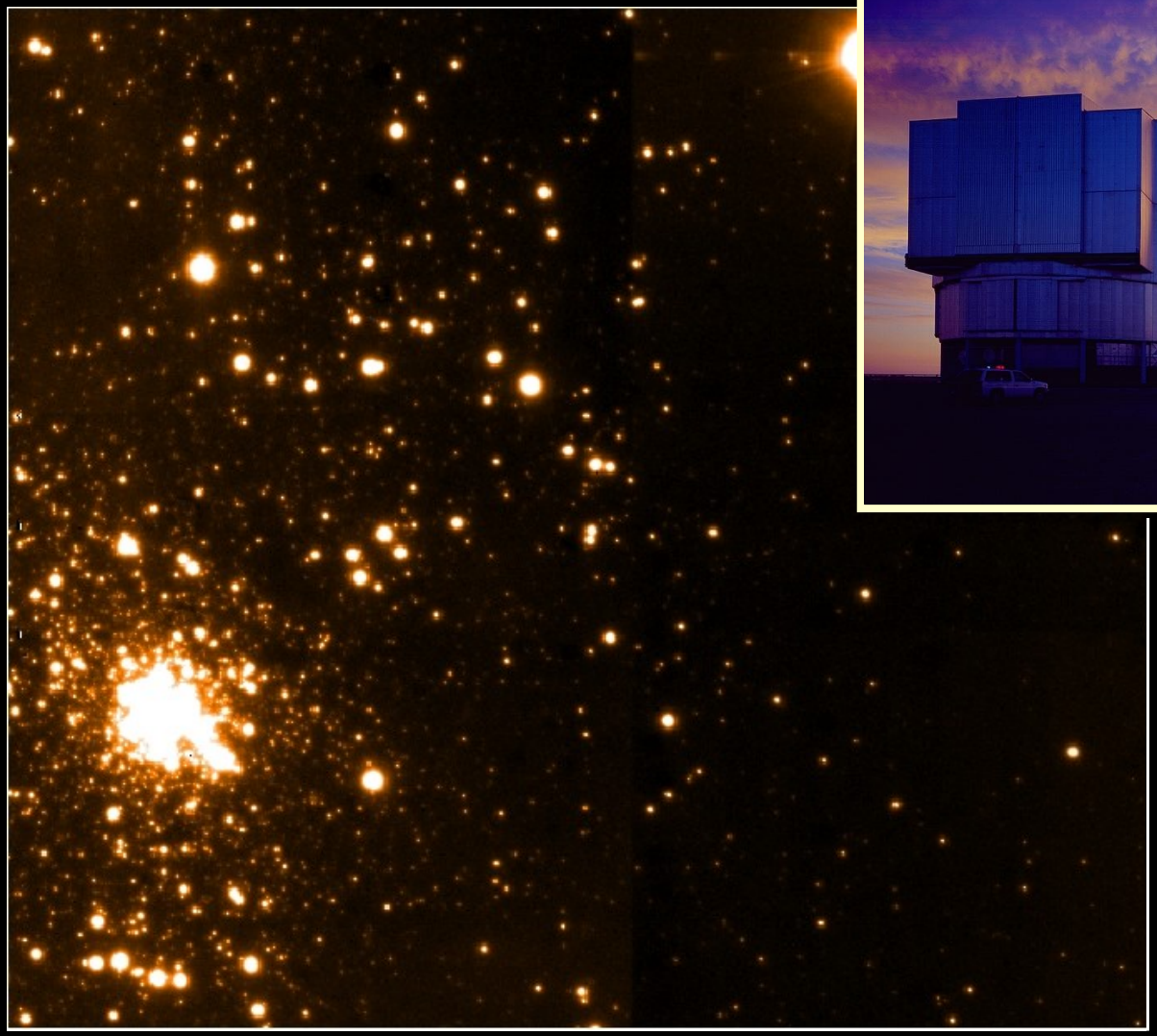
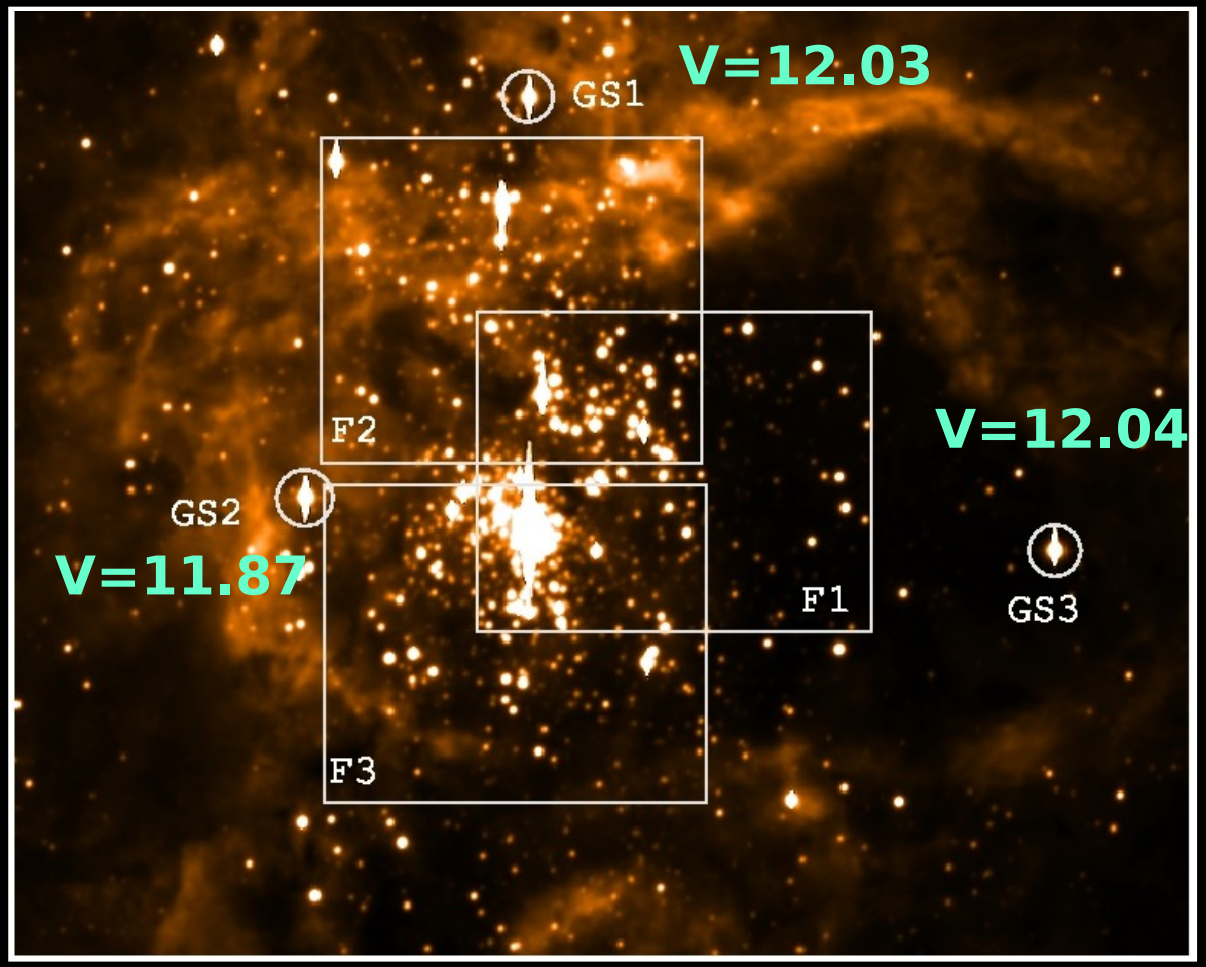
MAD – The Dense Stellar Cluster R136

Beyond MAD 2009

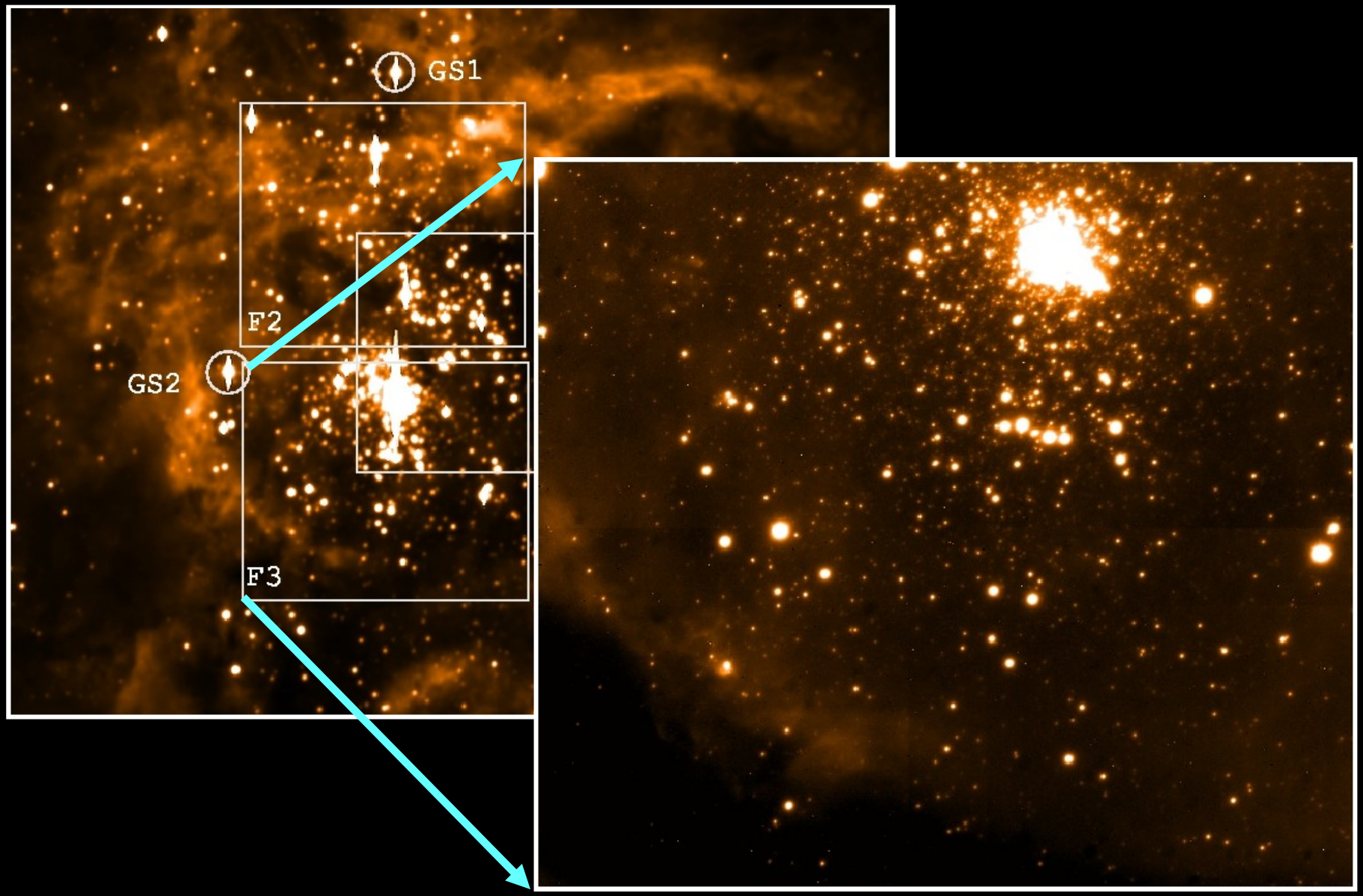


Mike Campbell, Chris Evans, Dougal Mackey, Joana Ascenso, Mark Gieles, Nate Bastian, Andy Longmore, Johann Kolb, Joao Alves

Observations



Observations



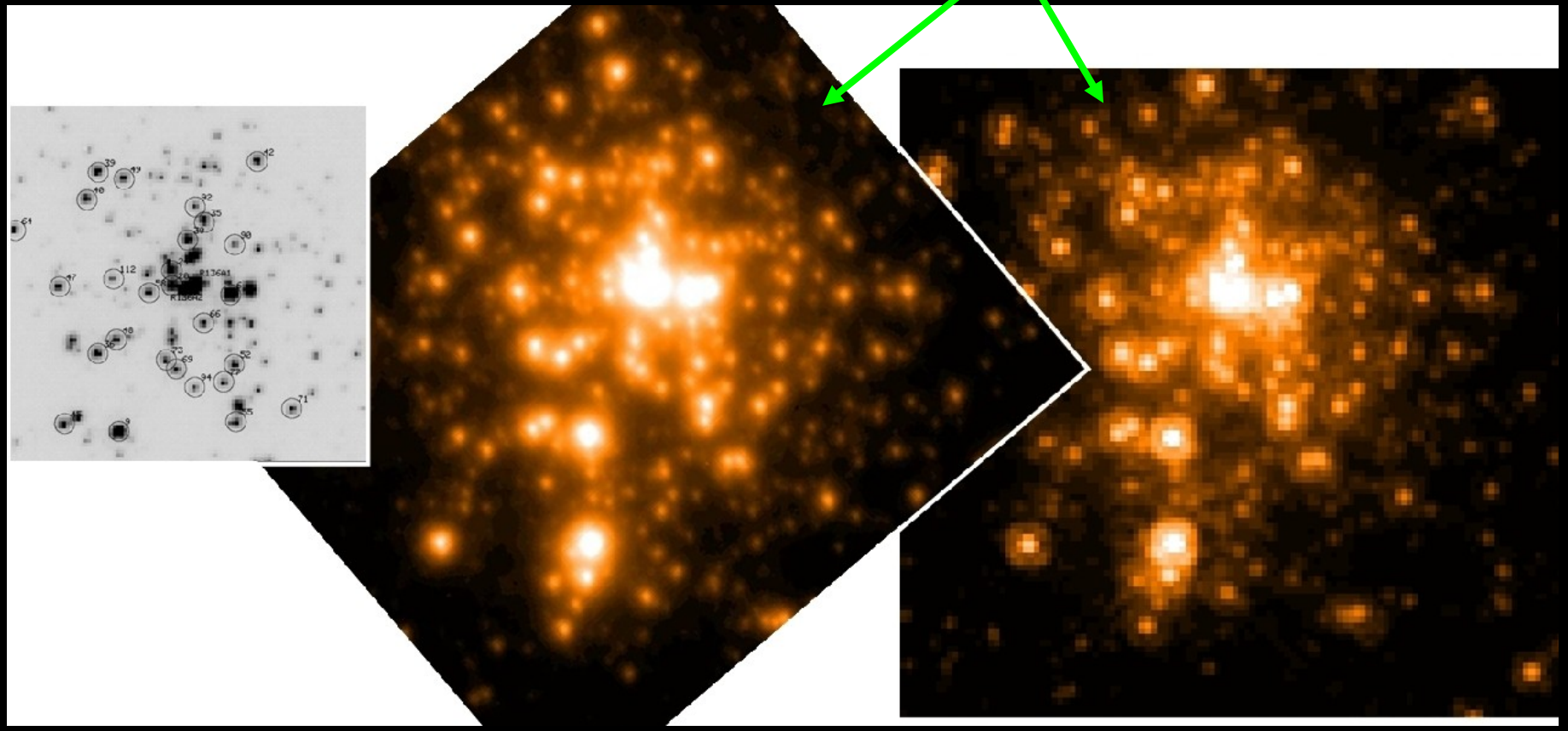
Performances

Data taken Nov 2007/Jan 2008

Field	Band	Exp [min]	DIMM	Image FWHM	<FWHM>
1	K	22	0.4 - 1.8	0.10 - 0.13	0.11
2	K	24	0.5 - 1.1	0.08 - 0.10	0.09
3	K	23	0.6 - 1.0	0.10 - 0.20	0.14
1	H	12	0.3 - 0.6	0.10 - 0.12	0.11
2	H	12	0.9 - 1.1	0.08 - 0.11	0.09
3	H	11	0.6 - 1.6	0.08 - 0.15	0.12

All at an airmass of 1.4-1.6

R136 – 30 Doradus



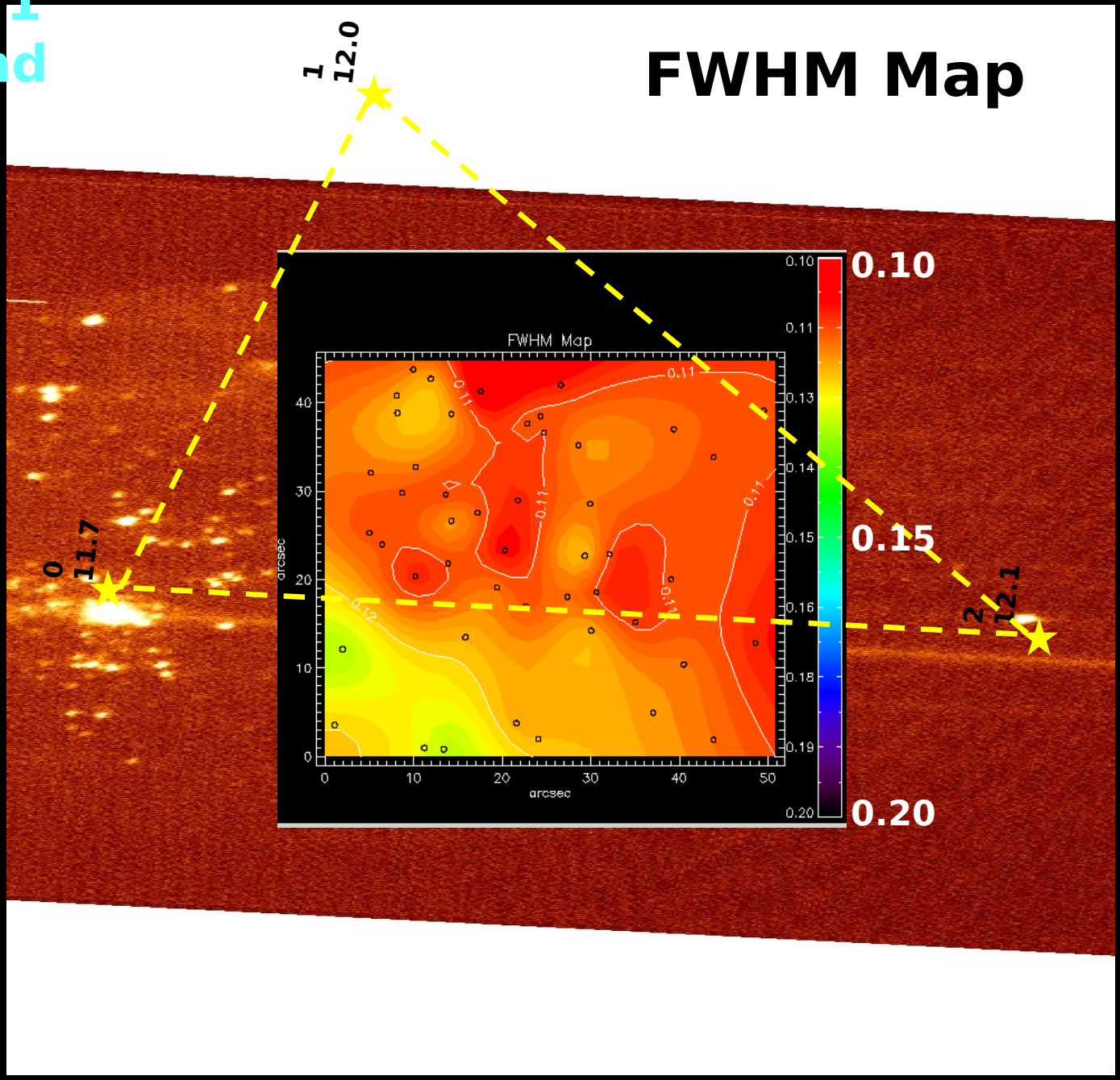
WFPC 2
Massey & Hunter (1998)

VLT-MAD

NICMOS
Andersen et al. (in press)

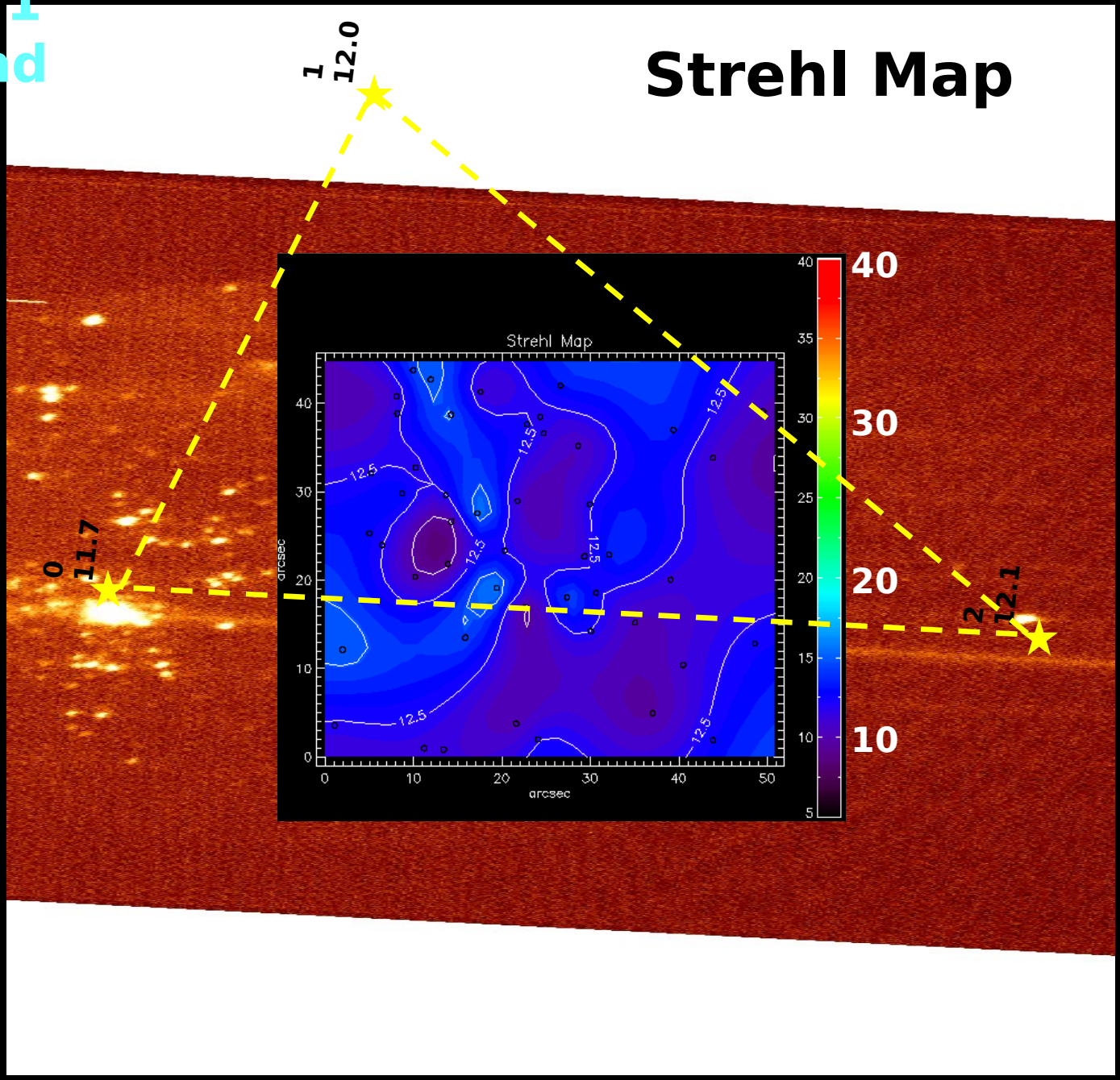
Field 1
K band

FWHM Map



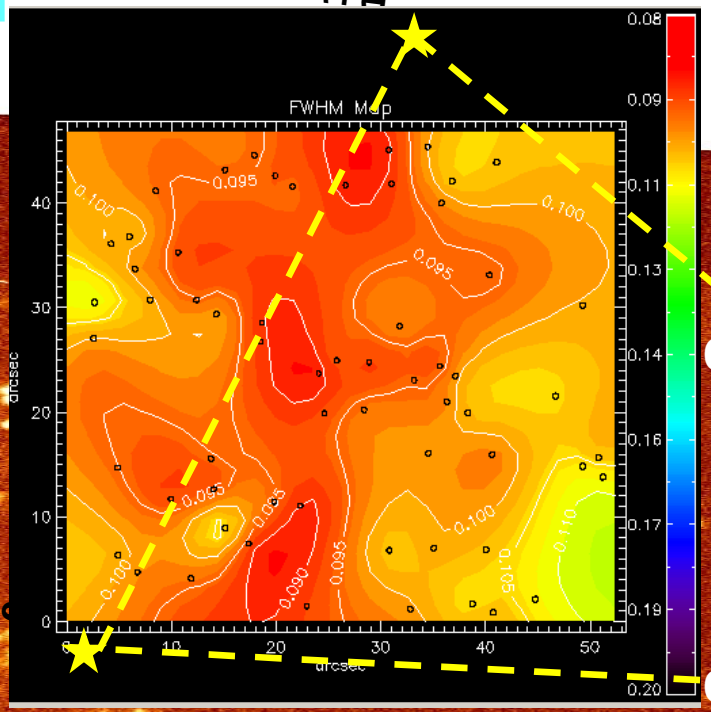
Field 1
K band

Strehl Map



Field 2
K band

FWHM Map

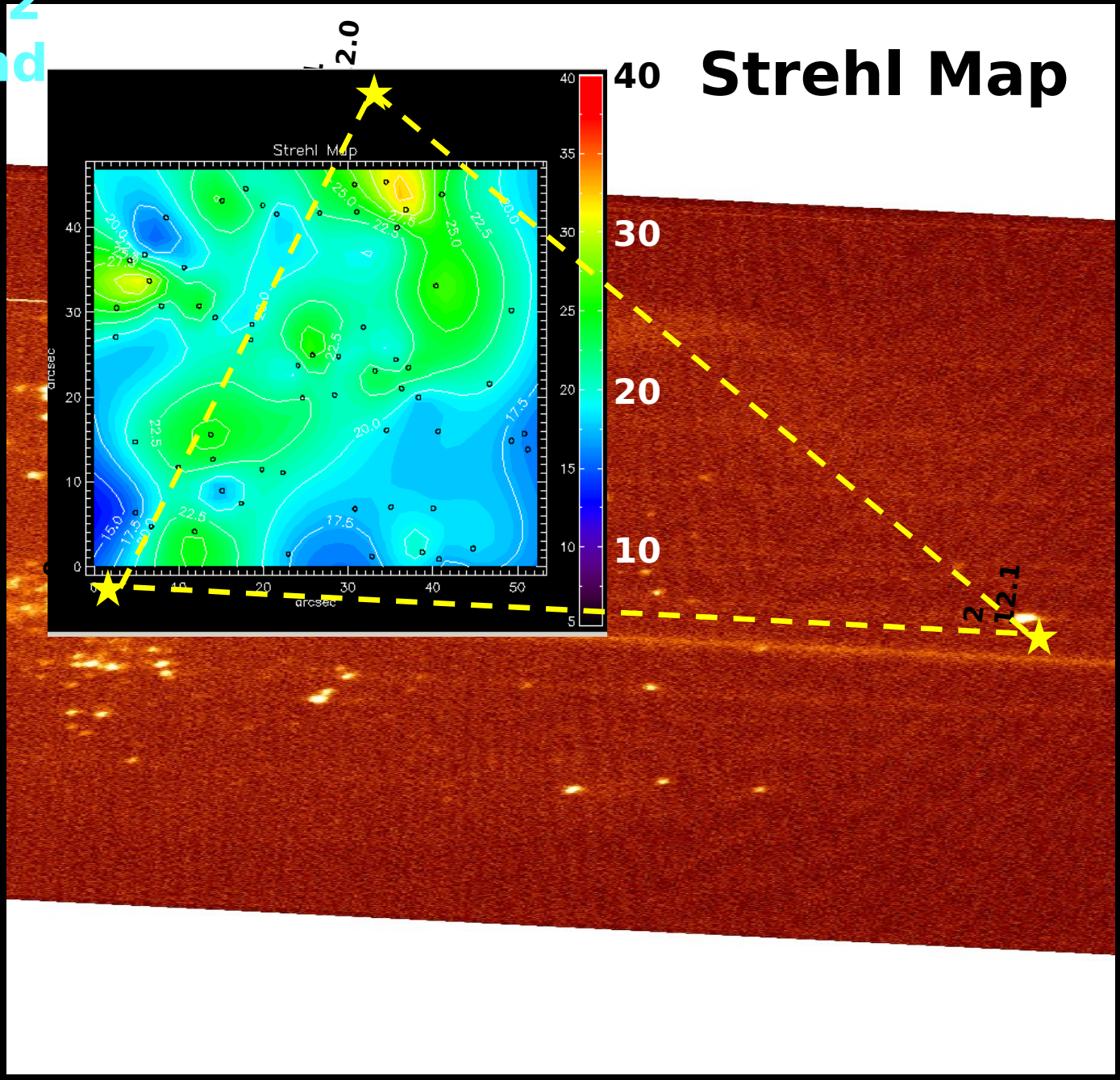


0.14

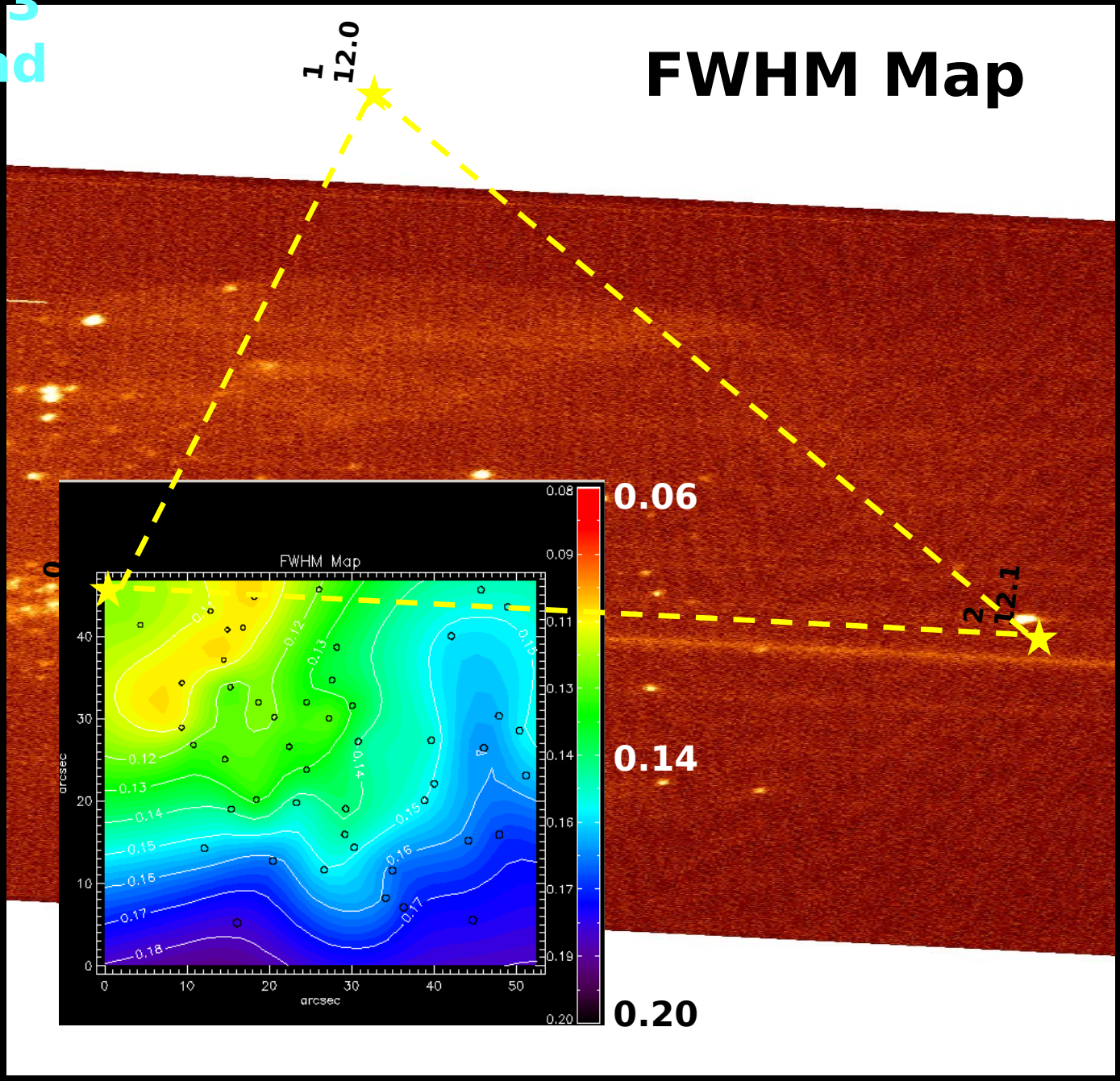
0.20

FWHM: 0.08-0.11"
cf. 0.07" diff. limit

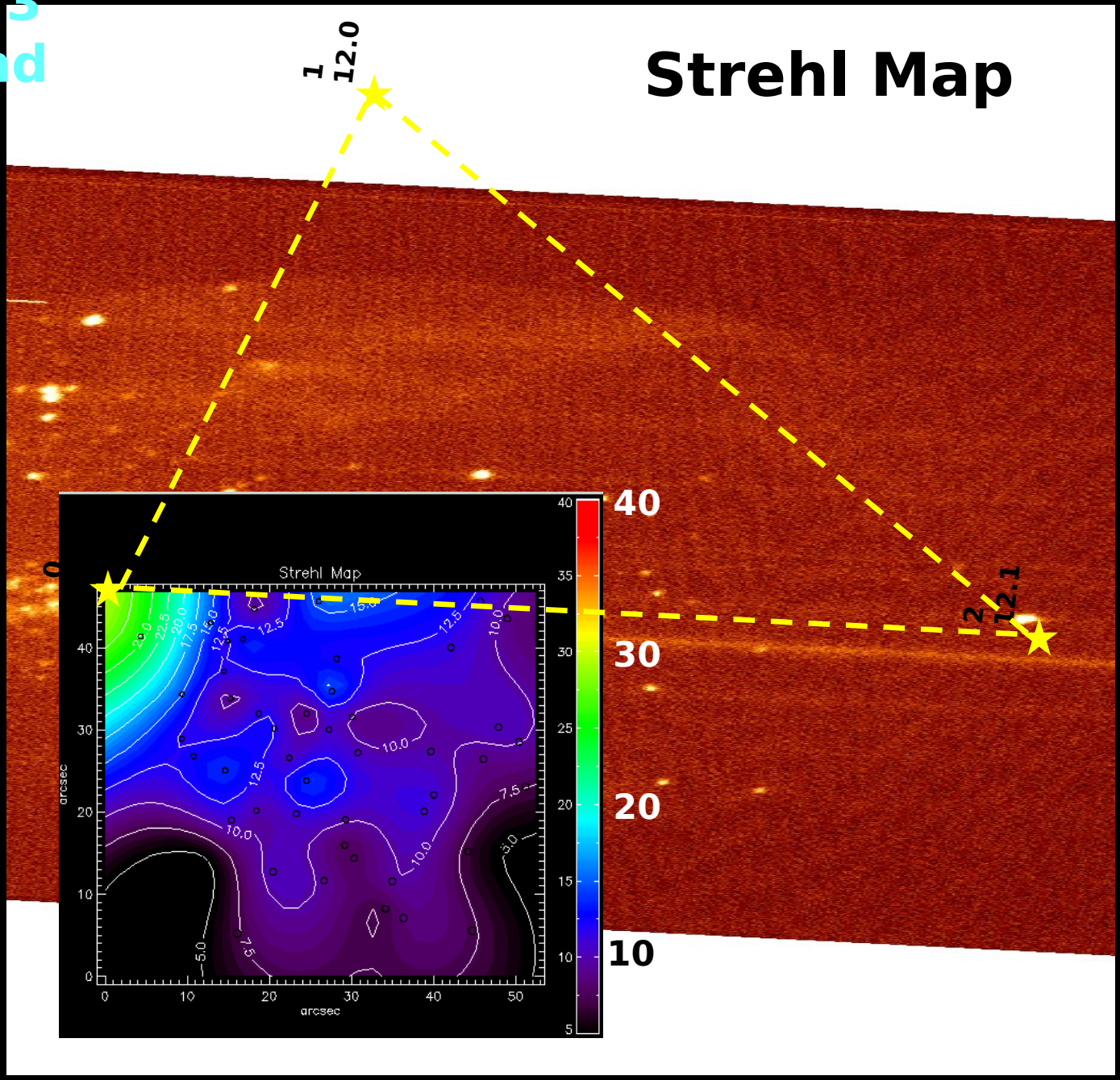
Field 2
K band



Field 3
K band



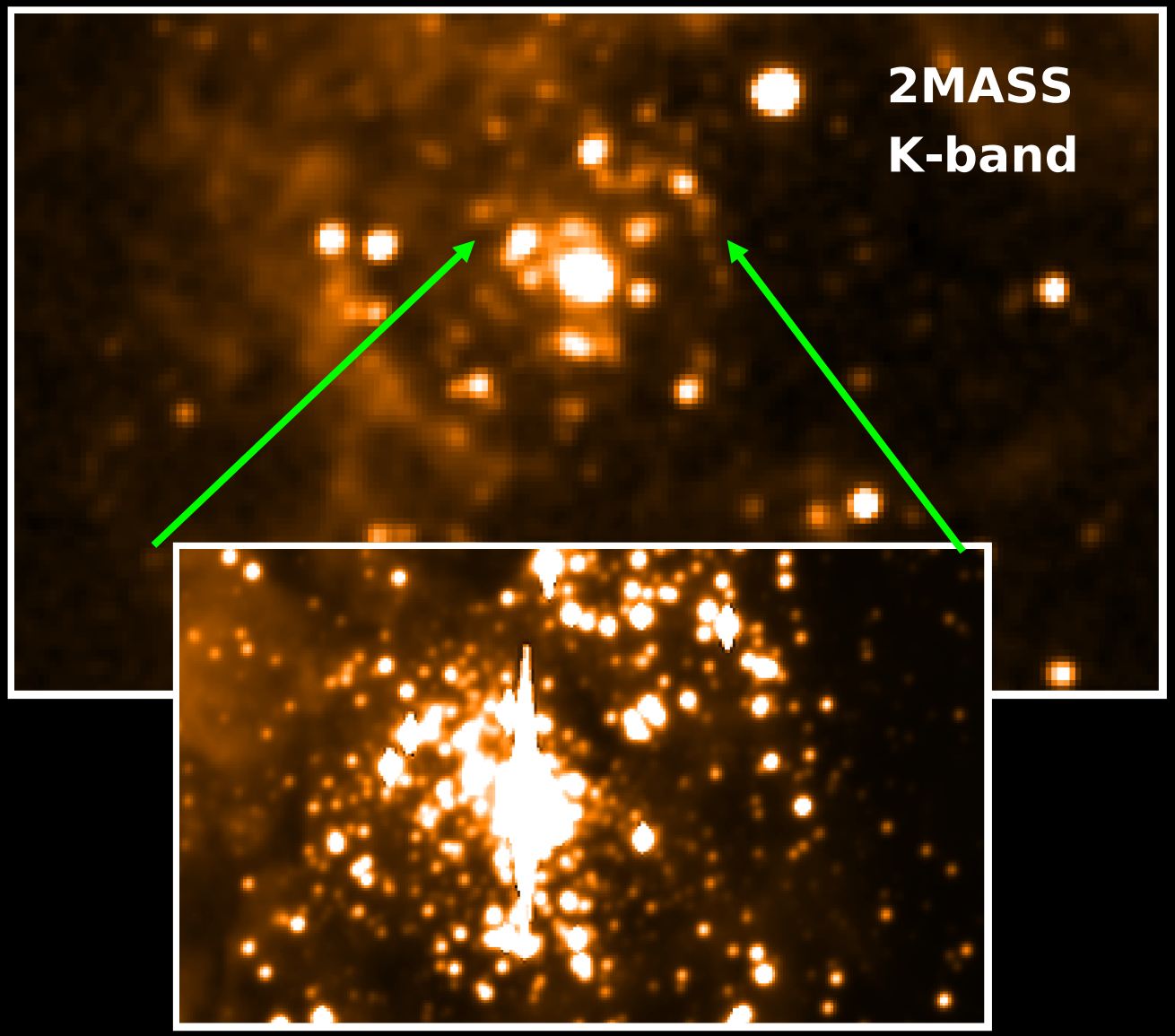
Field 3
K band



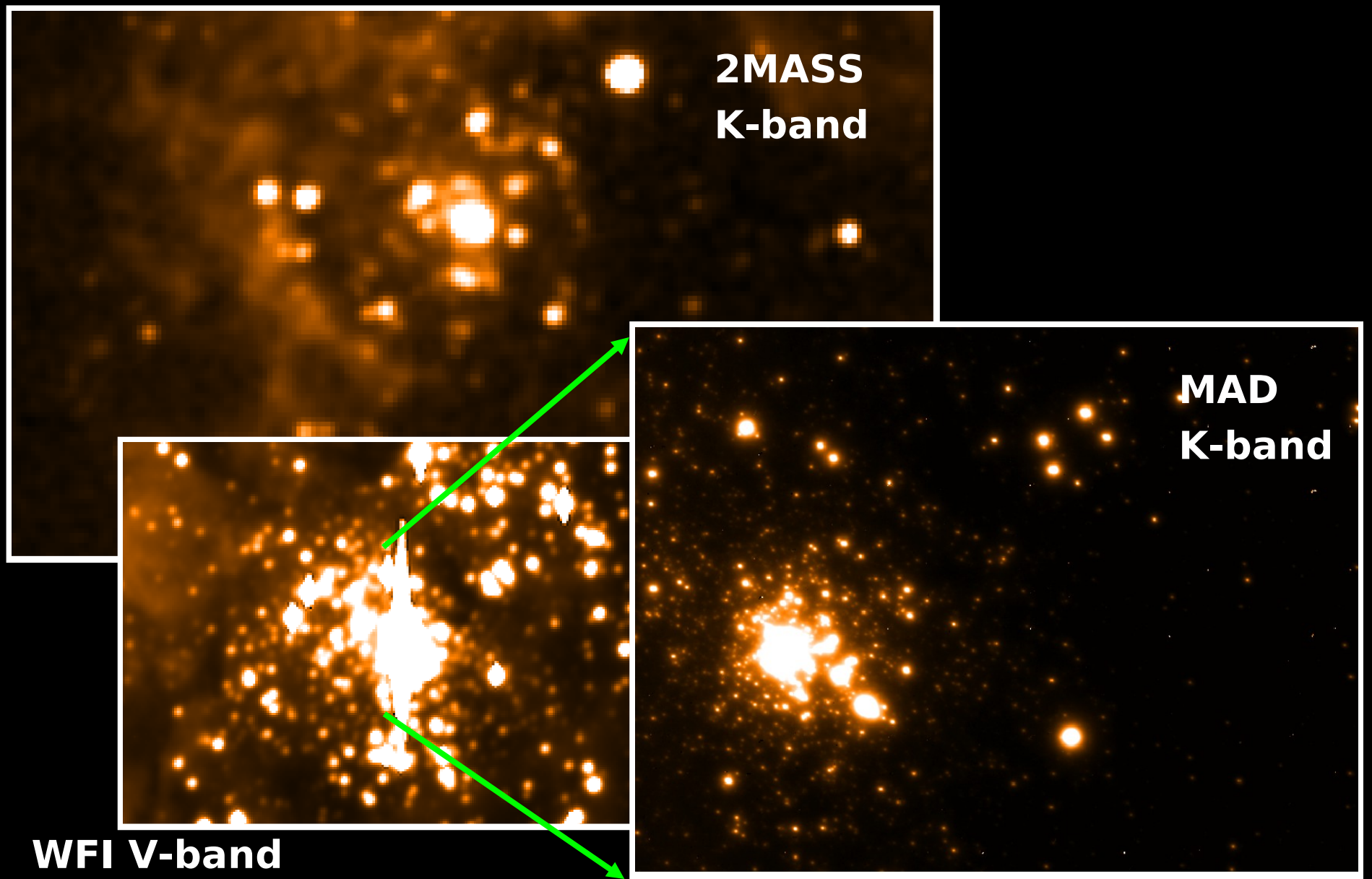
PSF Fitting Photometry

- Dithered images shifted & co-added
  - DAOPHOT PSF photometry
  - Penny function
  - PSF model variable

Calibration

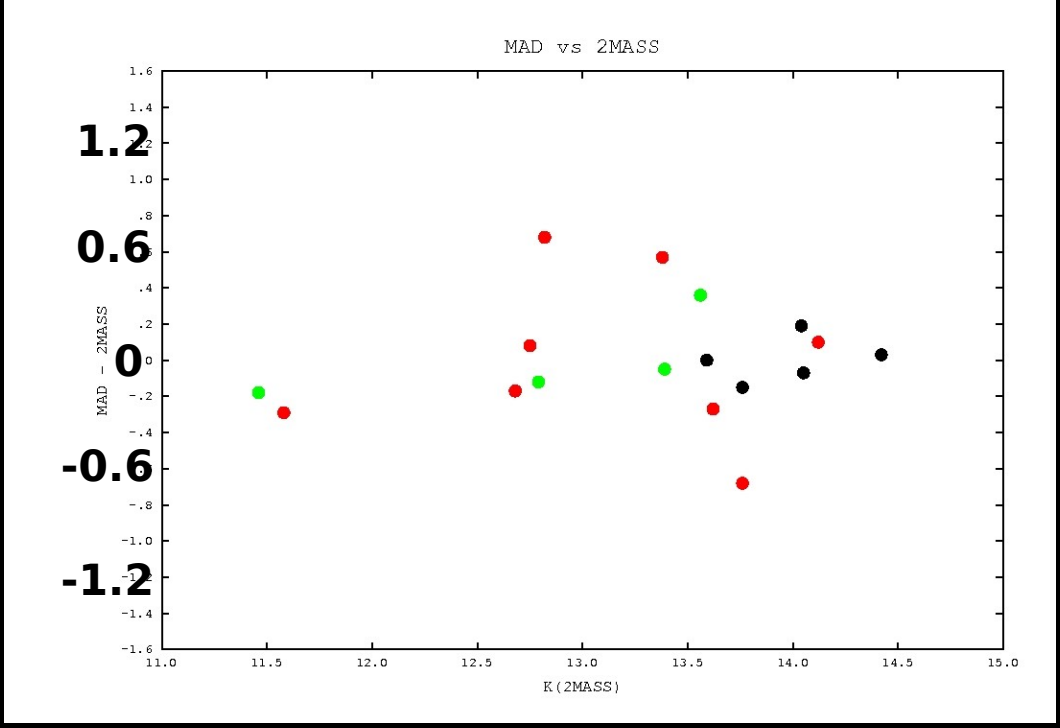


Calibration



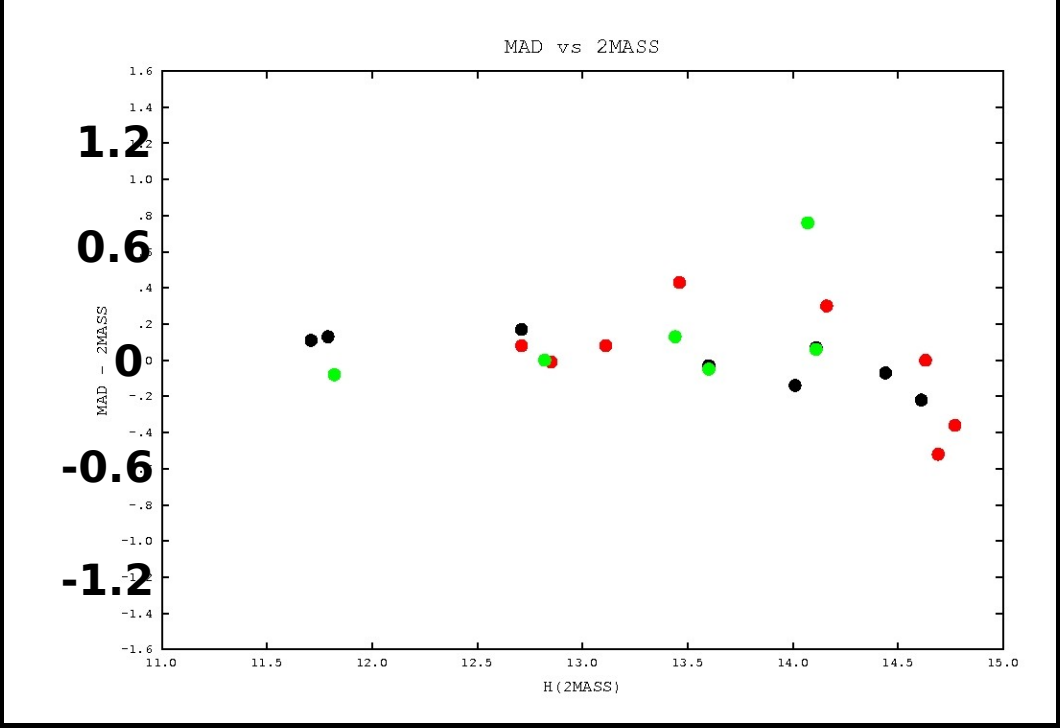
K Band Zero Points

Zero Points	K p1	K p2	K p3
2MASS	26.78 ± 0.13 (5)	26.61 ± 0.45 (8)	26.95 ± 0.25 (4)



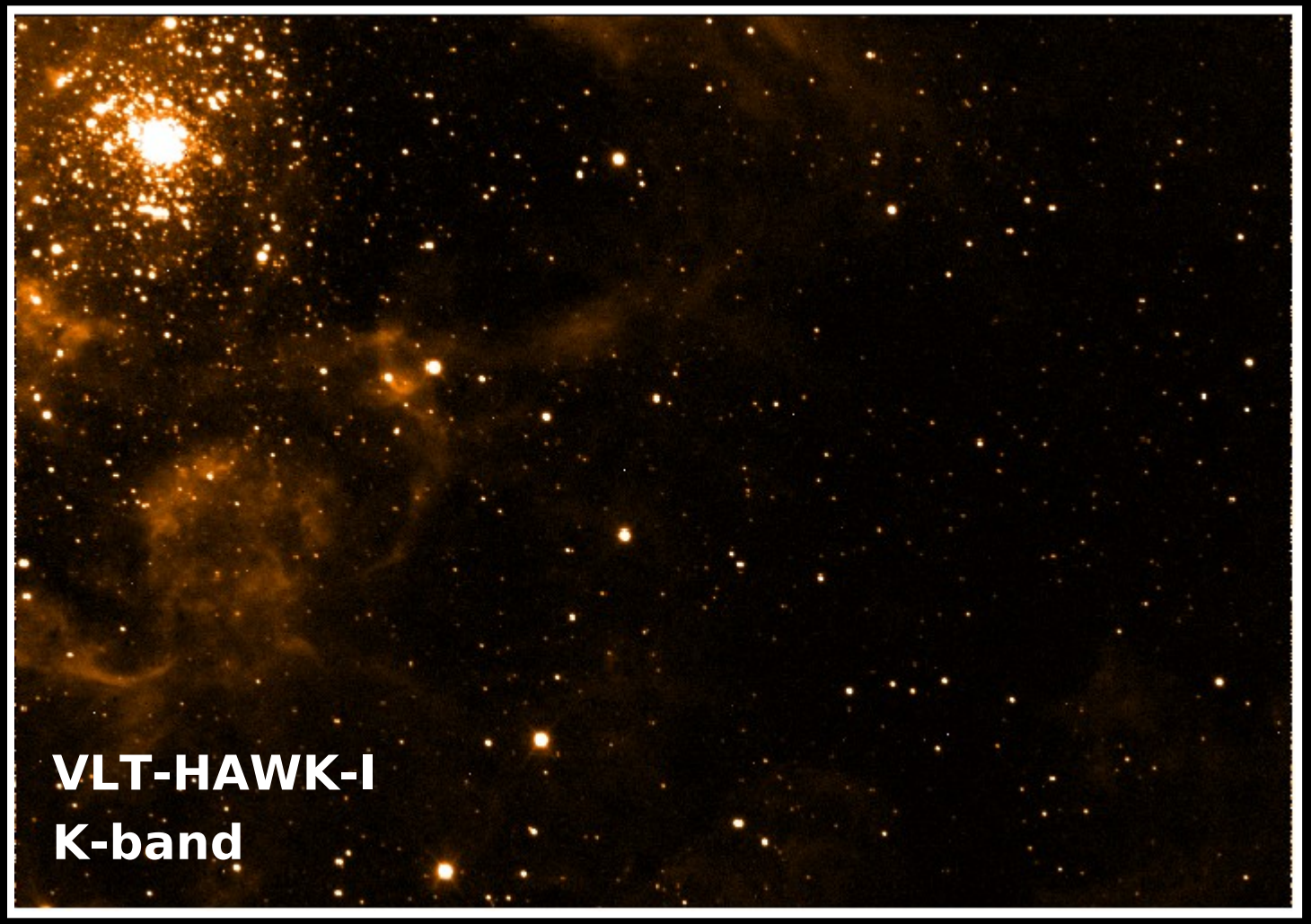
H Band Zero Points

Zero Points	H p1	H p2	H p3
2MASS	27.09 ± 0.14 (8)	27.14 ± 0.32 (8)	26.93 ± 0.08 (6)



Calibration

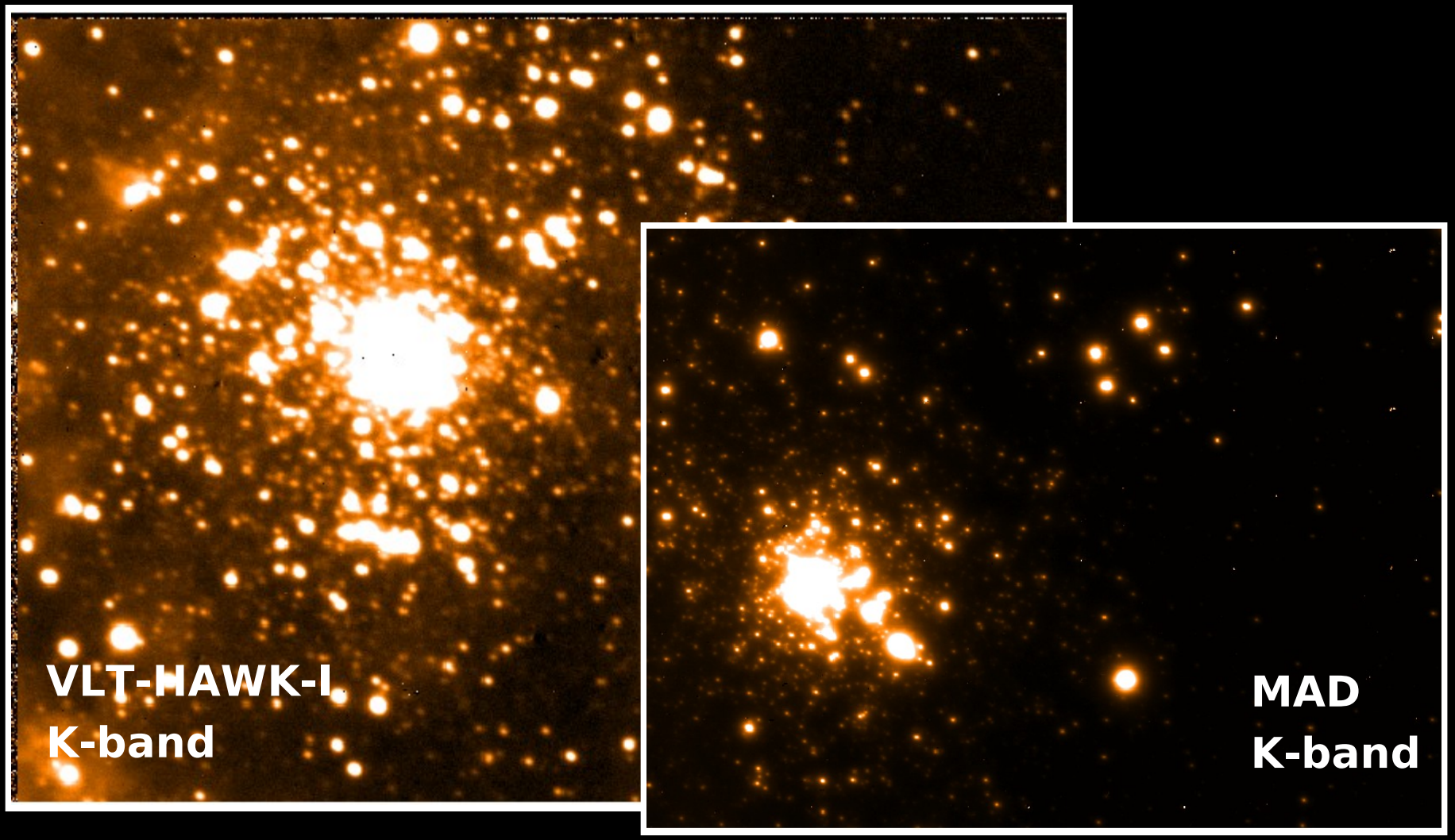
Bootstrap from HAWK-I commissioning data



~50 ‘AAA’ 2MASS stars per array

Calibration

Bootstrap from HAWK-I commissioning data



K Band Zero Points

Zero Points	K p1	K p2	K p3
2MASS	26.78 **± 0.13**	26.61 **± 0.45**	26.95 **± 0.25**
Hawk-I	26.69 **± 0.08**	27.11 **± 0.11**	27.07 **± 0.11**

H Band Zero Points

Zero Points	H p1	H p2	H p3
2MASS	27.09 ± 0.14	27.14 ± 0.32	26.93 ± 0.08
Hp1 Comparison		27.27 ± 0.04	26.93 ± 0.02

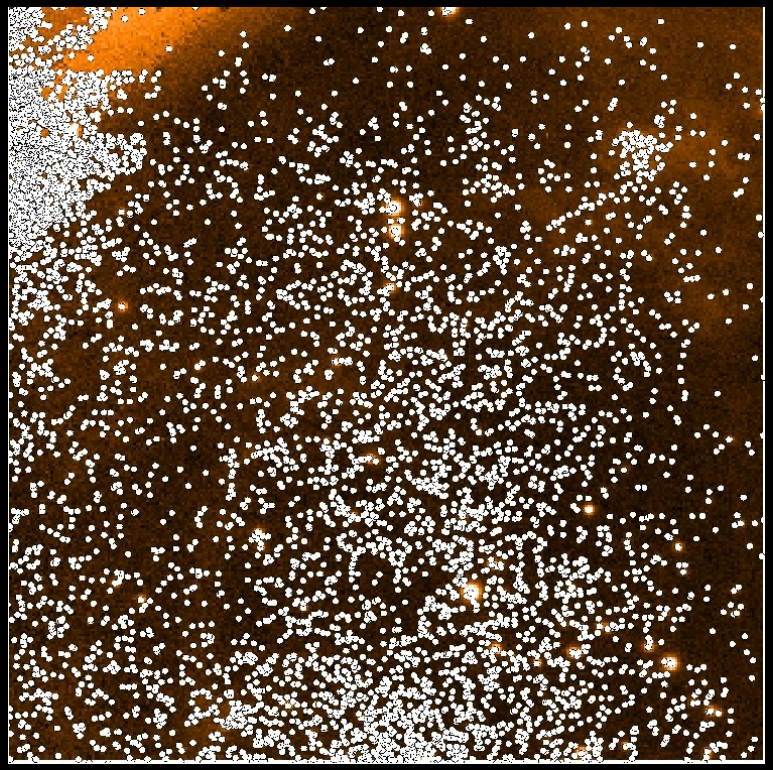
Ready for Science...

PSF Fitting Photometry

- Method 2:
  - Use co-added image for source detection

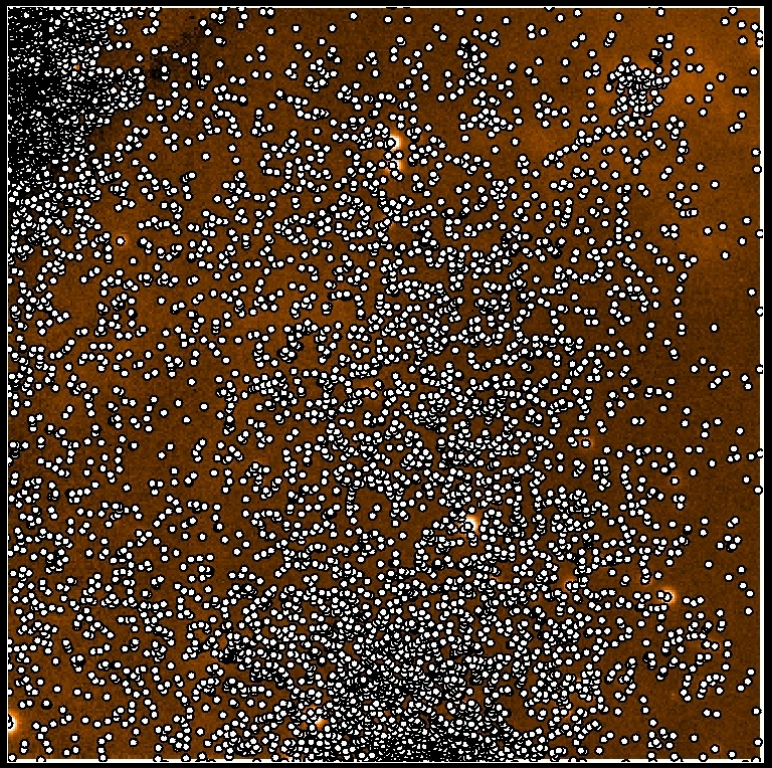
PSF Fitting Photometry

- Method 2:
  - Use to find objects in individual images



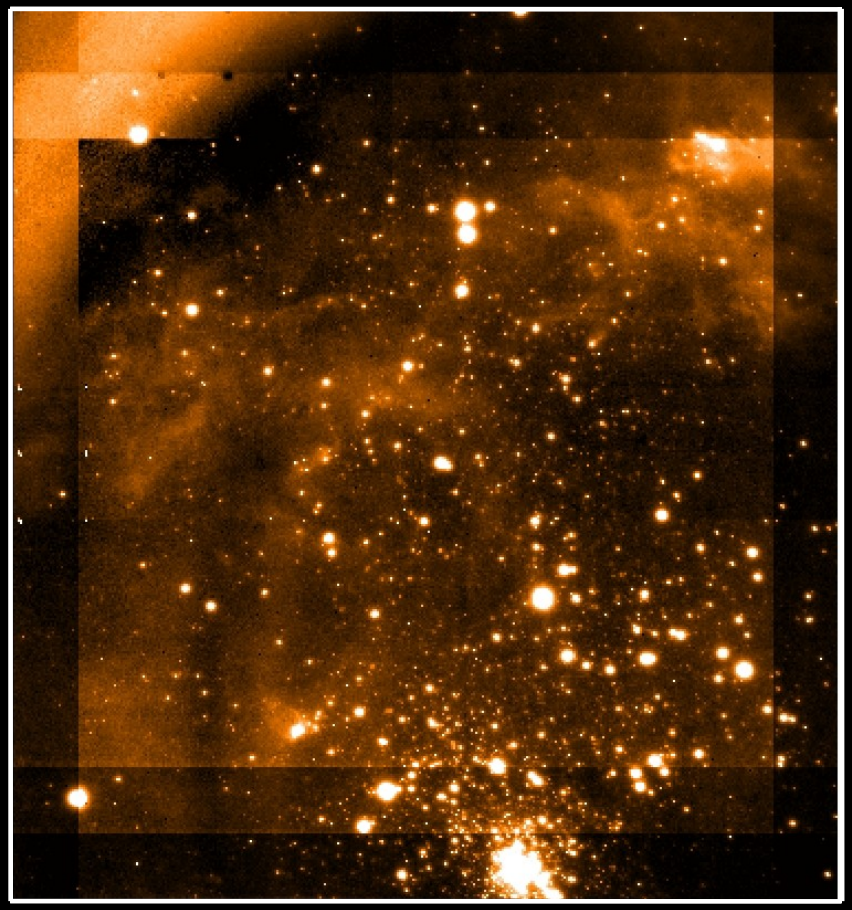
PSF Fitting Photometry

- Method 2:
  - PSF subtract on each image, create mean catalogue



PSF Fitting Photometry

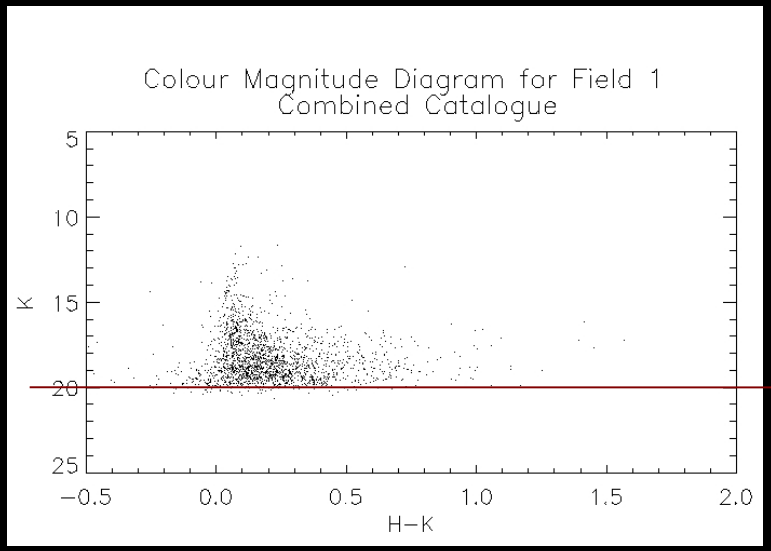
- Pro:
  - Larger FoV
  - Potentially better PSF fitting
- Con:
  - Potentially lower S/N

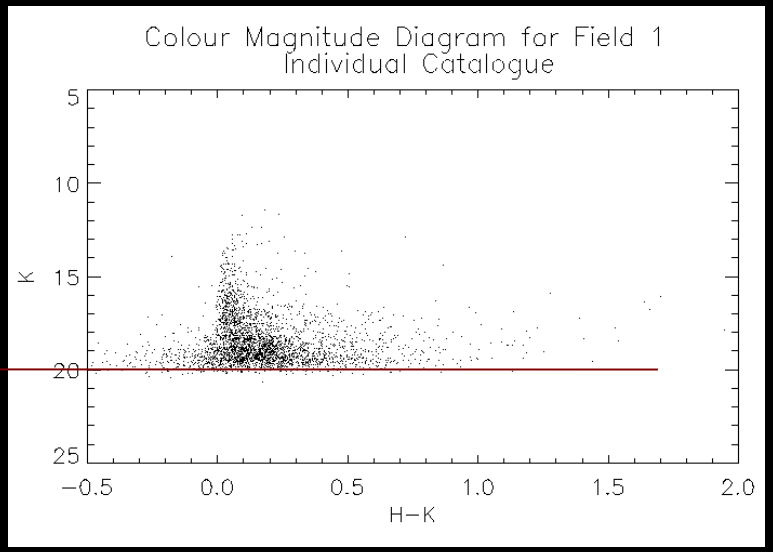


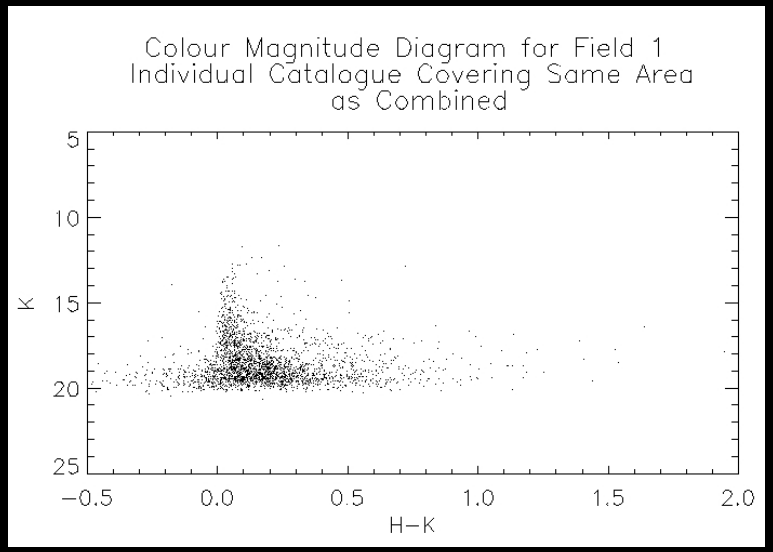
Zero Point Uncertainty Comparison

	ΔK p1	ΔK p2	ΔK p3	ΔH p1	ΔH p2	ΔH p3
Combined Method	**± 0.13**	**± 0.45**	**± 0.25**	**± 0.14**	**± 0.32**	**± 0.08**
Individual Method	**± 0.14**	**± 0.45**	**± 0.24**	**± 0.14**	**± 0.31**	**± 0.08**

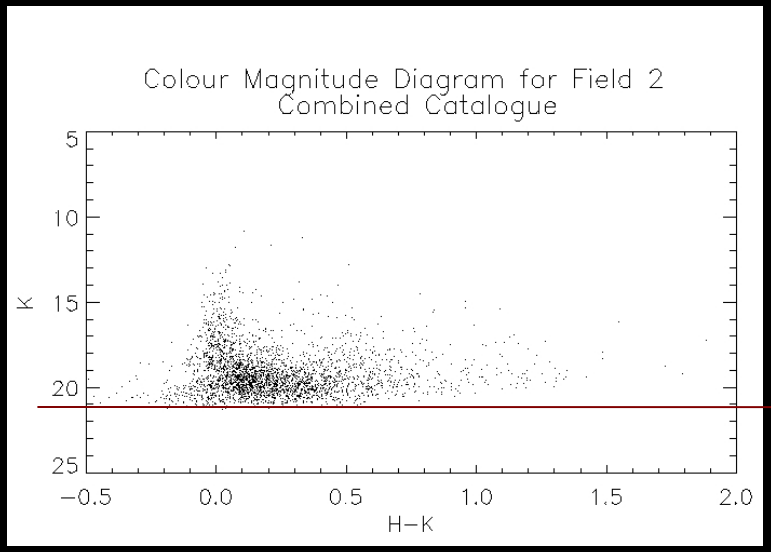
CMDs for Pointing 1

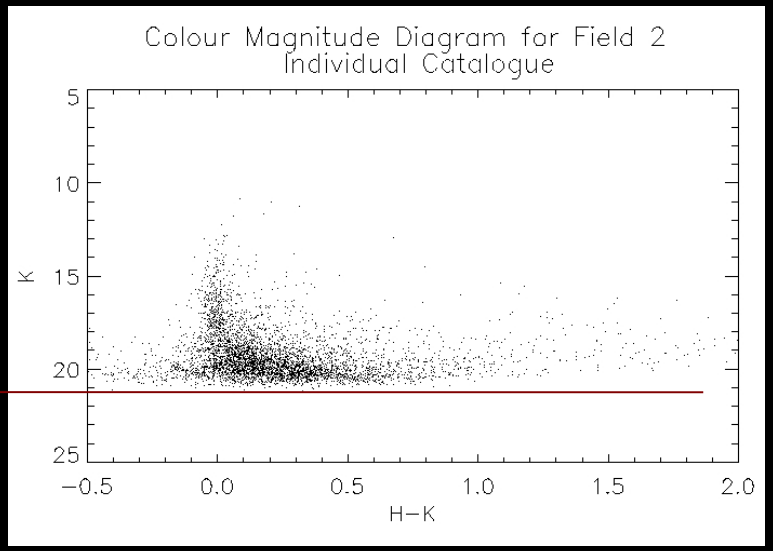


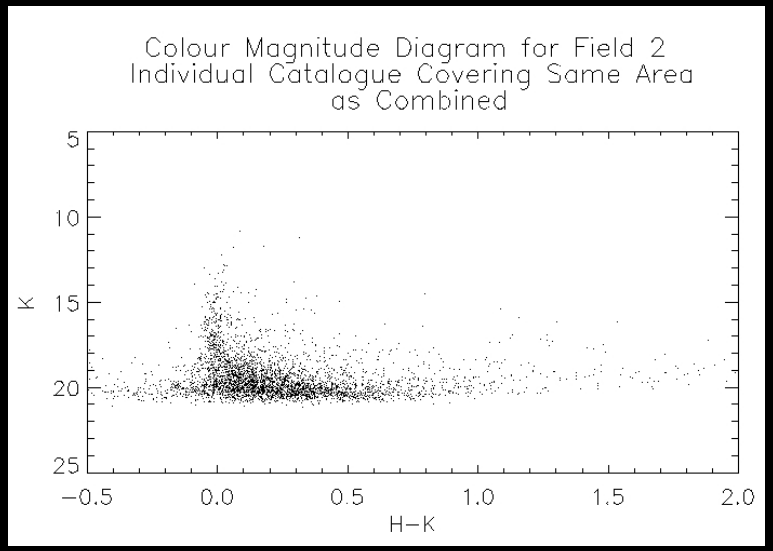




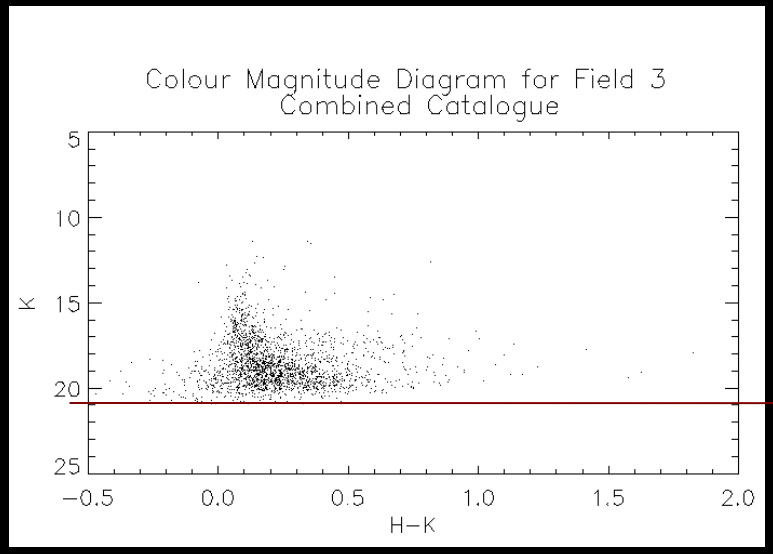
CMDs for Pointing 2

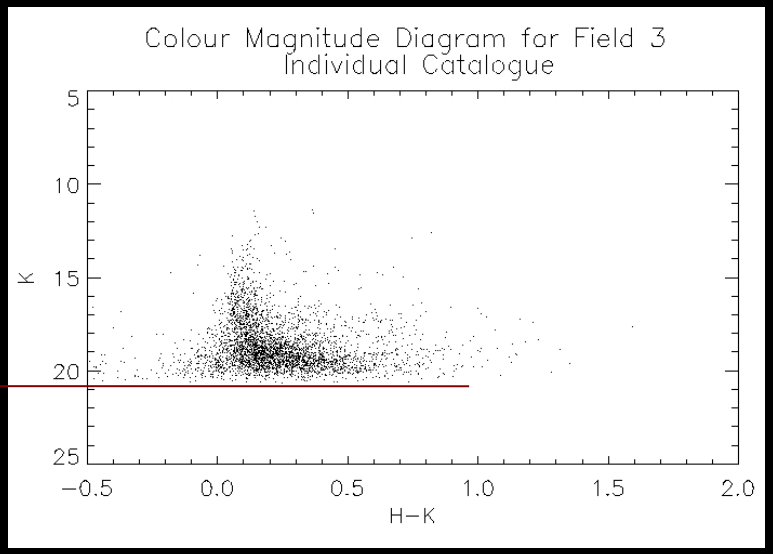


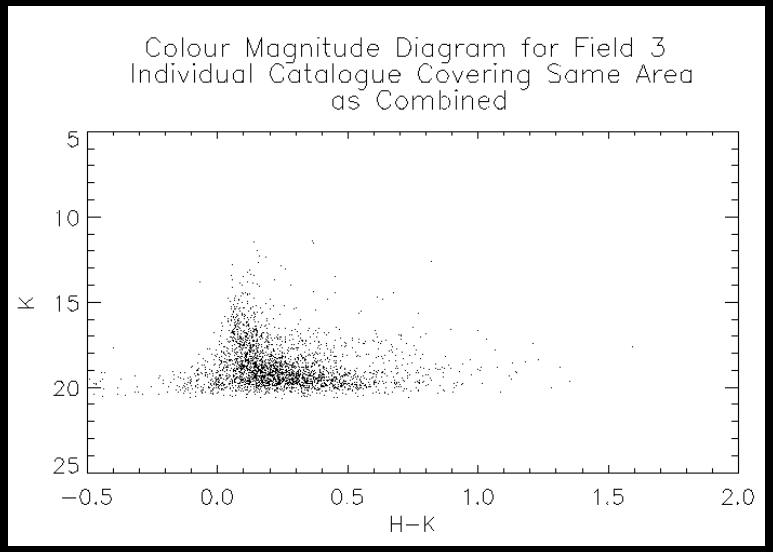




CMDs for Pointing 3



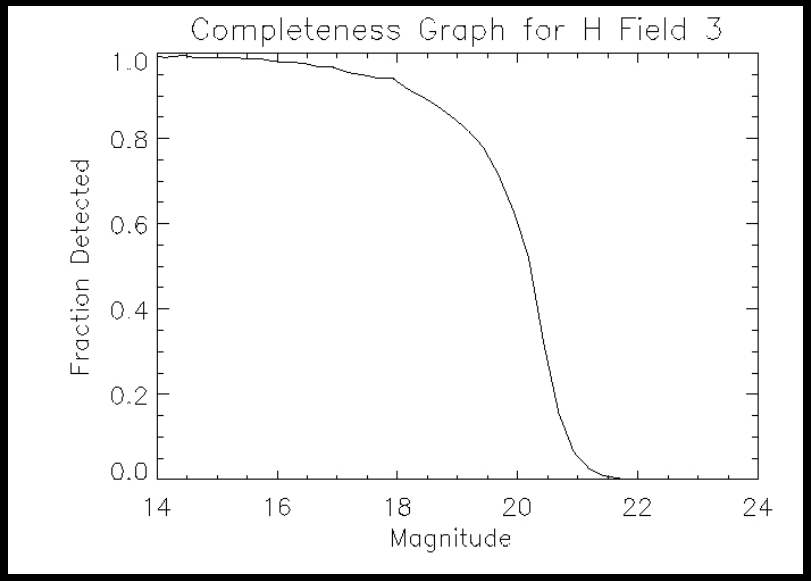


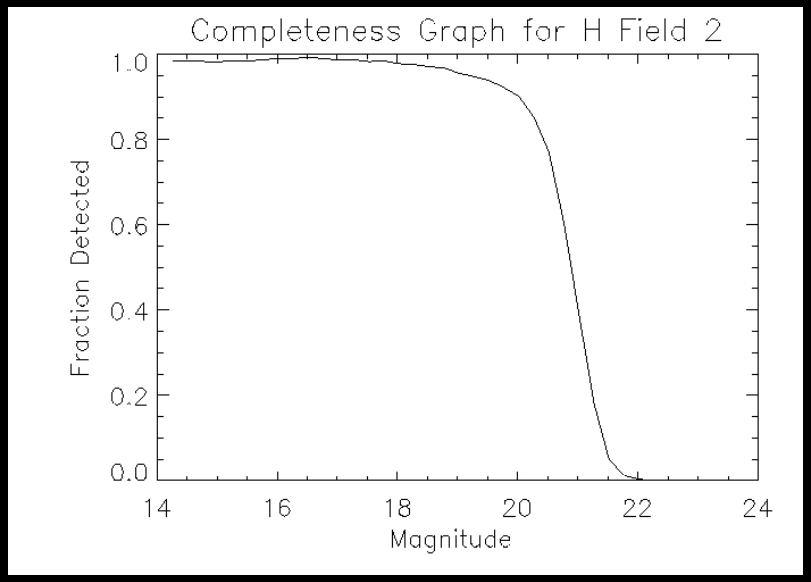


Analysis

- Zero Point uncertainty – Little difference
- Loss in sensitivity – Minimal
- CMDs – More data points with individual technique

Completeness



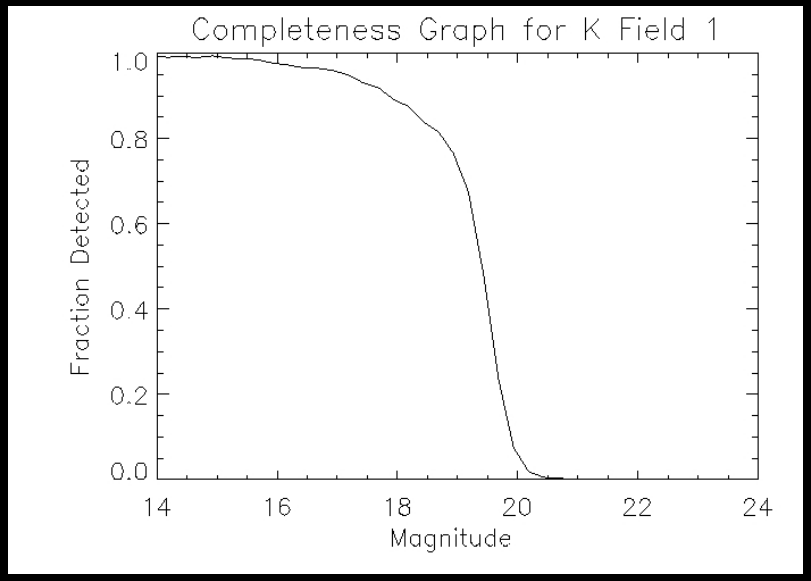


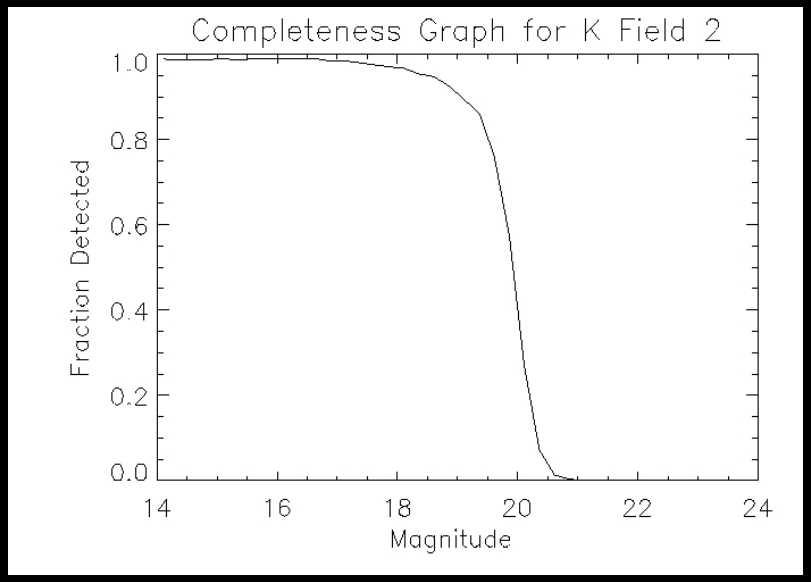
50% complete at H ~ 20.5

12 min exp.

5σ detections

Completeness



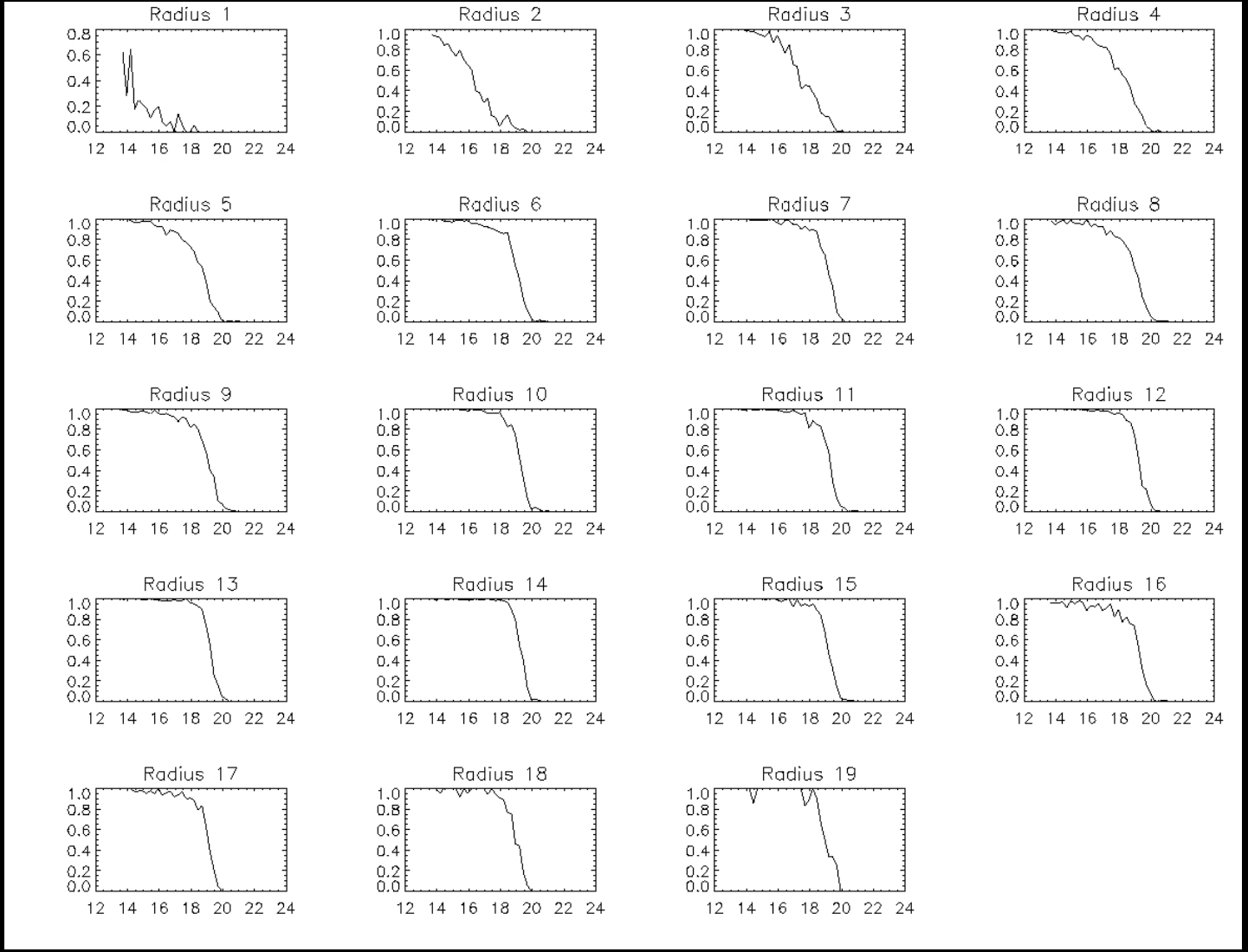


50% complete at K ~ 19.5

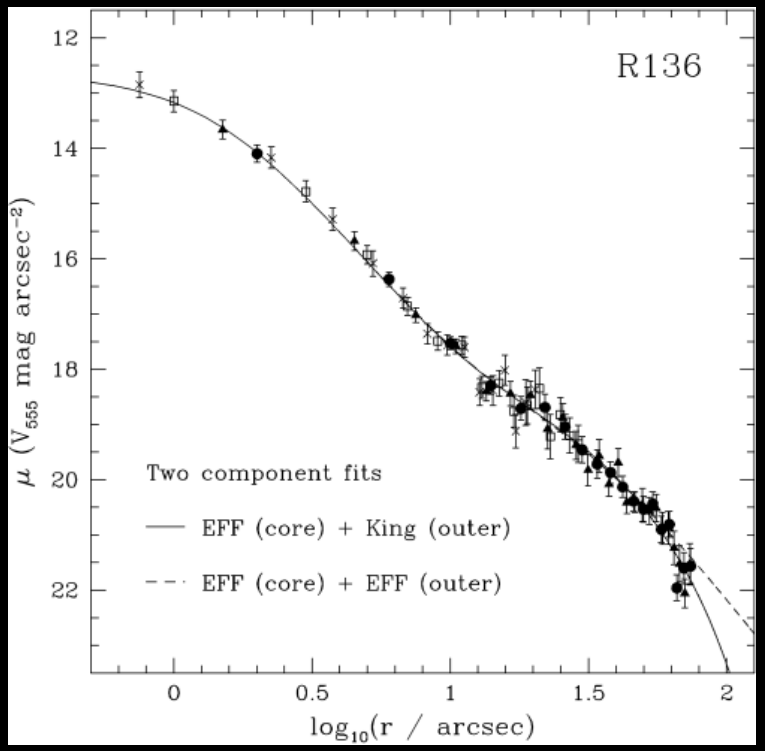
24 min exp.

5σ detections

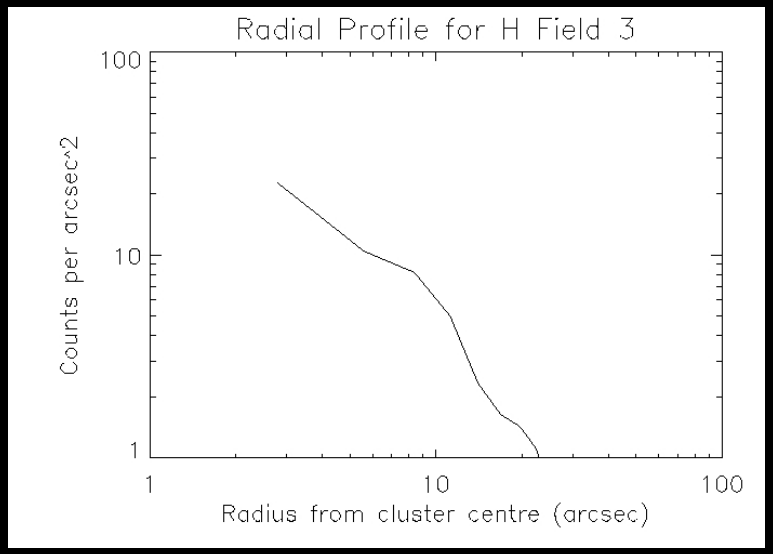
Radial Completeness

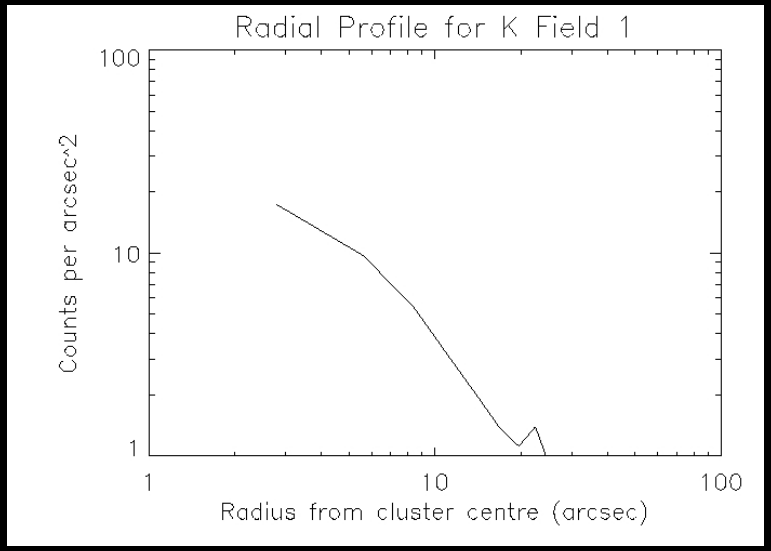


Preliminary Radial Profiles



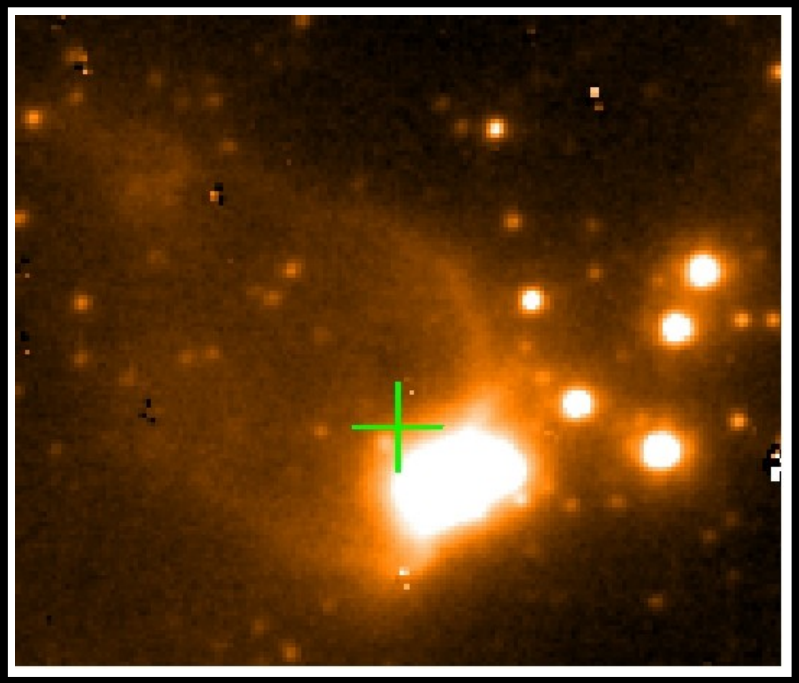
HST: Mackey & Gilmore (2003)





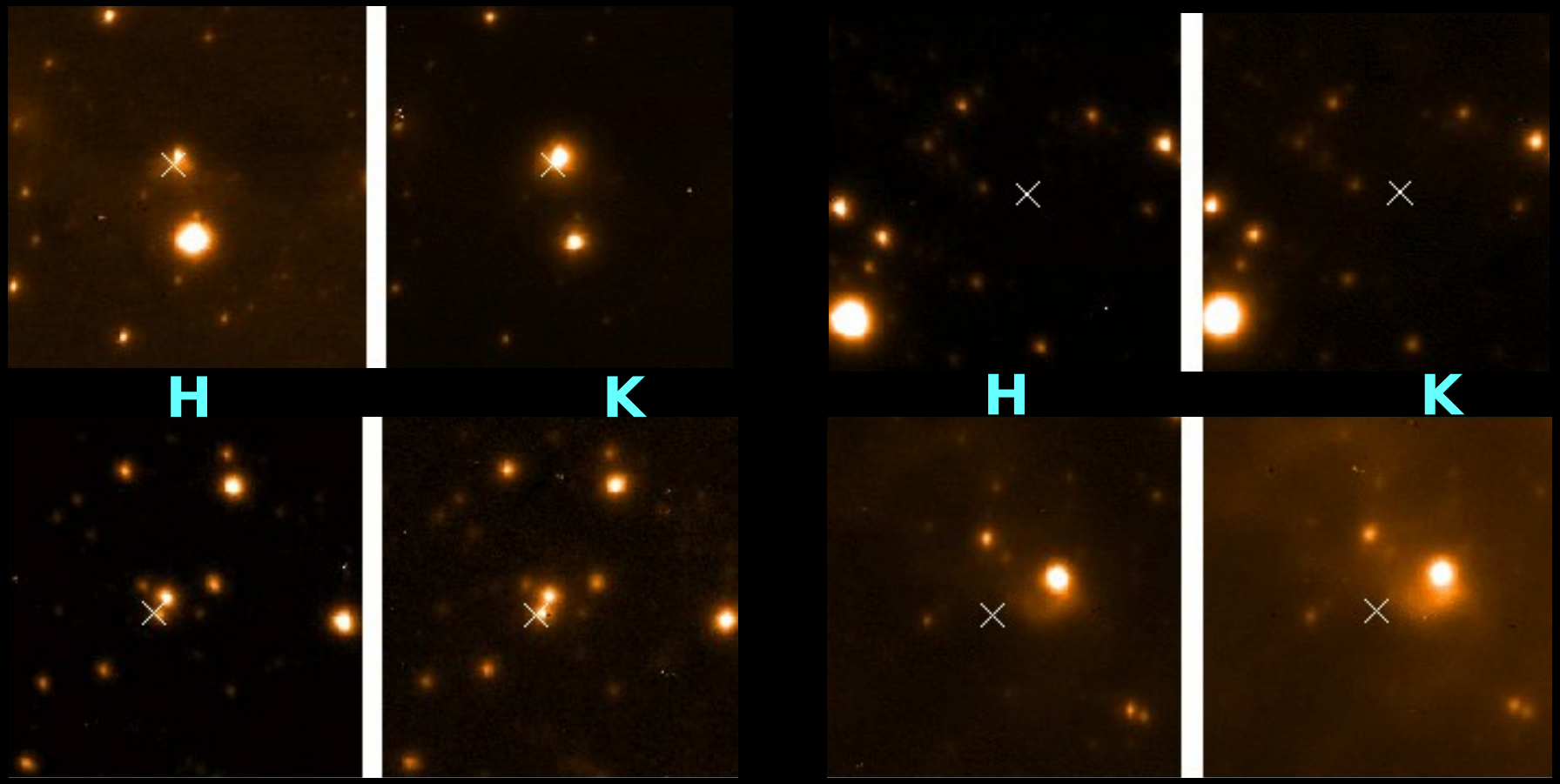
First Science

***Spitzer* YSO candidates from Gruendl et al. (2009)**



First Science

***Spitzer* YSO candidates from Gruendl et al. (2009)**



Conclusions

- Uniform corrections between NGS
- High strehl ratio
- Limited Calibration Sources without Hawk-I
- Gains from individual frame subtractions

Still to do

- Overlap CMD values
- Look at completeness effects on the radial profile
- Benefits from reducing number of images
- IMF

Paper with initial science
results coming soon

END