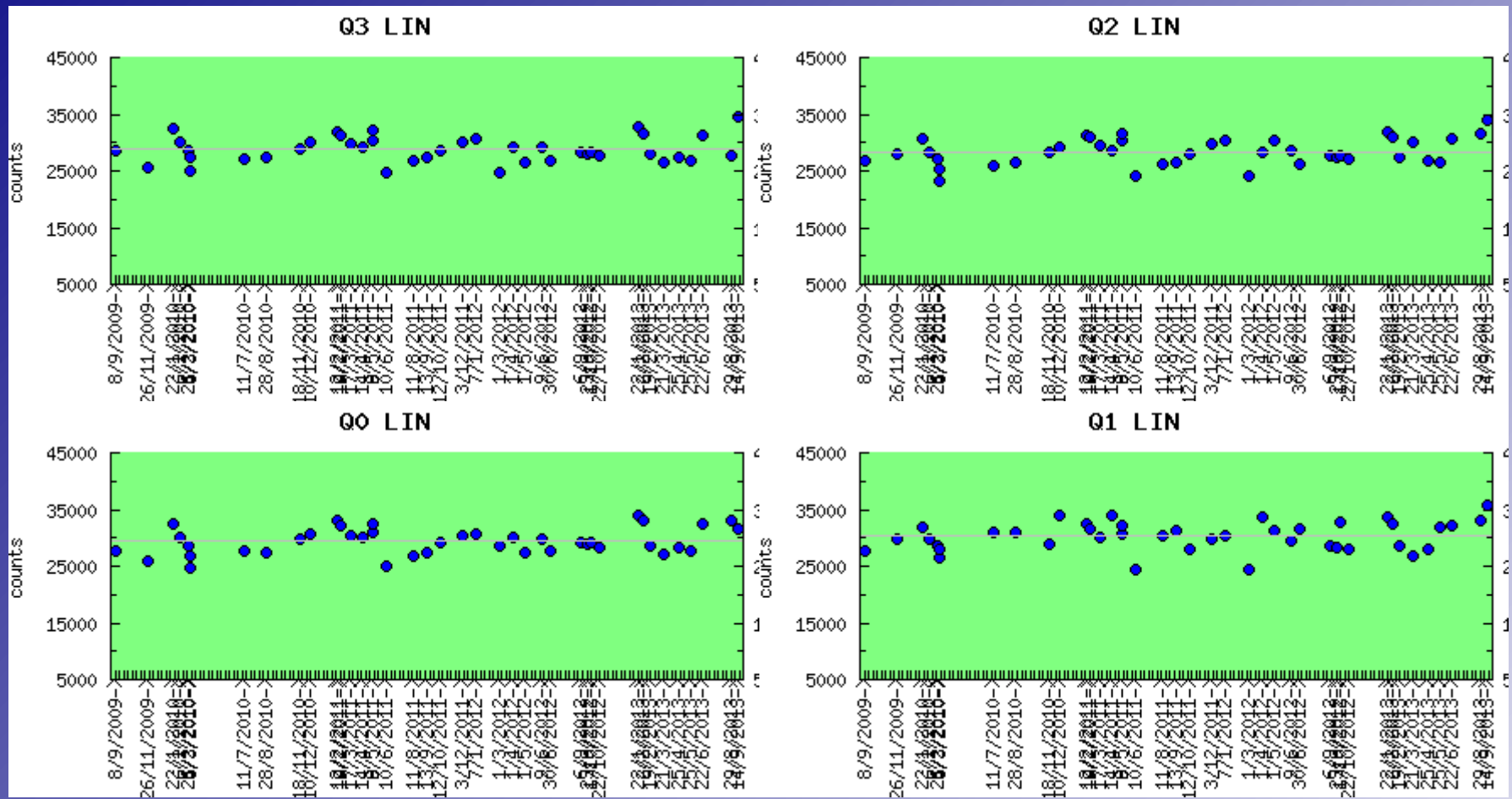
- www.not.iac.es/instruments/qc/
- RON (read-out-noise)
- Ramp-sampling mode (frame mode), RON $\sim 8.6 e^-$

Linearity



- www.not.iac.es/instruments/qc/
- Linearity region: range of counts with a constant gain within a small ($<1\%$) error
 - Typical problem with near-IR arrays (CCDs linear up to the saturation limit)
- **Linearity <25000 counts**

Linearity



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- **Linearity <25000 counts**

Sky background

- In near-IR the sky background is always high
 - Typical exposure of 6x10 sec with frame mode
 - In J-band ~3000-5000 ADU
 - In H-band ~15000-25000 ADU
 - In Ks-band ~20000-30000 ADU
- Sky subtraction crucial!
 - For compact sources dithered (jittered) target frames as sky frames
 - For extended sources separate sky frames (beam-switch mode)
 - **Target and sky observations require the same total exposure time**
- Observing strategy
 - Sky changes rapidly and **only <1-2 min exposures** should be used
 - **Pay attention to the linearity!!**
 - Adjust exposure parameters for the sequence, if necessary
 - Multiple short exposures with a dither pattern (5-point dice, 3x3 grid)
 - Repeat sequence if necessary for the desired S/N ratio
 - 1st exposure with a new filter usually low-quality

Exposure commands: exp, mexp, frame

- Reset-read-read mode (Fowler sampling):
 - reset the array, read out a reset frame, integrate, read-out, on-line subtract reset frame.
 - Used by **exp t** (single t sec exposure) and **mexp t N** (N exposures of t sec, the average of which is the final image).
 - **Image count level t sec**
 - Final single image *.fits[1] , reset frame *.fits[2]
 - mexp creates a separate average file to use (extension *.fits[1])
- Ramp-sampling mode:
 - reset the array, read out a reset frame, integrate, multiple read-outs during the integration.
 - Used by **frame t N** (t*N exposure corrected with linear regression analysis to reduce the noise by a factor of $N^{1/2}$)
 - **Image count level t * N sec**
 - Final image *.fits[1] , read-out files *.fits[2] ... *.fits[N+1] , reset frame *.fits[N+2].
- NOTCam files, like all NOT files, are Multiple Extensions FITS (MEF) files
- **Integration time + Overheads = 1.4 x integration time (more with beamswitch)**

Exposure commands: frame

The screenshot displays the SAOImage ds9 interface. The main window shows five astronomical images arranged in a 2x3 grid (with the bottom-right cell empty). The top-left image is highlighted with a blue border. The top row shows the full image, a zoomed-in view of the central region, and another zoomed-in view. The bottom row shows a zoomed-in view of the left side and a zoomed-in view of the right side. A vertical pattern, described as a "reset anomaly" or "bias tilt", is visible in all images, appearing as a vertical gradient or "dc-gradient". The interface includes a menu bar (File, Edit, View, Frame, Bin, Zoom, Scale, Color, Region, WCS, Analysis), a toolbar with buttons for file, edit, view, frame, bin, zoom, scale, color, region, wcs, and help, and a control panel on the left with fields for File (NCvi070107.fit), Object (AS33 3), Value, WCS, Physical (X, Y), Image (X, Y), Frame 3, Zoom (0.052), and Angle (0.000). A status bar at the bottom shows coordinates: 23, 44, 66, 87, 109, 131, 152, 174, 195.

- Vertical pattern is called a “reset anomaly” (“bias tilt”, “dc-gradient”), typical for Hawaii arrays. Present independent of the used exposure modes.

Exposure commands: mexp

- Look for an empty EXPMODE keyword in the header for the average files
- Average files are also byte-wise half the size of the original files
- Example: 5 (dice) J-band images observed with mexp 15 4
 - Files needed for reduction: NCve060274.fits , NCve060279.fits , NCve060284.fits , NCve060289.fits , NCve060294.fits

```
eskkank@kankare-latitude: ~/Arp299_20120506
File Edit View Search Terminal Help
eskkank@kankare-latitude:~$
eskkank@kankare-latitude:~$
eskkank@kankare-latitude:~$
eskkank@kankare-latitude:~$ cd Arp299_20120506/
eskkank@kankare-latitude:~/Arp299_20120506$ gethead OBJECT EXPMODE *
NCve060270.fits Arp299_J 1 mexp 15.0 4 1/4
NCve060271.fits Arp299_J 1 mexp 15.0 4 2/4
NCve060272.fits Arp299_J 1 mexp 15.0 4 3/4
NCve060273.fits Arp299_J 1 mexp 15.0 4 4/4
NCve060274.fits Arp299_J 1 mexp 15.0 4
NCve060275.fits Arp299_J 2 mexp 15.0 4 1/4
NCve060276.fits Arp299_J 2 mexp 15.0 4 2/4
NCve060277.fits Arp299_J 2 mexp 15.0 4 3/4
NCve060278.fits Arp299_J 2 mexp 15.0 4 4/4
NCve060279.fits Arp299_J 2 mexp 15.0 4
NCve060280.fits Arp299_J 3 mexp 15.0 4 1/4
NCve060281.fits Arp299_J 3 mexp 15.0 4 2/4
NCve060282.fits Arp299_J 3 mexp 15.0 4 3/4
NCve060283.fits Arp299_J 3 mexp 15.0 4 4/4
NCve060284.fits Arp299_J 3 mexp 15.0 4
NCve060285.fits Arp299_J 4 mexp 15.0 4 1/4
NCve060286.fits Arp299_J 4 mexp 15.0 4 2/4
NCve060287.fits Arp299_J 4 mexp 15.0 4 3/4
NCve060288.fits Arp299_J 4 mexp 15.0 4 4/4
NCve060289.fits Arp299_J 4 mexp 15.0 4
NCve060290.fits Arp299_J 5 mexp 15.0 4 1/4
NCve060291.fits Arp299_J 5 mexp 15.0 4 2/4
NCve060292.fits Arp299_J 5 mexp 15.0 4 3/4
NCve060293.fits Arp299_J 5 mexp 15.0 4 4/4
NCve060294.fits Arp299_J 5 mexp 15.0 4
eskkank@kankare-latitude:~/Arp299_20120506$ █
```

```
eskkank@kankare-latitude: ~/Arp299_20120506
File Edit View Search Terminal Help
NCve060292.fits Arp299_J 5 mexp 15.0 4 3/4
NCve060293.fits Arp299_J 5 mexp 15.0 4 4/4
NCve060294.fits Arp299_J 5 mexp 15.0 4
eskkank@kankare-latitude:~/Arp299_20120506$ ls -lrt
total 92740
-rw----- 1 eskkank eskkank 4216320 May 7 2012 NCve060270.fits
-rw----- 1 eskkank eskkank 4216320 May 7 2012 NCve060271.fits
-rw----- 1 eskkank eskkank 4216320 May 7 2012 NCve060272.fits
-rw----- 1 eskkank eskkank 4216320 May 7 2012 NCve060273.fits
-rw----- 1 eskkank eskkank 2113920 May 7 2012 NCve060274.fits
-rw----- 1 eskkank eskkank 4216320 May 7 2012 NCve060275.fits
-rw----- 1 eskkank eskkank 4216320 May 7 2012 NCve060276.fits
-rw----- 1 eskkank eskkank 4216320 May 7 2012 NCve060277.fits
-rw----- 1 eskkank eskkank 4216320 May 7 2012 NCve060278.fits
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-rw----- 1 eskkank eskkank 2113920 May 7 2012 NCve060294.fits
eskkank@kankare-latitude:~/Arp299_20120506$ █
```

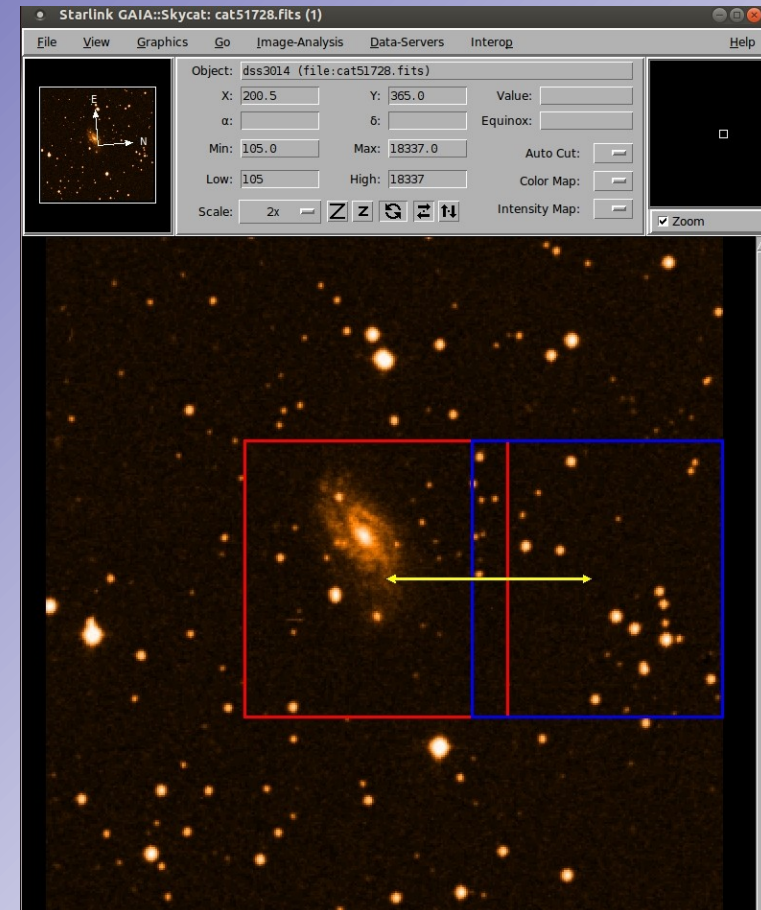
Field orientation

- Default field orientation of NOTCam is -90
 - North is Left, East is Up
- field-rot = -90 to minimize the spilling of LN_2

E S + N W	S W + E N	W N + S E	N E + W S
-90	0	+90	+-180

Beam-switch & Guiding

- Separate sky frames for extended targets
- Avoid bright stars on the OFF (sky) field
- Figure on the right: Example of beamswitching with NOTCAM-N-negX
- Beamswitch script ON-OFF sequence: target - sky - target - sky ...



Below is a listing of all available NOTCam guide areas:

- **NOTCAM-De** NOTCam_Default field (60" step guaranteed)
- **NOTCAM-Ma** NOTCam_Maximum field (not useful for dithering)
- **NOTCAM-Re** NOTCam_Reduced field (100" step guaranteed)

- **NOTCAM-Be-NS** Beamswitch offset in NS direction
- **NOTCAM-Be-EW** Beamswitch offset in EW direction

- **NOTCAM-S-posX** Beamswitch offset to the South (target moves in positive X direction)
- **NOTCAM-N-negX** Beamswitch offset to the North (target moves in negative X direction)
- **NOTCAM-E-negY** Beamswitch offset to the East (target moves in negative Y direction)
- **NOTCAM-W-posY** Beamswitch offset to the West (target moves in positive Y direction)

NOTCam observer's graphical user interface

The screenshot displays the NOTCam observer's graphical user interface (GUI) across multiple windows. Key components include:

- Terminal:** Shows system logs, connection status, and file operations.
- NOTCam Status:** Displays instrument parameters such as Aperture (4 Open Large), Filter 1 (15 Open), Filter 2 (13 J), Stop (12 15mm ring), Grism (2 Open), Lens (1 WF Camera), and Focus (5650).
- Sequence Manager:** Lists optical elements and their settings, including '44mm HR slit', '128mm WF slit', and '50mm pinhole'.
- Camera View:** Shows a real-time image of the star field AS16, with a color scale at the bottom ranging from -150 to 150.
- Sequence Log:** Provides detailed timing and status for each frame, including exposure times and completion percentages.
- Guidance Error Plot:** A graph showing the tracking performance over time, with a y-axis labeled 'Sky Guide Error' and an x-axis for 'Scaling options'.
- Sequence Control:** Includes buttons for 'Initialize' and 'Read setup', along with a 'Pressure' gauge showing 1.77e-01.

- Optical elements on the light path listed
- GUI to manually select optical elements
- 2 x ds9
- Sequencers for writing commands
- Status windows for the instrument/telescope
- Remote observers have a simplified version



How to observe with NOTCam?

- www.not.iac.es/observing/seq/notcam-seq-scripts.html
- www.not.iac.es/observing/seq/notcam-seq-commands.html
- www.not.iac.es/observing/forms/signal/v2.2/index.php
- Key notcam script 1: Setup imaging camera mode, filter and filter focus offset
 - `setup-ima camera filter-ID`
 - Example, setup H (#203) band with WF camera:
 - `setup-ima WF 203`
- Key notcam script 2: Sequence of observations with a 3x3 grid
 - `9point rmode t N "obj" step skew Ncycles`
 - Example, 1x9-point with 6x5sec per pointing in frame mode of SN 2012ej with 40" dither step and a 2" skew:
 - `9point frame 5 6 SN2012ej 40 2 1`
- Key notcam script 3: Beam-switch (takes 3x3 grid sequence both ON and OFF)
 - `beamswitch rmode t N "obj" dir beam step skew`
 - Example: 1x9-point with 6x5sec per pointing in frame mode of SN 2012ej with 10" dither step, a 2" skew and separate sky:
 - `beamswitch frame 5 6 SN2012ej N-negX 180 10 2`

notcam package installation

- Installation instructions: www.not.iac.es/instruments/notcam/quicklook.README
- To summarise, open a new terminal and type:

```
$ cd
```

```
$ cd iraf
```

```
$ mkdir extern
```

```
$ cd extern
```

```
$ wget www.not.iac.es/instruments/notcam/quicklook.tar.gz
```

```
$ tar xzf quicklook.tar.gz
```

```
$ cd ..
```

```
$ emacs login.cl
```

- Add the following lines after the first 'keep' line

```
reset notcam = /home/myusername/iraf/extern/notcam_v2.5/
```

```
task notcam.pkg = notcam$notcam.cl
```

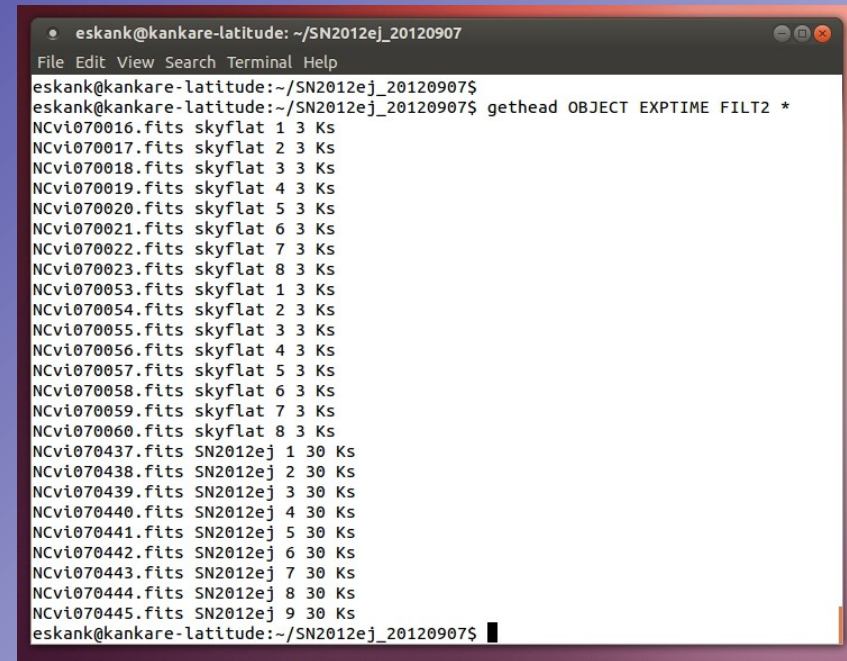
```
printf ("reset helpdb=%s,notcam$lib/helpdb.mip\nkeep\n",
```

```
envget("helpdb")) | cl
```

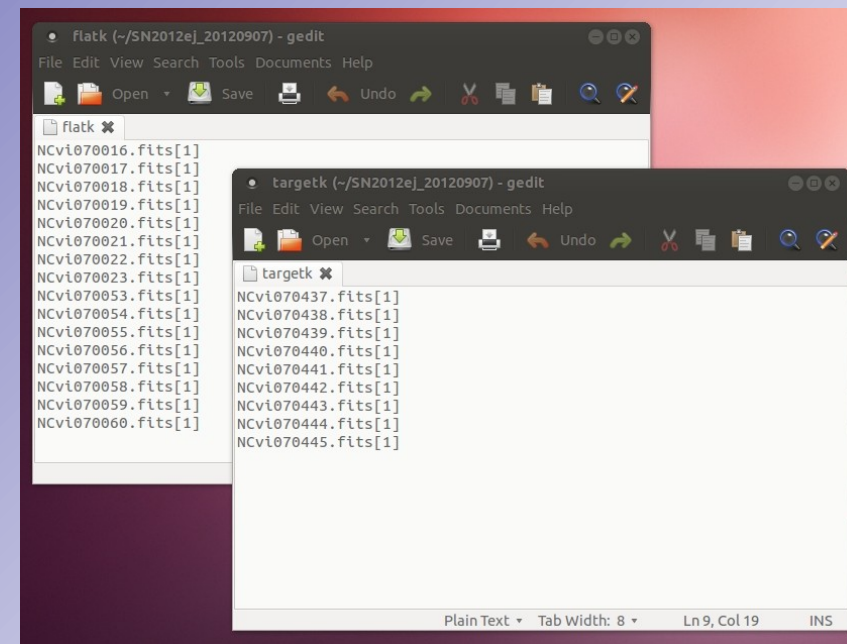
- Save and exit

Reduction example 1: files & lists

- Files needed for reduction: flats and target frames
- gethead command useful in reading file headers quickly
- Example data available in `/course_data/nir/SN2012ej_20120907.tar.gz`
- Create lists of files which include all the file names of 1 target in 1 band
- Create lists of files which include all the file names, in `*fits[1]` format, of flats in 1 band
- Command examples:
 - In a terminal:
 - `ls NCvi0704*fits > targetk`
 - In iraf:
 - `files NCvi0704*fits > targetk`
 - Modify with a text editor (gedit, emacs, vi ...)



```
eskank@kankare-latitude: ~/SN2012ej_20120907
File Edit View Search Terminal Help
eskank@kankare-latitude:~/SN2012ej_20120907$ gethead OBJECT EXPTIME FILT2 *
NCvi070016.fits skyflat 1 3 Ks
NCvi070017.fits skyflat 2 3 Ks
NCvi070018.fits skyflat 3 3 Ks
NCvi070019.fits skyflat 4 3 Ks
NCvi070020.fits skyflat 5 3 Ks
NCvi070021.fits skyflat 6 3 Ks
NCvi070022.fits skyflat 7 3 Ks
NCvi070023.fits skyflat 8 3 Ks
NCvi070053.fits skyflat 1 3 Ks
NCvi070054.fits skyflat 2 3 Ks
NCvi070055.fits skyflat 3 3 Ks
NCvi070056.fits skyflat 4 3 Ks
NCvi070057.fits skyflat 5 3 Ks
NCvi070058.fits skyflat 6 3 Ks
NCvi070059.fits skyflat 7 3 Ks
NCvi070060.fits skyflat 8 3 Ks
NCvi070437.fits SN2012ej 1 30 Ks
NCvi070438.fits SN2012ej 2 30 Ks
NCvi070439.fits SN2012ej 3 30 Ks
NCvi070440.fits SN2012ej 4 30 Ks
NCvi070441.fits SN2012ej 5 30 Ks
NCvi070442.fits SN2012ej 6 30 Ks
NCvi070443.fits SN2012ej 7 30 Ks
NCvi070444.fits SN2012ej 8 30 Ks
NCvi070445.fits SN2012ej 9 30 Ks
eskank@kankare-latitude:~/SN2012ej_20120907$
```



```
flatk (~/.SN2012ej_20120907) - gedit
File Edit View Search Tools Documents Help
flatk ✕
NCvi070016.fits[1]
NCvi070017.fits[1]
NCvi070018.fits[1]
NCvi070019.fits[1]
NCvi070020.fits[1]
NCvi070021.fits[1]
NCvi070022.fits[1]
NCvi070023.fits[1]
NCvi070053.fits[1]
NCvi070054.fits[1]
NCvi070055.fits[1]
NCvi070056.fits[1]
NCvi070057.fits[1]
NCvi070058.fits[1]
NCvi070059.fits[1]
NCvi070060.fits[1]

targetk (~/.SN2012ej_20120907) - gedit
File Edit View Search Tools Documents Help
targetk ✕
NCvi070437.fits[1]
NCvi070438.fits[1]
NCvi070439.fits[1]
NCvi070440.fits[1]
NCvi070441.fits[1]
NCvi070442.fits[1]
NCvi070443.fits[1]
NCvi070444.fits[1]
NCvi070445.fits[1]
```

Reduction example 1: notcam package & mkflat task

- Differential (bright and faint) flats with the same exposure time required
- Start iraf, open ds9, go to your data folder
- Download the bad pixel mask [bad_zero_sci.fits](http://www.not.iac.es/instruments/notcam/badmask/) www.not.iac.es/instruments/notcam/badmask/
- Uncompress and move to the data folder
- Open notcam package in iraf by typing **notcam**
- Select mkflat task by typing **epar mkflat** and set parameters, execute with **:go**

```
eskank@kankare-latitude: ~/iraf
File Edit View Search Terminal Help
NCvi070053.fits skyflat 1 3 Ks
NCvi070054.fits skyflat 2 3 Ks
NCvi070055.fits skyflat 3 3 Ks
NCvi070056.fits skyflat 4 3 Ks
NCvi070057.fits skyflat 5 3 Ks
NCvi070058.fits skyflat 6 3 Ks
NCvi070059.fits skyflat 7 3 Ks
NCvi070060.fits skyflat 8 3 Ks
NCvi070437.fits SN2012ej 1 30 Ks
NCvi070438.fits SN2012ej 2 30 Ks
NCvi070439.fits SN2012ej 3 30 Ks
NCvi070440.fits SN2012ej 4 30 Ks
NCvi070441.fits SN2012ej 5 30 Ks
NCvi070442.fits SN2012ej 6 30 Ks
NCvi070443.fits SN2012ej 7 30 Ks
NCvi070444.fits SN2012ej 8 30 Ks
NCvi070445.fits SN2012ej 9 30 Ks
eskank@kankare-latitude:~/SN2012ej_20120907$ ls NCvi0704*fits > targetk
eskank@kankare-latitude:~/SN2012ej_20120907$ ls NCvi0700*fits > flatk
eskank@kankare-latitude:~/SN2012ej_20120907$ cd
eskank@kankare-latitude:~$ cd iraf
eskank@kankare-latitude:~/iraf$ pwd
/home/eskank/iraf
eskank@kankare-latitude:~/iraf$ xgterm&
[1] 17957
eskank@kankare-latitude:~/iraf$ ds9&
[2] 18214
eskank@kankare-latitude:~/iraf$
```

```
IRAF
ec1> cd SN2012ej_20120907/
ec1> notcam

-----
                Space Telescope Tables Package
                TABLES Version 3.14

Space Telescope Science Institute, Baltimore, Maryland
Copyright (C) 2003 Association of Universities for
Research in Astronomy, Inc.(AURA)
See stsdas$copyright.stsdas for terms of use.
For help, send e-mail to help@stsci.edu
-----

-----
| NOTCam scripts for quicklook reductions |
| Version 2.5, Sep 2012                    |
-----

dophot   mkflat   reduce   skysub
mkbad    mklinco  reduce_bs

notcam> epar mkflat
```

```
IRAF
Image Reduction and Analysis Facility

PACKAGE = notcam
TASK = mkflat

images = @flatk Input images [*]
outim = flatk.fits Output file name
badpix = bad_zero_sci.fits Input bad pixel image (zero pixels)
camid = WF Camera (WF or HR)
filtid = Ks Filter (Yn, J, H, K, Ks, or NOT number)
suppress= yes Suppress dc-gradient structure?
(datamax= INDEF) DATAMAX (if INDEF, saturation limit is used)
(autosea= yes) Auto-search the valid flatfields?
(flist = )
(list = )
(mode = ql)

ESC-? for HELP
```


Reduction example 1: master flat

Warning: for mkflat to work correctly the input raw flats must be equal numbers of bright and faint images with the same EXPTIME!

Searching for WF Ks flat fields, please wait ...
2012 9 7 FRI 19:26:44.0 19:26:44.0 2012.68531 2456178.3102 17:24:17.8
Julian date is: 2456178.3102315
Doing image statistics, please wait ...

File	Value
NCvi070016.Fits[1]	26389.44
NCvi070017.Fits[1]	26083.79
NCvi070018.Fits[1]	25676.99
NCvi070019.Fits[1]	25293.86
NCvi070020.Fits[1]	24839.14
NCvi070021.Fits[1]	24324.46
NCvi070022.Fits[1]	23891.58
NCvi070023.Fits[1]	23644.8
NCvi070053.Fits[1]	3742.909
NCvi070054.Fits[1]	2871.26
NCvi070055.Fits[1]	2760.18
NCvi070056.Fits[1]	2658.507
NCvi070057.Fits[1]	2561.102
NCvi070058.Fits[1]	2472.039
NCvi070059.Fits[1]	2384.996
NCvi070060.Fits[1]	2307.4

3. 0. 16
All images have equal EXPTIME as required by the differential method.
Sorted from brightest to faintest image
Two lists with 8 images each are made
Bad pixel correction done.
8 difference images obtained
Subtracted dc-gradient from each difference image.

Oct 10 21:51: IMCOMBINE
combine = median, scale = none, zero = median, weight = none
reject = sigclip, mclip = yes, nkeep = 1
lsigma = 3., hsigma = 3.
blank = 0.

Images	Median	Zero
dif5574v	22651.	0.
dif5574w	23186.	-534.76
dif5574x	22911.	-259.78
dif5574y	22674.	-22.318
dif5574z	22241.	410.84
dif5574aa	21881.	770.91
dif5574ba	21517.	1134.3
dif5574ca	21347.	1304.2

Output image = flat_5574d, ncombine = 8
z1=0.742601 z2=1.261061
Normalized masterflat: flatk.fits - ready and displayed!

Image	mean	stddev
flatk.Fits[140:160,140:160]	1.050621	0.03505777
flatk.Fits[350:370,350:370]	1.01404	0.03503872
flatk.Fits[650:670,170:190]	0.990676	0.0337076
flatk.Fits[700:720,370:390]	0.9903919	0.03873669
flatk.Fits[600:620,600:620]	1.01906	0.04096627
flatk.Fits[930:950,210:230]	0.9464503	0.04033541
flatk.Fits[750:770,860:880]	1.001554	0.04181723
flatk.Fits[830:850,670:690]	0.9888438	0.03878708
flatk.Fits[350:370,810:830]	0.9856766	0.05816747
flatk.Fits[140:160,740:760]	0.9971613	0.03434817

notcam>

SAOImage ds9: flatk.fits, skyflat 1, Value: 0.969264, WCS: X: 779.000, Y: 770.000, Image: X: 779.000, Y: 770.000, Frame 1: Zoom: 0.500, Angle: 0.000

irafterm: NDAO/IRAF V2.15.1a eskank@kankare-latitude Thu 21:51:22 10-Oct-2013
flatk.Fits: vector 1024.0:1.0 to 1.0:1024.0 width: 3

Reduction example 1: reduce task

- Download the distortion correction model **notcam.db** for NOTCam WF camera from the NOT web pages:
www.not.iac.es/instruments/notcam/distortion/
- Move notcam.db into the data folder
- Select reduce task by typing **epar reduce** and set parameters, execute with **:go**
- When prompted, select field star(s), common in the raw frames, close to the science target with key press 'a'. Finish with 'q'.
- If trim = no, FOV of the final reduced image will match the first frame.

```
IRAF
dif5574ba 21517. 1134.3
dif5574ca 21347. 1304.2

Output image = flat_5574d, ncombine = 8
z1=0.742601 z2=1.261061
Normalized masterflat: flatk.fits - ready and displayed!

Image                mean      stddev
-----
flatk.fits[140:160,140:160] 1.050621 0.03505777
flatk.fits[350:370,350:370] 1.01404  0.03503872
flatk.fits[650:670,170:190] 0.990676 0.0337076
flatk.fits[700:720,370:390] 0.9903919 0.03873669
flatk.fits[600:620,600:620] 1.01906  0.04096627
flatk.fits[930:950,210:230] 0.9464503 0.04033541
flatk.fits[750:770,860:880] 1.001554 0.04181723
flatk.fits[830:850,670:690] 0.9888438 0.03878708
flatk.fits[350:370,810:830] 0.9856766 0.05816747
flatk.fits[140:160,740:760] 0.9971613 0.03434817

notcam> ?
      dophot      mkflat      reduce      skysub
      mkbad       mklincor    reduce_bs

notcam> epar reduce
```

```
IRAF
Image Reduction and Analysis Facility

PACKAGE = notcam
TASK = reduce

iimages =  @targetk Input images (or first image)
nimages = 9 Number of input images
output = SN2012ej_20120907_k.fits Output image
flatfiel= flatk.fits Flat field image
badpixma= bad_zero_sci.fits Bad pixel mask for fixpix (or INDEF)
scale = add Scaling the sky (none, add, mult)
combine = median Final imcombine (median or average)
boundary= wrap Boundary type (nearest,constant,reflect,wrap)
skip = yes Skip the first image when combining?
trim = yes Trim the shifted images?
badpixfi= no Interpolate over individual bad pixels?
distcorr= yes Apply WF-cam distortion correction?
destripe= no Remove stripes from bright stars?
(imlist = )
(list = )
(mode = ql)

ESC-? for HELP
```

Reduction example 1: reduce task

Applications Places Oct 10, 22:42 Erkki Kankare

IRAF

```
NCvi070437.fits[1]
NCvi070438.fits[1]
NCvi070439.fits[1]
NCvi070440.fits[1]
NCvi070441.fits[1]
NCvi070442.fits[1]
NCvi070443.fits[1]
NCvi070444.fits[1]
NCvi070445.fits[1]
Flat fielding done.
Median background value:
14569.36
14446.47
14438.57
14430.02
14400.66
14393.96
14402.19
14414.41
14390.06

Oct 10 22:42: IMCOMBINE
combine = median, scale = none, zero = median, weight = none
reject = ccclip, mclip = yes, nkeep = 1
rdnoise = 9.3, gain = 2.6425, snoise = 0., sigma = 3., hsigma = 3.
blank = 0.

      Images   Median   Zero
tmp$im5574bq  14203.    0.
tmp$im5574eq  14214.  -10.994
tmp$im5574hq  14214.  -10.874
tmp$im5574kq  14215.  -12.055
tmp$im5574nq  14222.  -18.571
tmp$im5574qq  14204.  -0.1631
tmp$im5574tq  14203.   0.0459
tmp$im5574wq  14191.  12.746
tmp$im5574zq  14213.  -9.585

Output image = SN2012ej_20120907_k.sky, ncombine = 9
z1=11424.39 z2=17040.37
Sky subtraction done.
Sky image displayed (NB! Includes the dark).

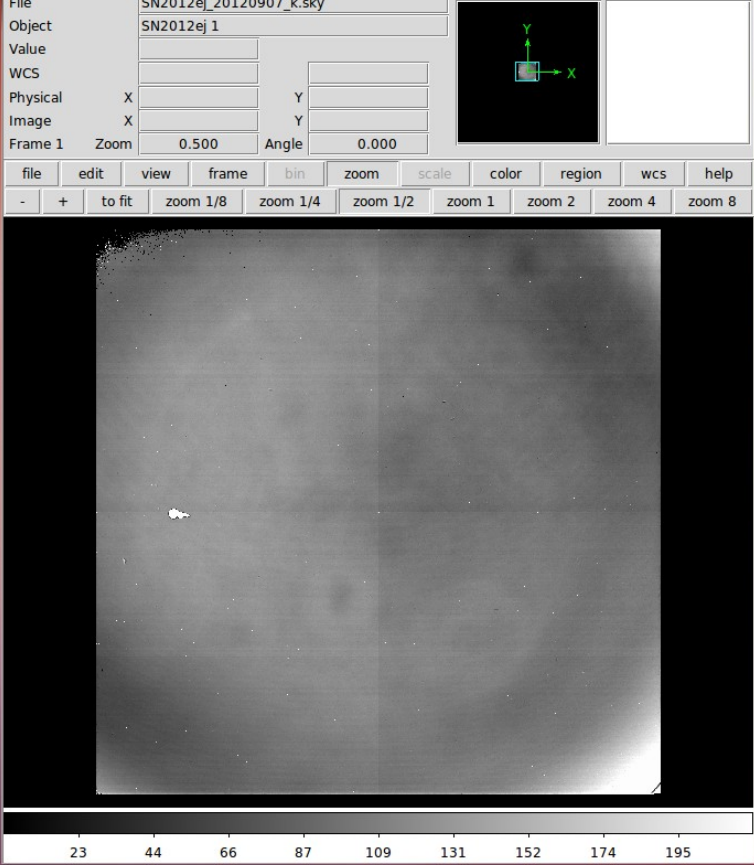
2012  9  8 SAT  4:28:10.0  4:28:10.0  2012.68634  2456178.6862  2:27:12.7
Julian date is: 2456178.6862269
Pixel scale is: 0.234
Doing distortion correction ...
Filter IDs: 0 207 Stop wheel: 15mm ring
Using model: dist-k.dat ... please, wait ...
```

SAOImage ds9

File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help

File: SN2012ej_20120907_k.sky
Object: SN2012ej 1
Value:
WCS:
Physical X: Y:
Image X: Y:
Frame 1 Zoom: 0.500 Angle: 0.000

file edit view frame bin zoom scale color region wcs help
- + to fit zoom 1/8 zoom 1/4 zoom 1/2 zoom 1 zoom 2 zoom 4 zoom 8



23 44 66 87 109 131 152 174 195

IRAF SAOImage ds9

Reduction example 1: reduce task

```
Applications Places S P- G .cc .star
Oct 10, 22:42 Erkki Kankare

IRAF
NCvi070437.fits[1]
NCvi070438.fits[1]
NCvi070439.fits[1]
NCvi070440.fits[1]
NCvi070441.fits[1]
NCvi070442.fits[1]
NCvi070443.fits[1]
NCvi070444.fits[1]
NCvi070445.fits[1]
Flat fielding done.
Median background value:
14569.36
14446.47
14438.57
14430.02
14400.66
14393.96
14402.19
14414.41
14390.06

Oct 10 22:42: IMCOMBINE
combine = median, scale = none, zero = median, weight = none
reject = ccdclip, mclip = yes, nkeep = 1
rdnoise = 9.3, gain = 2.6425, snoise = 0., sigma = 3., hsigma = 3.
blank = 0.

Images Median Zero
tmp$im5574bq 14203. 0.
tmp$im5574eq 14214. -10.994
tmp$im5574hq 14214. -10.874
tmp$im5574kq 14215. -12.055
tmp$im5574nq 14222. -18.571
tmp$im5574qq 14204. -0.1631
tmp$im5574tq 14203. 0.0459
tmp$im5574wq 14191. 12.746
tmp$im5574zq 14213. -9.585

Output image = SN2012ej_20120907_k.sky, ncombine = 9
z1=11424.39 z2=17040.37
Sky subtraction done.
Sky image displayed (NB! Includes the dark).

2012 9 8 SAT 4:28:10.0 4:28:10.0 2012.68634 2456178.6862 2:27:12.7
Julian date is: 2456178.6862269
Pixel scale is: 0.234
Doing distortion correction ...
Filter IDs: 0 207 Stop wheel: 15mm ring
Using model: dist-k.dat ... please, wait ...
WF-camera distortion correction done.
z1=-531.9247 z2=858.4438
Select stars for alignment by clicking on the image.
Press 'a' on each star selected. Press 'q' when finished.
If no stars are selected, exit with 'q' and WCS info is used.
...
Log file tmp$coo5574xp open
# COL LINE COORDINATES
# R MAG FLUX SKY PEAK E PA ENCLOSED GAUSSIAN DIRECT
353.65 845.52 353.65 845.52
9.16 12.29 121027. 177.3 7783. 0.06 -55 3.96 3.22 3.05
317.22 482.81 317.22 482.81
9.59 11.24 319217. 203.3 19603. 0.08 -51 4.00 3.29 3.20
```

SAOImage ds9

File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help

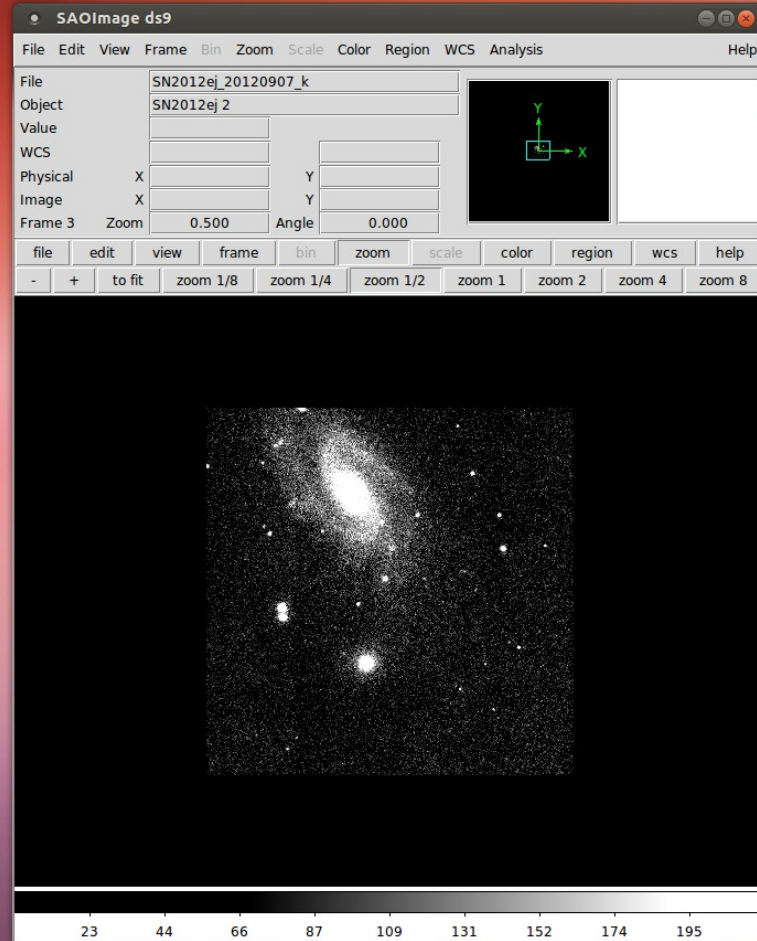
File tmp\$im25574zp
Object SN2012ej 1
Value <-531.925
WCS
Physical X -85.000 Y 376.000
Image X -85.000 Y 376.000
Frame 2 Zoom 0.500 Angle 0.000

file edit view frame bin zoom scale color region wcs help
- + to fit zoom 1/8 zoom 1/4 zoom 1/2 zoom 1 zoom 2 zoom 4 zoom 8

23 44 66 87 109 131 152 174 195

Reduction example 1: reduce task

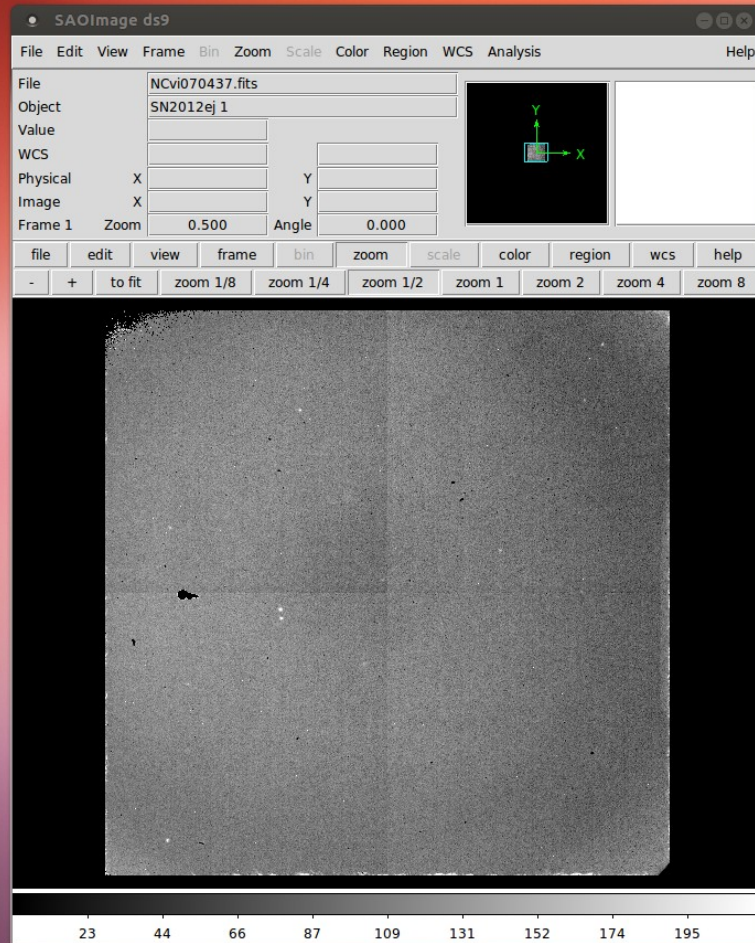
```
IRAF
tmp$im5574pq 145.871 (0.006) 474.580 (0.006) 2
tmp$im5574sq 189.318 (0.010) 666.376 (0.011) 1
tmp$im5574sq 153.600 (0.006) 303.688 (0.006) 2
tmp$im5574vq 360.254 (0.011) 675.027 (0.010) 1
tmp$im5574vq 324.455 (0.006) 311.962 (0.006) 2
tmp$im5574yq 531.446 (0.010) 682.971 (0.011) 1
tmp$im5574yq 495.449 (0.007) 320.207 (0.006) 2
#RefCoords Reference X-center Err Y-center Err Num
tmp$im25574zp 353.677 (0.012) 845.518 (0.012) 1
tmp$im25574zp 317.176 (0.008) 482.851 (0.008) 2
#Shifts Image X-shift Err Y-shift Err N Internal
tmp$im5574aq -0.000 (0.010) 0.000 (0.010) 2 (0.000,0.000)
tmp$im5574dq -169.863 (0.011) -7.791 (0.011) 2 (0.256,0.034)
tmp$im5574gq -163.570 (0.011) -178.500 (0.011) 1 (INDEF,INDEF)
tmp$im5574jq 7.516 (0.009) -169.984 (0.010) 2 (0.132,0.000)
tmp$im5574mq 178.629 (0.009) -161.496 (0.010) 2 (0.017,0.085)
tmp$im5574pq 171.411 (0.010) 8.326 (0.009) 2 (0.103,0.054)
tmp$im5574sq 163.967 (0.009) 179.153 (0.010) 2 (0.391,0.000)
tmp$im5574vq -6.929 (0.010) 170.690 (0.010) 2 (0.351,0.201)
tmp$im5574yq -178.021 (0.010) 162.596 (0.010) 2 (0.252,0.060)
#Trim_Section = [180:845,181:845]
# Shifting images:
# Trimming images: corrected section = [180:845,181:845]
Skipping the first image when combining ...
Oct 10 22:42: IMCOMBINE
combine = median, scale = none, zero = median, weight = none
reject = minmax, nlow = 1, nhigh = 0
blank = 0.
statsec = Oct 10 22:42
Images Median Zero
tmp$im5574dq 12.418 0.
tmp$im5574gq 14.684 -2.2661
tmp$im5574jq 10.507 1.9107
tmp$im5574mq 18.688 -6.2697
tmp$im5574pq 5.8979 6.5202
tmp$im5574sq 5.9774 6.4407
tmp$im5574vq -5.6366 18.055
tmp$im5574yq 15.462 -3.0434
Output image = SN2012ej_20120907_k, ncombine = 8
The images are flatfield corrected, sky subtracted
aligned, shifted and combined.
SN2012ej_20120907_k001
SN2012ej_20120907_k002
SN2012ej_20120907_k003
SN2012ej_20120907_k004
SN2012ej_20120907_k005
SN2012ej_20120907_k006
SN2012ej_20120907_k007
SN2012ej_20120907_k008
SN2012ej_20120907_k009
z1=-36.33753 z2=126.2785
Image SN2012ej_20120907_k is displayed.
notcam>
```



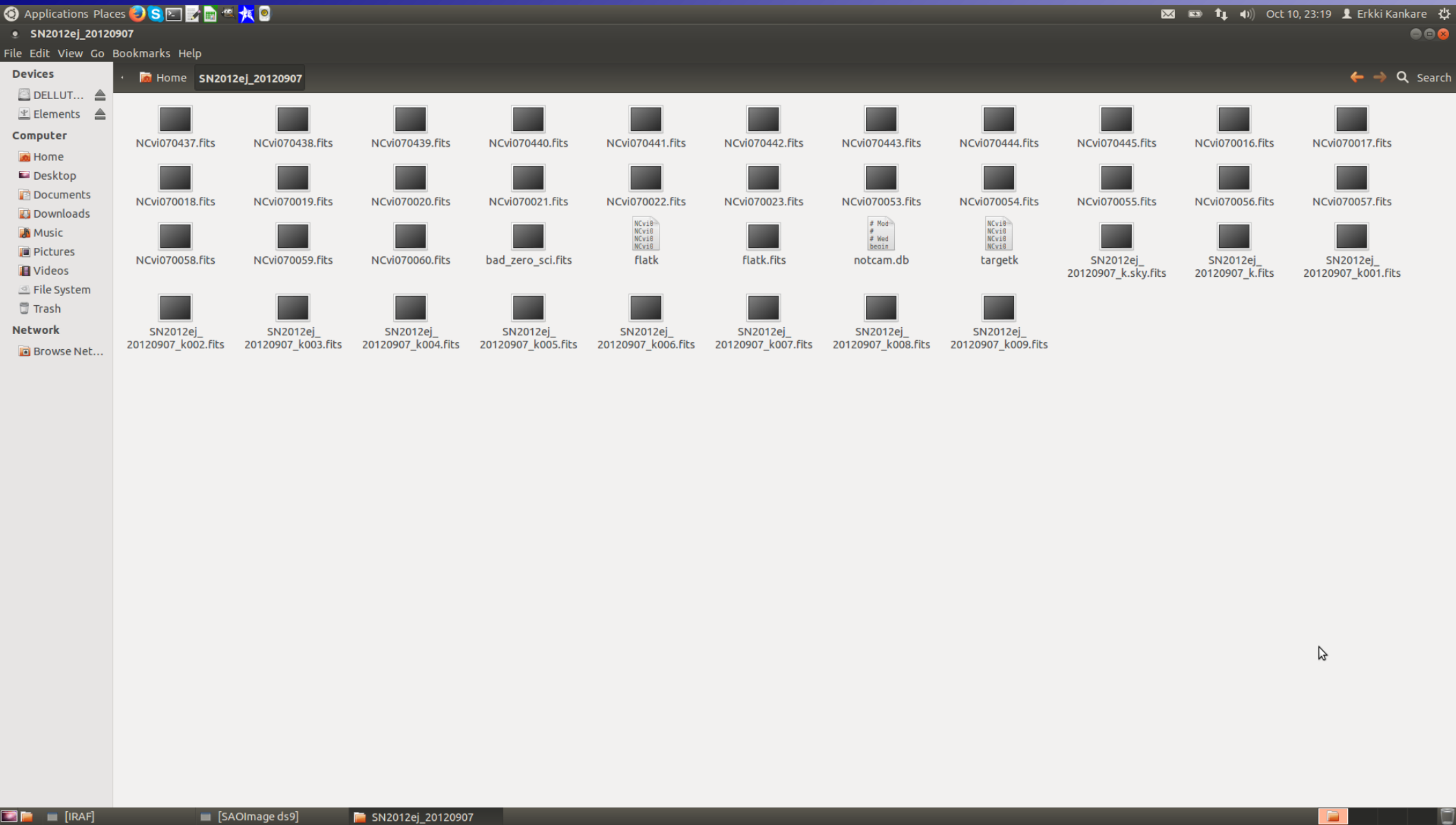
Reduction example 1: reduce task

```
Applications Places S P-1 G-1 G-2 G-3 G-4 G-5 G-6 G-7 G-8 G-9 G-10 G-11 G-12 G-13 G-14 G-15 G-16 G-17 G-18 G-19 G-20 G-21 G-22 G-23 G-24 G-25 G-26 G-27 G-28 G-29 G-30 G-31 G-32 G-33 G-34 G-35 G-36 G-37 G-38 G-39 G-40 G-41 G-42 G-43 G-44 G-45 G-46 G-47 G-48 G-49 G-50 G-51 G-52 G-53 G-54 G-55 G-56 G-57 G-58 G-59 G-60 G-61 G-62 G-63 G-64 G-65 G-66 G-67 G-68 G-69 G-70 G-71 G-72 G-73 G-74 G-75 G-76 G-77 G-78 G-79 G-80 G-81 G-82 G-83 G-84 G-85 G-86 G-87 G-88 G-89 G-90 G-91 G-92 G-93 G-94 G-95 G-96 G-97 G-98 G-99 G-100 G-101 G-102 G-103 G-104 G-105 G-106 G-107 G-108 G-109 G-110 G-111 G-112 G-113 G-114 G-115 G-116 G-117 G-118 G-119 G-120 G-121 G-122 G-123 G-124 G-125 G-126 G-127 G-128 G-129 G-130 G-131 G-132 G-133 G-134 G-135 G-136 G-137 G-138 G-139 G-140 G-141 G-142 G-143 G-144 G-145 G-146 G-147 G-148 G-149 G-150 G-151 G-152 G-153 G-154 G-155 G-156 G-157 G-158 G-159 G-160 G-161 G-162 G-163 G-164 G-165 G-166 G-167 G-168 G-169 G-170 G-171 G-172 G-173 G-174 G-175 G-176 G-177 G-178 G-179 G-180 G-181 G-182 G-183 G-184 G-185 G-186 G-187 G-188 G-189 G-190 G-191 G-192 G-193 G-194 G-195 G-196 G-197 G-198 G-199 G-200 G-201 G-202 G-203 G-204 G-205 G-206 G-207 G-208 G-209 G-210 G-211 G-212 G-213 G-214 G-215 G-216 G-217 G-218 G-219 G-220 G-221 G-222 G-223 G-224 G-225 G-226 G-227 G-228 G-229 G-230 G-231 G-232 G-233 G-234 G-235 G-236 G-237 G-238 G-239 G-240 G-241 G-242 G-243 G-244 G-245 G-246 G-247 G-248 G-249 G-250 G-251 G-252 G-253 G-254 G-255 G-256 G-257 G-258 G-259 G-260 G-261 G-262 G-263 G-264 G-265 G-266 G-267 G-268 G-269 G-270 G-271 G-272 G-273 G-274 G-275 G-276 G-277 G-278 G-279 G-280 G-281 G-282 G-283 G-284 G-285 G-286 G-287 G-288 G-289 G-290 G-291 G-292 G-293 G-294 G-295 G-296 G-297 G-298 G-299 G-300 G-301 G-302 G-303 G-304 G-305 G-306 G-307 G-308 G-309 G-310 G-311 G-312 G-313 G-314 G-315 G-316 G-317 G-318 G-319 G-320 G-321 G-322 G-323 G-324 G-325 G-326 G-327 G-328 G-329 G-330 G-331 G-332 G-333 G-334 G-335 G-336 G-337 G-338 G-339 G-340 G-341 G-342 G-343 G-344 G-345 G-346 G-347 G-348 G-349 G-350 G-351 G-352 G-353 G-354 G-355 G-356 G-357 G-358 G-359 G-360 G-361 G-362 G-363 G-364 G-365 G-366 G-367 G-368 G-369 G-370 G-371 G-372 G-373 G-374 G-375 G-376 G-377 G-378 G-379 G-380 G-381 G-382 G-383 G-384 G-385 G-386 G-387 G-388 G-389 G-390 G-391 G-392 G-393 G-394 G-395 G-396 G-397 G-398 G-399 G-400 G-401 G-402 G-403 G-404 G-405 G-406 G-407 G-408 G-409 G-410 G-411 G-412 G-413 G-414 G-415 G-416 G-417 G-418 G-419 G-420 G-421 G-422 G-423 G-424 G-425 G-426 G-427 G-428 G-429 G-430 G-431 G-432 G-433 G-434 G-435 G-436 G-437 G-438 G-439 G-440 G-441 G-442 G-443 G-444 G-445 G-446 G-447 G-448 G-449 G-450 G-451 G-452 G-453 G-454 G-455 G-456 G-457 G-458 G-459 G-460 G-461 G-462 G-463 G-464 G-465 G-466 G-467 G-468 G-469 G-470 G-471 G-472 G-473 G-474 G-475 G-476 G-477 G-478 G-479 G-480 G-481 G-482 G-483 G-484 G-485 G-486 G-487 G-488 G-489 G-490 G-491 G-492 G-493 G-494 G-495 G-496 G-497 G-498 G-499 G-500 G-501 G-502 G-503 G-504 G-505 G-506 G-507 G-508 G-509 G-510 G-511 G-512 G-513 G-514 G-515 G-516 G-517 G-518 G-519 G-520 G-521 G-522 G-523 G-524 G-525 G-526 G-527 G-528 G-529 G-530 G-531 G-532 G-533 G-534 G-535 G-536 G-537 G-538 G-539 G-540 G-541 G-542 G-543 G-544 G-545 G-546 G-547 G-548 G-549 G-550 G-551 G-552 G-553 G-554 G-555 G-556 G-557 G-558 G-559 G-560 G-561 G-562 G-563 G-564 G-565 G-566 G-567 G-568 G-569 G-570 G-571 G-572 G-573 G-574 G-575 G-576 G-577 G-578 G-579 G-580 G-581 G-582 G-583 G-584 G-585 G-586 G-587 G-588 G-589 G-590 G-591 G-592 G-593 G-594 G-595 G-596 G-597 G-598 G-599 G-600 G-601 G-602 G-603 G-604 G-605 G-606 G-607 G-608 G-609 G-610 G-611 G-612 G-613 G-614 G-615 G-616 G-617 G-618 G-619 G-620 G-621 G-622 G-623 G-624 G-625 G-626 G-627 G-628 G-629 G-630 G-631 G-632 G-633 G-634 G-635 G-636 G-637 G-638 G-639 G-640 G-641 G-642 G-643 G-644 G-645 G-646 G-647 G-648 G-649 G-650 G-651 G-652 G-653 G-654 G-655 G-656 G-657 G-658 G-659 G-660 G-661 G-662 G-663 G-664 G-665 G-666 G-667 G-668 G-669 G-670 G-671 G-672 G-673 G-674 G-675 G-676 G-677 G-678 G-679 G-680 G-681 G-682 G-683 G-684 G-685 G-686 G-687 G-688 G-689 G-690 G-691 G-692 G-693 G-694 G-695 G-696 G-697 G-698 G-699 G-700 G-701 G-702 G-703 G-704 G-705 G-706 G-707 G-708 G-709 G-710 G-711 G-712 G-713 G-714 G-715 G-716 G-717 G-718 G-719 G-720 G-721 G-722 G-723 G-724 G-725 G-726 G-727 G-728 G-729 G-730 G-731 G-732 G-733 G-734 G-735 G-736 G-737 G-738 G-739 G-740 G-741 G-742 G-743 G-744 G-745 G-746 G-747 G-748 G-749 G-750 G-751 G-752 G-753 G-754 G-755 G-756 G-757 G-758 G-759 G-760 G-761 G-762 G-763 G-764 G-765 G-766 G-767 G-768 G-769 G-770 G-771 G-772 G-773 G-774 G-775 G-776 G-777 G-778 G-779 G-780 G-781 G-782 G-783 G-784 G-785 G-786 G-787 G-788 G-789 G-790 G-791 G-792 G-793 G-794 G-795 G-796 G-797 G-798 G-799 G-800 G-801 G-802 G-803 G-804 G-805 G-806 G-807 G-808 G-809 G-810 G-811 G-812 G-813 G-814 G-815 G-816 G-817 G-818 G-819 G-820 G-821 G-822 G-823 G-824 G-825 G-826 G-827 G-828 G-829 G-830 G-831 G-832 G-833 G-834 G-835 G-836 G-837 G-838 G-839 G-840 G-841 G-842 G-843 G-844 G-845 G-846 G-847 G-848 G-849 G-850 G-851 G-852 G-853 G-854 G-855 G-856 G-857 G-858 G-859 G-860 G-861 G-862 G-863 G-864 G-865 G-866 G-867 G-868 G-869 G-870 G-871 G-872 G-873 G-874 G-875 G-876 G-877 G-878 G-879 G-880 G-881 G-882 G-883 G-884 G-885 G-886 G-887 G-888 G-889 G-890 G-891 G-892 G-893 G-894 G-895 G-896 G-897 G-898 G-899 G-900 G-901 G-902 G-903 G-904 G-905 G-906 G-907 G-908 G-909 G-910 G-911 G-912 G-913 G-914 G-915 G-916 G-917 G-918 G-919 G-920 G-921 G-922 G-923 G-924 G-925 G-926 G-927 G-928 G-929 G-930 G-931 G-932 G-933 G-934 G-935 G-936 G-937 G-938 G-939 G-940 G-941 G-942 G-943 G-944 G-945 G-946 G-947 G-948 G-949 G-950 G-951 G-952 G-953 G-954 G-955 G-956 G-957 G-958 G-959 G-960 G-961 G-962 G-963 G-964 G-965 G-966 G-967 G-968 G-969 G-970 G-971 G-972 G-973 G-974 G-975 G-976 G-977 G-978 G-979 G-980 G-981 G-982 G-983 G-984 G-985 G-986 G-987 G-988 G-989 G-990 G-991 G-992 G-993 G-994 G-995 G-996 G-997 G-998 G-999 G-1000
```

```
IRAF
tmp$im5574sq 189.318 (0.010) 666.376 (0.011) 1
tmp$im5574sq 153.600 (0.006) 303.688 (0.006) 2
tmp$im5574vq 360.254 (0.011) 675.027 (0.010) 1
tmp$im5574vq 324.455 (0.006) 311.962 (0.006) 2
tmp$im5574yq 531.446 (0.010) 682.971 (0.011) 1
tmp$im5574yq 495.449 (0.007) 320.207 (0.006) 2
#Refcoords Reference X-center Err Y-center Err Num
tmp$im25574zp 353.677 (0.012) 845.518 (0.012) 1
tmp$im25574zp 317.176 (0.008) 482.851 (0.008) 2
#Shifts Image X-shift Err Y-shift Err N Internal
tmp$im5574aq -0.000 (0.010) 0.000 (0.010) 2 (0.000,0.000)
tmp$im5574dq -169.863 (0.011) -7.791 (0.011) 2 (0.256,0.034)
tmp$im5574gq -163.570 (0.011) -178.500 (0.011) 1 (INDEF,INDEF)
tmp$im5574jq 7.516 (0.009) -169.984 (0.010) 2 (0.132,0.000)
tmp$im5574mq 178.629 (0.009) -161.496 (0.010) 2 (0.017,0.085)
tmp$im5574pq 171.411 (0.010) 8.326 (0.009) 2 (0.103,0.054)
tmp$im5574sq 163.967 (0.009) 179.153 (0.010) 2 (0.391,0.000)
tmp$im5574vq -6.929 (0.010) 170.690 (0.010) 2 (0.351,0.201)
tmp$im5574yq -178.021 (0.010) 162.596 (0.010) 2 (0.252,0.060)
#Trim_Section = [180:845,181:845]
# Shifting images:
# Trimming images: corrected section = [180:845,181:845]
Skipping the first image when combining ...
Oct 10 22:42: IMCOMBINE
combine = median, scale = none, zero = median, weight = none
reject = minmax, nlow = 1, nhigh = 0
blank = 0.
statsec = Oct 10 22:42
Images Median Zero
tmp$im5574dq 12.418 0.
tmp$im5574gq 14.684 -2.2661
tmp$im5574jq 10.507 1.9107
tmp$im5574mq 18.688 -6.2697
tmp$im5574pq 5.8979 6.5202
tmp$im5574sq 5.9774 6.4407
tmp$im5574vq -5.6366 18.055
tmp$im5574yq 15.462 -3.0434
Output image = SN2012ej_20120907_k, ncombine = 8
The images are flatfield corrected, sky subtracted
aligned, shifted and combined.
SN2012ej_20120907_k001
SN2012ej_20120907_k002
SN2012ej_20120907_k003
SN2012ej_20120907_k004
SN2012ej_20120907_k005
SN2012ej_20120907_k006
SN2012ej_20120907_k007
SN2012ej_20120907_k008
SN2012ej_20120907_k009
z1=-36.33753 z2=126.2785
Image SN2012ej_20120907_k is displayed.
notcam> displ NCvi070437.fits[1] 1
z1=9883.246 z2=19060.94
notcam>
```

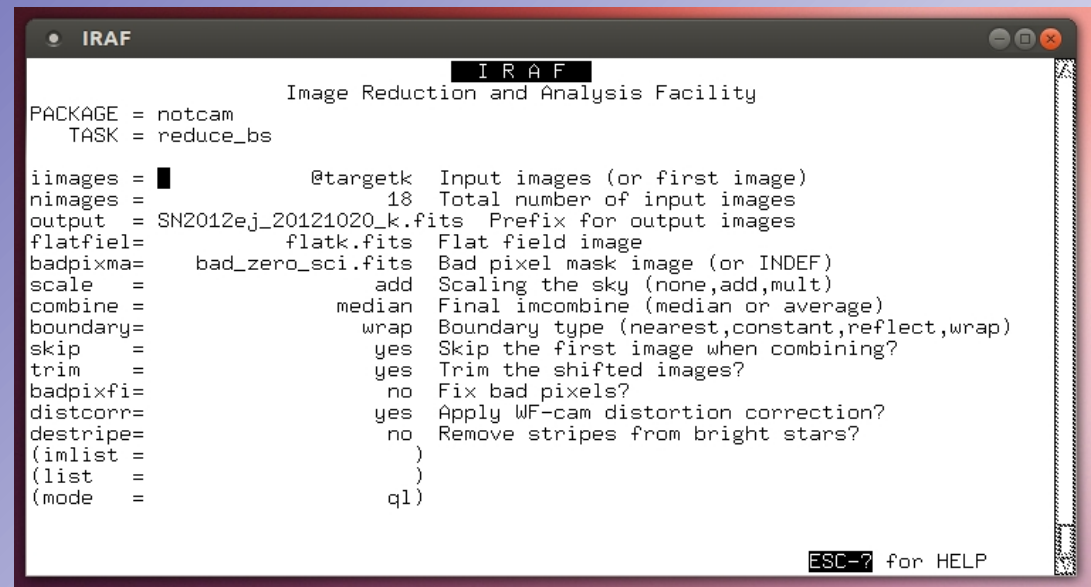


Reduction example 1: output files



Reduction example 2: reduce_bs task

- Example data available in /course_data/nir/SN2012ej_20121020.tar.gz
- Repeat the previous steps to create master flat(s) if not carried out yet
- Download and move the **notcam.db** file to the data folder as before:
www.not.iac.es/instruments/notcam/distortion/
- Select reduce_bs task by typing **epar reduce_bs** and set parameters, execute with **:go**
- When prompted, select field star(s), common in the raw frames, close to the science target with key press 'a'. Finish with 'q'. Repeat with the sky (OFF) field.



```
IRAF
Image Reduction and Analysis Facility
PACKAGE = notcam
TASK = reduce_bs

iimages = @targetk Input images (or first image)
nimages = 18 Total number of input images
output = SN2012ej_20121020_k.fits Prefix for output images
flatfiel= flatk.fits Flat field image
badpixma= bad_zero_sci.fits Bad pixel mask image (or INDEF)
scale = add Scaling the sky (none,add,mult)
combine = median Final imcombine (median or average)
boundary= wrap Boundary type (nearest,constant,reflect,wrap)
skip = yes Skip the first image when combining?
trim = yes Trim the shifted images?
badpixfi= no Fix bad pixels?
distcorr= yes Apply WF-cam distortion correction?
destripe= no Remove stripes from bright stars?
(imlist = )
(list = )
(mode = ql)

ESC-? for HELP
```


Reduction example 2: reduce_bs task

Applications Places [Icons] Oct 11, 20:03 Erkki Kankare

```
IRAF
NCvj200680.fits[1]
NCvj200682.fits[1]
NCvj200684.fits[1]
NCvj200686.fits[1]
NCvj200688.fits[1]
NCvj200690.fits[1]
NCvj200692.fits[1]
NCvj200694.fits[1]
NCvj200696.fits[1]
NCvj200681.fits[1]
NCvj200683.fits[1]
NCvj200685.fits[1]
NCvj200687.fits[1]
NCvj200689.fits[1]
NCvj200691.fits[1]
NCvj200693.fits[1]
NCvj200695.fits[1]
NCvj200697.fits[1]
9 ON target and 9 OFF target images found.
Flat fielding done.
Median background value of OFF field images:
11285.82
11527.82
11366.74
11496.29
11387.04
11274.27
11424.75
11320.48
11619.32
Making the sky image ...

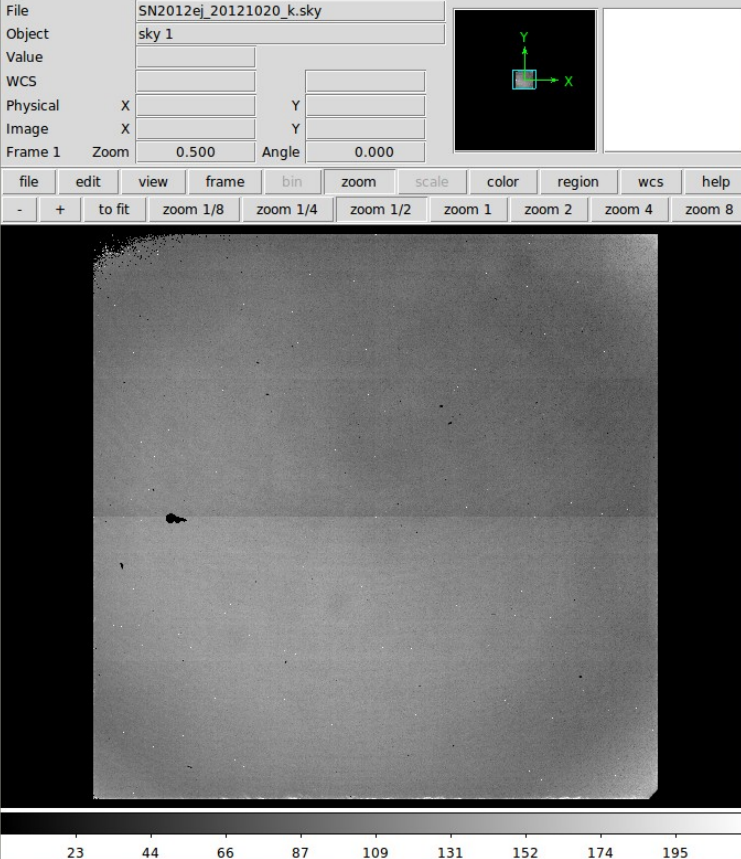
Oct 11 20:03: IMCOMBINE
combine = median, scale = median, zero = median, weight = none
reject = ccdclip, mclip = yes, nkeep = 1
rdnoise = 9.3, gain = 2.6425, snoise = 0.001, sigma = 3., hsigma = 3.
blank = 0.

```

Images	Median	Scale	Zero
tmp\$im6033bg	11404.	1.000	0.
tmp\$im6033fg	11403.	1.000	0.
tmp\$im6033jg	11393.	1.001	0.
tmp\$im6033ng	11397.	1.001	0.
tmp\$im6033rg	11395.	1.001	0.
tmp\$im6033vg	11408.	1.000	0.
tmp\$im6033zg	11405.	1.000	9.77E-4
tmp\$im6033dh	11392.	1.001	0.
tmp\$im6033hh	11405.	1.000	0.

```
Output image = SN2012ej_20121020_k.sky, ncombine = 9
z1=8605.723 z2=14285.74
The 18 raw images are sky subtracted.
Sky image displayed (NB! Includes the dark).
# ASTTIMES: Observatory parameters for Roque de los Muchachos, La Palma
#   timezone = 0
#   longitude = 17:52.8
##YR MON DAY ZT UT EPOCH JD LMST
2012 10 21 SUN 4:51:08.0 4:51:08.0 2012.80411 2456221.7022 5:39:46.4
Doing distortion correction ...
Filter IDs: 1007 207 Stop wheel: 15mm ring
Using model: dist-k.dat ... please, wait ...
```

```
SAOImage ds9
File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help
File SN2012ej_20121020_k.sky
Object sky 1
Value
WCS
Physical X Y
Image X Y
Frame 1 Zoom 0.500 Angle 0.000
```



file edit view frame bin zoom scale color region wcs help
- + to fit zoom 1/8 zoom 1/4 zoom 1/2 zoom 1 zoom 2 zoom 4 zoom 8

23 44 66 87 109 131 152 174 195

IRAF SAOImage ds9

Reduction example 2: reduce_bs task

The screenshot displays two windows from a Linux desktop environment. The top window is titled "IRAF" and shows the output of the `reduce_bs` task. The output includes a list of input files, a table of image statistics, and a log of the reduction process.

```
NCvj200696.fits[1]
NCvj200681.fits[1]
NCvj200683.fits[1]
NCvj200685.fits[1]
NCvj200687.fits[1]
NCvj200689.fits[1]
NCvj200691.fits[1]
NCvj200693.fits[1]
NCvj200695.fits[1]
NCvj200697.fits[1]
9 ON target and 9 OFF target images found.
Flat fielding done.
Median background value of OFF field images:
11285.82
11527.82
11366.74
11496.29
11387.04
11274.27
11424.75
11320.48
11619.32
Making the sky image ...

Oct 11 20:03: IMCOMBINE
combine = median, scale = median, zero = median, weight = none
reject = ccdclip, mclip = yes, nkeep = 1
rdnoise = 9.3, gain = 2.6425, snoise = 0.001, sigma = 3., hsigma = 3.
blank = 0.
Images  Median  Scale  Zero
tmp$im6033bg  11404.  1.000  0.
tmp$im6033fg  11403.  1.000  0.
tmp$im6033jg  11393.  1.001  0.
tmp$im6033ng  11397.  1.001  0.
tmp$im6033rg  11395.  1.001  0.
tmp$im6033vg  11408.  1.000  0.
tmp$im6033zg  11405.  1.000  9.77E-4
tmp$im6033dh  11392.  1.001  0.
tmp$im6033hh  11405.  1.000  0.

Output image = SN2012ej_20121020_k.sky, ncombine = 9
z1=-8605.723 z2=14285.74
The 18 raw images are sky subtracted.
Sky image displayed (NB! Includes the dark).
# ASTTIMES: Observatory parameters for Roque de los Muchachos, La Palma
#   timezone = 0
#   longitude = 17:52.8
##YR MDN  DAY  ZT  UT  EPOCH  JD  LMST
2012 10 21  SUN  4:51:08.0  4:51:08.0  2012.80411  2456221.7022  5:39:46.4
Doing distortion correction ...
Filter IDs: 1007 207 Stop wheel: 15mm ring
Using model: dist-k.dat ... please, wait ...
WF-camera distortion correction done.
z1=-539.3416 z2=83.39968
Select stars for ON target image alignment.
Press 'a' on each star selected. Press 'q' when finished.
...
Log file tmp$coo6033tf open
# COL  LINE  COORDINATES
# R  MAG  FLUX  SKY  PEAK  E  PA  ENCLOSED  GAUSSIAN  DIRECT
366.28  845.17  366.28  845.17
6.02  12.19  132816.  -271.5  19035.  0.04  -17  2.55  2.08  2.01
331.20  482.26  331.20  482.26
6.46  11.17  341017.  -272.6  44810.  0.06  -54  2.62  2.27  2.15
```

The bottom window is titled "SAOImage ds9" and shows a zoomed-in view of the resulting sky image. The image displays a field of stars with a coordinate system overlay. The x and y axes are labeled, and the zoom level is set to 1/2. The image shows a dense field of stars, with a few brighter stars visible. The zoom level is set to 1/2, and the image is displayed in a dark background.

Reduction example 2: reduce_bs task

```
Applications Places S P- G .cc *
Oct 11 20:03: IMCOMBINE
Flat fielding done.
Median background value of OFF field images:
11285.82
11527.82
11366.74
11496.29
11387.04
11274.27
11424.75
11320.48
11619.32
Making the sky image ...

Oct 11 20:03: IMCOMBINE
combine = median, scale = median, zero = median, weight = none
reject = ccdclip, mclip = yes, rkeep = 1
rdnoise = 9.3, gain = 2.6425, snoise = 0.001, sigma = 3., hsigma = 3.
blank = 0.

  Images  Median  Scale  Zero
tmp$im6033bg 11404.  1.000  0.
tmp$im6033fg 11403.  1.000  0.
tmp$im6033jg 11393.  1.001  0.
tmp$im6033ng 11397.  1.001  0.
tmp$im6033rg 11395.  1.001  0.
tmp$im6033vg 11408.  1.000  0.
tmp$im6033zg 11405.  1.000  9.77E-4
tmp$im6033dh 11392.  1.001  0.
tmp$im6033hh 11405.  1.000  0.

Output image = SN2012ej_20121020_k.sky, ncombine = 9
z1=8605.723 z2=14285.74
The 18 raw images are sky subtracted.
Sky image displayed (NB! Includes the dark).
# ASTTIMES: Observatory parameters for Roque de los Muchachos, La Palma
#   timezone = 0
#   longitude = 17:52.8
##YR MON DAY ZT UT EPOCH JD LMST
2012 10 21 SUN 4:51:08.0 2012.80411 2456221.7022 5:39:46.4
Doing distortion correction ...
Filter IDs: 1007 207 Stop wheel: 15mm ring
Using model: dist-k.dat ... please, wait ...
WF-camera distortion correction done.
z1=-539.3416 z2=83.39968
Select stars for ON target image alignment.
Press 'a' on each star selected. Press 'q' when finished.
...
Log file tmp$coo6033tf open
# COL LINE COORDINATES
# R MAG FLUX SKY PEAK E PA ENCLOSED GAUSSIAN DIRECT
366.28 845.17 366.28 845.17
6.02 12.19 132816. -271.5 19035. 0.04 -17 2.55 2.08 2.01
331.20 482.26 331.20 482.26
6.46 11.17 341017. -272.6 44810. 0.06 -54 2.62 2.27 2.15
z1=-558.549 z2=31.51565
Select stars for OFF target image alignment.
Press 'a' on each star selected. Press 'q' when finished.
...
Log file tmp$coo6033uf open
# COL LINE COORDINATES
# R MAG FLUX SKY PEAK E PA ENCLOSED GAUSSIAN DIRECT
422.11 586.28 422.11 586.28
6.13 12.76 78853. -328.3 11104. 0.10 83 2.59 2.11 2.04
615.78 322.56 615.78 322.56
7.17 10.96 413674. -325.4 50684. 0.03 49 2.64 2.49 2.39
```

SAOImage ds9

File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help

File tmp\$im6033yf

Object sky 1

Value <-558.549

WCS

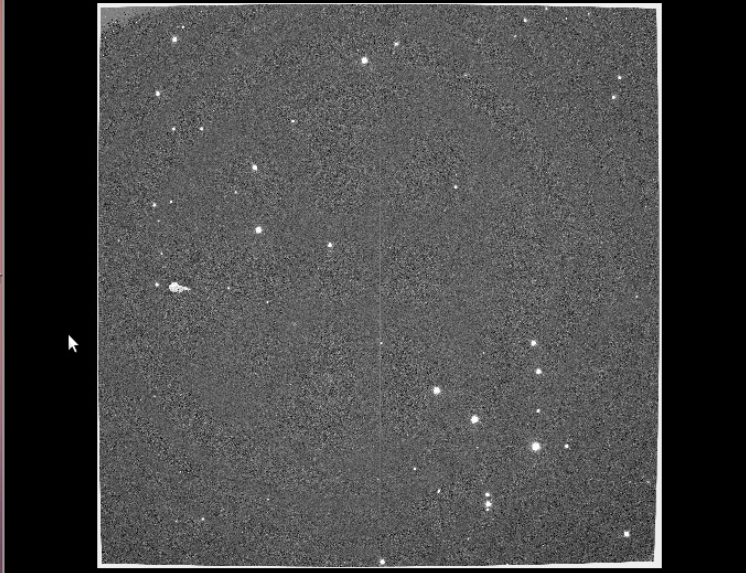
Physical X -51.000 Y 424.000

Image X -51.000 Y 424.000

Frame 2 Zoom 0.500 Angle 0.000

file edit view frame bin zoom scale color region wcs help

- + to fit zoom 1/8 zoom 1/4 zoom 1/2 zoom 1 zoom 2 zoom 4 zoom 8



23 44 66 87 109 131 152 174 195

Reduction example 2: reduce_bs task

```
Applications Places S P G C * O
IRAF
# Shifting images:
# Trimming images: corrected section = [74:951,73:951]
Skipping the first image when combining ...
Oct 11 20:04: IMCOMBINE
combine = median, scale = none, zero = mode, weight = none
reject = minmax, nlow = 1, nhigh = 0
blank = 0.
statsec = Oct 11 20:04
      Images      Mode      Zero
tmp$im6033dg -11.074      0.
tmp$im6033hg  162.73    -173.8
tmp$im6033lg   75.025   -86.099
tmp$im6033pg  176.18   -187.25
tmp$im6033tg   60.055   -71.129
tmp$im6033tg  183.57  -194.64
tmp$im6033xg  -121.78   110.71
tmp$im6033fh  -264.41   253.34

Output image = SN2012ej_20121020_k, ncombine = 8

Oct 11 20:04: IMCOMBINE
combine = median, scale = none, zero = mode, weight = none
reject = minmax, nlow = 1, nhigh = 0
blank = 0.
statsec = Oct 11 20:04
      Images      Mode      Zero
tmp$im6033cg      0.      0.
tmp$im6033gg   1.2138  -1.2138
tmp$im6033kg  -14.215   14.215
tmp$im6033og   -7.6886   7.6886
tmp$im6033sg   -3.2584   3.2584
tmp$im6033wg   2.3974  -2.3974
tmp$im6033ah   2.2315  -2.2315
tmp$im6033eh  -16.216   16.216
tmp$im6033ih      0.      0.

Output image = SN2012ej_20121020_k_OFF, ncombine = 9
The images are flatfield corrected, sky subtracted,
aligned, shifted and combined.
SN2012ej_20121020_k001
SN2012ej_20121020_k002
SN2012ej_20121020_k003
SN2012ej_20121020_k004
SN2012ej_20121020_k005
SN2012ej_20121020_k006
SN2012ej_20121020_k007
SN2012ej_20121020_k008
SN2012ej_20121020_k_OFF001
SN2012ej_20121020_k_OFF002
SN2012ej_20121020_k_OFF003
SN2012ej_20121020_k_OFF004
SN2012ej_20121020_k_OFF005
SN2012ej_20121020_k_OFF006
SN2012ej_20121020_k_OFF007
SN2012ej_20121020_k_OFF008
SN2012ej_20121020_k_OFF009
z1=-42.11141 z2=82.70922
Image SN2012ej_20121020_k_OFF is displayed in frame 3.
z1=-59.70681 z2=114.9561
Image SN2012ej_20121020_k is displayed in frame 4.
notcam>
```

SAOImage ds9

File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help

File: SN2012ej_20121020_k
Object: SN2012ej 2
Value:
WCS:
Physical X Y
Image X Y
Frame 4 Zoom 0.500 Angle 0.000

file edit view frame bin zoom scale color region wcs help
- + to fit zoom 1/8 zoom 1/4 zoom 1/2 zoom 1 zoom 2 zoom 4 zoom 8

23 44 66 87 109 131 152 174 195

Reduction example 2: reduce_bs task

The screenshot shows a Linux desktop environment with a file manager window open. The window title is "SN2012ej_20121020". The left sidebar shows the "Devices" section with "Home" selected, and the "Computer" section with "Home", "Desktop", "Documents", "Downloads", "Music", "Pictures", "Videos", "File System", "Trash", and "Network" options. The main area displays a grid of files in the "Home" directory. The files are:

- NCvj200062.fits
- NCvj200063.fits
- NCvj200064.fits
- NCvj200065.fits
- NCvj200066.fits
- NCvj200067.fits
- NCvj200068.fits
- NCvj200069.fits
- NCvj200090.fits
- NCvj200091.fits
- NCvj200092.fits
- NCvj200093.fits
- NCvj200094.fits
- NCvj200095.fits
- NCvj200096.fits
- NCvj200097.fits
- bad_zero_sci.fits
- notcam.db
- targetk
- flatk
- flatk.fits
- SN2012ej_20121020_k.sky.fits
- NCvj200680.fits
- NCvj200681.fits
- NCvj200682.fits
- NCvj200683.fits
- NCvj200684.fits
- NCvj200685.fits
- NCvj200686.fits
- NCvj200687.fits
- NCvj200688.fits
- NCvj200689.fits
- NCvj200690.fits
- NCvj200691.fits
- NCvj200692.fits
- NCvj200693.fits
- NCvj200694.fits
- NCvj200695.fits
- NCvj200696.fits
- NCvj200697.fits
- SN2012ej_20121020_k001.fits
- SN2012ej_20121020_k002.fits
- SN2012ej_20121020_k003.fits
- SN2012ej_20121020_k004.fits
- SN2012ej_20121020_k005.fits
- SN2012ej_20121020_k006.fits
- SN2012ej_20121020_k007.fits
- SN2012ej_20121020_k008.fits
- SN2012ej_20121020_k.fits
- SN2012ej_20121020_k_OFF.fits
- SN2012ej_20121020_k_OFF001.fits
- SN2012ej_20121020_k_OFF002.fits
- SN2012ej_20121020_k_OFF003.fits
- SN2012ej_20121020_k_OFF004.fits
- SN2012ej_20121020_k_OFF005.fits
- SN2012ej_20121020_k_OFF006.fits
- SN2012ej_20121020_k_OFF007.fits
- SN2012ej_20121020_k_OFF008.fits
- SN2012ej_20121020_k_OFF009.fits

The desktop taskbar at the bottom shows the "IRAF" application icon, a terminal window titled "SAOImage ds9", and the active window titled "SN2012ej_20121020". The system tray on the right shows the date "Oct 11, 20:07" and the user name "Erkki Kankare".

Reduction example 2: reduce_bs task

The screenshot shows a Linux desktop environment with a file manager window open. The window title is "SN2012ej_20121020". The left sidebar shows the "Devices" section with "Home" selected, and the "Computer" section with "Home", "Desktop", "Documents", "Downloads", "Music", "Pictures", "Videos", "File System", "Trash", and "Network" options. The main area displays a grid of files in the "Home" directory. The files are organized into rows and columns, with names including "NCvj200062.fits", "NCvj200063.fits", "NCvj200064.fits", "NCvj200065.fits", "NCvj200066.fits", "NCvj200067.fits", "NCvj200068.fits", "NCvj200069.fits", "NCvj200090.fits", "NCvj200091.fits", "NCvj200092.fits", "NCvj200093.fits", "NCvj200094.fits", "NCvj200095.fits", "NCvj200096.fits", "NCvj200097.fits", "bad_zero_sci.fits", "notcam.db", "targetk", "flatk", "flatk.fits", "SN2012ej_20121020_k.sky.fits", "NCvj200680.fits", "NCvj200681.fits", "NCvj200682.fits", "NCvj200683.fits", "NCvj200684.fits", "NCvj200685.fits", "NCvj200686.fits", "NCvj200687.fits", "NCvj200688.fits", "NCvj200689.fits", "NCvj200690.fits", "NCvj200691.fits", "NCvj200692.fits", "NCvj200693.fits", "NCvj200694.fits", "NCvj200695.fits", "NCvj200696.fits", "NCvj200697.fits", "SN2012ej_20121020_k001.fits", "SN2012ej_20121020_k002.fits", "SN2012ej_20121020_k003.fits", "SN2012ej_20121020_k004.fits", "SN2012ej_20121020_k005.fits", "SN2012ej_20121020_k006.fits", "SN2012ej_20121020_k007.fits", "SN2012ej_20121020_k008.fits", "SN2012ej_20121020_k.fits", "SN2012ej_20121020_k_OFF.fits", "SN2012ej_20121020_k_OFF001.fits", "SN2012ej_20121020_k_OFF002.fits", "SN2012ej_20121020_k_OFF003.fits", "SN2012ej_20121020_k_OFF004.fits", "SN2012ej_20121020_k_OFF005.fits", "SN2012ej_20121020_k_OFF006.fits", "SN2012ej_20121020_k_OFF007.fits", "SN2012ej_20121020_k_OFF008.fits", and "SN2012ej_20121020_k_OFF009.fits". The desktop background is blue. The top panel shows the system tray with icons for mail, network, volume, and power, along with the date "Oct 11, 20:07" and the user name "Erkki Kankare". The bottom panel shows the taskbar with icons for "IRAF", "SAOImage ds9", and "SN2012ej_20121020".

Photometry

- Most likely photometric standard star observations are not needed. 2MASS JHK magnitudes of field stars can be used most of the time to derive zero points and calibrate images.
- GAIA is a useful software for quick photometry.
- Couple of basic features:
 - Overplot 2MASS stars:
Data-Servers → Catalogs → 2MASS
 - Aperture photometry:
Image-Analysis → Aperture photometry → Results in magnitudes
 - Adjust if necessary:
Semimajor axis, Annulus inner scale, Annulus outer scale,
Sky estimator: mean → clipped mean
- Do not use non-linear field stars for photometry
- PSF photometry beyond the scope of this lecture

GAIA

Applications Places Oct 11, 22:56 Erkki Kankare

```
eskank@kankare-latitude: ~/SN2012ej_20120907
File Edit View Search Terminal Help
eskank@kankare-latitude:~$ cd SN2012ej_20120907
eskank@kankare-latitude:~/SN2012ej_20120907$ gaia
GAIA_DIR = /scisoft/share/star/bin/gaia
```

Starlink GAIA::Skycat: SN2012ej_20120907_k.fits (1)

Object: SN2012ej 2 (file:SN2012ej_20120907_k.fits)

X: -287.0 Y: -8.0 Value:

α : δ : Equinox:

Min: -73.6224670410156 Max: 19627.642578125

Low: -42.5559 High: 206.967

Scale: 1x

Auto Cut: Color Map: Intensity Map: Zoom

2MASS at CADC (1)

File Edit Options Data-Servers Help

Search Options

Object Name: Equinox: J2000

a: 06:26:50.403 d: +59:05:05.31

Min Radius: 0.0 Max Radius: 1.8439

Kmag Brightest (min): Kmag Faintest (max):

Max Objects: 20000

Provided by Vizier@CADC

Search Results (26)

Jmag	e_Jmag	Hmag	e_Hmag	Kmag	e_Kmag	Qflg	Rflg	Bflg	Cf	
27.15	14.105	0.027	13.417	0.034	13.314	0.028	AAA	222	111	00
48.01	14.455	0.125	13.799	0.153	13.483	0.107	EEA	222	111	00
54.21	14.586	0.068	13.836	0.074	13.498	0.064	AAA	222	111	00
41.57	14.898		15.313	0.210	13.715		UCU	020	010	00
31.97	14.408	0.031	14.138	0.045	14.060	0.048	AAA	222	111	00
52.28	15.036	0.028	14.262	0.039	14.213	0.050	AAA	222	111	00
39.23	15.151	0.034	14.478	0.039	14.231	0.049	AAA	222	111	00
25.50	15.394	0.042	14.847	0.058	14.650	0.069	AAA	222	111	00
26.51	15.043	0.027	14.795	0.061	14.705	0.078	AAA	222	111	00
45.01	15.870	0.070	15.207	0.067	14.958	0.093	AAA	222	111	00
23.60	16.878	0.152	15.317		15.033		BUU	200	100	00
33.86	15.692	0.052	15.364	0.104	15.291	0.136	AAB	222	111	00

eskank@kankare-latit... SN2012ej_20120907_k... 2mass@cdc

Top 10 things to remember

- 1) **Linearity <25000 counts – Check & adjust exposure times if necessary**
- 2) In near-IR the sky background is always high – Dither & sky-subtract
- 3) Overhead factor ~ 1.4 – More with beamswitch
- 4) FOV 4' x 4' – Use beam-switch for extended objects
- 5) Basic scripts for observing – setup-ima , 9point , beamswitch
- 6) Target and sky observations require the same total exposure time
- 7) frame exposure mode reduces noise – Use if possible
- 8) Dead column in the centre of the array – Include a skew in the observing grid
- 9) Guide probe area limited – Select guide area carefully
- 10) notcam package – mkflat , reduce , reduce_bs