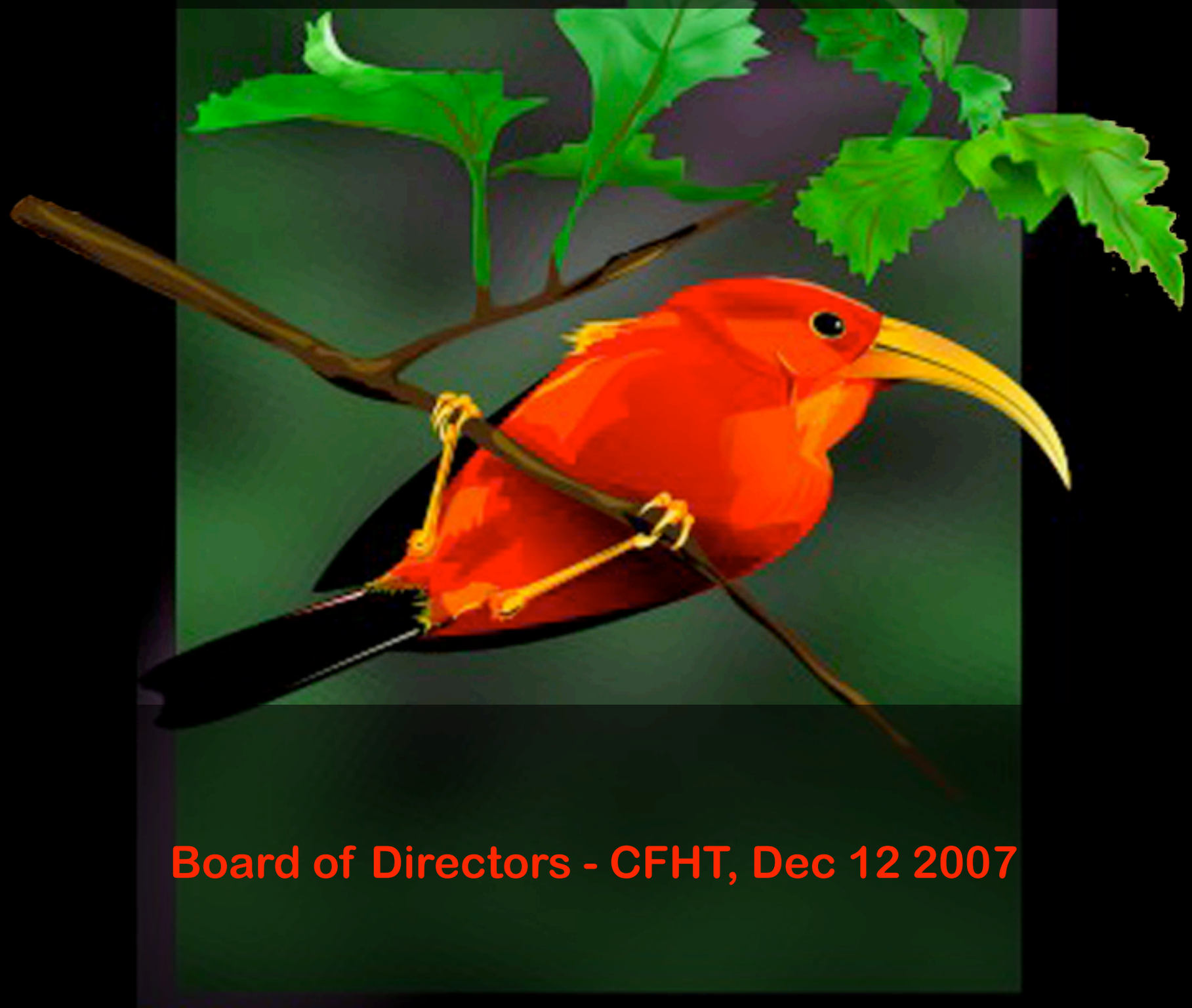
`I`iwi
the IDL Interpretor of the WIRCam Images



Board of Directors - CFHT, Dec 12 2007

Proprietary

Latest Developments.

- Late 2006
  - 05B/06A data was processed with a beta version of `I`iwi
- First half of 2007
  - Reducing crosstalk subtraction residues.
  - Non-linearity characterization and correction.
  - More aggressive source masking in sky construction.
  - Zero point determination through narrow-band filters.
  - More robust WCS linear solution (whole mosaic)
- September 2007
  - Freeze of `I`iwi version 1.0 (Albert)
  - Start of massive preprocessing of 06B/07A/07B programs (Devost)
- Fall 2007 - Various bug fixes mostly in the data flow aspects, not the recipes.

M27 in H_2 for ~60 minutes

`I`iwi Flow chart.

DETRENDED

Saturated Pixels Flagging

Non-Linearity Correction (NLC)

Reference Pixel Subtraction

Dark Subtraction

Dome Flat Fielding

Bad Pixels Masking

Guide Window Cross Masking

Temporary ??????s.fits

Negative and Edge Crosstalks Removal

??????s.fits

SKY SUBTRACTED

Sky Construction

Sky Subtraction

Negative and Edge Crosstalks Construction

Negative and Edge Crosstalks Removal

??????p.fits

ASTROMETRY

Crunch Cube

SExtractor

Whole Mosaic WCS Linear Solution

Chip to Chip WCS Linear Solution

Catalogue of Matched SEx and 2MASS Sources

PHOTOMETRY

Split Slices

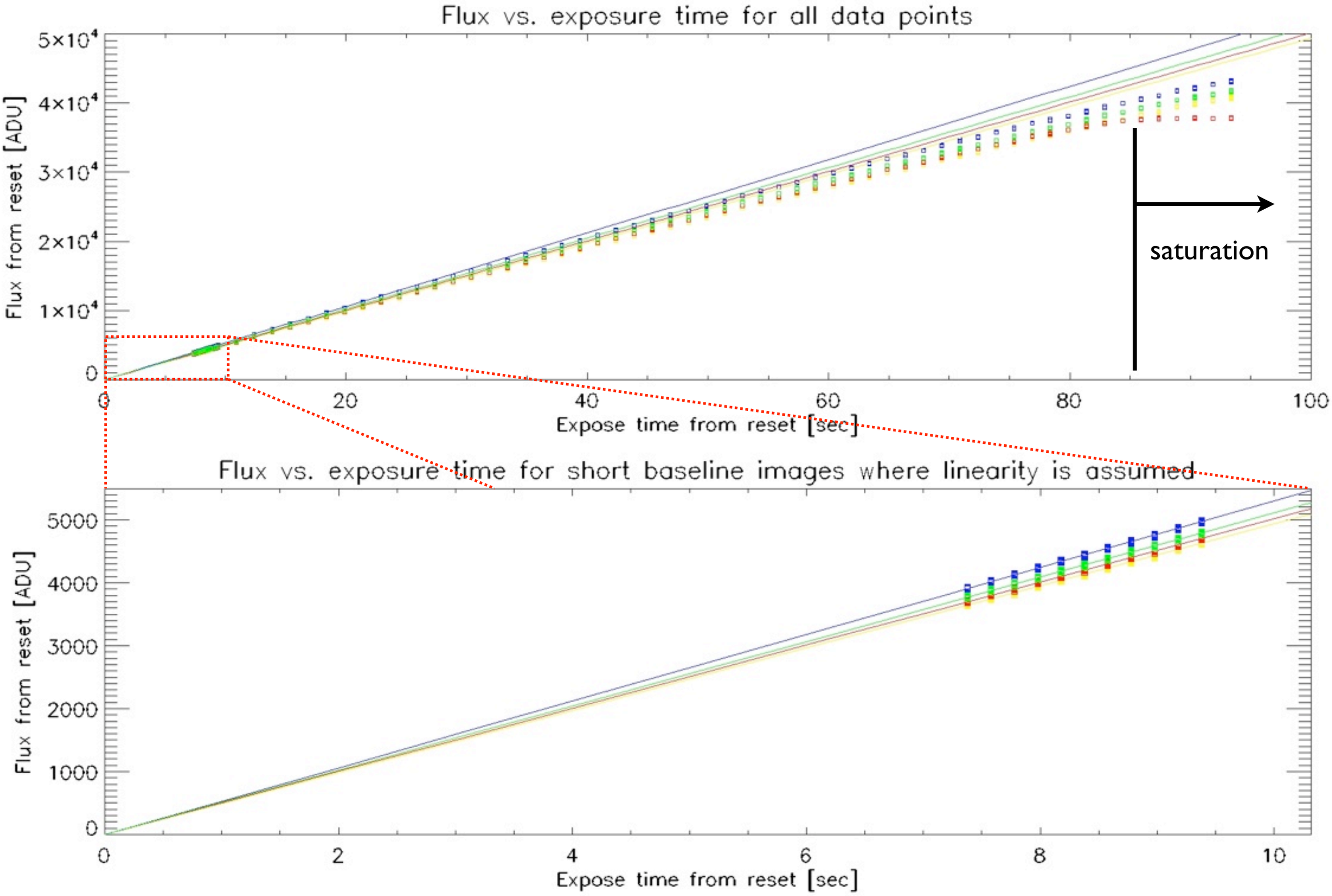
SExtractor

Use WCS to Match SEX and 2MASS Sources

For J,H,Ks: Determine 2MASS Zero Point

For Other Filters: Use Only Standard Stars Zero Point

Taking dome flats with lamp ON at various exposure times



(ext #1)

fit

adu^2

r response

he fit

4×10⁴ 5×10⁴

Non−linear correction vs. flux (ext #2)

Parameters of 2nd−order polynomial fit

non−linearity = a0 + a1*adu + a2*adu^2

a0 = 0.996922

a1 = 1.28674e−06

a2 = 4.18800e−11

Non−linearity correction

1.10

1.05

1.00

0.95

If linear response

Kept for the fit

Rejected from the fit

0 1×10⁴ 2×10⁴ 3×10⁴ 4×10⁴ 5×10⁴

Flux from reset (ADU)

Non−linear correction vs. flux (ext #3)

Parameters of 2nd−order polynomial fit

non−linearity = a0 + a1*adu + a2*adu^2

a0 = 0.998038

a1 = 1.15189e−06

a2 = 4.63836e−11

Non−linearity correction

1.10

1.05

1.00

0.95

If linear response

Kept for the fit

Rejected from the fit

0 1×10⁴ 2×10⁴ 3×10⁴ 4×10⁴ 5×10⁴

Flux from reset (ADU)

Non−lined

Parameters of

non−linearity =

a0 = 0.99

a1 = 9.29

a2 = 5.25

1.10

1.05

1.00

0.95

0 1×10⁴

lynomial fit

710

4×10⁴ 5×10⁴

Deviations to the 2nd−order polynomial fit

Measurements Over Fit Ratio

1.02

1.01

1.00

0.99

0.98

Date of Sequence: 20070710

0 1×10⁴ 2×10⁴ 3×10⁴ 4×10⁴ 5×10⁴

Flux from reset (adu)

Deviations to the 2nd−order polynomial fit

Measurements Over Fit Ratio

1.02

1.01

1.00

0.99

0.98

Date of Sequence: 20070710

0 1×10⁴ 2×10⁴ 3×10⁴ 4×10⁴ 5×10⁴

Flux from reset (adu)

Deviations t

Measurements Over Fit Ratio

1.02

1.01

1.00

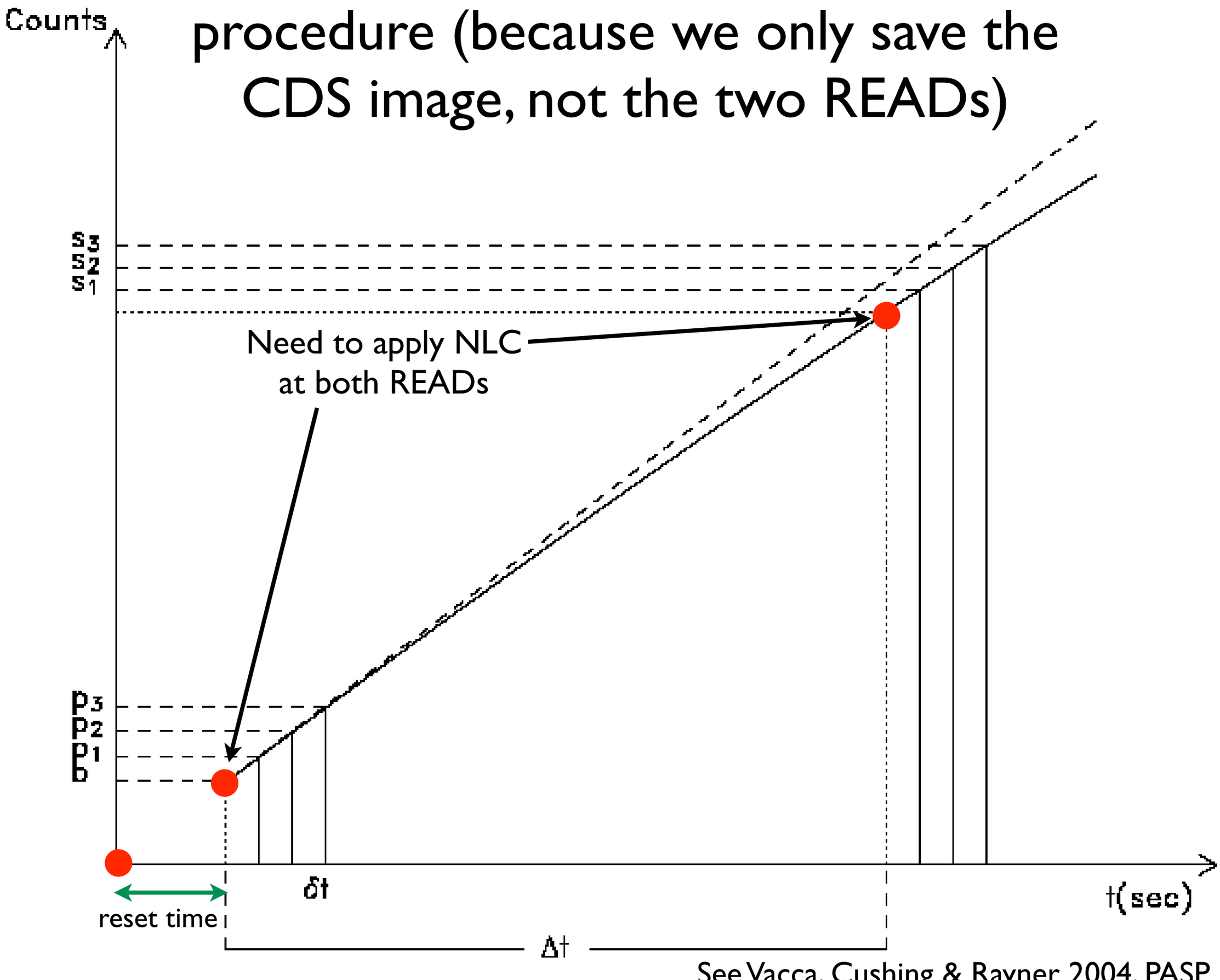
0.99

0.98

Dat

0 1×10⁴

Applying the NLC is an iterative procedure (because we only save the CDS image, not the two READs)



See Vacca, Cushing & Rayner 2004, PASP 116 352

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Status of data processing and distribution to PIs

WIRCam Preprocessing at CFHT, stacking at Terapix

http://www.cfht.hawaii.edu/Instruments/Imaging/WIRCam/WIRCamPreprocQueue.html

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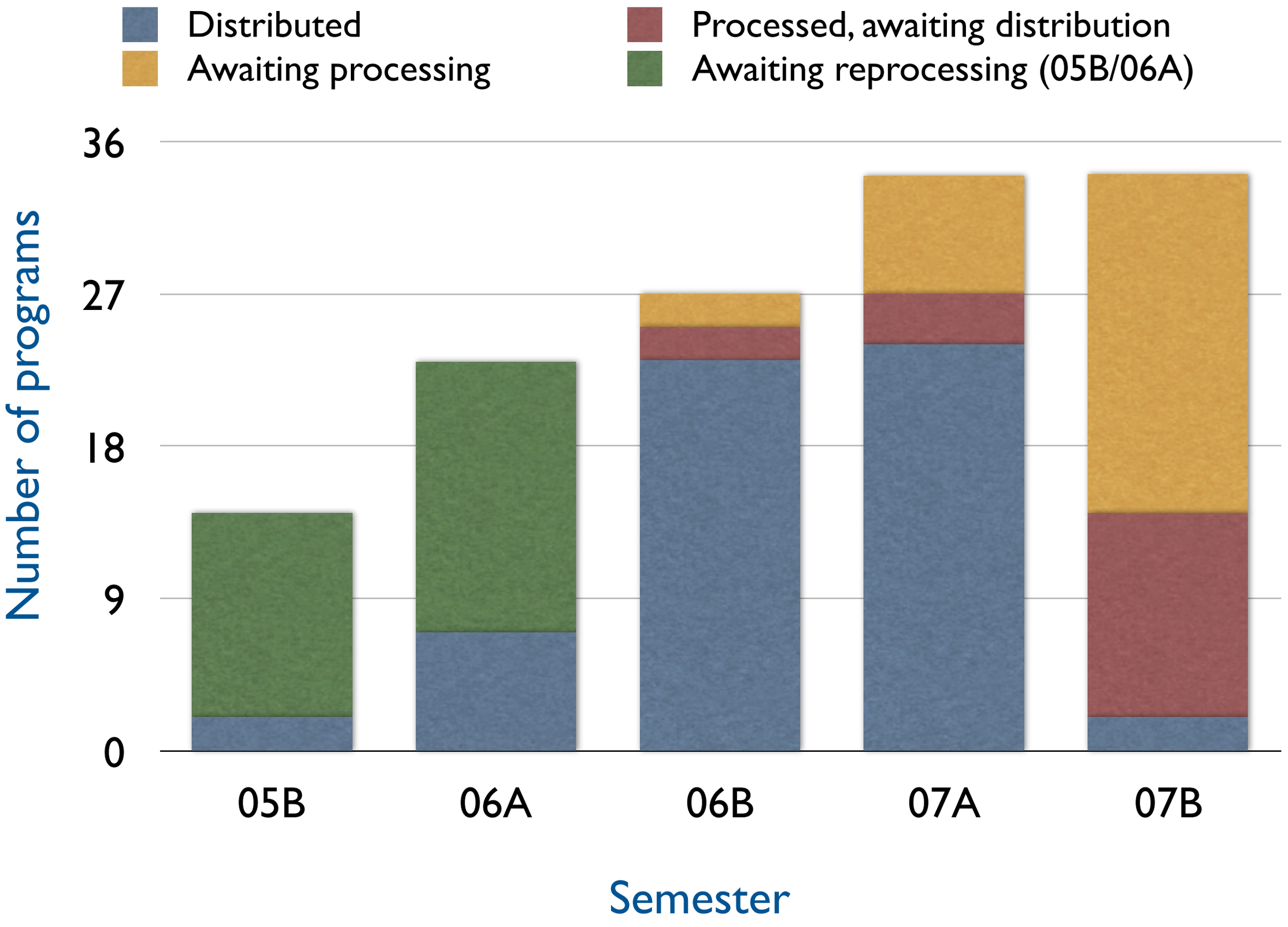
WIRCam Preprocessing ... | CFHT Queue Preview

1. Daniel D. processes data using `I`iwi (creates scripts for each program, runs the scripts in `I`iwi, checks the results)
2. Herb W. launches the distribution (creates jpeg, ancillary data, web page, etc)

Iiwi_version	RunID	Status	Date	Comments
1.0.1	07BC01	On hold	20 Nov 2007	Observations completed. ControlField Ks was missing in the program summary. Added it. Still only 200 files out of 313 are in the scripts. Wircam_makewcreduc has a hard time finding skies.
1.0.1	07BC07	Preprocessed	Oct 18 2007	Ready to be distributed.
1.0.1	07BC20	Preprocessed	Nov 5 2007	Ready to be distributed. Nodding
1.0.1	07BC23	On hold	Oct 25 2007	Still observing it. Will need to be reprocessed.
1.0.1	07BC99	On hold	Oct 25 2007	Still observing it. Will need to be reprocessed.
1.0.1	07BD89			Nodding. PI is Martin. Do not distribute.
1.0.1	07BD90			Observations completed. Ready to be processed. PI is Veillet.
1.0.1	07BD91	Preprocessed	20 nov 2007	PI is Devost. Do not distribute.
1.0.1	07BD96	On hold		wircam_makewcreduc crashes. Do not distribute. PI is Morisson.
1.0.1	07BD97			Observations completed. Ready to process. Do not distribute. PI is Albert
1.0.1	07BD98			PI is Devost. Do not distribute.
1.0.1	07BD99			Still observing. PI is Albert. Do not distribute.
1.0.1	07BF12	On hold	07 Dec 2007	Path problem still present. Nodding.
1.0.1	07BF23	Preprocessed	11/05/07	Ready for distribution. Nodding
1.0.1	07BF97	Preprocessed	23 Nov 2007	Ready for distribution. Observations completed.
1.0.1	07BF98	Preprocessed	Oct 25 2007	Ready for distribution.
1.0.1	07BF99			Still observing it.

Status of data processing and distribution (Dec 12 2007)



WIRCam data processing status (Dec 12 2007)

Nbr of programs (06B,07A,07B)	95	
Distributed	49	52%
Processed	66	69%

WIRCam data processing status (Dec 12 2007)
Including already processed 05B/06A programs

Nbr of programs (all semesters)	132	
Distributed	86	65%
Processed	103	78%

WIRCam raw science data acquired

Semester	Raw Volume	Nbr Images
07B	1.0TB	32065
07A	1.4TB	43403
06B	0.7TB	22694
06A	0.9TB	28429
05B	0.3TB	9235
total	4.3TB	107397

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`Ĩ`iwi version 1.0 - Documentation on the web.

WIRCam Image Preprocessing

http://www.cfht.hawaii.edu/Instruments/Imaging/WIRCam/IiwiVersion1Doc.html

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The IDL Interpretor of the WIRCam Images (`Ĩ`iwi) - Version 1.0

Table of contents:

Introduction and Overview

The raw WIRCam images have the odometer names ??????o.fits, are coded in 16-bit unsigned integers (0-65535 - make sure to use the BZERO and CHIPBIAS keywords) and are stored as multi-extension FITS (MEF) images (1 primary header + 4 extensions). Additionnally, the MEF can be cubes or singles slices, i.e. each extension can contain one or more images (look for NAXIS3=? in the extension headers). The full mosaic and cube slices can be correctly viewed with ds9 version 4 and higher with the commands:

```
ds9 -mosaicimage ??????o.fits, or

ds9 -mosaicimage wcs ??????o.fits (correctly displays the WCS)
```

The IDL Interpretor of WIRCam Images (`Ĩiwi - pronounced E-e-vee - a native hawaiian bird) preprocesses all the o.fits images and produces two sets of results: 1) the ??????p.fits images which are detrended (dark subtracted, flat fielded, etc) and are sky subtracted; 2) the ??????s.fits images which are detrended but NOT sky subtracted. This is intended so that PIs can use their own sky subtraction strategy without having to start from scratch. There is a subtle difference between PREprocessing and processing. CFHT preprocesses every single image but does NOT coadd them into a deeper stack. The stacking, so-called the processing, can be done on request by the TERAPIX team.

The image processing steps needed to remove the instrument imprints are globally referred as the "detrending". In addition to the standard detrending steps usually taken (dark subtraction, flat fielding, etc), the WIRCam detectors (HAWAII-2RG) have specific imprints requiring special detrending recipes (R stands for Reference pixels, G for on-chip Guider - not the same beast as HAWAII-2 - a.k.a. WFCAM). For example, on some detectors, the guide window produces a structured cross extending all the way to the edges of the arrays. But the most important artifact plagging the WIRCam images is the different types of electronic crosstalks which produce doughnut-shaped artifacts which need to be accounted for. The next section will dwelve in all the details

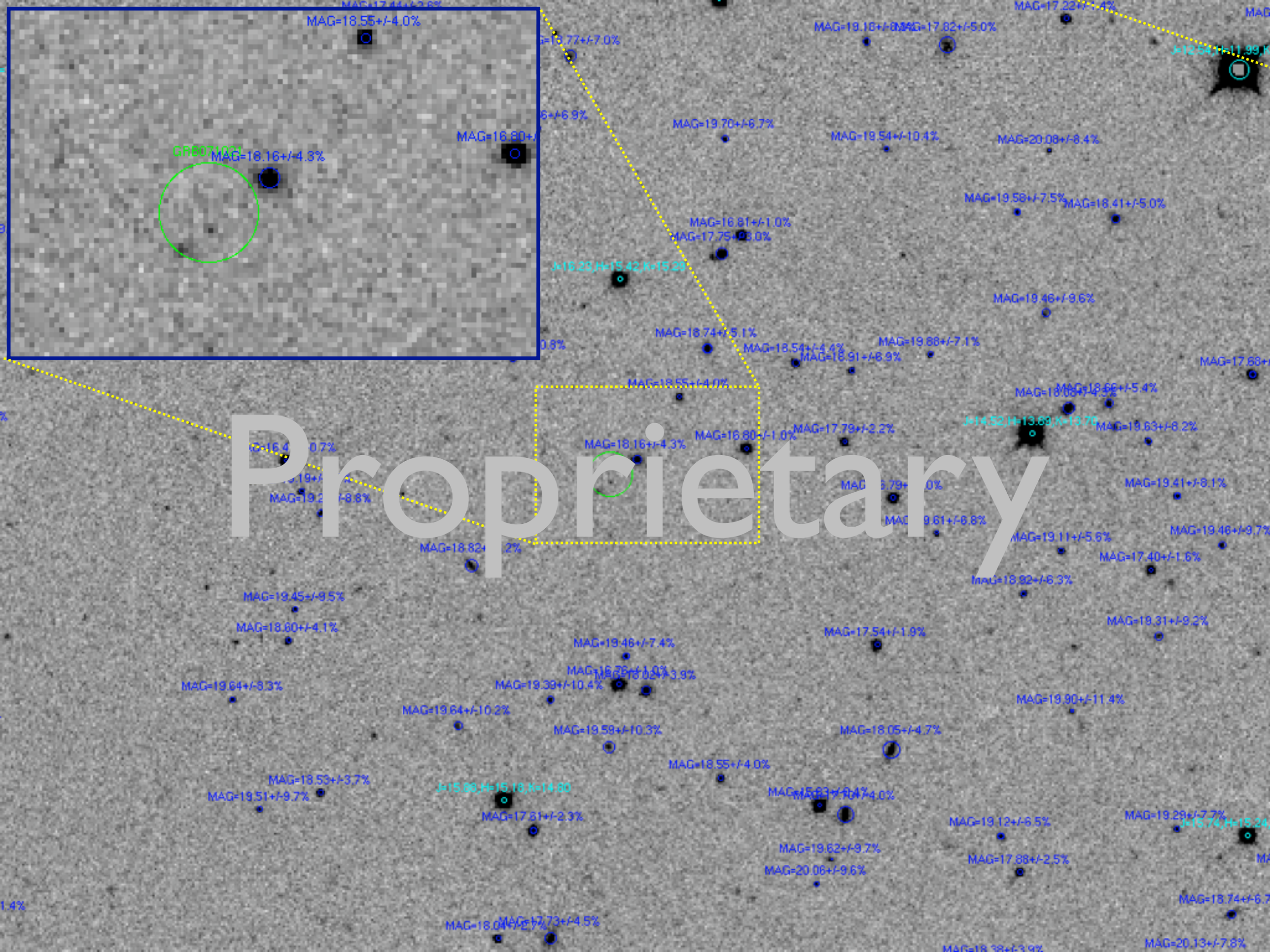
To be studied for next `I`iwi version

- ★A definitive (!) crosstalk subtraction recipe
- ★Persistence masking
- ★Color-term correction for absolute photometry
- ★Positive crosstalk subtraction for pre-07B data
- ★Use of twilight flats and an illumination correction
- ★Improve data flow automation

arXiv WIRCam publications

- T. J. Davidge, The Disk and Extraplanar Regions of NGC 2403 (2007)
- M. Huertas-Company, D. Rouan, L. Tasca et al., A robust morphological classification of high-redshift galaxies using support vector machines on seeing limited images. I Method description (2007)
- Wei-Hao Wang , Lennox L. Cowie , Jennifer van Saders Amy J. Barger et al., GOODS 850-5 -- A z>4 Galaxy Discovered in the Submillimeter? (2007)
- Joshua D. Younger, Jia-Sheng Huang, Giovanni G. Fazio et al., Rest-Frame Ultraviolet to Near Infrared Observations of an Interacting Lyman Break Galaxy at z = 4.42 (2007)

GRB071021 - 40 min in Ks - Y. Urata (Taiwan)



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M27 in H_2 for ~60 minutes