KiDS

OmegaCEN

OmegaCAM calibrations for KiDS

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for
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A.
Issues common to wide field imaging surveys data processing

KiDS

ASTRO WISE

OmegaCEN

- Baseline: chip-based processing
- Combining information full mosaic:
  - Global Astrometry
  - Illumination correction
  - Global Photometry (likely)
- Calibrate the instrument, not the data
  - use calibration data as a ‘calibration survey’

Astro-WISE optical pipeline: McFarland et al 2011,
Experimental Astronomy, arXiv:1110.2509

De-biasing

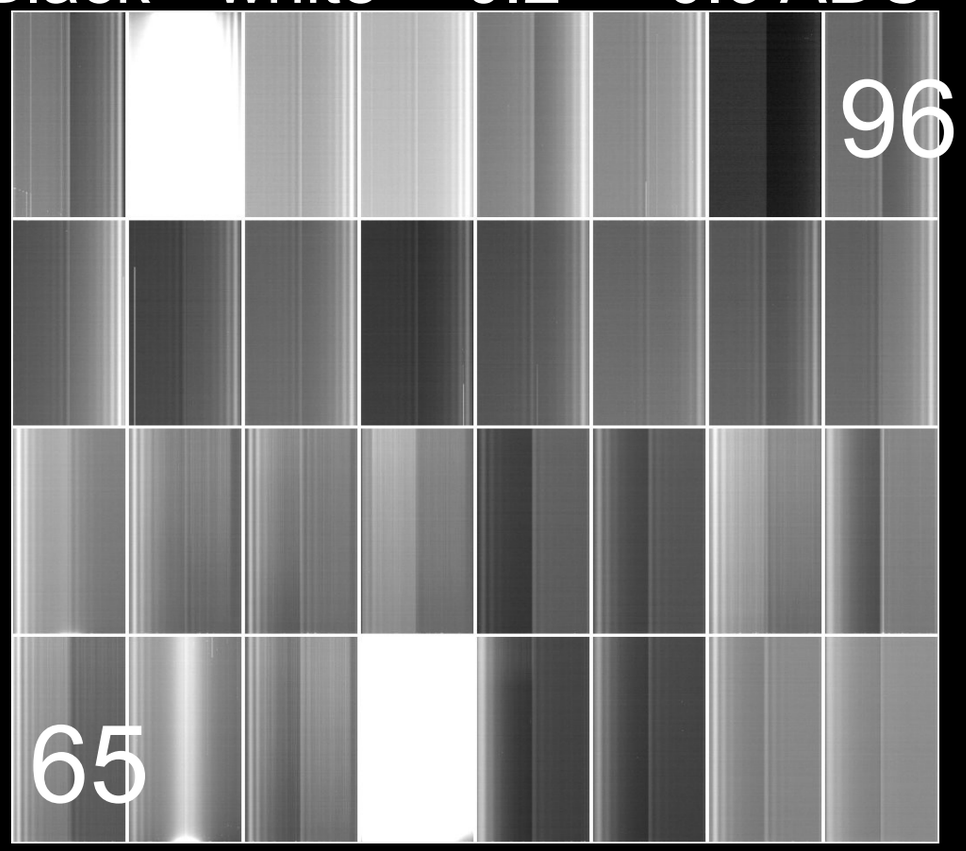
Two subtractions:

1. **Overscan**: per-exposure, row-average(overscan-X)
   - NB: ramp in overscan; variation in raw bias levels
2. **Masterbias**, nightly, overscan-subtracted

Figs:170 masterbias 1aug11 -> 1feb12

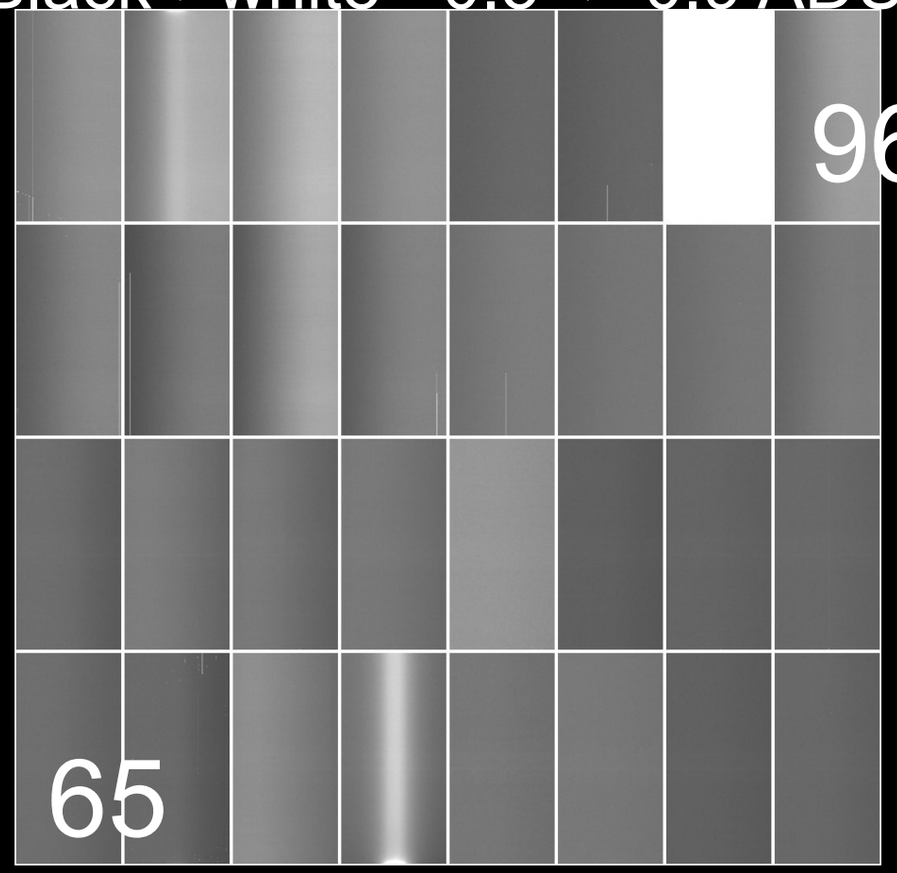
Mean

Black->white= -0.2 -> 0.3 ADU



Stdev

Black->white= 0.5 -> 0.9 ADU



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Mean **Stdev**

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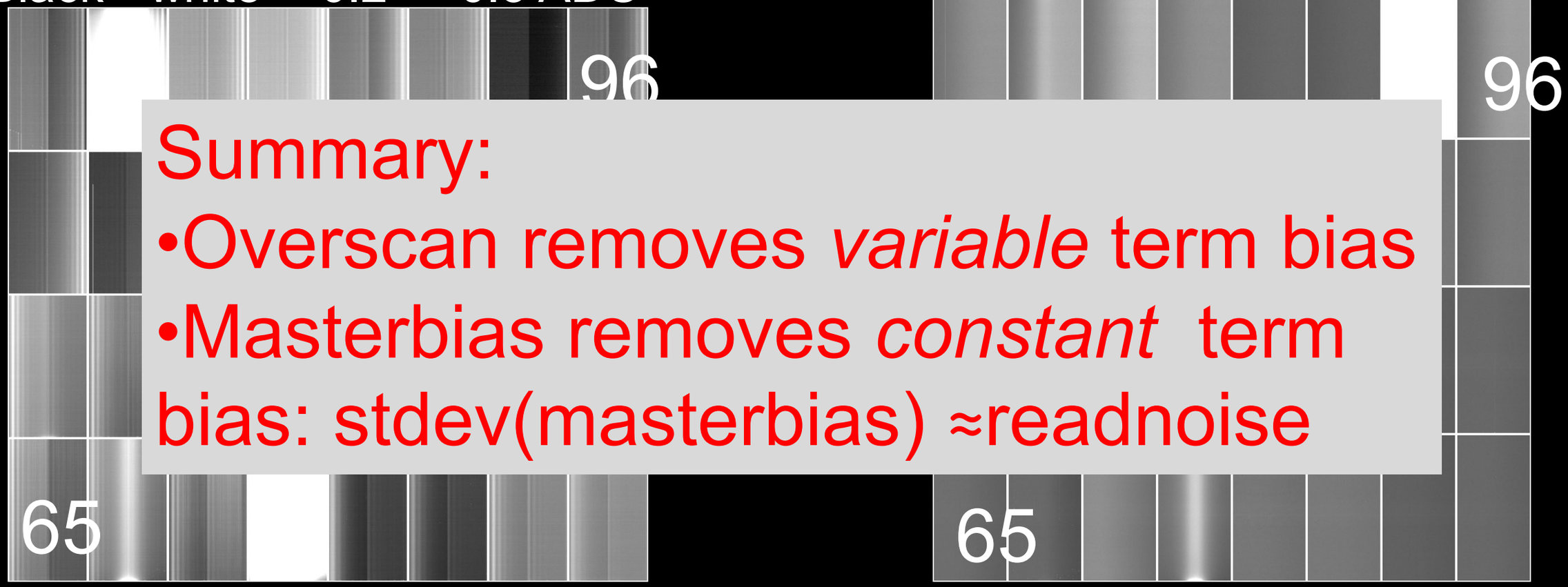


Summary:

- Overscan removes *variable* term bias
- Masterbias removes *constant* term bias: stdev(masterbias) ≈readnoise

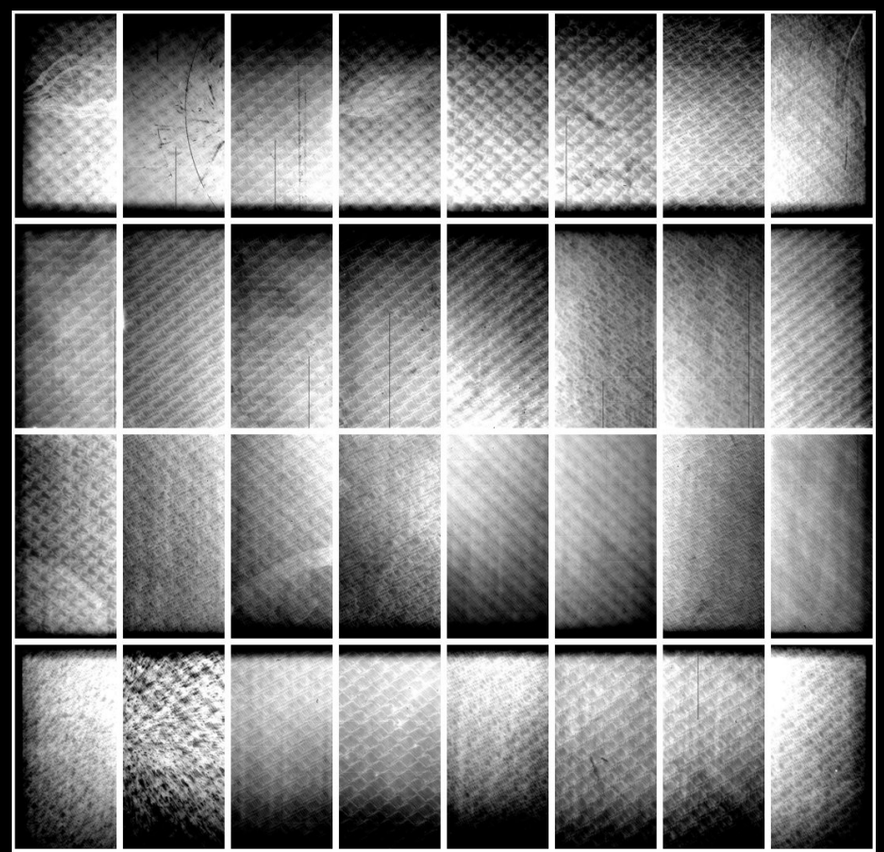
Flat-fielding (ugri)

- Combine dome (small-scale) + twilight (large-scale)
  - Except u: twilight-only

Figs: g twilights 1aug11 -> 1feb12

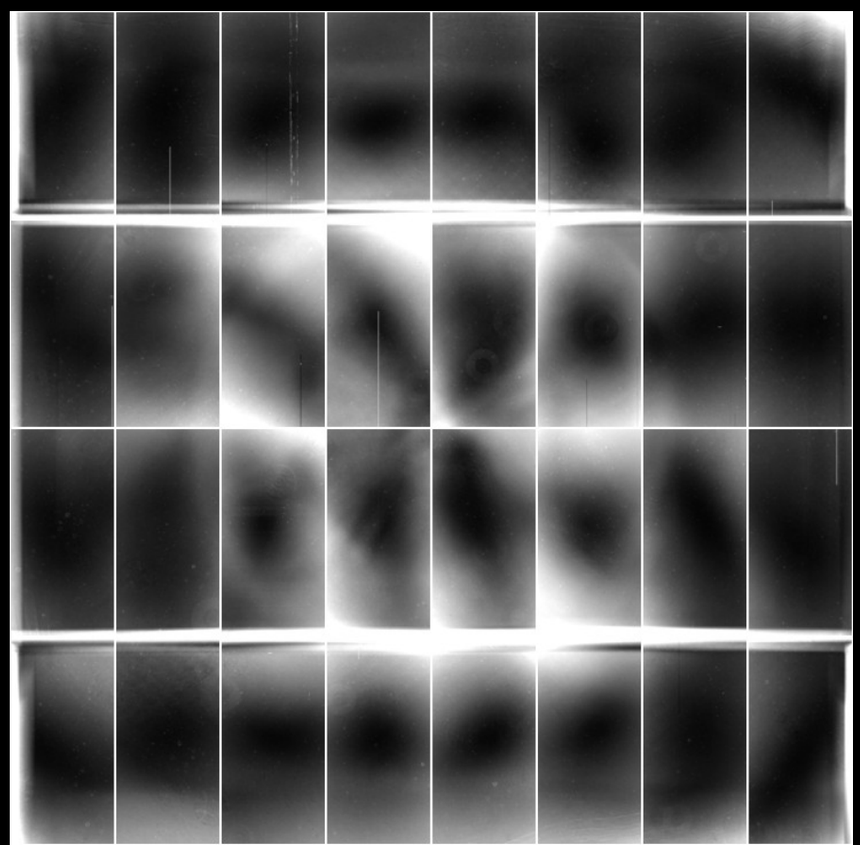
Mean, g

Black->white= 0.98 -> 1.02



Stdev, g

Black->white= 0.002 -> 0.006



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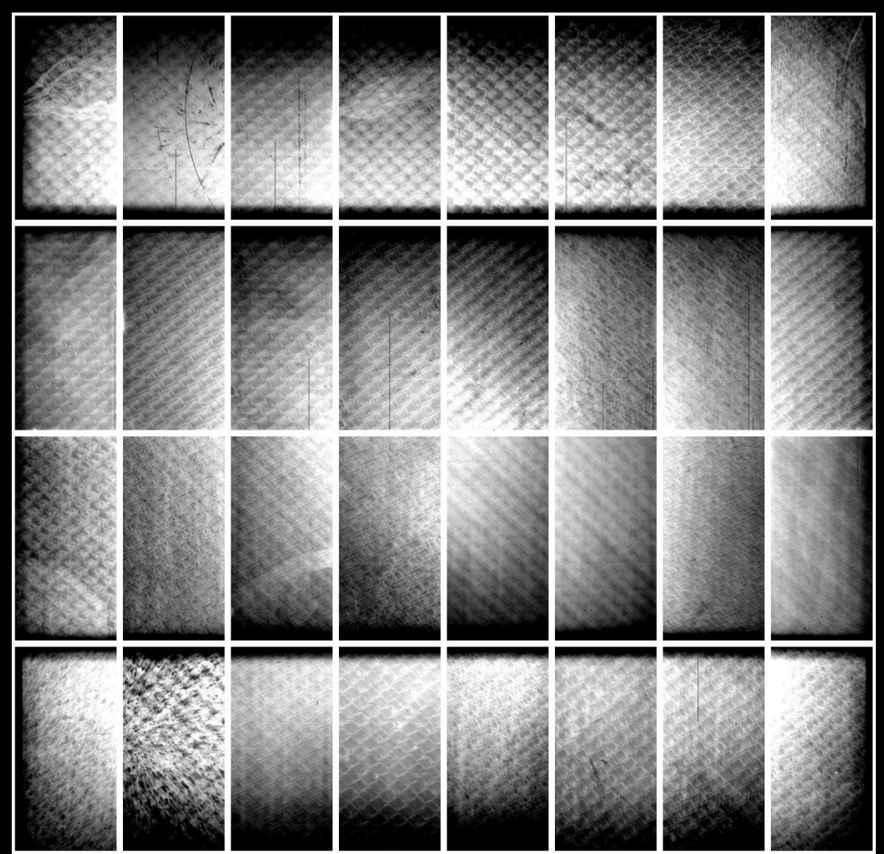
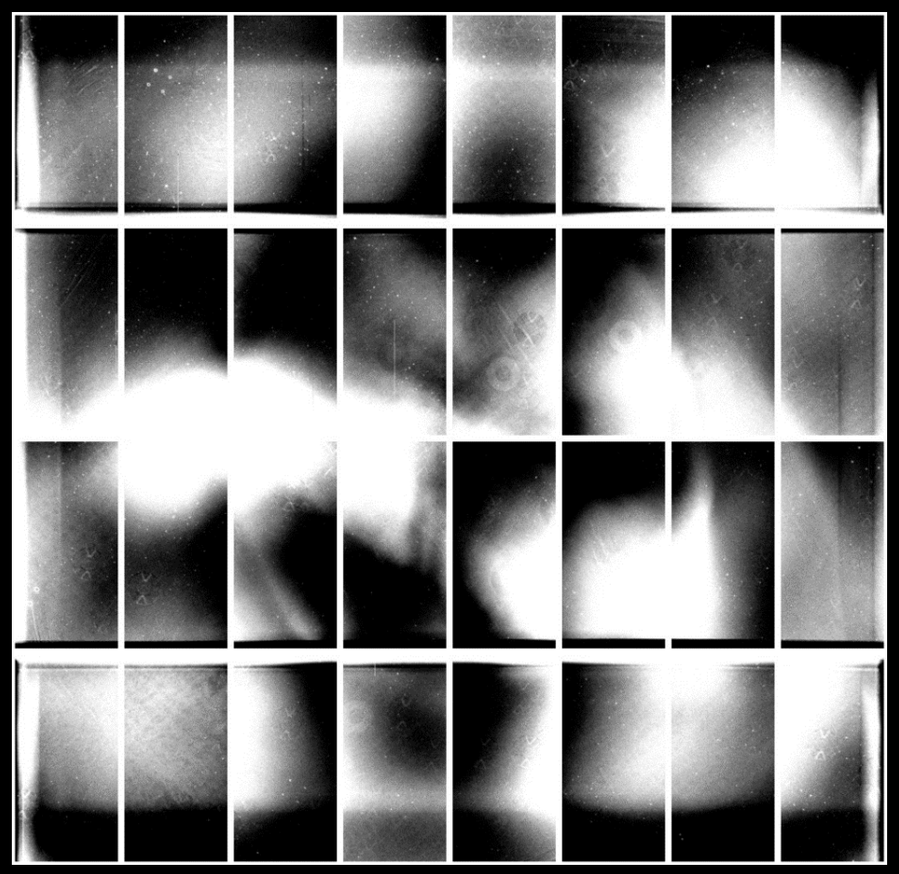


Flat residual vs rotation(ABSROT)

Black->white= -0.002 -> 0.002

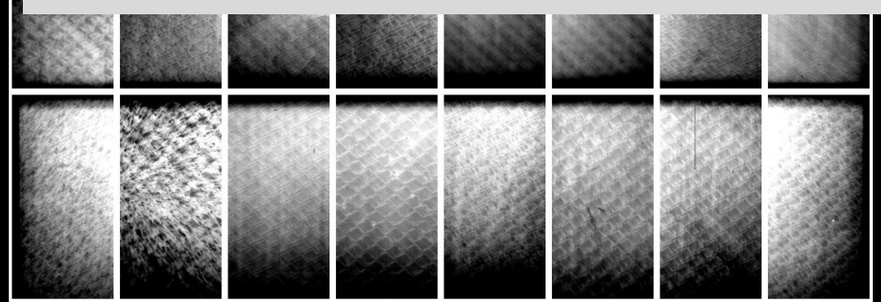


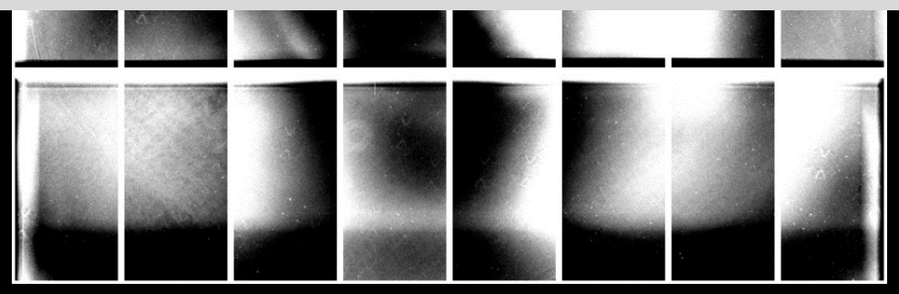
Flat-fielding (ugri)

- Combine dome (small-scale) + twilight (large-scale)
  - Except u: twilight-only

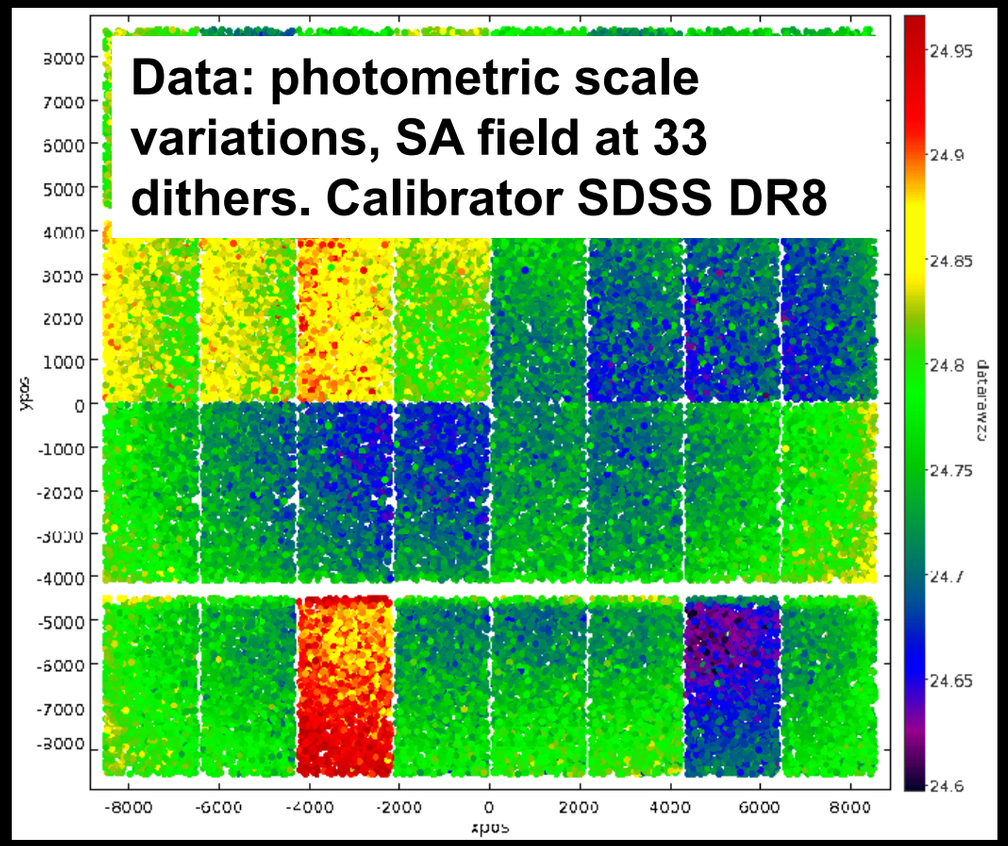
Figs: g twilights 1aug11 -> 1feb12

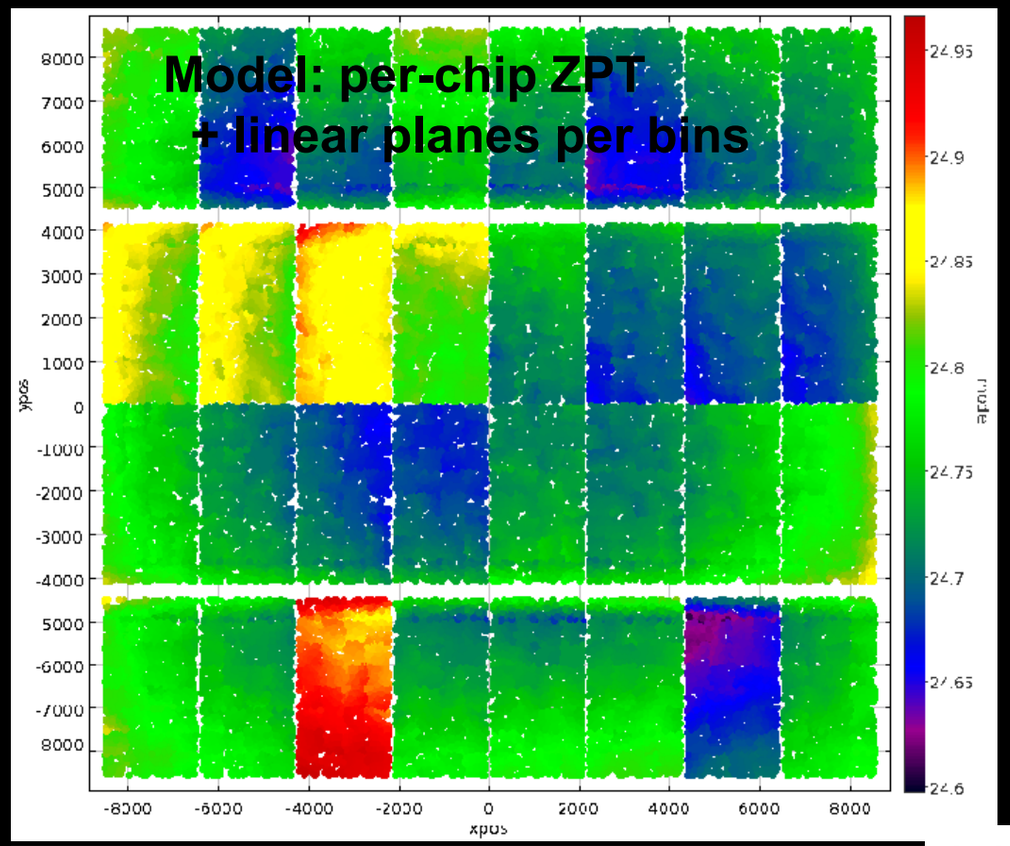
Summary:
- <~1% variability in flatfields dominated by rotator angle dependent stray-light.
- KiDS uses fixed flatfield for internal consistency with illumination variation modelling. Investigations on-going.

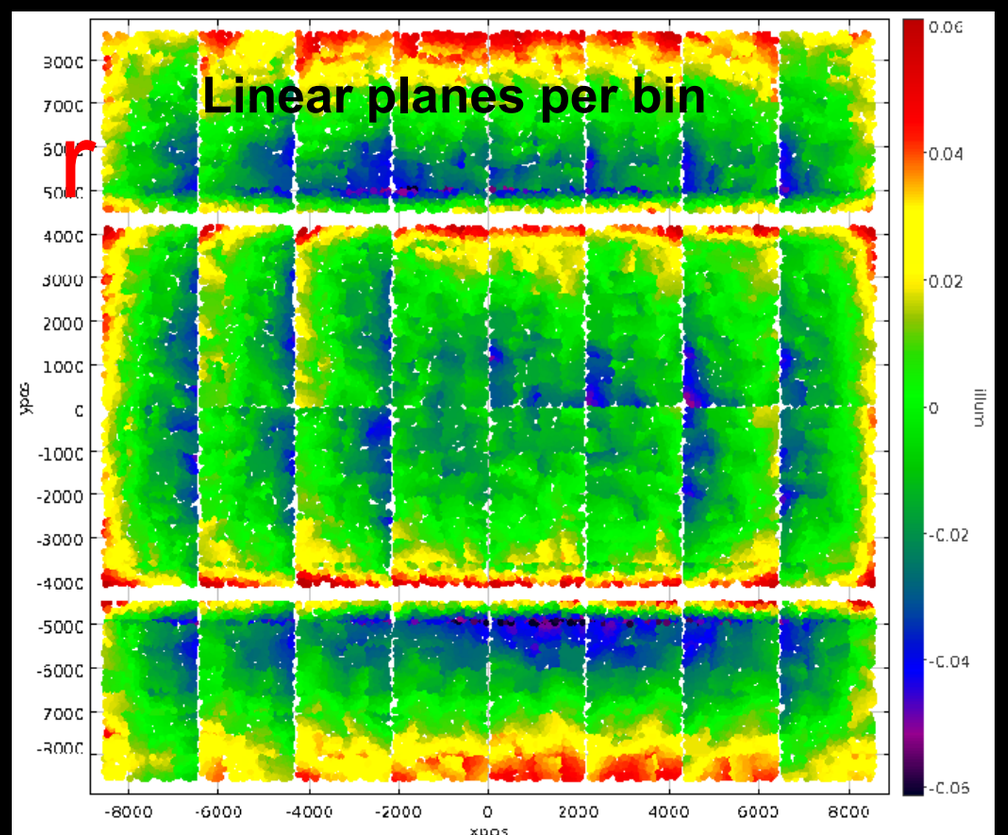


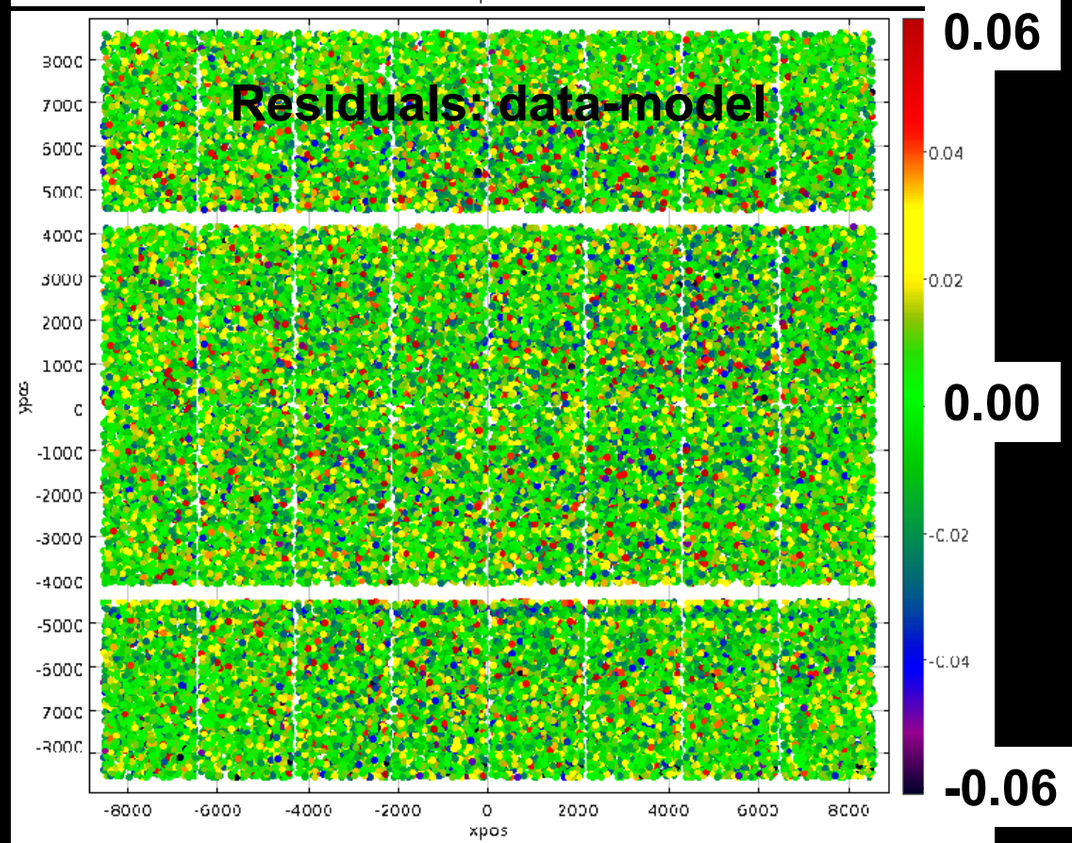


Illumination correction





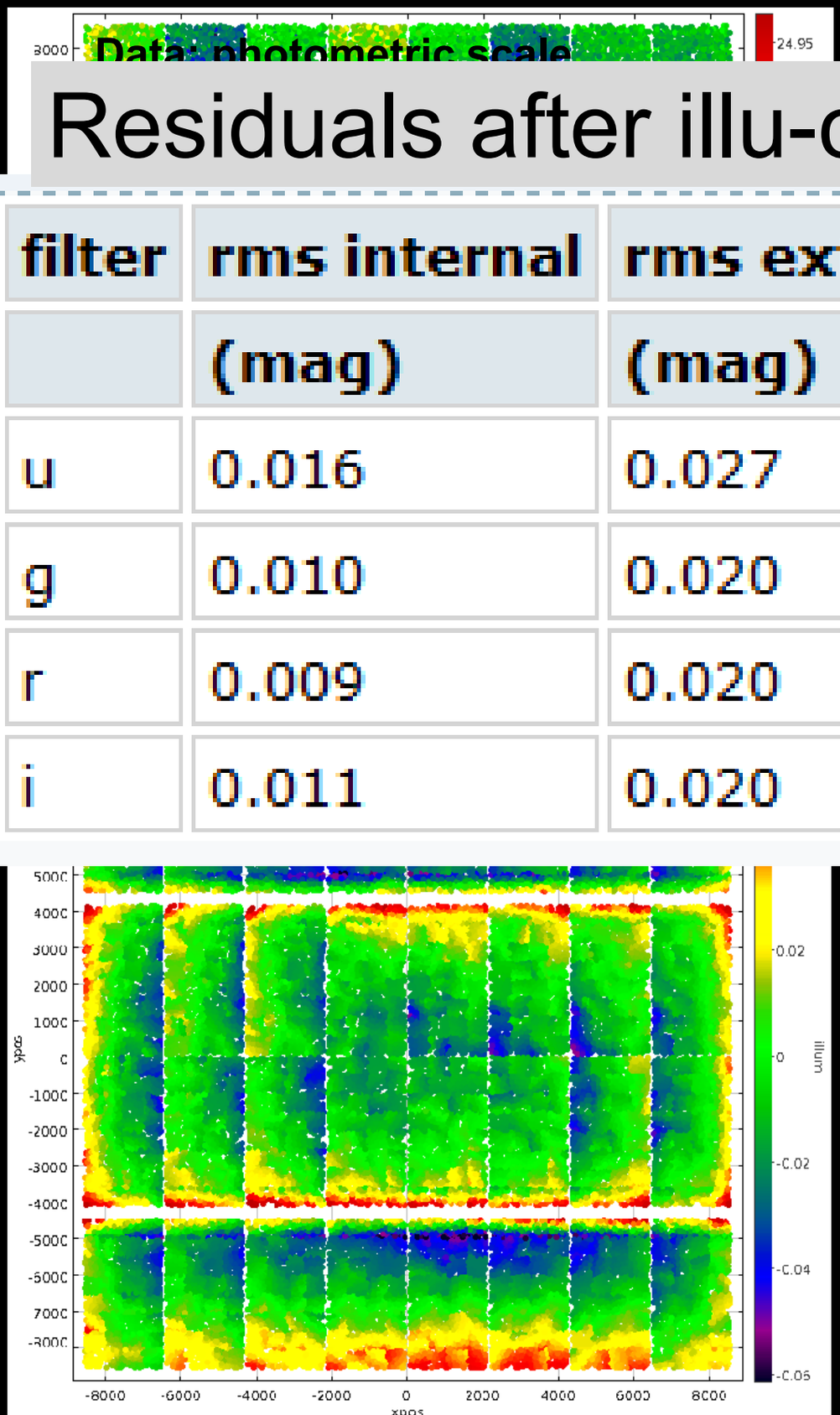




Illumination correction

Residuals after illu-corr

filter	rms internal (mag)	rms external (mag)
u	0.016	0.027
g	0.010	0.020
r	0.009	0.020
i	0.011	0.020



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Illumination correction

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Residuals after illu-corr

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SA113->SA113

Residuals after illu-corr

filter	rms internal	rms external	comments (all illum corrs derived from SA113 data-set)
	(mag)	(mag)	
r	0.009	0.020	binning model applied on same data-set (i.e. SA113)
r	0.011	0.023	binning model applied on SA95 data-set, SA95 reduced with same ff
r	0.011	0.024	binning model applied on SA95 reduced with tw. flat with rotator angle different by 70 degrees

Table 4: Rms of residual magnitudes in the SLOAN r filter for 3 different datasets using a single illumination correction with local binning.

SA113->SA95

Summary:

- Illumination characterized to 2% in u and 1% gri
- improvement flatfielding at detector edges on-going

KiDS

Photometric scale on-sky

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- Standards: SDSS DR8 / 2dary STDs / Landolt / Stetson
- Aperture mags, diam = 12arcsec

filter	Stdev(ZPT) (*) for mosaic	Stdev(ΔZPT)) (**) per ccd-pair Mean / median
u	0.011	~0.012 / 0.010
g	0.010	~0.010 / 0.008
r	0.012	0.017 / 0.014
i	0.011	0.029 / 0.028

(*): within single photometric night, (**) over ~5 months

Photometric scale on-sky

- Standards: SDSS DR8 / 2dary STDs / Landolt / Stetson
- Aperture mags, diam = 12arcsec

filter	Stdev(ZPT) (*)	Stdev(ΔZPT)) (**)
i	0.011	0.029 / 0.028

Summary:
- ~1% absolute photometry can be achieved
- chip-to-chip photometry will be improved

(*): within single photometric night, (**) over ~5 months

Astrometry

- 2 models: local → global)
  - common: TAN projection, least squares fit to polynomial, USNO-A2.0 → 2MASS-PSC
  - Local: 2nd degree polynomial, per chip solution (32*n_dither solutions), no overlapping sources
  - Global: 3rd degree polynomial, per dither solution (one solution for 32*n_dither frames), linear terms between dither steps constrained to linear variation, higher-order terms fixed , overlapping sources have been associated

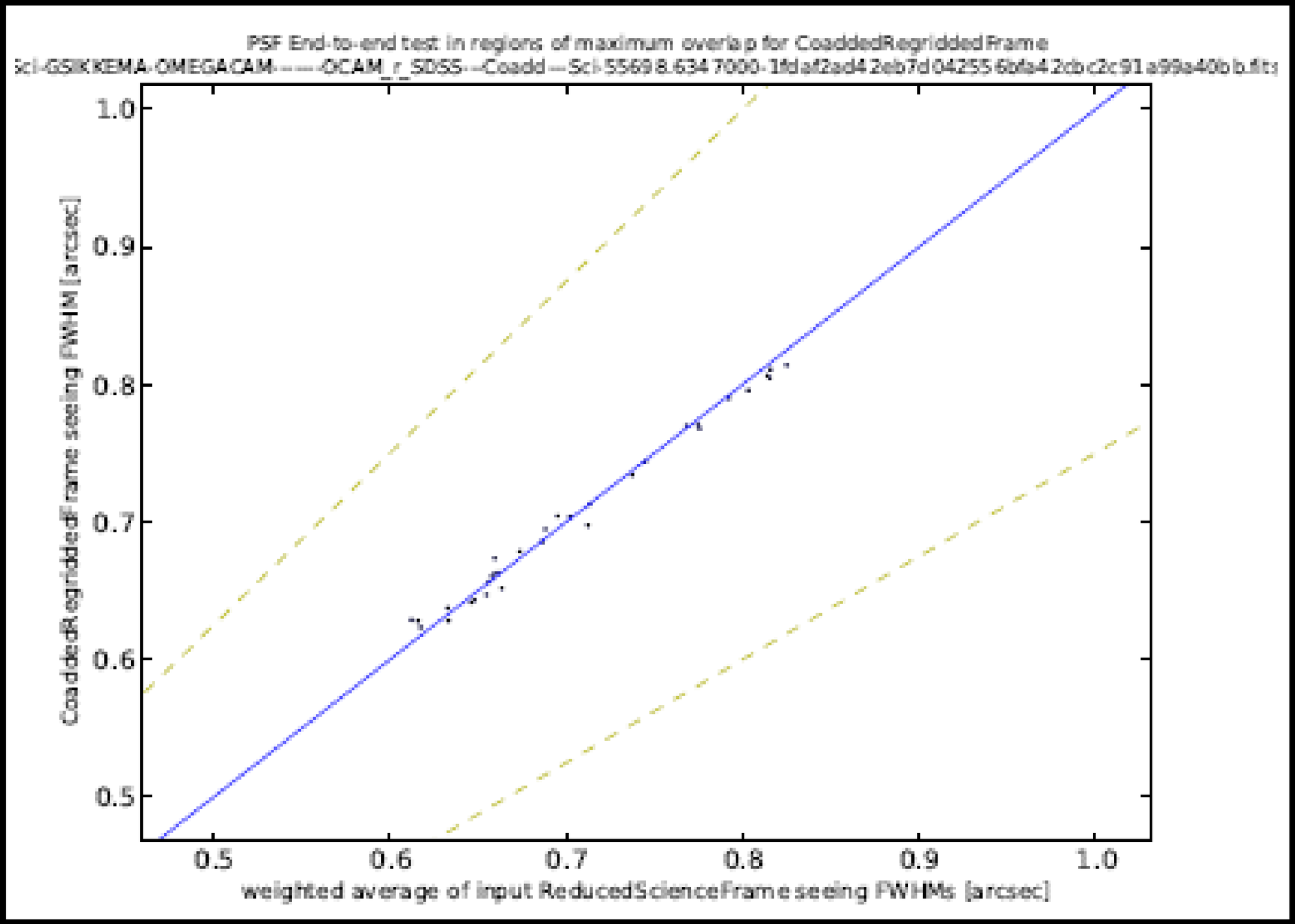
See also: McFarland et al., 2009 Astro-WISE Astrometry Report

KiDS astrometric quality

<RMS> 2D (“) Solu. / Qual=ok	u	g	r	i
Internal local	0.15	0.11	0.10	0.11
External local	0.4 100% / 99.9%	0.4 100% / 100%	0.4 100% / 100%	0.4 100% / 100%
Internal global	TBC (0.05) 100% / TBD	TBC (0.05) 100% / TBD	TBC (0.05) 100% / TBD	TBC (0.07) 100% / TBD
External global	TBC (0.4) 100% / TBD	TBC (0.4) 100% / TBD	TBC (0.4) 100% / TBD	TBC (0.4) 100% / TBD

(*) Good quality: rms,sig(Δra), sig(Δdec)<1”

PSF-end-to-end test



De-fringing

- Only needed for KiDS i
- Baseline: nightly fringemaps (>=10 exposures KiDS+some ATLAS)

1) Temporary Background Subtraction

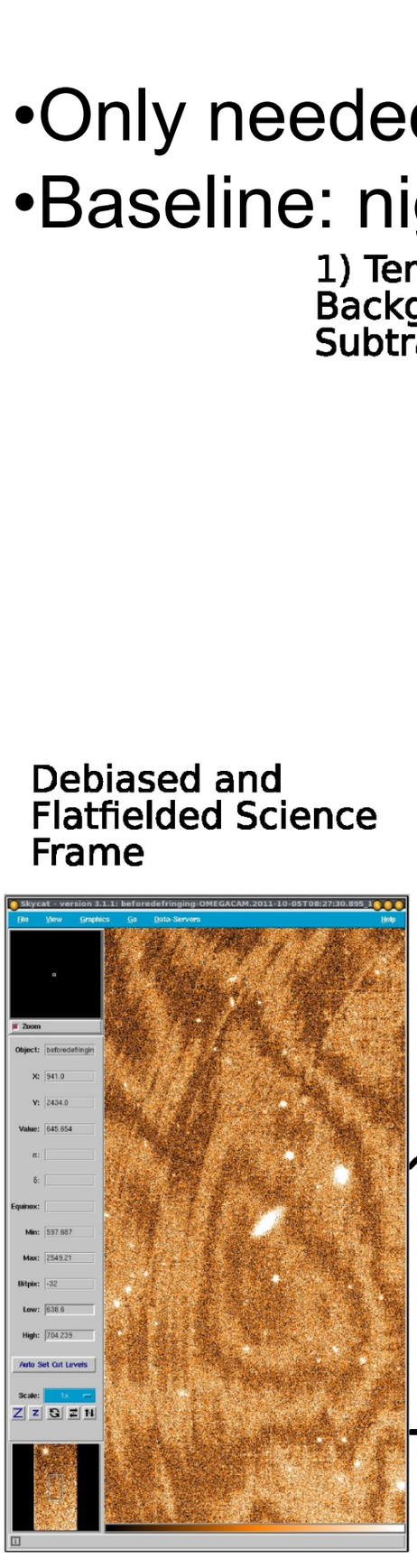
2) Scale Factor λ Determination

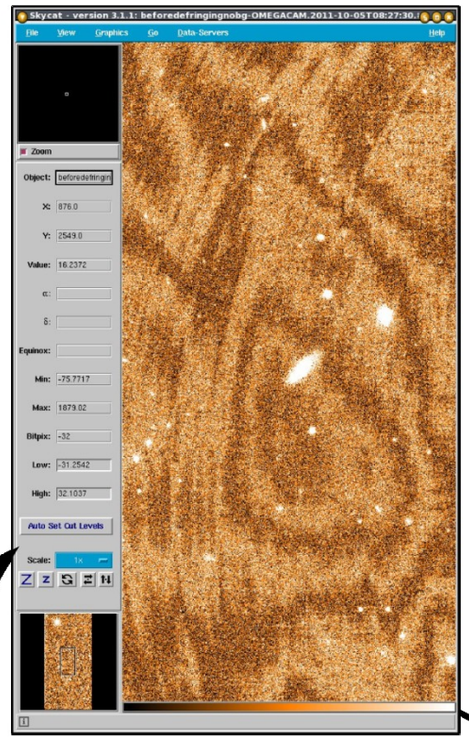
3) Fringe Subtraction

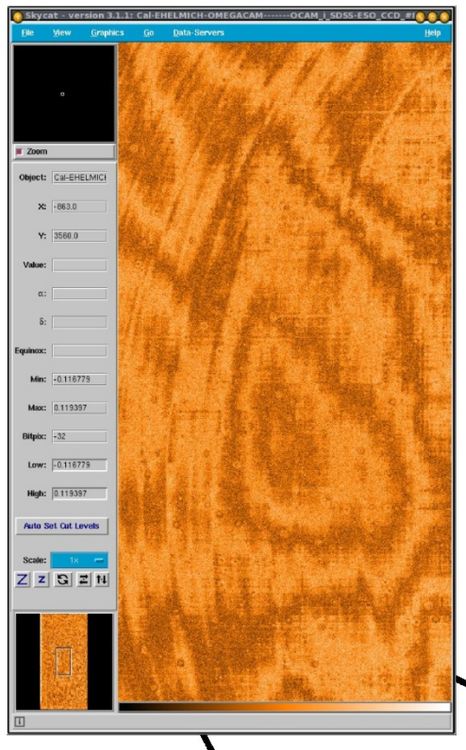
Background Subtracted

Nightly Fringe Frame

Debiased and Flatfielded Science Frame

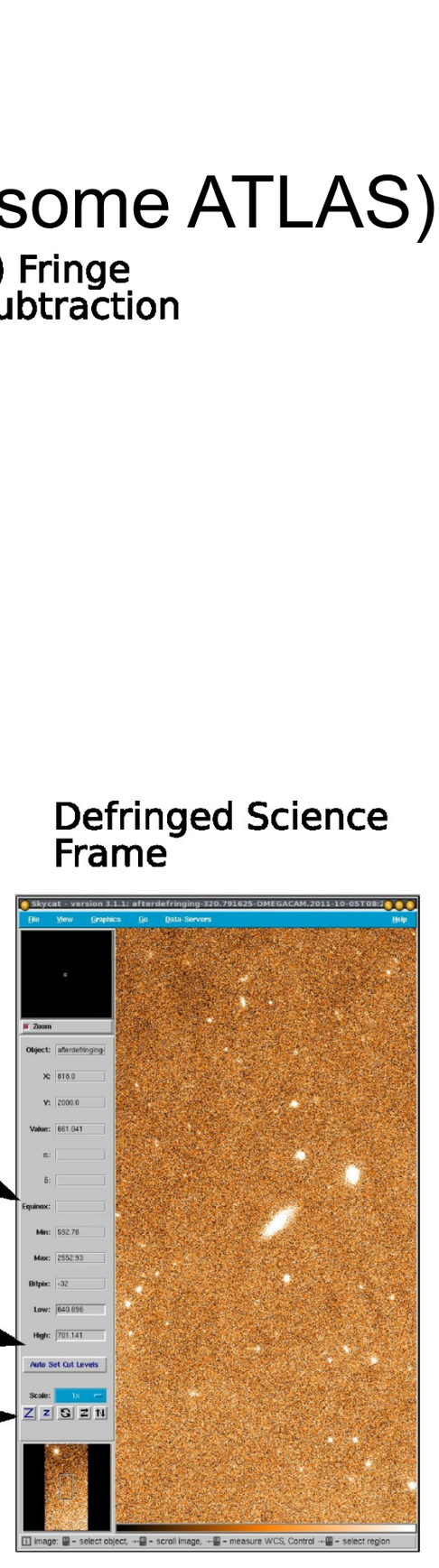






λ: Scale Factor

Defringed Science Frame



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Persistence

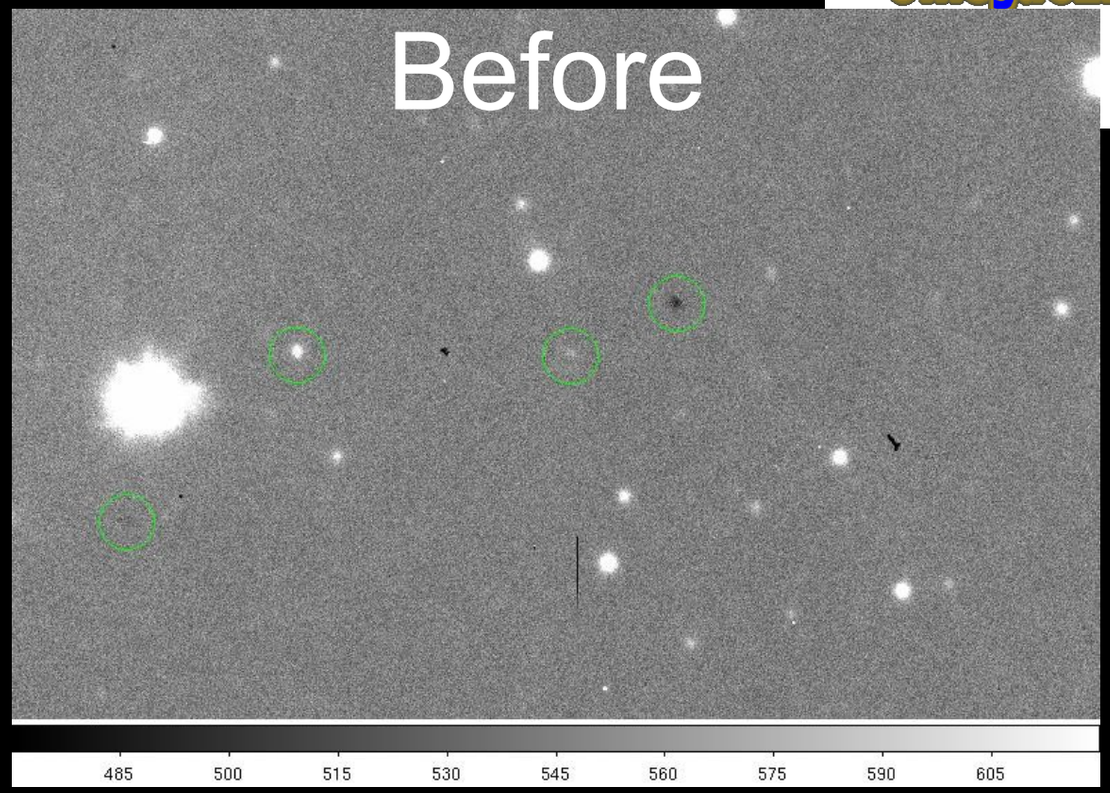
- Commissioning: not detected
- KiDS survey: not detected

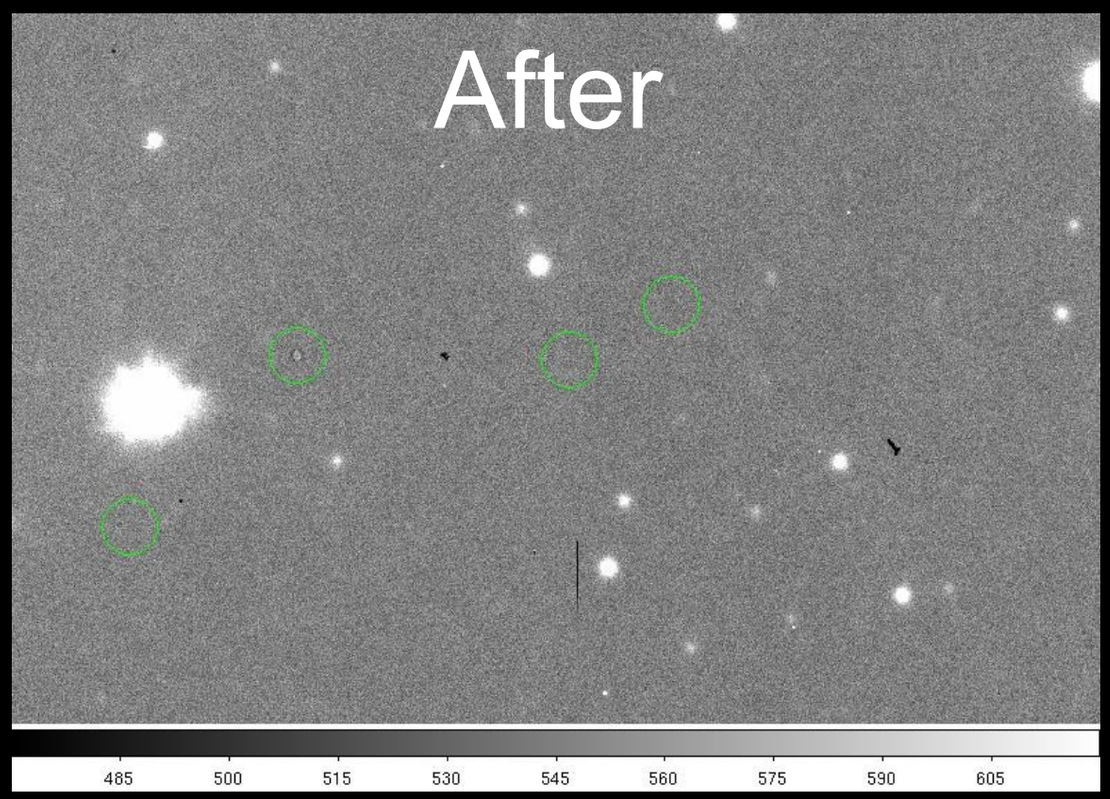
Cross-talk

Cross-talk from non-saturated pixels		
Target CCD	Source CCD	Type
#96	#94	Positive
#96	#95	Negative
Correction algorithm developed, to be fine-tuned		

- Also occurences of cross-talk from saturated pixels within CCDs #93 - #96

To be implemented in KiDS pipeline

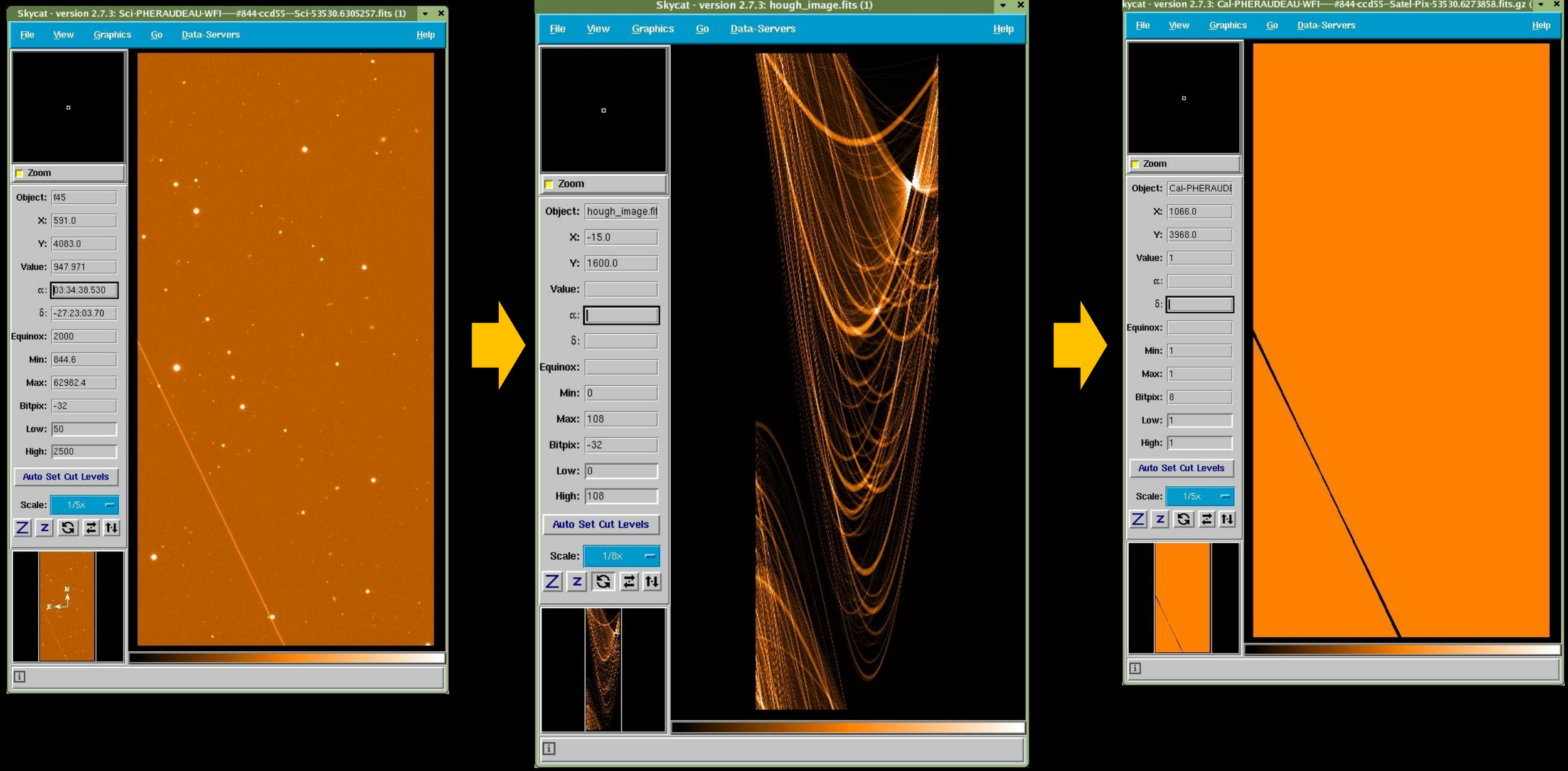




KiDS

Satellite maps

Hough transform



Bit more fine-tuning needed for KiDS

KiDS

Background subtraction

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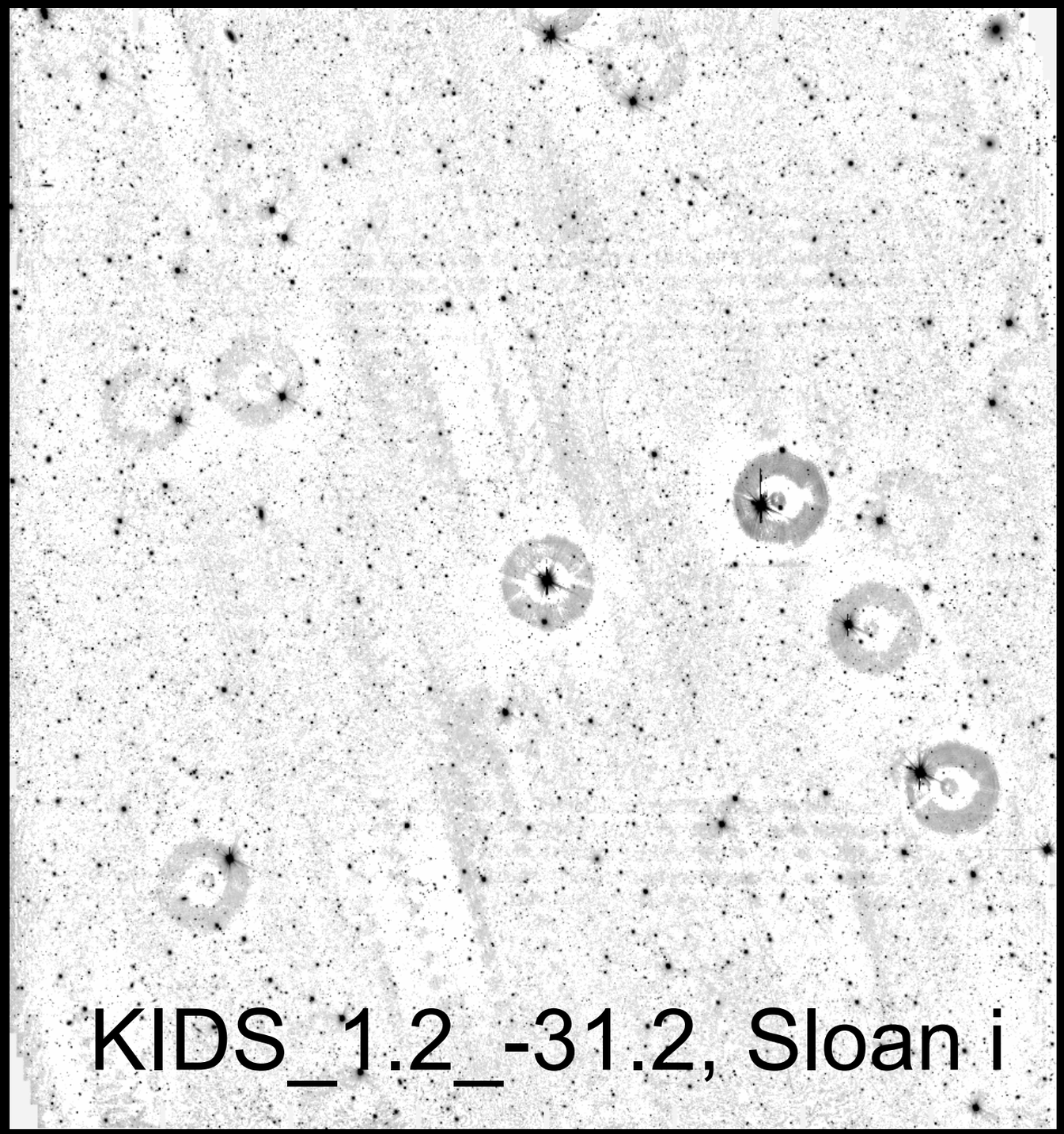
- Subtraction after regridding, before coadding.
- Two methods in pipeline:
  - deep fields: background by SWARP (default for KiDS)
  - Crowded fields: Sextractor with segmentation-image (a la Erben et al 2005, used for NGC 253)

KiDS

Background subtraction:

few cases: challenge in bright-time i



KIDS_1.2_-31.2, Sloan i

KiDS

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B.
KiDS survey products

KiDS

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See presentation by Jelte de Jong

KiDS

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C.
Test data set

NGC253

KiDS

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OB.name	OB.start	template.start	#coadds	EXPTIME (sec,total)	coadd quality (1=ok)	Comments Coadd	Comments OBd	QWISE link for coadd
NGC253_u_n1	2011-08-30 05:01:46	2011-08-30 05:07:43	1	3108.0	TBD	[]	[]	coadd NGC253_u_n1
NGC253_u_n2	2011-08-31 04:53:15	2011-08-31 04:58:38	1	3108.0	TBD	[]	[]	coadd NGC253_u_n2
NGC253_u_n3	2011-08-31 07:19:42	2011-08-31 07:25:10	1	3108.0	TBD	[]	[]	coadd NGC253_u_n3
NGC253_u_n5	2011-09-01 07:50:19	2011-09-01 07:58:29	1	3108.0	TBD	[]	[]	coadd NGC253_u_n5
NGC253_u_n7	2011-09-02 04:52:57	2011-09-02 04:57:39	1	3108.0	TBD	[]	[]	coadd NGC253_u_n7
NGC253_u_n8	2011-09-02 08:29:20	2011-09-02 08:41:15	1	3108.0	TBD	['coaddQuickLook: (Residual) satellite track']	[]	coadd NGC253_u_n8
NGC253_u_n9	2011-09-03 04:06:29	2011-09-03 04:12:37	1	3108.0	TBD	[]	[]	coadd NGC253_u_n9
NGC253_u_n6	2011-09-03 07:01:22	2011-09-03 07:06:54	1	3108.0	TBD	[]	[]	coadd NGC253_u_n6
NGC253_u_n10	2011-09-04 07:31:46	2011-09-04 07:36:59	1	3108.0	TBD	[]	[]	coadd NGC253_u_n10
NGC253_u_n11	2011-09-04 08:33:42	2011-09-04 08:42:40	1	3108.0	TBD	[]	[]	coadd NGC253_u_n11
NGC253_u_n12	2011-09-04 09:41:42	2011-09-04 09:46:12	1	900.0	TBD	[]	[]	coadd NGC253_u_n12

OB.name	OB.start	template.start	#coadds	EXPTIME (sec,total)	coadd quality (1=ok)	Comments Coadd	Comments OBd	QWISE link for coadd
NGC253_g_n1	2011-08-30 04:35:37	2011-08-30 04:43:03	1	900.0	TBD	[]	[]	coadd NGC253_g_n1
NGC253_g_n2	2011-08-30 08:12:20	2011-08-30 08:20:21	1	1200.0	TBD	[]	[]	coadd NGC253_g_n2

OB.name	OB.start	template.start	#coadds	EXPTIME (sec,total)	coadd quality (1=ok)	Comments Coadd	Comments OBd	QWISE link for coadd
NGC253_rband_n1	2011-08-31 03:50:33	2011-08-31 03:56:55	1	900.0	TBD	[]	[]	coadd NGC253_rband_n1
NGC253_rband_n1	2011-08-31 04:24:25	2011-08-31 04:32:32	1	900.0	TBD	[]	[]	coadd NGC253_rband_n1
NGC253_rband_n2	2011-09-02 02:51:42	2011-09-02 02:58:15	1	900.0	TBD	[]	[]	coadd NGC253_rband_n2
NGC253_rband_n3	2011-09-04 04:23:31	2011-09-04 04:37:25	1	900.0	TBD	[]	[]	coadd NGC253_rband_n3

OB.name	OB.start	template.start	#coadds	EXPTIME (sec,total)	coadd quality (1=ok)	Comments Coadd	Comments OBd	QWISE link for coadd
NGC253_i_n1	2011-09-03 03:29:30	2011-09-03 03:36:52	1	1500.0	TBD	[]	[]	coadd NGC253_i_n1

OB.name	OB.start	template.start	#coadds	EXPTIME (sec,total)	coadd quality (1=ok)	Comments Coadd	Comments OBd	QWISE link for coadd
NGC253_Ha_n1	2011-08-30 08:45:11	2011-08-30 08:51:22	1	3000.0	TBD	[]	[]	coadd NGC253_Ha_n1
NGC253_Ha_n2	2011-08-31 09:32:11	2011-08-31 09:35:47	1	1250.0	TBD	[]	[]	coadd NGC253_Ha_n2
NGC253_Ha_twi	2011-09-03 09:09:14	2011-09-03 09:16:59	1	1750.0	TBD	[]	[]	coadd NGC253_Ha_twi

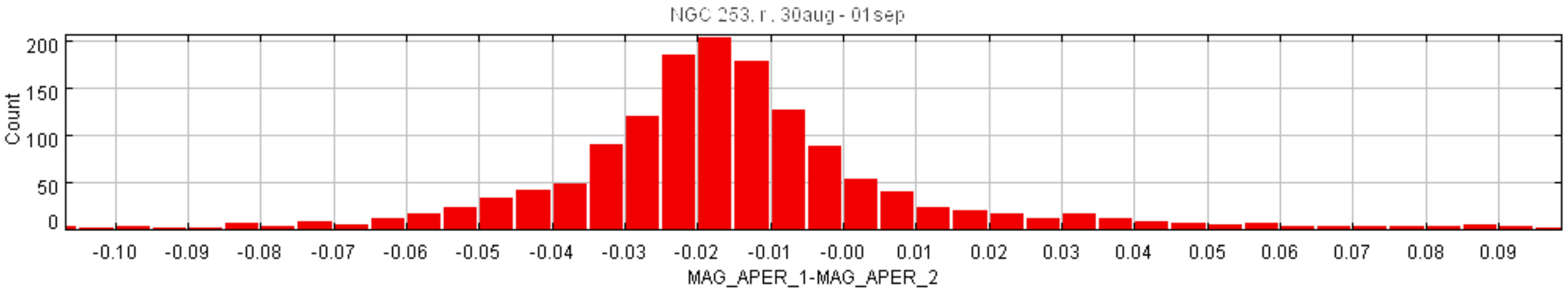
NGC 253

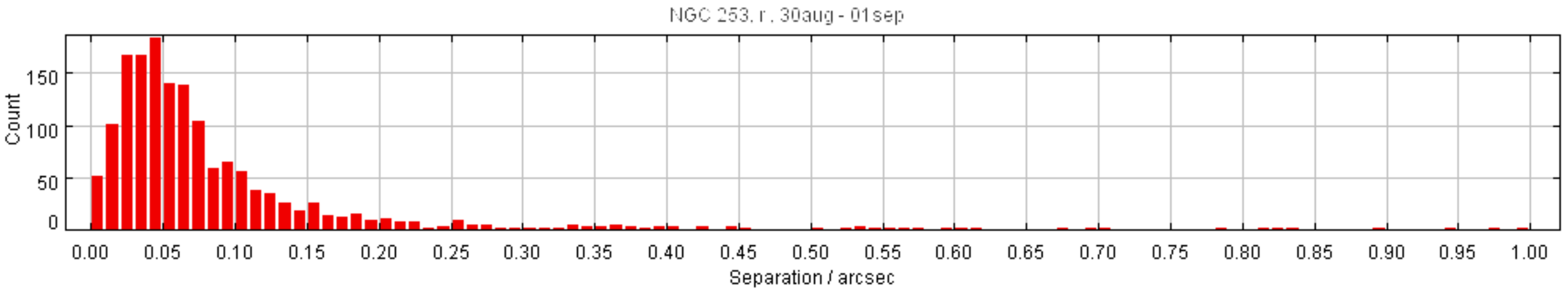
- Coadds and catalogs per O
- KiDS pipeline adjustments
  - Background subtraction
  - Fixed preliminary Halpha ZPT

- Relevance for KiDS minimal
  - Repeatability in u,r, (g): astrom, photom

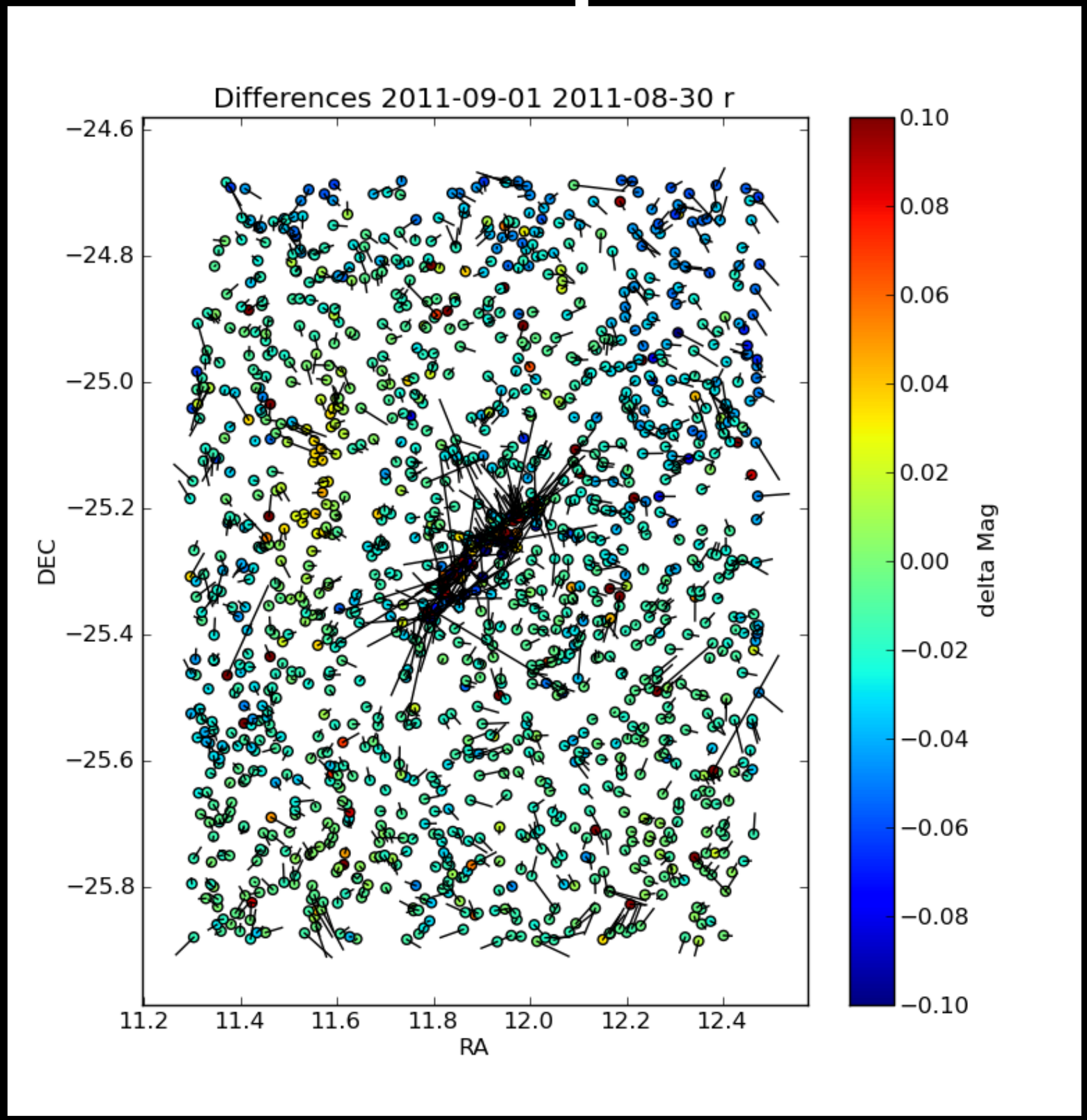
NGC253 repeatability

14< Sloan r <19





NGC253 repeatability



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NGC253 repeatability