CASU processing for VST

VST ⟵ V-ST-

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- experience from near-infrared processing for
  - all WFCAM & VISTA data
- optical mosaic camera processing experience
  - MegaCam, Subaru, INT WFC, ESO WFI .....

OmegaCAM

fov 1 deg x 1 deg

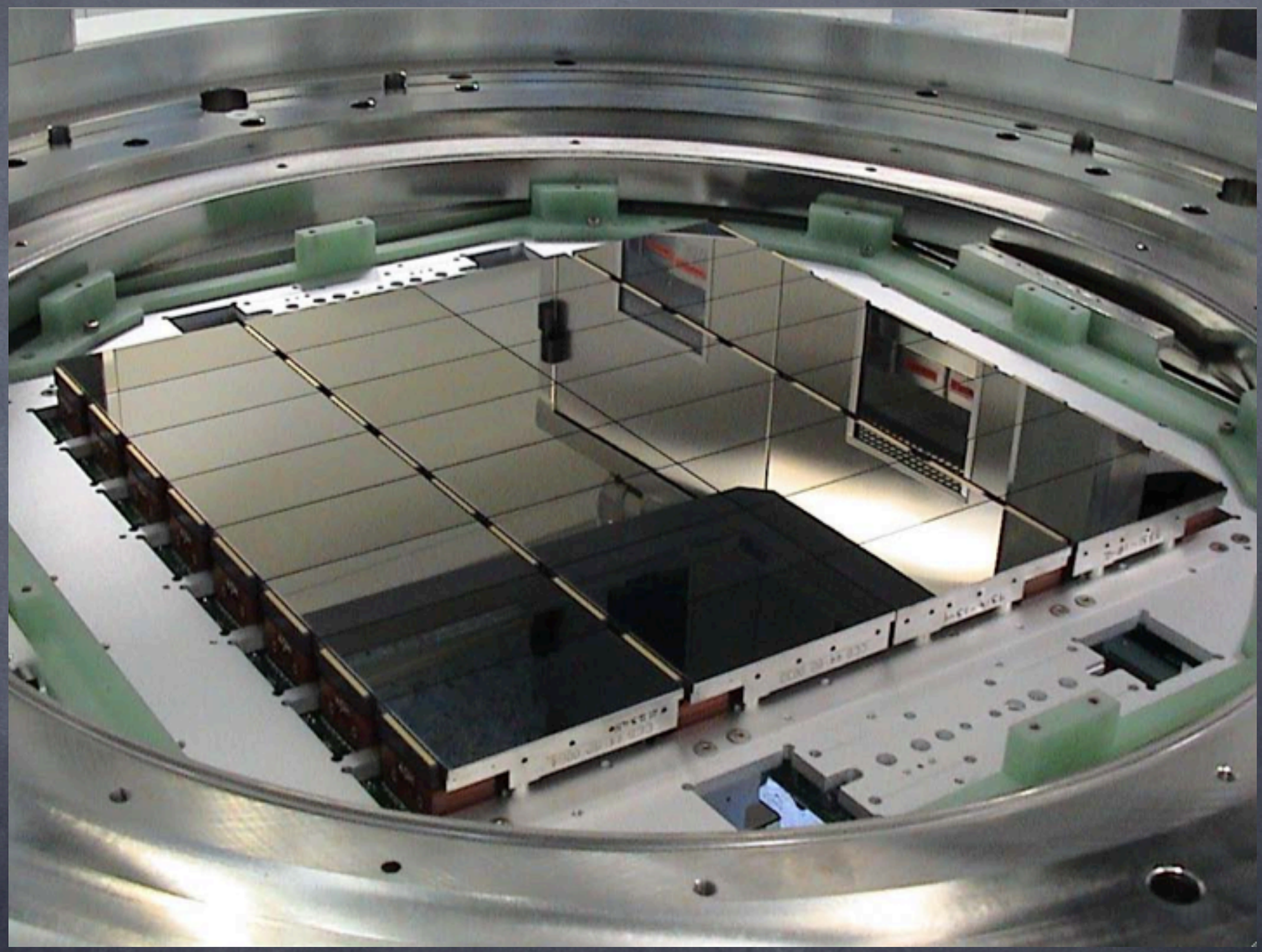
32 CCD mosaic
2k x 4k e2v 44-82
256 Mpixels

0.21 arcsec sampling

co-planar to +/-20um

r/o time 30s

2 x 6 filter stack
changes 30s - 2min



VST data flow

- raw data transfers
  - how ? Rice-compressed MEFs ? 16-bit ?
- ingest & verification -> raw data archive
- off-line tape backups
- update calibration files as necessary
- parallel nightly processing
  -> astrometric & photometric calibration
- band-merged science products
- check derived QC info & sample of images
- processing web page updates
- ingest to post-processing database enables checks:- FITS header contents, file size, provenance and calibration files, exploration of long-term trends, survey progress, data access http://casu.ast.cam.ac.uk/vistasp/imgquery/search

Cambridge Astronomical Survey Unit

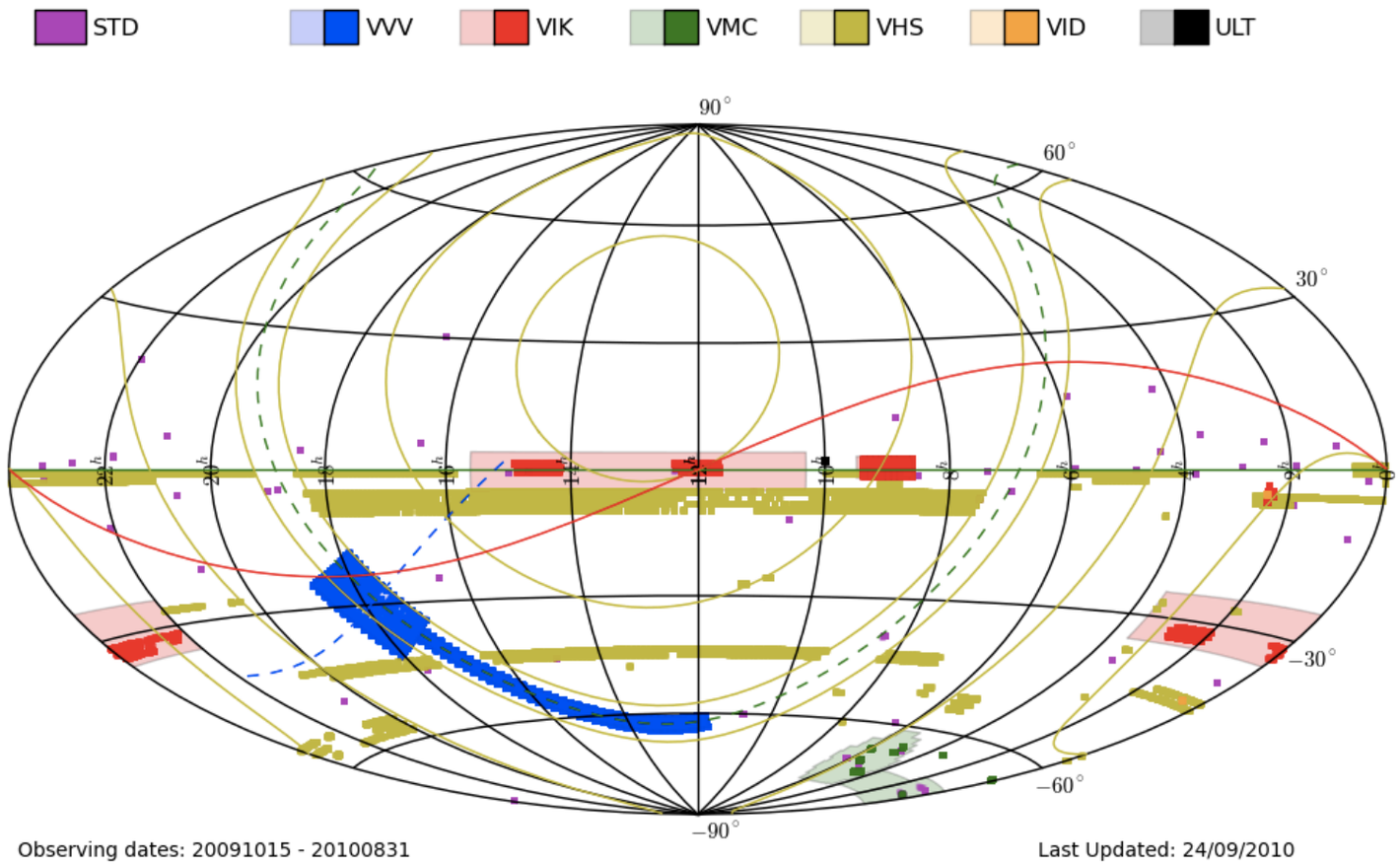
VISTA DATA REDUCTION PROGRESS: COMMISSIONING

This page displays the reduction progress of VISTA data. Information is automatically updated hourly.

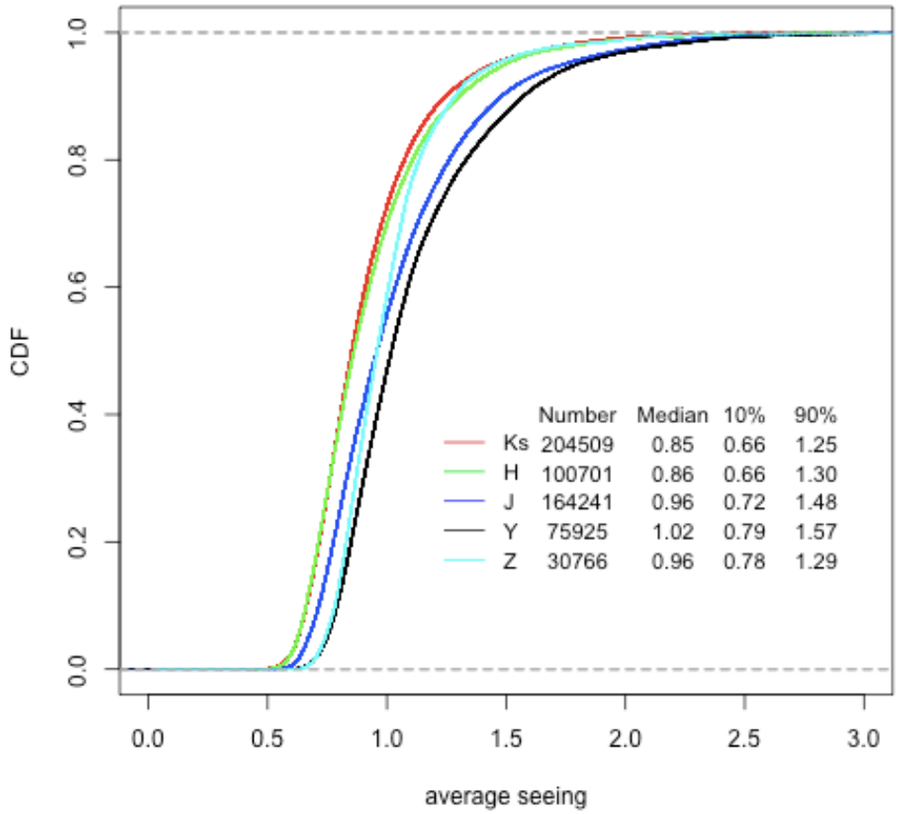
Night	Status	N_{raw}	Version	Summary Plots	Photometry Plots	Summary Info	Observation Log	Paranal ambient conditions	Size raw [Gb]	Size red [Gb]
2009/10/15	REDUCED	363		GIF1 GIF2	GIF	summary	obs_log	nightmon	23.86	43.78
2009/10/16	REDUCED	341		GIF1 GIF2	GIF	summary	obs_log	nightmon	25.53	137.65
2009/10/17	REDUCED	470		GIF1 GIF2	GIF	summary	obs_log	nightmon	33.61	183.47
2009/10/18	REDUCED	398		GIF1 GIF2	GIF	summary	obs_log	nightmon	29.51	154.95
2009/10/19	REDUCED	505		GIF1 GIF2	GIF	summary	obs_log	nightmon	35.24	184.86
2009/10/20	REDUCED	401		GIF1 GIF2	GIF	summary	obs_log	nightmon	29.76	192.84
2009/10/21	Reduction status	448		GIF1 GIF2	GIF	summary	obs_log	nightmon	32.11	179.83
2009/10/22	REDUCED	476		GIF1 GIF2	GIF	summary	obs_log	nightmon	36.66	204.01
2009/10/23	REDUCED	589		GIF1 GIF2	GIF	summary	obs_log	nightmon	42.97	266.31
2009/10/24	REDUCED	434		GIF1 GIF2	GIF	summary	obs_log	nightmon	30.17	131.61
2009/10/25	REDUCED	454		GIF1 GIF2	GIF	summary	obs_log	nightmon	34.09	191.42
2009/10/26	REDUCED	454		GIF1 GIF2	GIF	summary	obs_log	nightmon	33.89	192.52
2009/10/27	REDUCED	492		GIF1 GIF2	GIF	summary	obs_log	nightmon	35.20	198.65
2009/10/28	UNPROCESSED	15					obs_log	nightmon	0.92	
2009/10/29	REDUCED	435		GIF1 GIF2	GIF	summary	obs_log	nightmon	33.04	191.13
2009/10/30	UNPROCESSED	46					obs_log	nightmon	2.64	
2009/10/31	UNPROCESSED	100					obs_log	nightmon	4.91	
2009/11/01	UNPROCESSED	15					obs_log	nightmon	0.85	
2009/11/02	REDUCED	340		GIF1 GIF2	GIF	summary	obs_log	nightmon	25.31	102.82
2009/11/03	REDUCED	599		GIF1 GIF2	GIF	summary	obs_log	nightmon	47.72	249.12
2009/11/04	REDUCED	656		GIF1 GIF2	GIF	summary	obs_log	nightmon	53.90	205.86

Table description :

- **N_{raw}**: total number of raw images for the given night (this includes darks, flats, focus runs etc.).

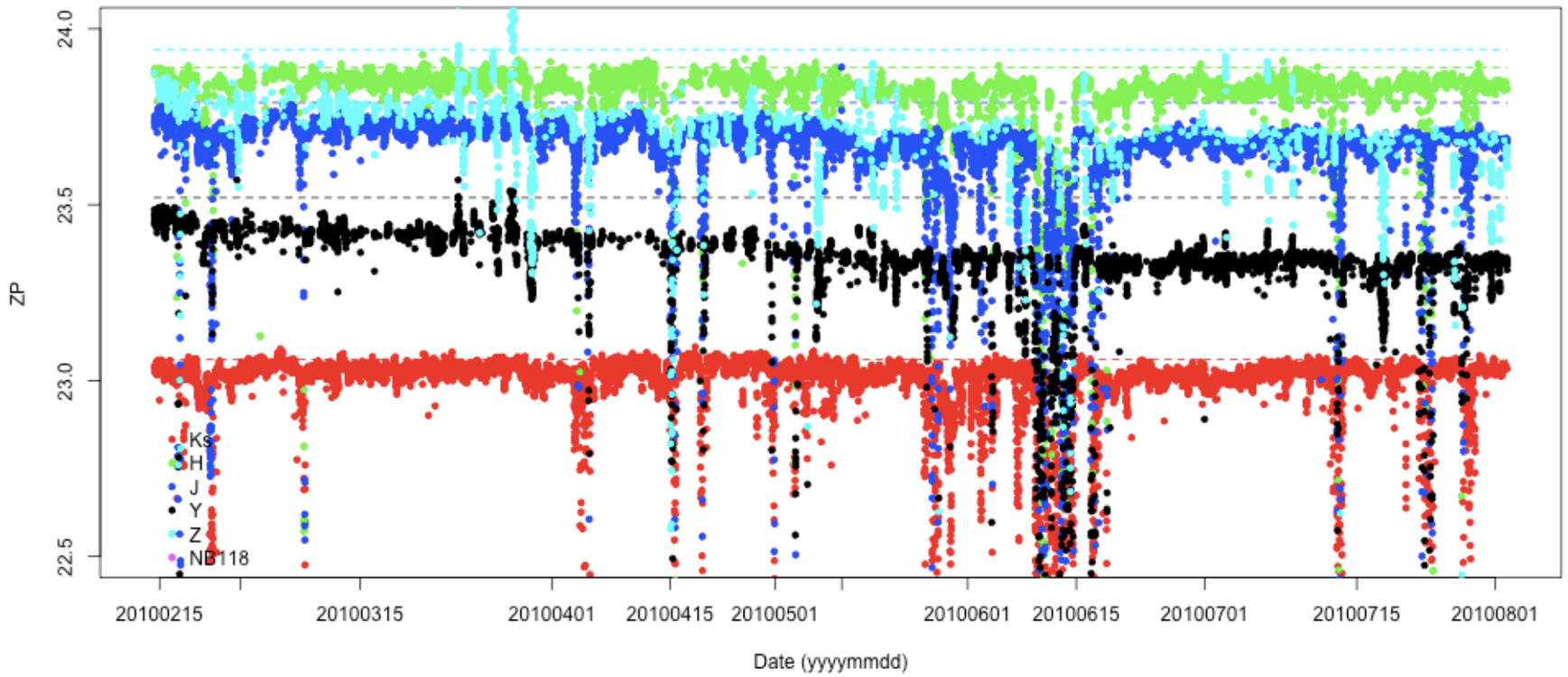


Survey progress overview



QC plots summarise:

astrometry; seeing; stellar ellipticity; sky brightness; magnitude zero-point trends



Monitoring sky surface brightness

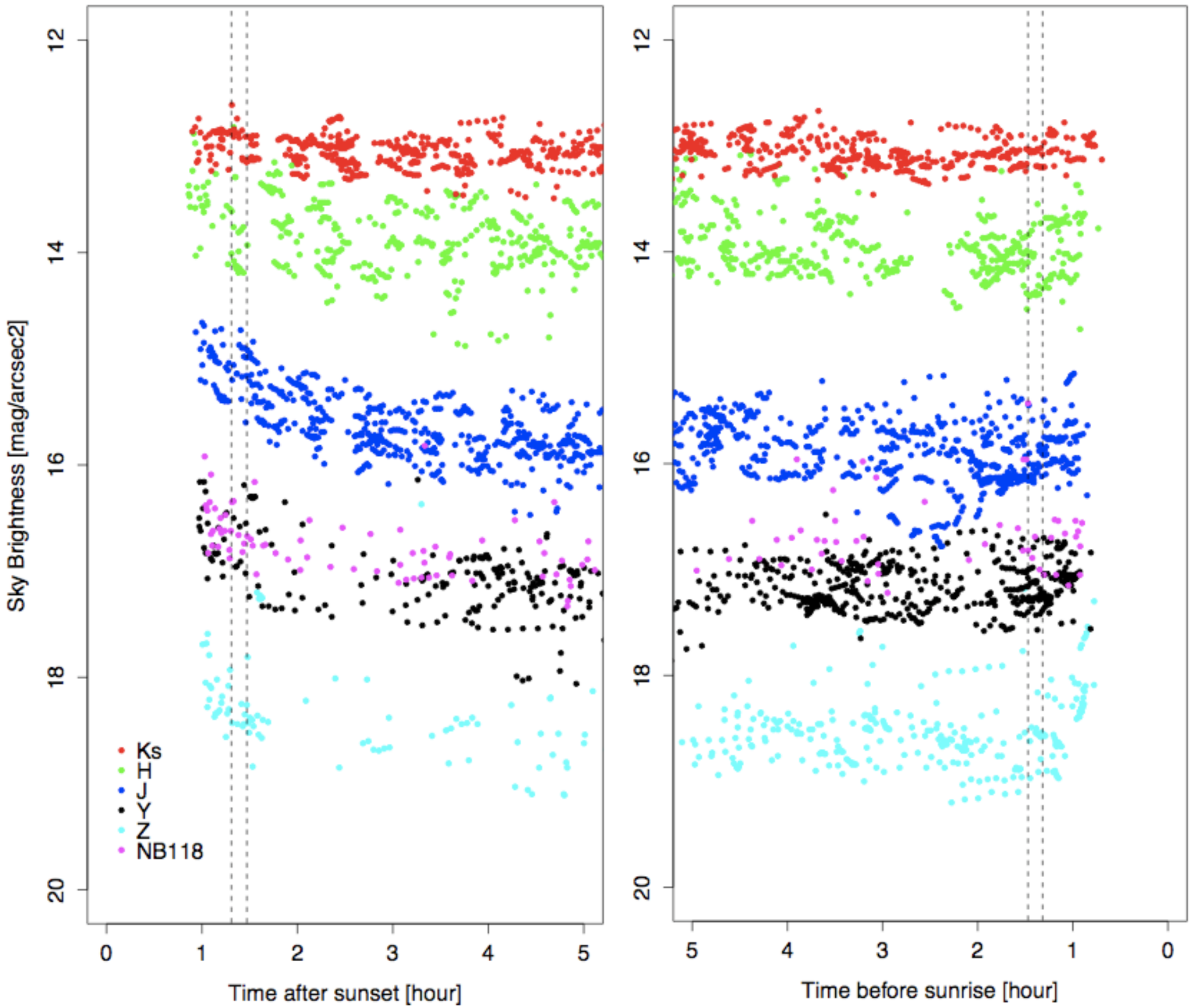
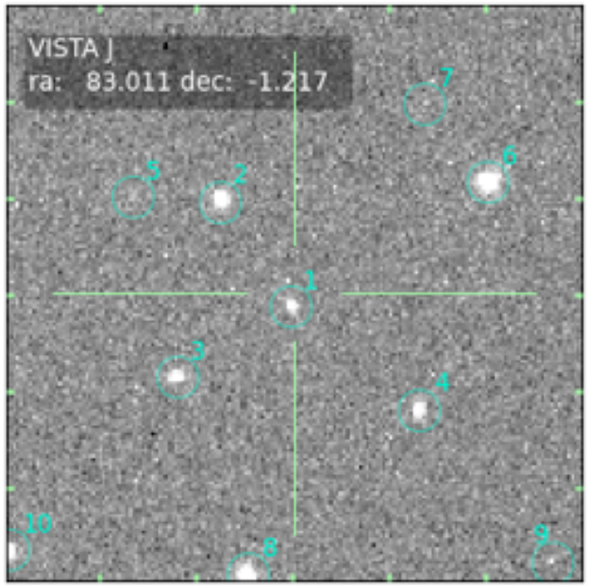


Image search, preview & download

[?]	Filename	Chip	Object	Coordinates	Band	UTC	Airmass	Exp time	Seeing	Ellipt	ZP	APcor	Maglim	WCS rms	Prog	OB Status	Version
H P C +	v20100508_00087 [S]	F	No name	09:17:28.96 +02:19:42.92	J	01:11:23	1.368	100	1.06 1.09 1.20	0.04 0.07 0.08	23.70 (0.02)	0.44 0.45 0.47	19.76 20.04 20.14	0.07 0.09 0.13	VIKING	Completed (B)	1.0
H P +	v20100508_00087 [T]	F	No name	09:17:50.90 +02:25:10.77	J	01:11:23	1.368	100	1.06 1.06 1.06	0.10 0.10 0.10	23.70 (0.01)	0.40 0.40 0.40	20.36 20.36 20.36	0.09 0.09 0.09	VIKING	Completed (B)	1.0
H P C +	v20100508_00089 [S]	F	No name	09:17:28.84 +02:25:09.58	J	01:13:34	1.379	100	0.95 1.00 1.06	0.07 0.12 0.13	23.71 (0.02)	0.40 0.41 0.43	19.86 20.10 20.22	0.08 0.09 0.12	VIKING	Completed (B)	1.0
H P C +	v20100508_00091 [S]	F	No name	09:17:28.84 +02:30:39.18	J	01:15:36	1.389	100	0.99 1.01 1.09	0.08 0.10 0.12	23.71 (0.01)	0.40 0.42 0.44	19.69 20.11 20.21	0.07 0.09 0.11	VIKING	Completed (B)	1.0
H P C +	v20100508_00093 [S]	F	No name	09:18:12.85 +02:30:39.43	J	01:17:44	1.395	100	0.92 0.95 1.01	0.08 0.10 0.14	23.71 (0.01)	0.36 0.38 0.39	19.95 20.14 20.22	0.09 0.10 0.14	VIKING	Completed (B)	1.0
H P C +	v20100508_00095 [S]	F	No name	09:18:12.86 +02:25:09.26	J	01:19:55	1.404	100	0.91 0.95 1.02	0.14 0.16 0.18	23.70 (0.01)	0.38 0.40 0.41	19.60 20.12 20.20	0.09 0.10 0.14	VIKING	Completed (B)	1.0
H P C +	v20100508_00097 [S]	F	No name	09:18:12.93 +02:19:42.72	J	01:22:02	1.412	100	0.85 0.92 0.97	0.08 0.11 0.14	23.70 (0.02)	0.36 0.38 0.41	19.94 20.14 20.24	0.08 0.11 0.14	VIKING	Completed (B)	1.0
H P C +	v20100508_00099 [S]	F	No name	09:17:28.95 +02:19:42.78	Ks	01:24:42	1.429	240	0.78 0.82 0.91	0.05 0.09 0.15	23.01 (0.02)	0.24 0.26 0.28	18.57 18.90 19.00	0.07 0.09 0.13	VIKING	Completed (B)	1.0
H P +	v20100508_00099 [T]	F	No name	09:17:50.89 +02:25:10.80	Ks	01:24:42	1.429	240	0.91 0.91 0.91	0.08 0.08 0.08	23.02 (0.01)	0.27 0.27 0.27	19.28 19.28 19.28	0.09 0.09 0.09	VIKING	Completed (B)	1.0
H P C +	v20100508_00103 [S]	F	No name	09:17:28.84 +02:25:09.47	Ks	01:30:01	1.458	240	0.81 0.86 0.99	0.04 0.09 0.13	23.01 (0.02)	0.26 0.28 0.31	18.73 18.91 18.99	0.08 0.10 0.14	VIKING	Completed (B)	1.0
H P C +	v20100508_00107 [S]	F	No name	09:17:28.83 +02:30:39.06	Ks	01:35:18	1.489	240	0.77 0.84 0.94	0.04 0.06 0.13	23.02 (0.02)	0.26 0.27 0.30	18.50 18.92 18.99	0.07 0.09 0.12	VIKING	Completed (B)	1.0

v20091118_00513_st.fit[13] - J



Obs date	2009-11-19 08:12:42
Airmass	1.244
Exposure Time [sec]	30.0
Average seeing [arcsec]	0.82
WCS fit rms	0.06
Ellipticity	0.07
Magnitude limit [Vega]	19.58
Programme	179.A-2010 (VHS)

Current cutout size 60 arcsec

30 arcsec | 60 arcsec | 90 arcsec | 120 arcsec

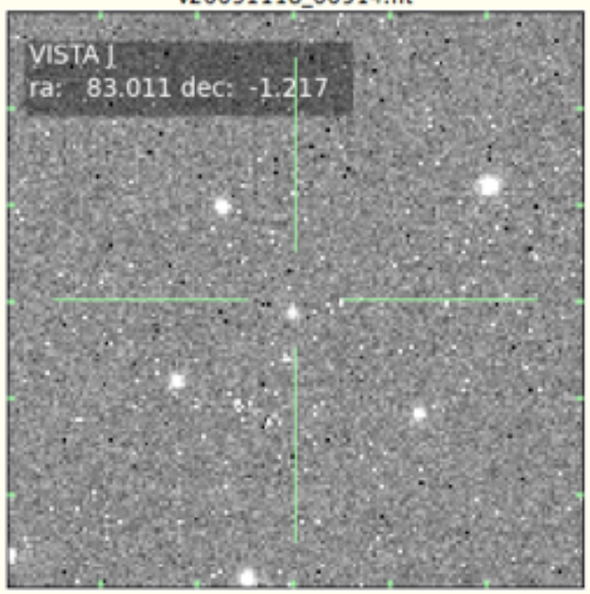
A search by position returns images that contain that position and allows preview of postage stamps, catalogue sources and postage stamps of provenance images.

ID	Coords (J2000)	Apermag3	Class	Ellipt	Pos Ang	X	Y	AvConf	ErrBit
1	05:32:02.657 -01:13:02.421	17.856 (0.047)	pointlike	0.30	25.37	1206.13	1267.14	98.9289	0.0
2	05:32:03.146 -01:12:51.545	16.824 (0.023)	pointlike	0.15	17.30	1184.65	1234.91	99.4766	0.0
3	05:32:03.443 -01:13:09.748	17.111 (0.028)	pointlike	0.13	-61.94	1171.12	1289.05	99.3135	0.0
4	05:32:01.766 -01:13:13.130	17.421 (0.034)	pointlike	0.27	-12.37	1245.47	1298.81	87.4947	0.0
5	05:32:03.749 -01:12:51.034	19.516 (0.187)	extended	0.31	24.14	1157.91	1233.5	99.2068	0.0
6	05:32:01.299 -01:12:49.468	15.921 (0.016)	pointlike	0.10	-11.59	1266.68	1228.43	100.003	0.0
7	05:32:01.724 -01:12:41.442	19.534 (0.190)	pointlike	0.18	-12.87	1247.97	1204.66	100.32	0.0
8	05:32:02.953 -01:13:30.162	16.552 (0.020)	pointlike	0.06	-40.21	1192.41	1349.63	102.121	0.0
9	05:32:04.735 -01:12:46.237	17.619 (0.039)	extended	0.15	47.49	1114.28	1219.41	98.2643	0.0
10	05:32:00.257 -01:12:49.724	19.655 (0.210)	extended	0.35	-39.78	1312.91	1229.02	98.5274	0.0

Individual Jitter Images

v20091118_00513.fit

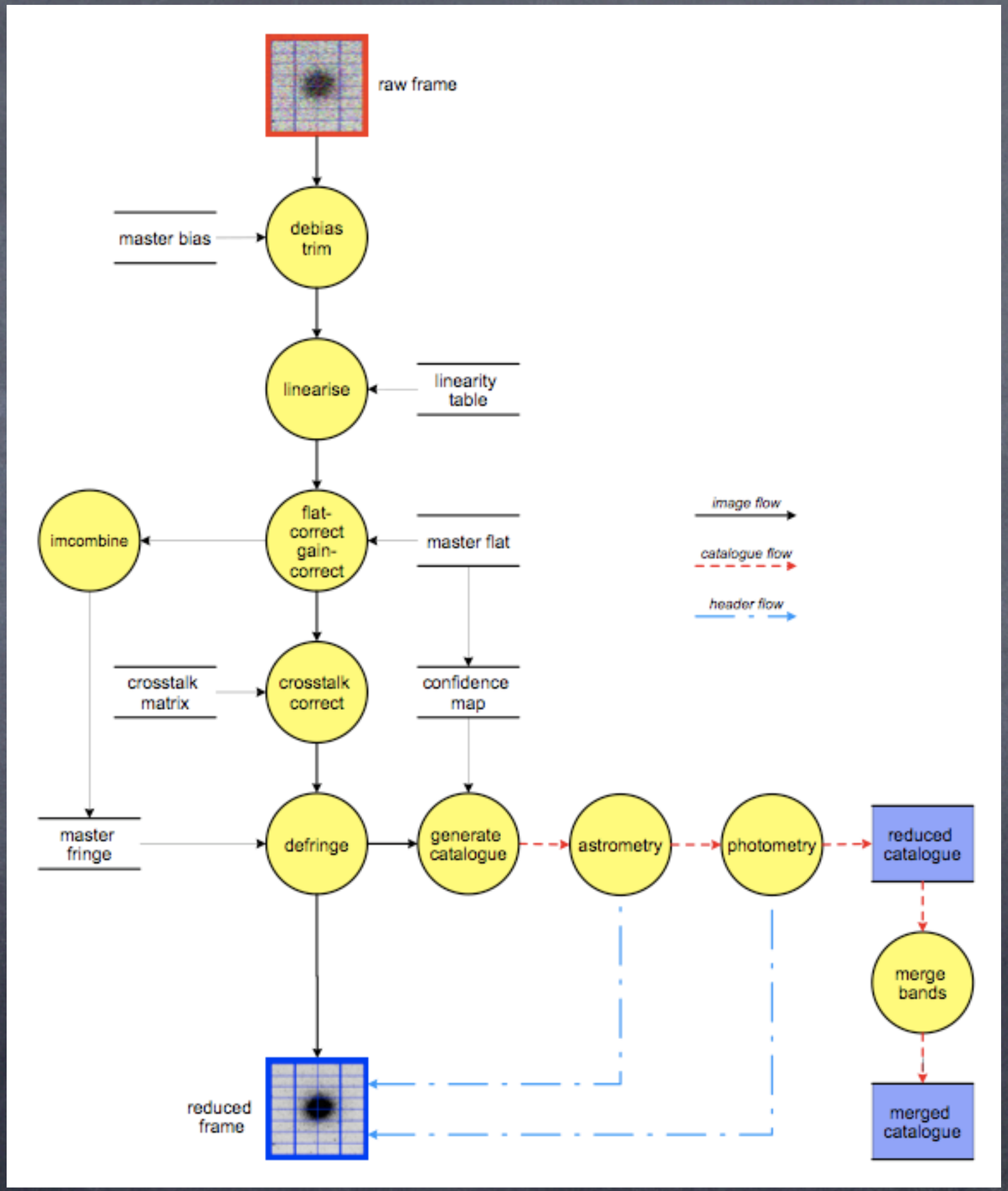
v20091118_00514.fit



CASU mantra

- MEFs as container -> simplifies bookkeeping
- use lossless Rice-compression -> (x 2-4 less space)
- FITS images and catalogue binary tables (CFITSIO)
- FITS headers record processing details
  - derived QC parameters
  - WCS astrometric calibration
  - photometric calibration
  - table/image fluxes in ADU, x,y positions
  - versioning and software details
- modular software -> C & perl/python scripts
- minimise external software dependencies

VST processing schema



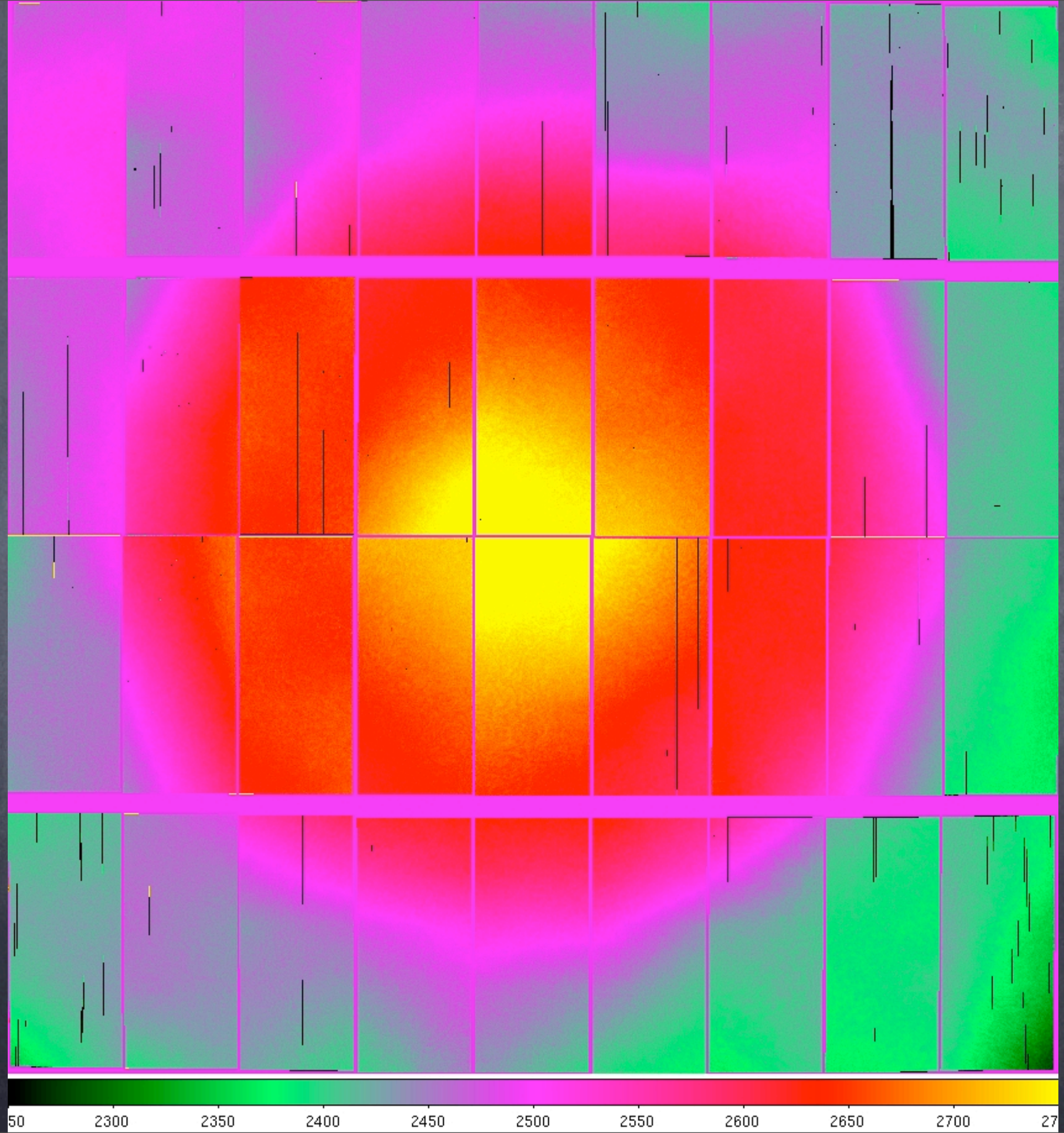
Issues/features

- strategy to deal with gaps
  - ignore; dither for deeper stacks; offset exposures
- data rate ~10% of VISTA
- non-linearity; fringing in i,z bands; charge bleeding from saturated stars -> "spikes"
- optical surfaces -> scattered light; bright star halos; -> illumination correction ?
- photometric calibration (Halpha - tie to r' ?)
- astrometric calibration effects of distortion ?
- master calibration images - update frequency ?
- hardware, software & CPU requirements
- delivery of data products to ESO

CFHT MegaCam scattered light

i-darksky 08b

36 CCD mosaic 2k x 4.5k



Astrometric Calibration from 2MASS/UCAC3

WCS - ZPN projection $\quad r' = r + k_3 r^3 + k_5 r^5 ...$

Linear solution
per detector

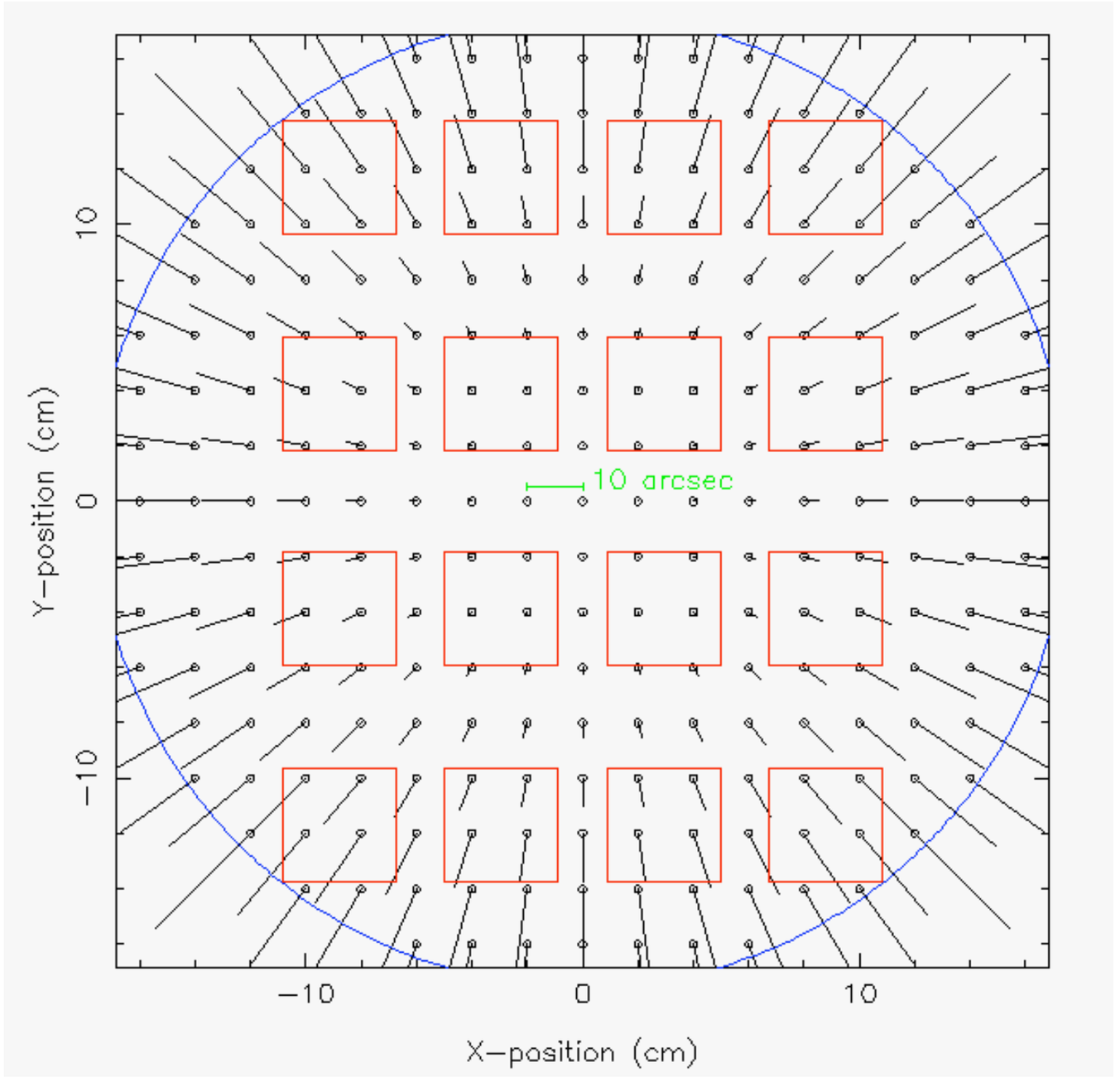
$$\xi' = ax' + by' + c$$

$$\eta' = dx' + ey' + f$$

⟶ rms < 100 mas

Tabulated
systematics
from stacked
residuals

⟶ sys < 25 mas



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$$\xi' = ax' + by' + c$$

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⟶ rms < 100 mas

Tabulated
systematics
from stacked
residuals

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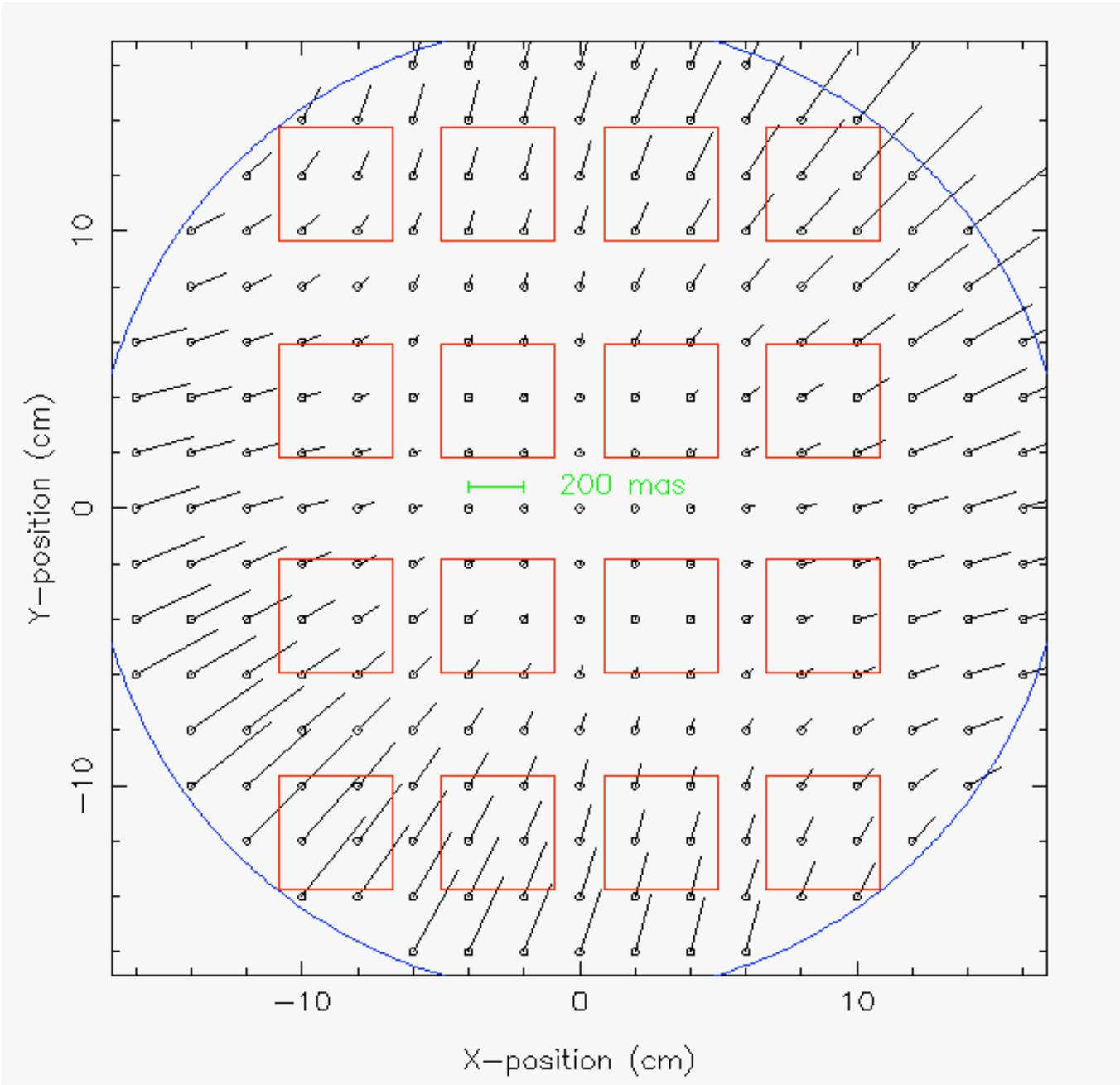


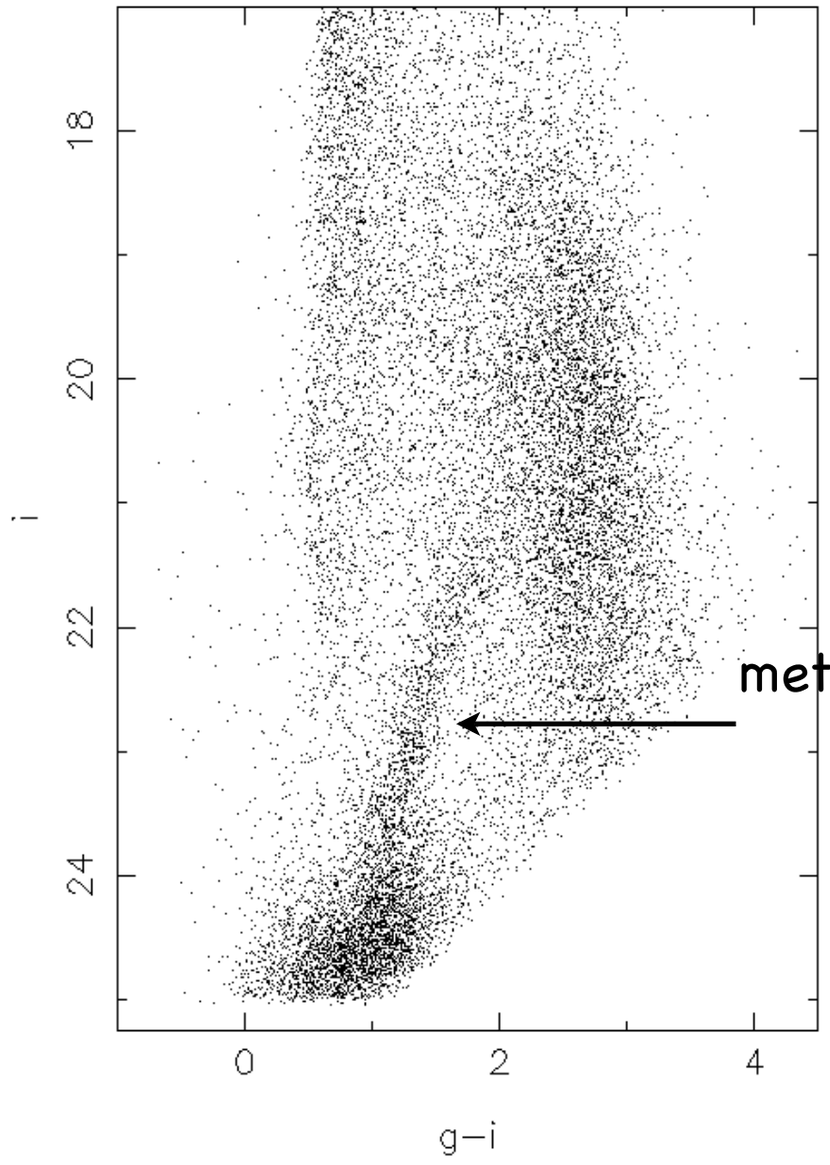
Data products

- calibrated images & catalogues for single exposures
- confidence maps (weight, exposure, bad pixels)
- QC information for each detector/exposure
- [deep stacked images, tiles and catalogues if needed]
- homogeneous band-merged catalogues
- federation with 2MASS PSC, WFCAM, VISTA .....
- database of all derived information, QC, logs .....
- assorted analysis assessment plots (CMDs), spatial distributions .....

Accurate morphological classification crucial

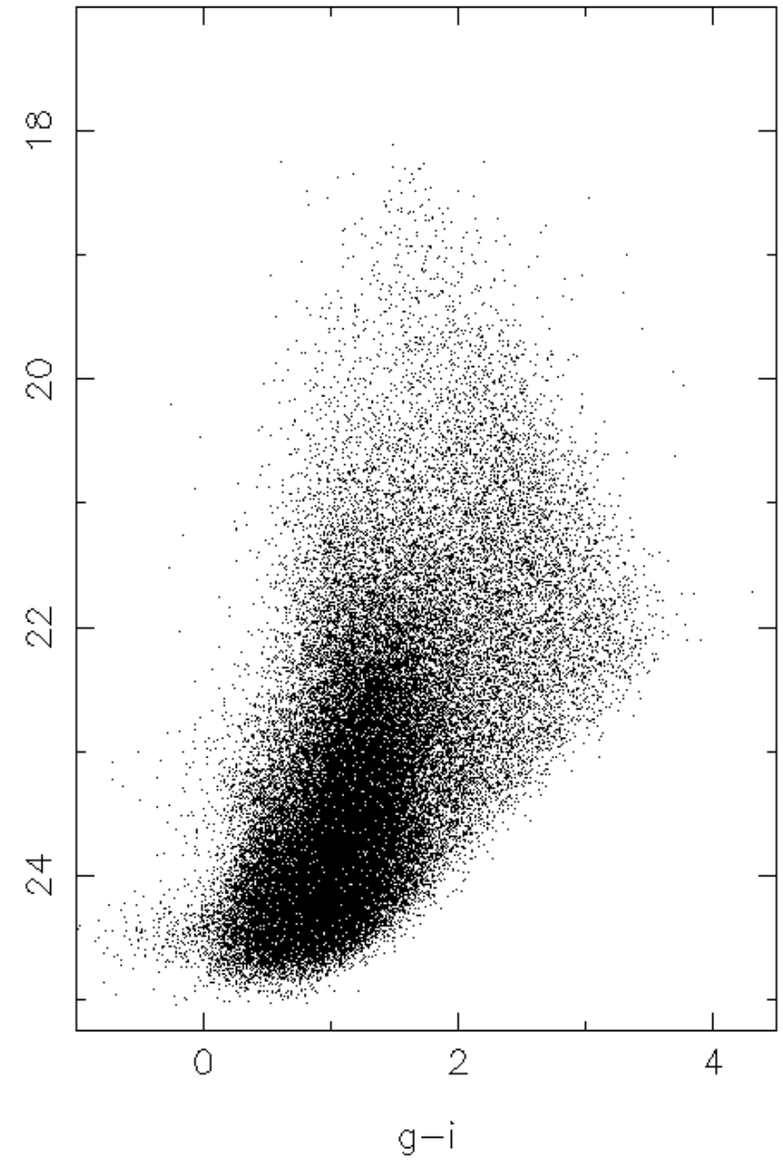
M31 halo field 100kpc W - single 1 sq deg MegaCam pointing

Stellar



metal-poor RGB

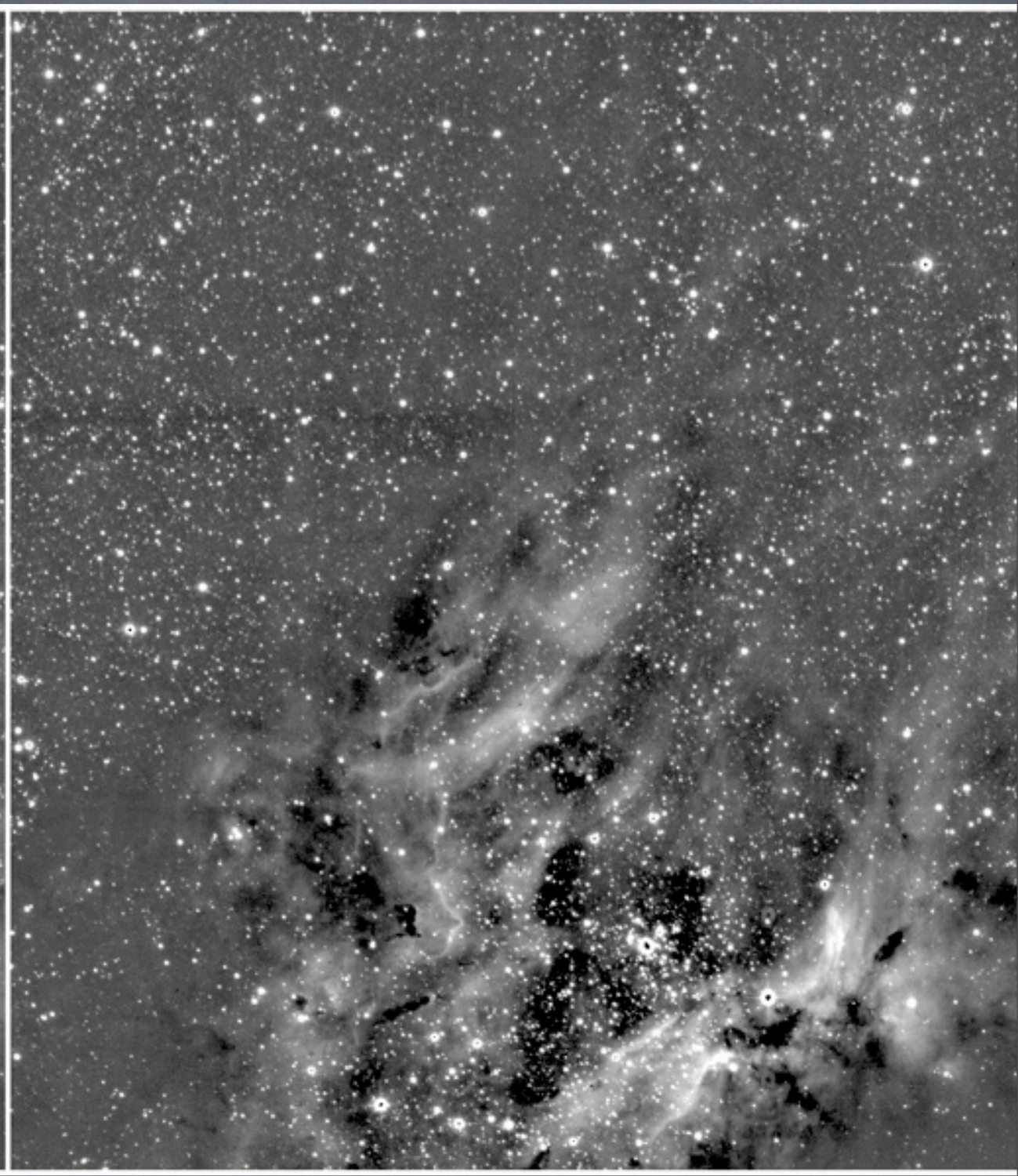
Non-stellar



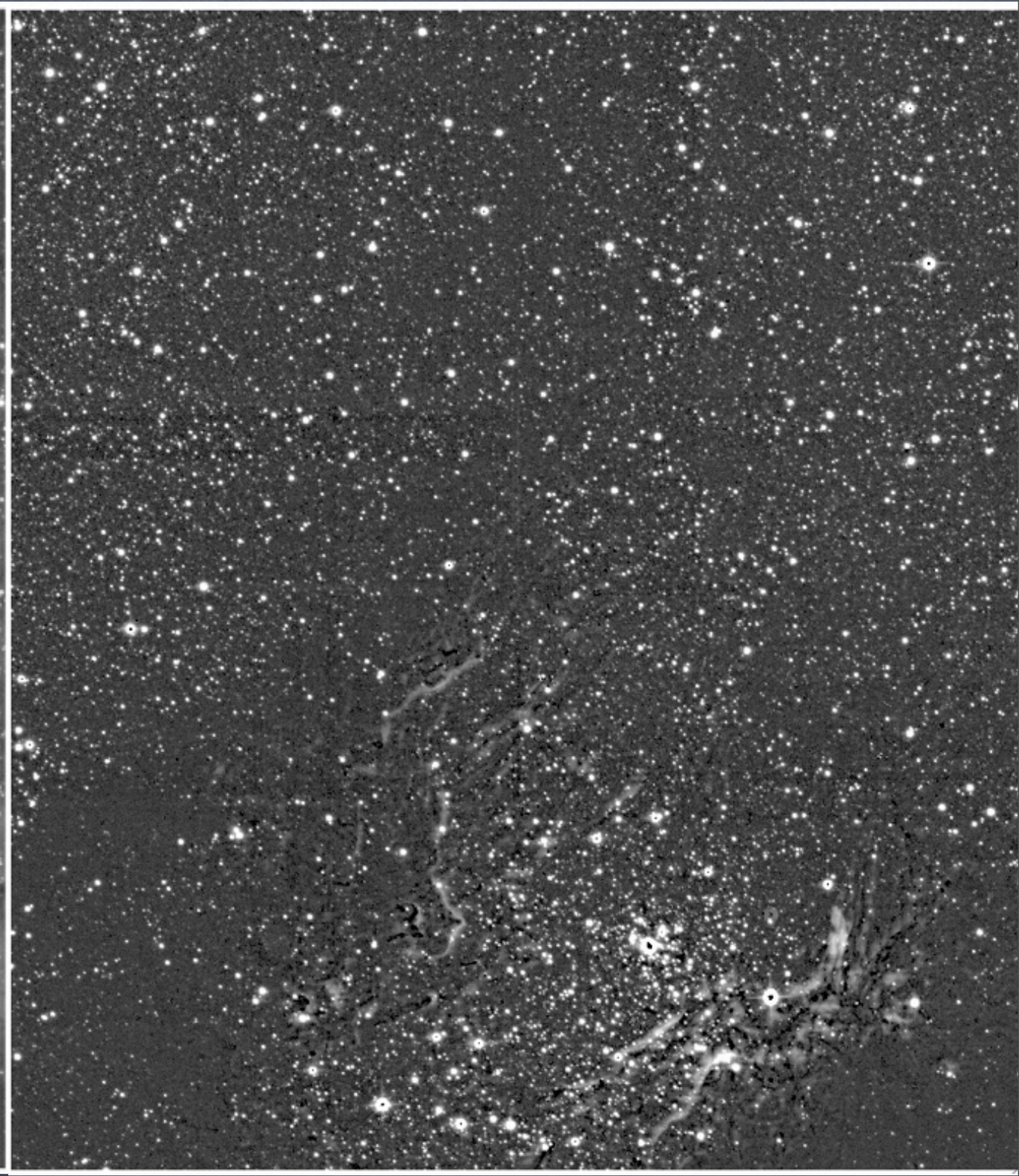
Innovative software solutions

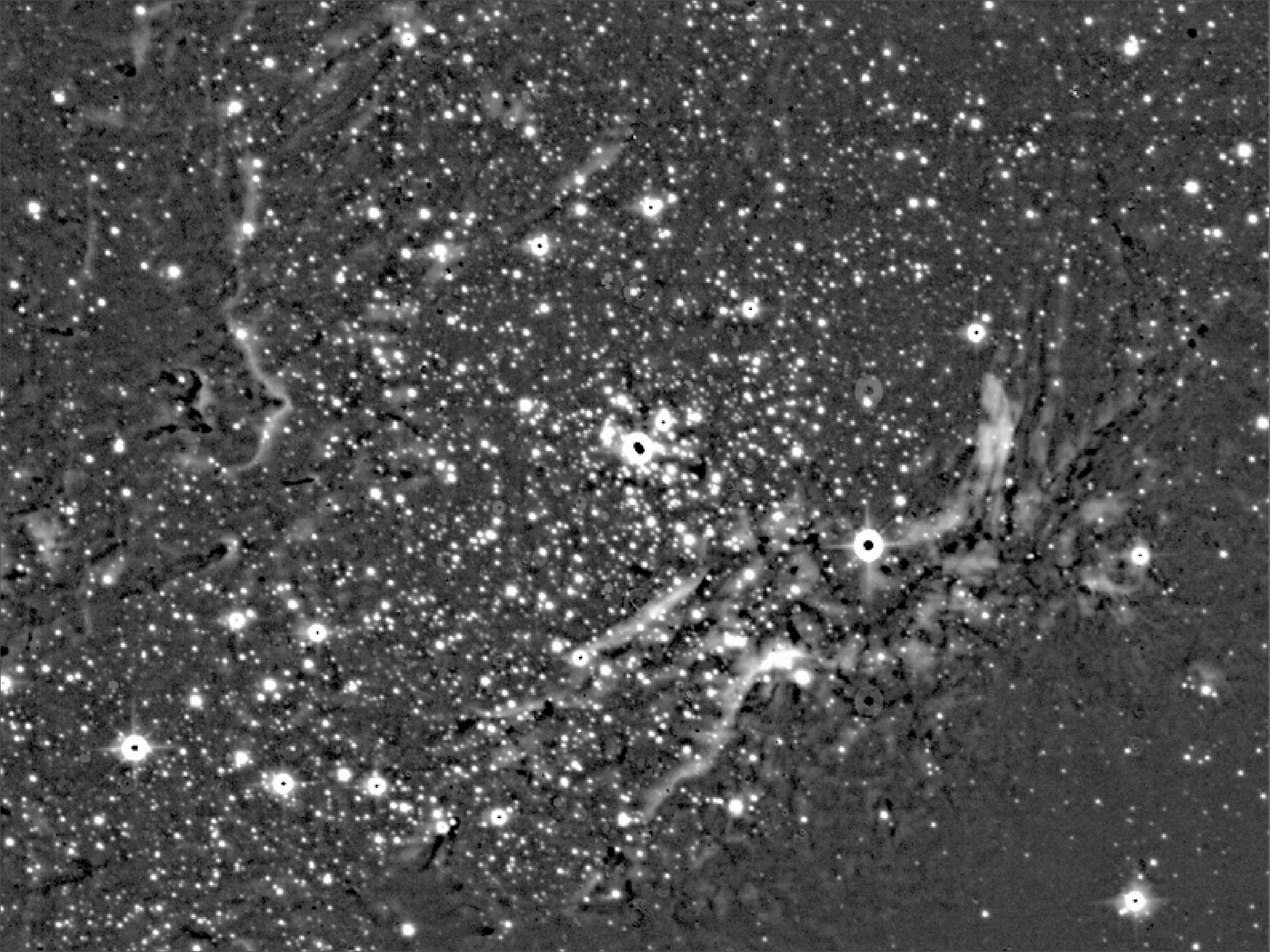
- nebuliser
  - removes complex background variations
  - enhanced object detection & parameterisation
- despiker
  - removes diffaction spikes, charge bleeding artefacts, and satuarated stellar cores
- mosaicer
  - CASU tiling software developed for VISTA
- psf'ers
  - automatically generates detector-level PSFs
  - and performs PSF photometry

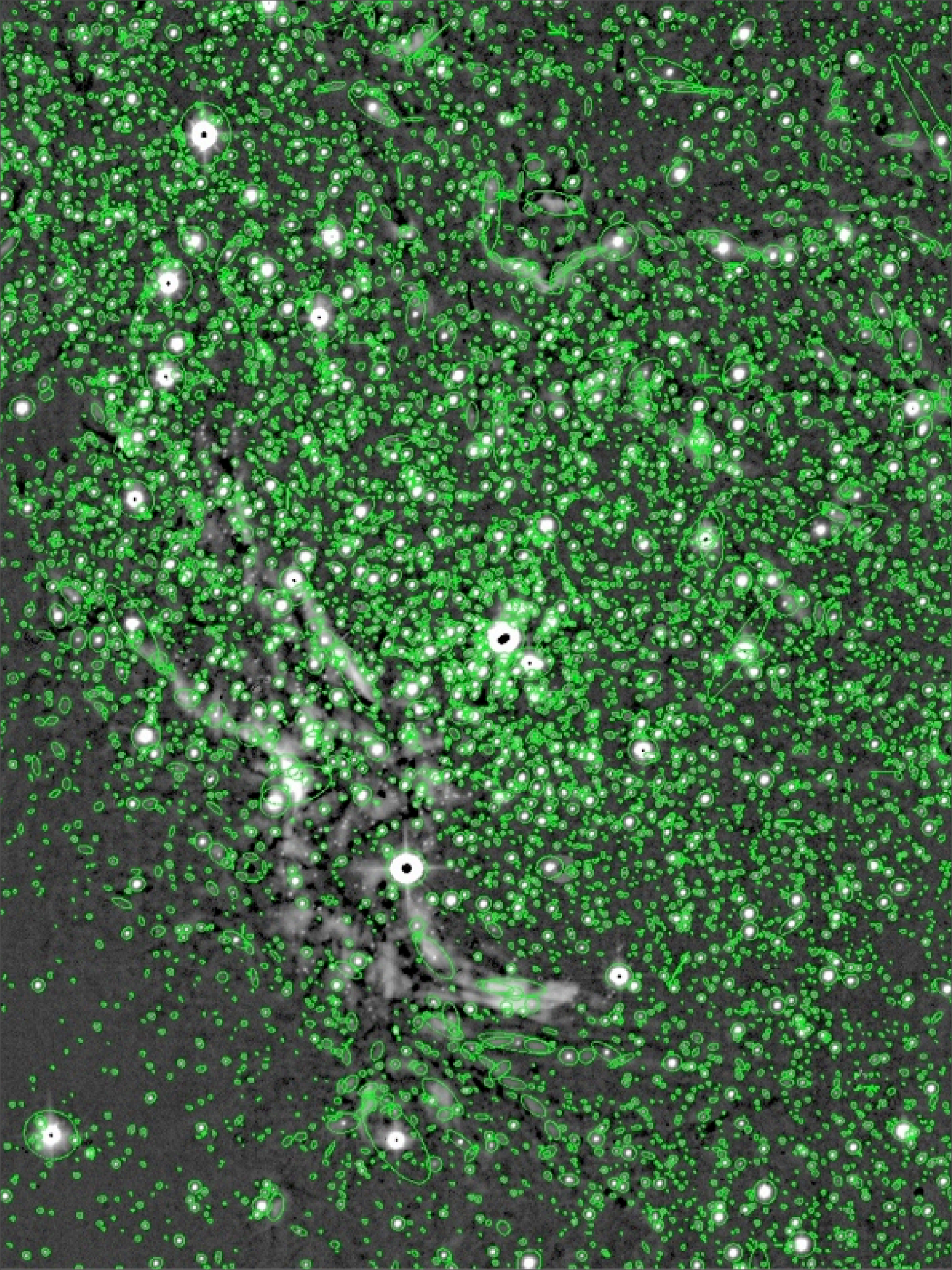
Nebuliser -> M17 K-band WFCAM



Nebuliser -> M17 K-band WFCAM

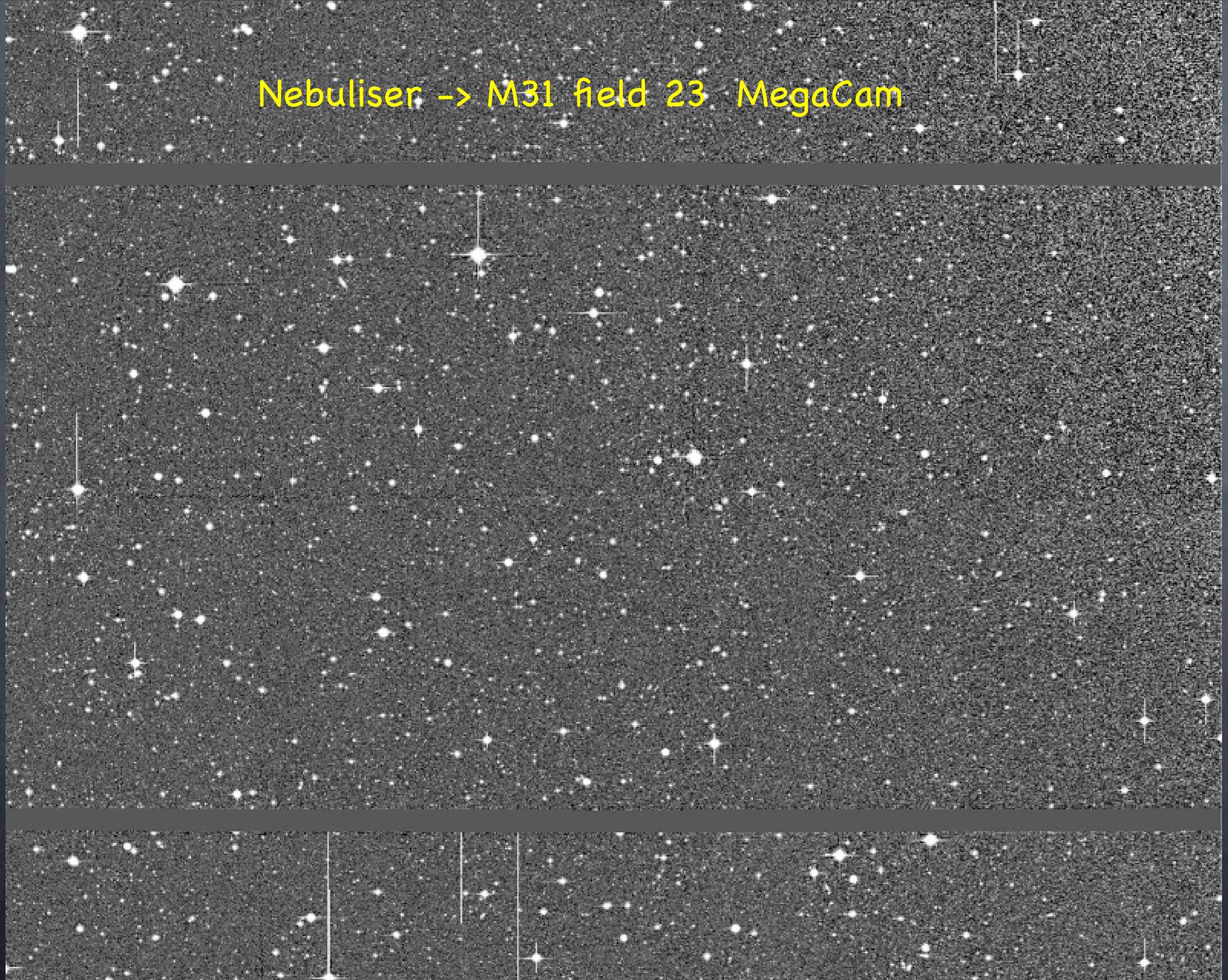






Nebuliser -> M31 field 23 MegaCam

Nebuliser -> M31 field 23 MegaCam



Despiker -> Subaru Suprime-Cam HolmbergII

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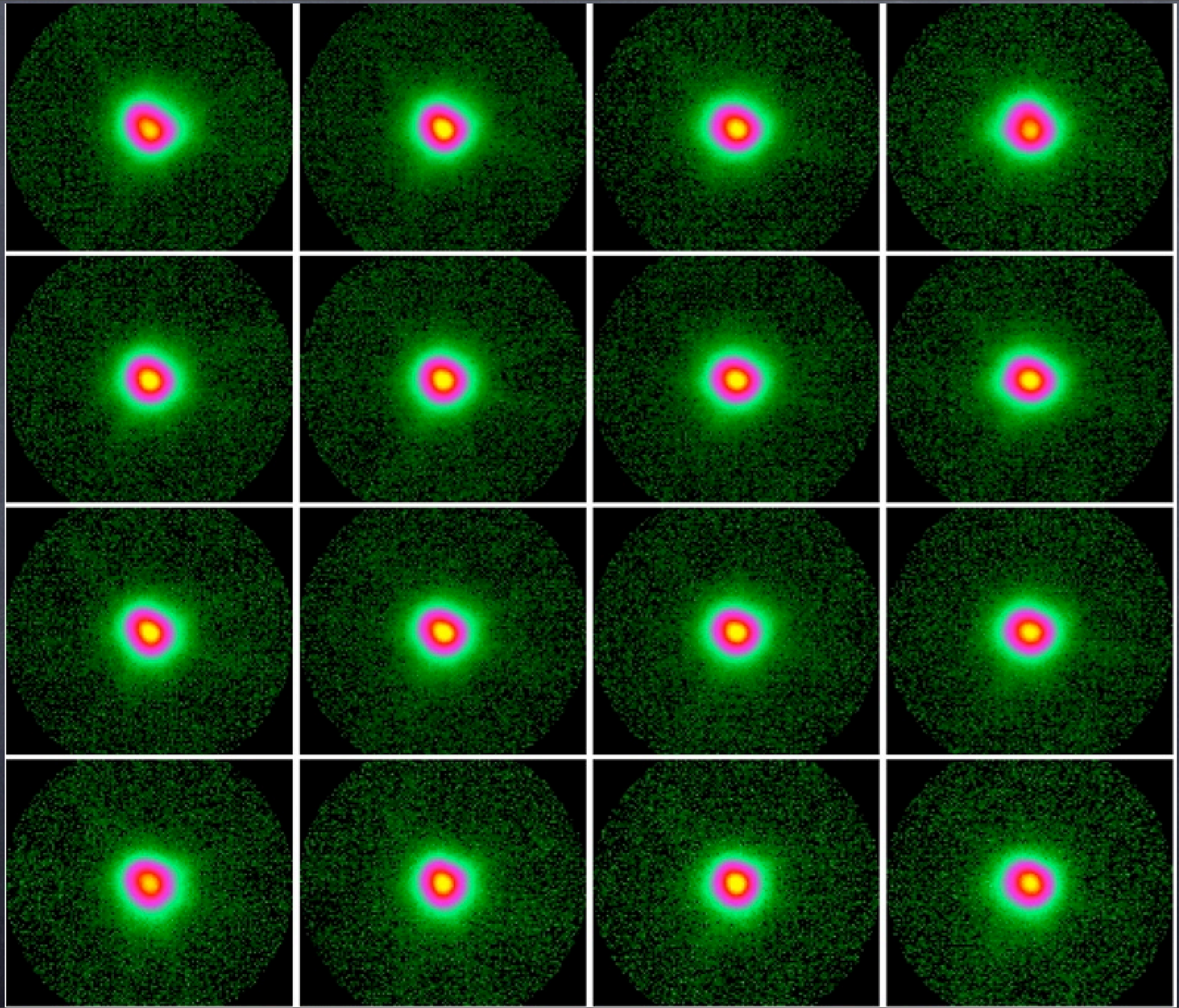

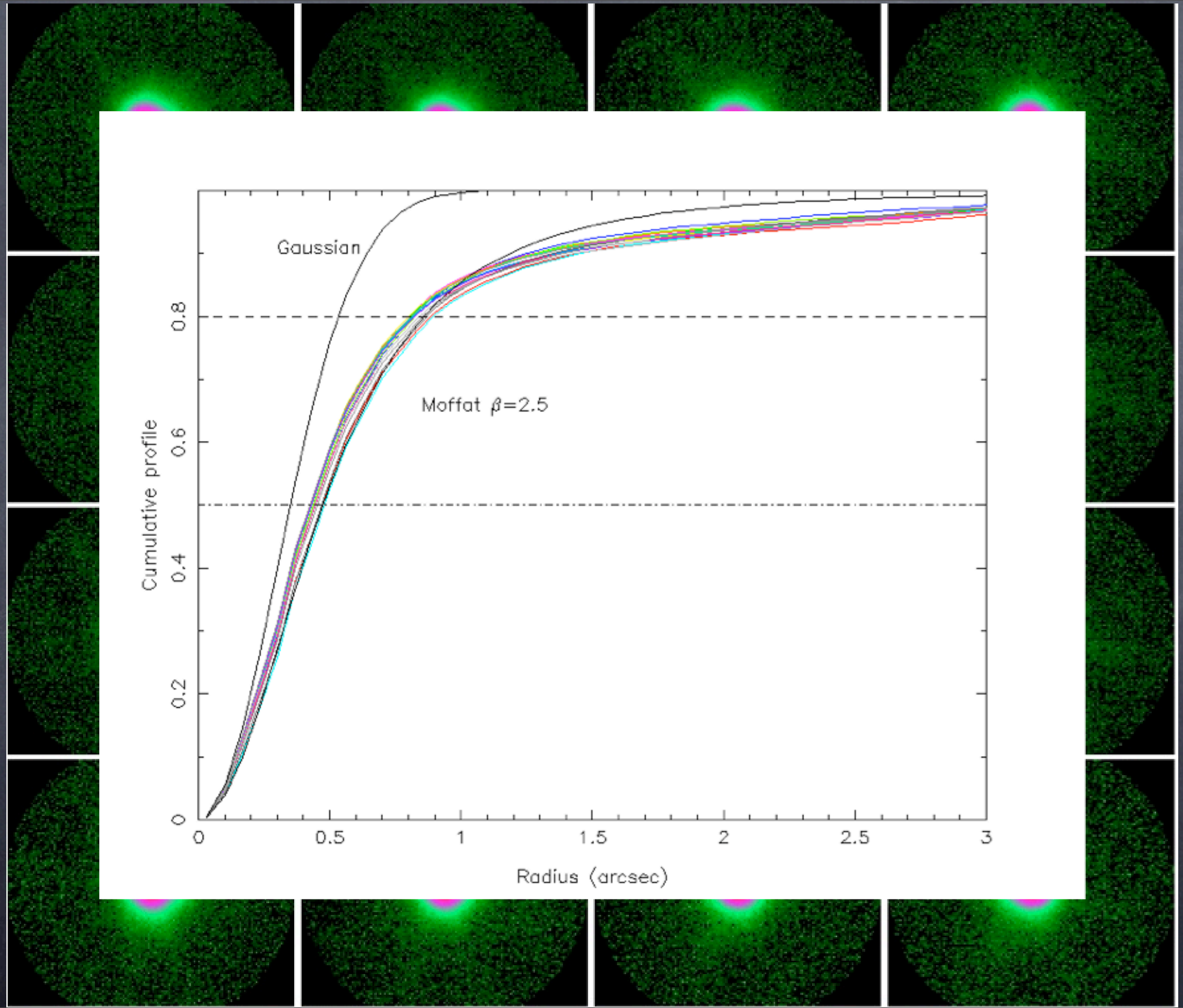
Gaussian
Moffat β=2.5
Cumulative profile
0
0.2
0.4
0.6
0.8
0
0.5
1
1.5
2
2.5
3
Radius (arcsec)