

A galaxy at redshift 10?

Brigitta Eder

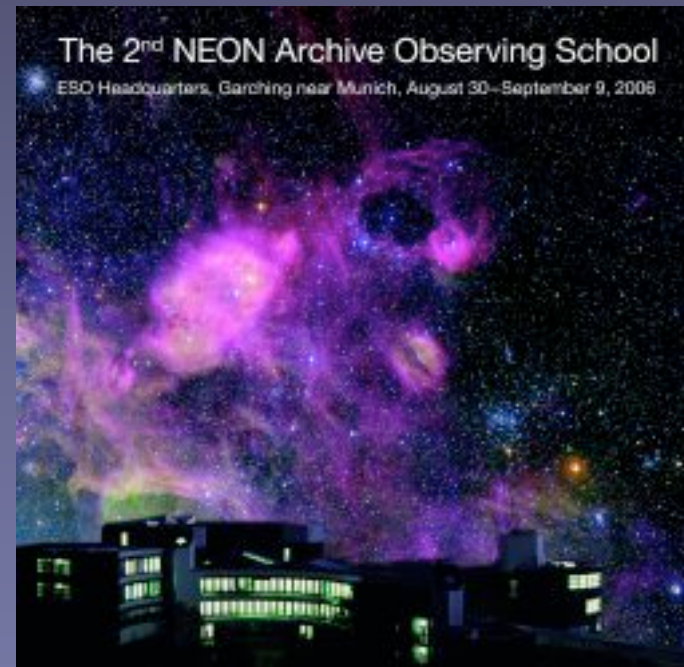
Vera Könyves

Juan Carlos Muñoz Mateos

Magdalena Polińska

Tutor:

Mischa Schirmer



ESO, Garching

08 September 2006

Overview

Presenting the data

Data reduction

Results

A&A 416, L35–L40 (2004)
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**Astronomy
&
Astrophysics**

ISAAC/VLT observations of a lensed galaxy at $z = 10.0^*$

R. Pelló¹, D. Schaerer^{2,1}, J. Richard¹, J.-F. Le Borgne¹, and J.-P. Kneib^{3,1}

¹ Laboratoire d'Astrophysique, UMR 5572, Observatoire Midi-Pyrénées, 14 Avenue E. Belin, 31400 Toulouse, France

² Observatoire de Genève, 51, Ch. des Maillettes, 1290 Sauverny, Switzerland

³ Caltech Astronomy, MC105-24, Pasadena, CA 91125, USA

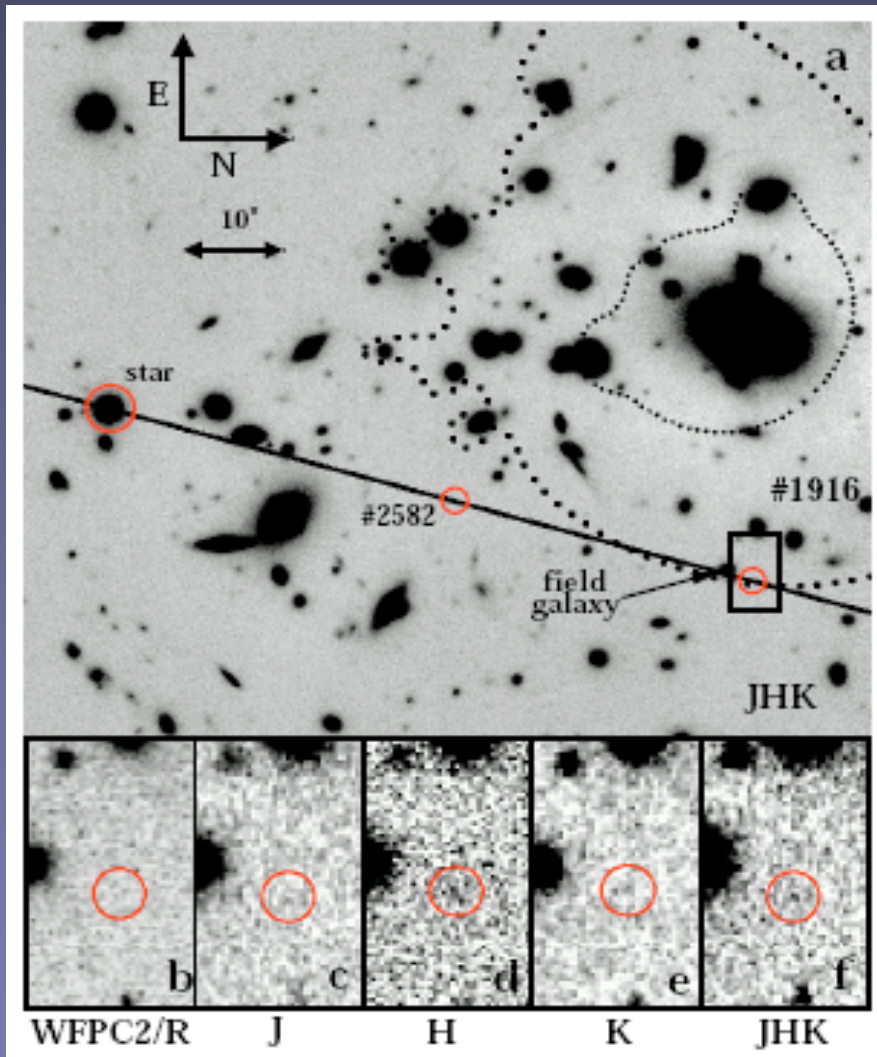
Received 20 January 2004 / Accepted 13 February 2004

The imaging of the lensing cluster A1835 was obtained at ESO/VLT with the NIR imaging spectrograph ISAAC.

Photometric data were complemented by deep VRI observations (CFHT) and R band (HST) images.

Overview

Pelló et al., 2004:



The core of the lensing cluster A1835 with the position of the slit used during spectroscopic survey.

Gemini H-Band Imaging of the Field of a $z = 10$ Candidate

Bremer M.N. et al. **2004**, *ApJ*

Reanalysis of the spectrum of the $z = 10$ galaxy

Weatherley S.J. et al. **2004**, *A&A*

Deep Very Large Telescope V-Band Imaging of the Field of a $z = 10$ Candidate Galaxy: Below the Lyman Limit?

Lehnert M.D. et al. **2005**, *ApJ*

Optical and Infrared Nondetection of the $z = 10$ Galaxy behind Abell 1835

Smith G.P. et al. **2006**, *ApJ*

Presenting the data

Instruments:

ISAAC – Infrared Spectrometer and Array Camera

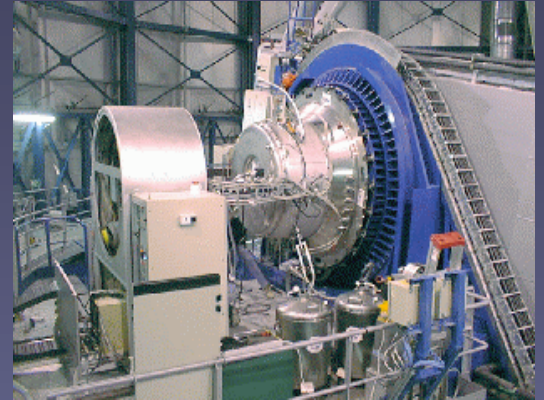
FOV 2.5 x 2.5 arcmin, 0.148 "/pixel

⇒ Z (1.06 μ m), J (1.25 μ m), H (1.65 μ m), K (2.2 μ m)

FORS1 – Focal Reducer/low dispersion Spectrograph 1

FOV 6.8 x 6.8 arcmin, 0.20 "/pixel

⇒ V (554nm)



Presenting the data

ESO Science Archive

about 800 files retrieved: 600 object exposures, 200 flat fields & biases

| | Image seeing ["] | Exp Time [ksec] |
|----|------------------|-----------------|
| V | 0.74 | 16.8 |
| Z | 0.58 | 5.5 |
| J | 0.49 | 11.0 |
| H | 0.53 | 13.9 |
| Ks | 0.40 | 27.0 |

IR data - Preparation for the reduction

- **sorting** out object data taken at different dates
- **retrieving** of flats obtained over the same period
- **reducing** them separately

Reduction software



THELI v.1.1.1

File Edit Settings View Reduction Miscellaneous Delete Help

Initialise Preparation Calibration Superflating Weighting Astrom / Photom Coaddition

Superflating, defringing

SCIENCE

OFFTARGET

Smoothing SIZE:

Smooth SUPERFLAT create fringe model

Superflat data

Defringe data

Subtract SUPERFLAT

Chop/Nod sky subtraction

Merge sequence (IR)

Collapse correction

Pattern:

Number of groups:

DT:

Commands that will be executed (you have the last word):

```
./parallel_manager.sh process_science_subsuperflat_eclipse  
./parallel_manager.sh process_collapsecorr_para.sh /scratch/
```

ISAAC@VLT

THELI v.1.1.1

File Edit Settings View Reduction Miscellaneous Delete Help

Initialise Preparation Calibration Superflating Weighting Astrom / Photom Coaddition

Weighting, cosmetics and target separation

SCIENCE

OFFTARGET

Saturation threshold:

Debloom images

Create global weights

Create binned mosaics

Binning: DS9

Create WEIGHTS

Distribute target sets

Minimum overlap:

Commands that will be executed (you have the last word):

```
./parallel_manager.sh create_global_weights_para.sh -m /scratch/ -f 2004_flat_k_nod  
./transform_ds9_reg.sh /scratch/ SCIENCE_Ks6  
./parallel_manager.sh create_weights_para.sh /scratch/ SCIENCE_Ks6 OFCUC
```

ISAAC@VLT 487 MB (+ sv)

THELI v.1.1.1

File Edit Settings View Reduction Miscellaneous Delete Help

Initialise Preparation Calibration Superflating Weighting Astrom / Photom Coaddition

Debiasing, flatfielding, creation of superflat

Do not apply BIAS / DARK

Do not apply FLAT

SCIENCE

OFFTARGET

min max

Process biases / darks

Process flats

Spread sequence (IR)

of groups | length:

Calibrate data

Use DARK

Calculate SUPERFLAT

DT: DMIN: SIZE: Median

Window size:

| Parameter | low | high |
|----------------------------|-----|------|
| FLAT (min max) | 0.6 | 1.4 |
| DARK (min max) | | |
| SUPERFLAT (min max) | | |
| WEIGHT thresh (low high) | | |
| OVERSCAN (nlow nhigh) | 0 | 1 |
| BIAS/DARK (nlow nhigh) | 0 | 1 |
| FLAT (nlow nhigh) | 0 | 2 |
| SCIENCE (nlow nhigh) | 0 | 2 |

Override the FLAT directory specified in "Initialise":

Reset fields Abort

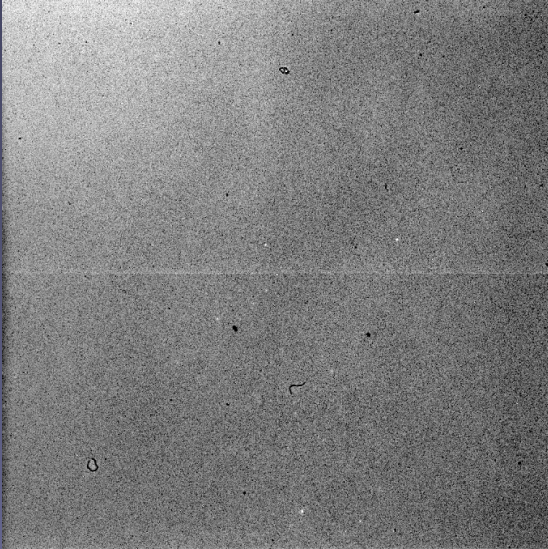
THELI messages

Commands that will be executed (you have the last word!)

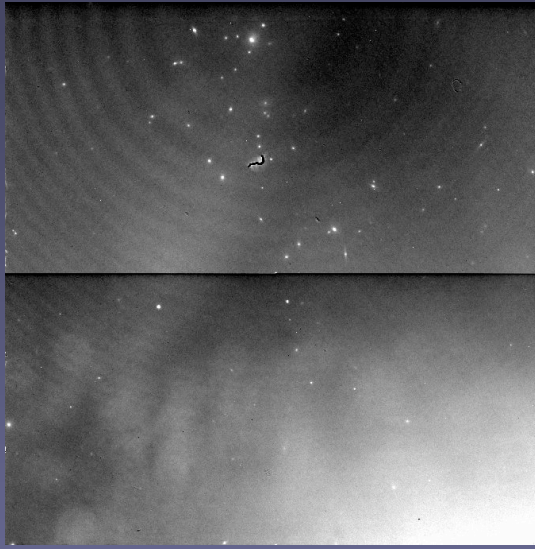
```
./check_files.sh /scratch/ 2004_flat_k 8000 35000  
./parallel_manager.sh process_flat_eclipse_para.sh /scratch/ 2004_flat_k  
./parallel_manager.sh create_norm_para.sh /scratch/ 2004_flat_k  
./parallel_manager.sh process_science_para.sh /scratch/ BIAS 2004_flat_k SCIENCE_Ks6  
./parallel_manager.sh create_norm_para.sh /scratch/ SCIENCE_Ks6
```


Data reduction

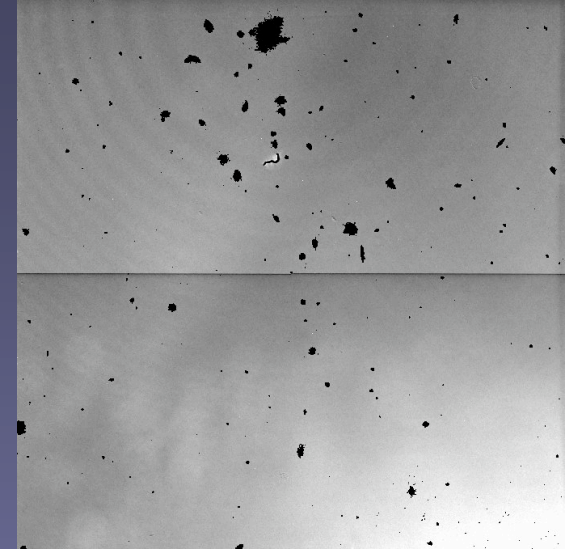
1. Raw scientific frame



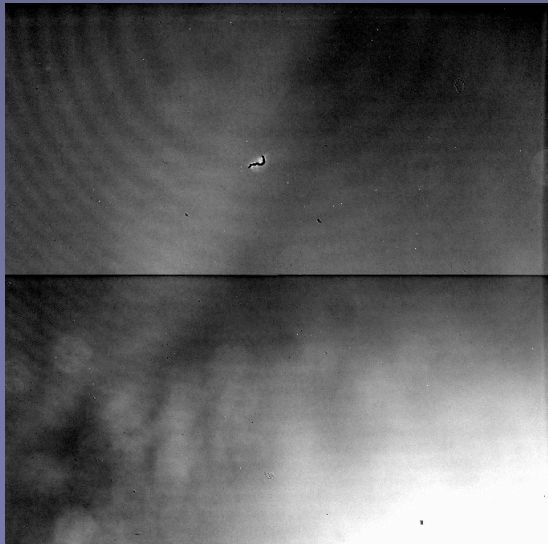
2. Flatfielded frame



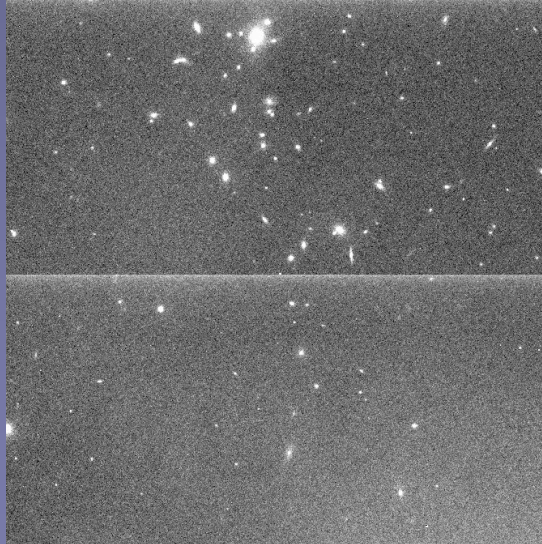
3. Object mask



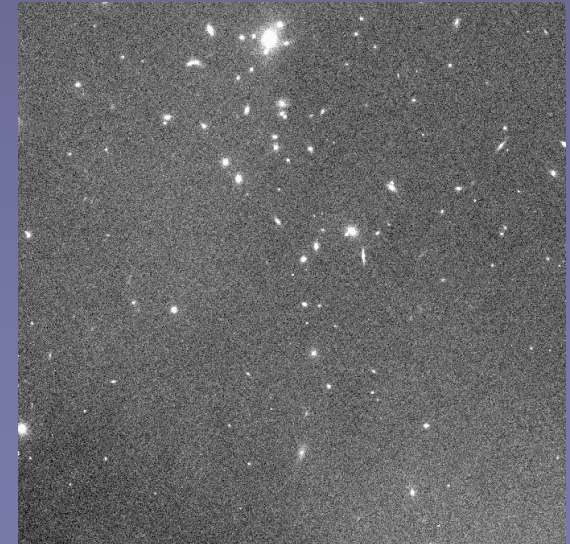
4. Sky model



5. Sky model subtracted

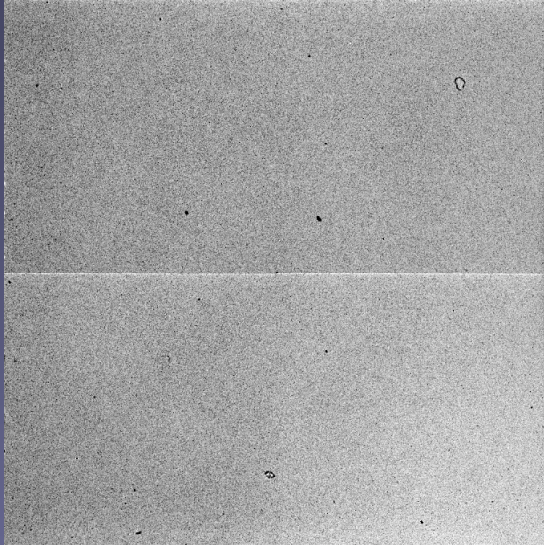


6. Collapse correction



Data reduction

7. Weight map

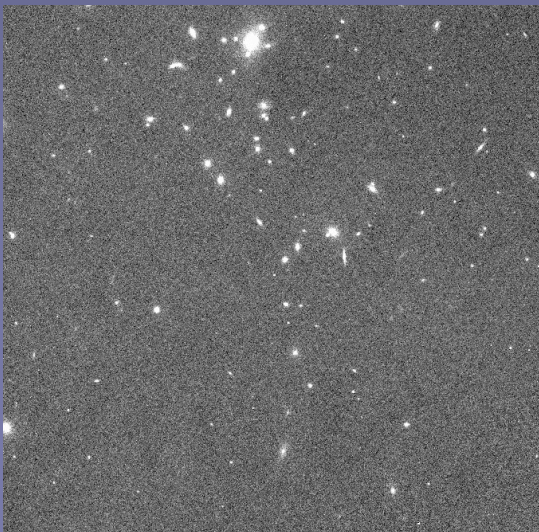


8. Astrometry

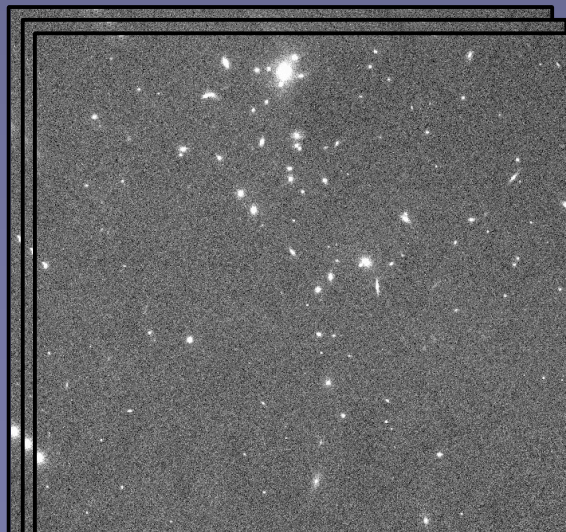
Objects are detected in each image and matched with the USNO – B1 astrometric catalog.

Finer alignment and resampling is performed by measuring the residual shifts between the objects in each frame.

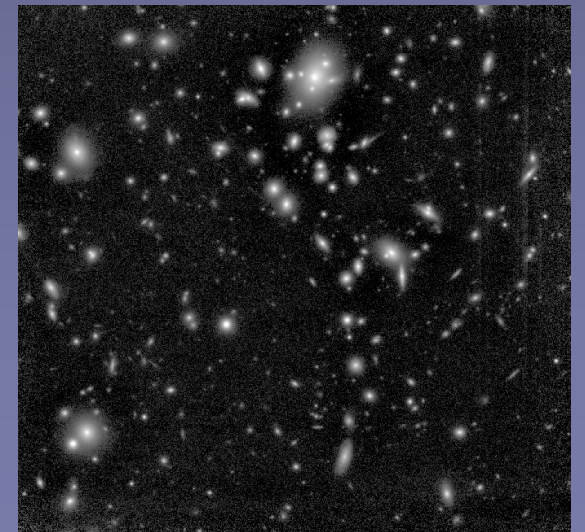
9. Final sky subtraction



10. Coadding

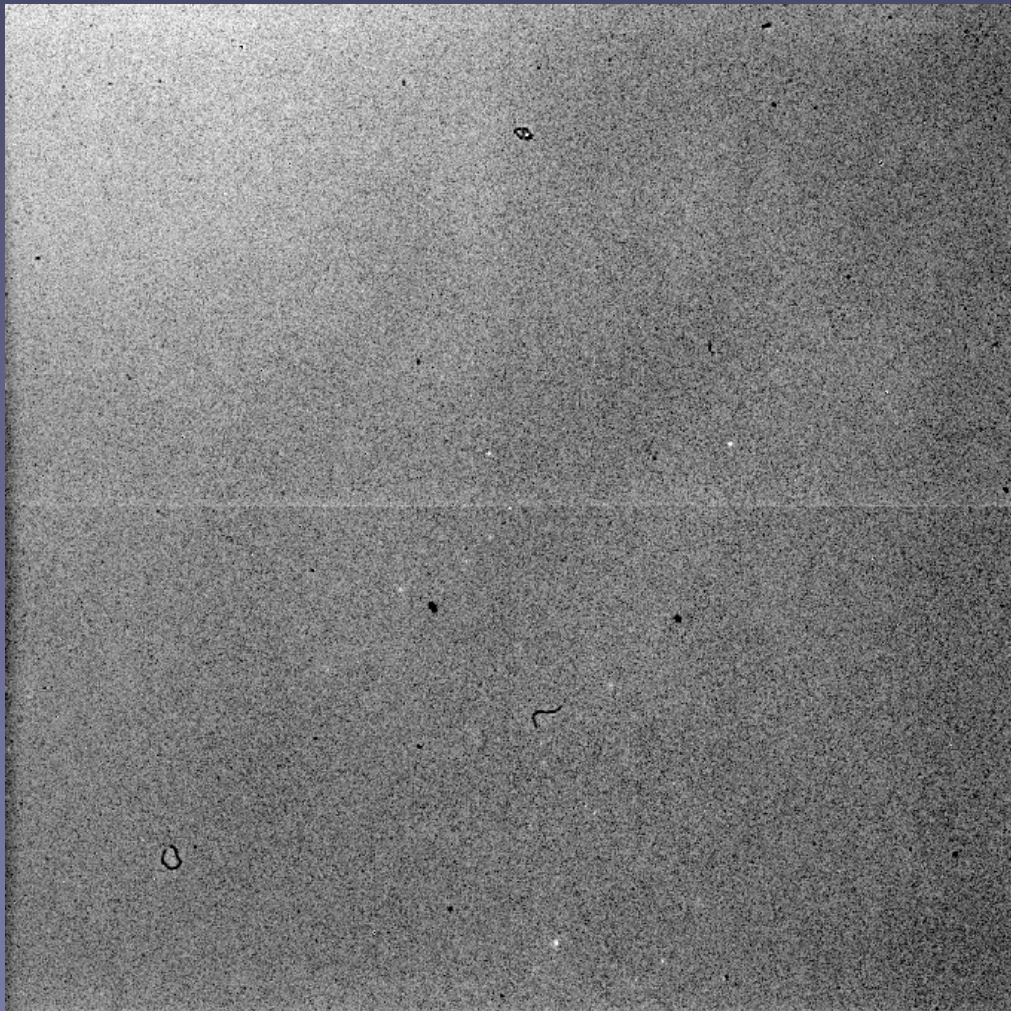


11. Final image

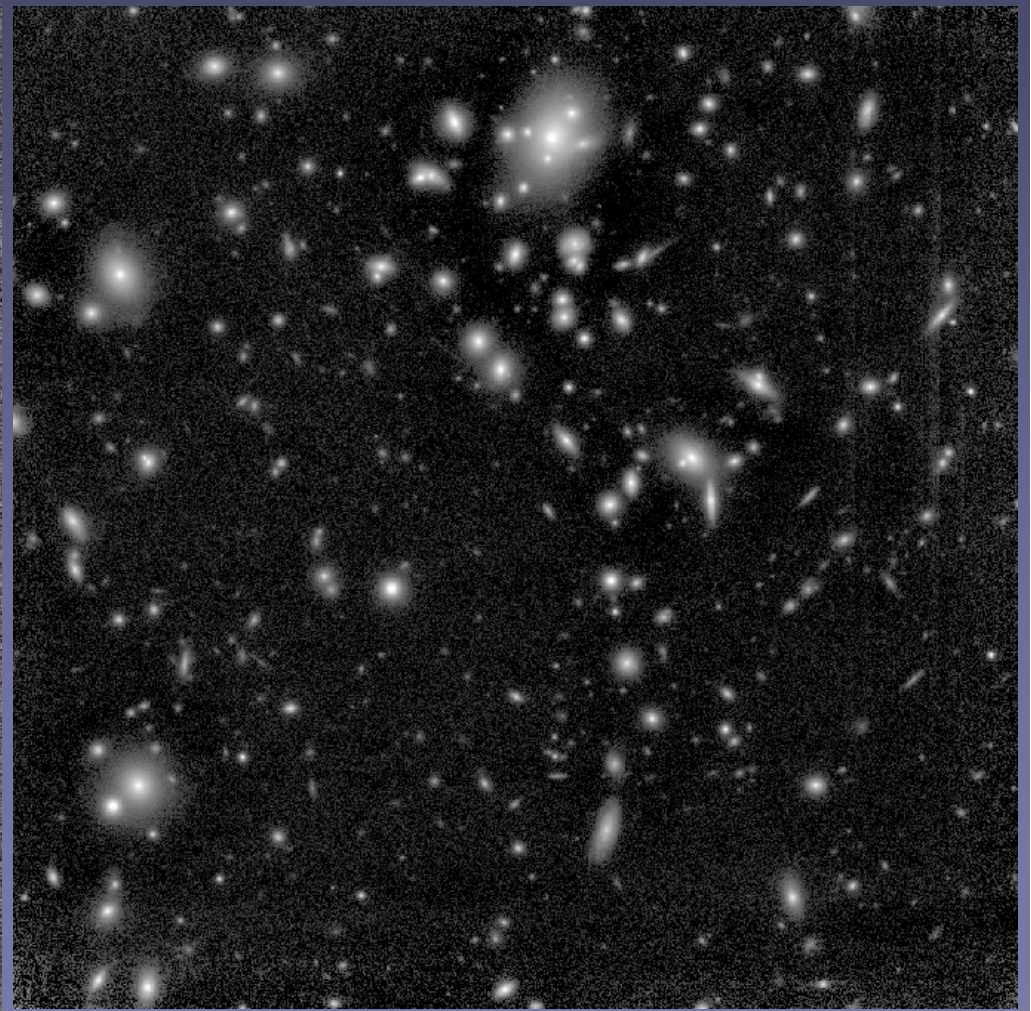


Data reduction

We began with this ...

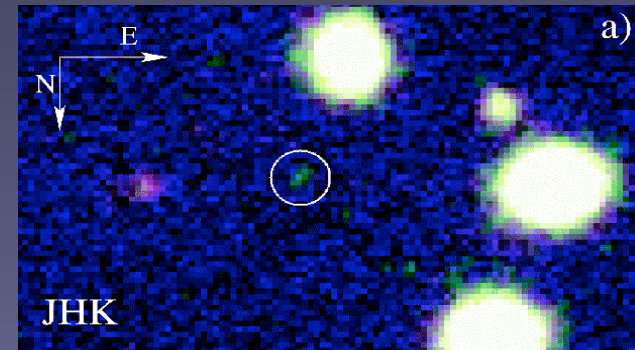
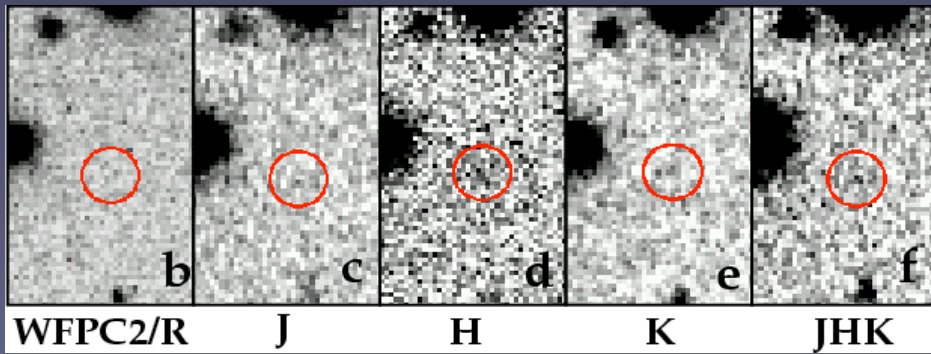


... and ended up with this.

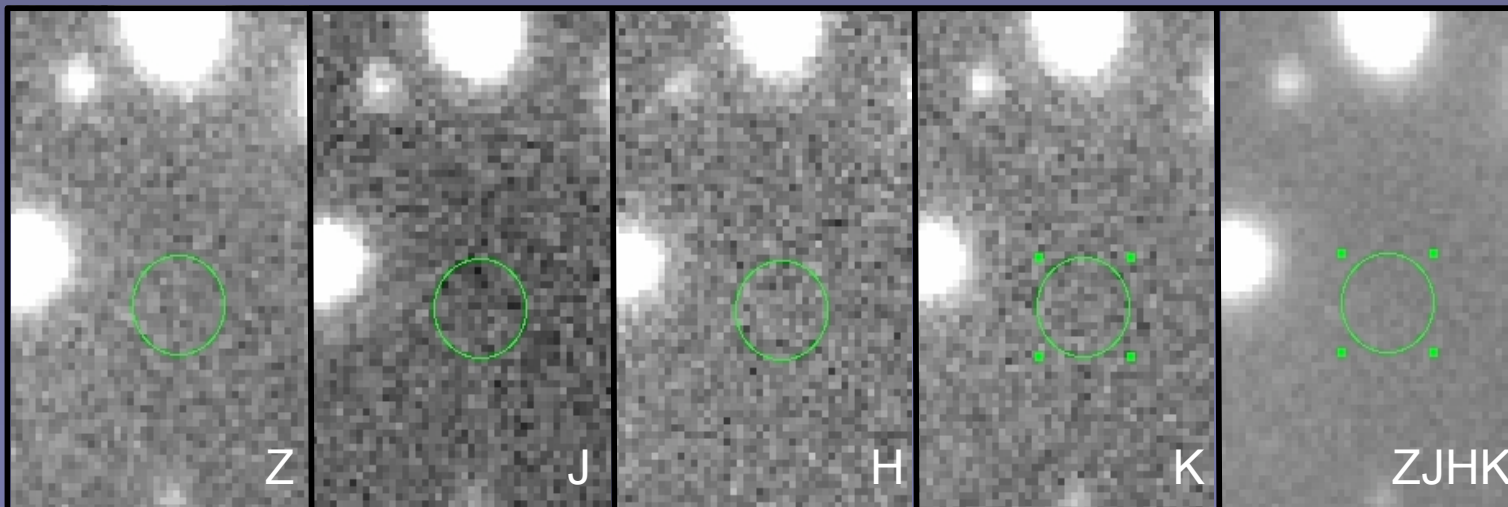


Results

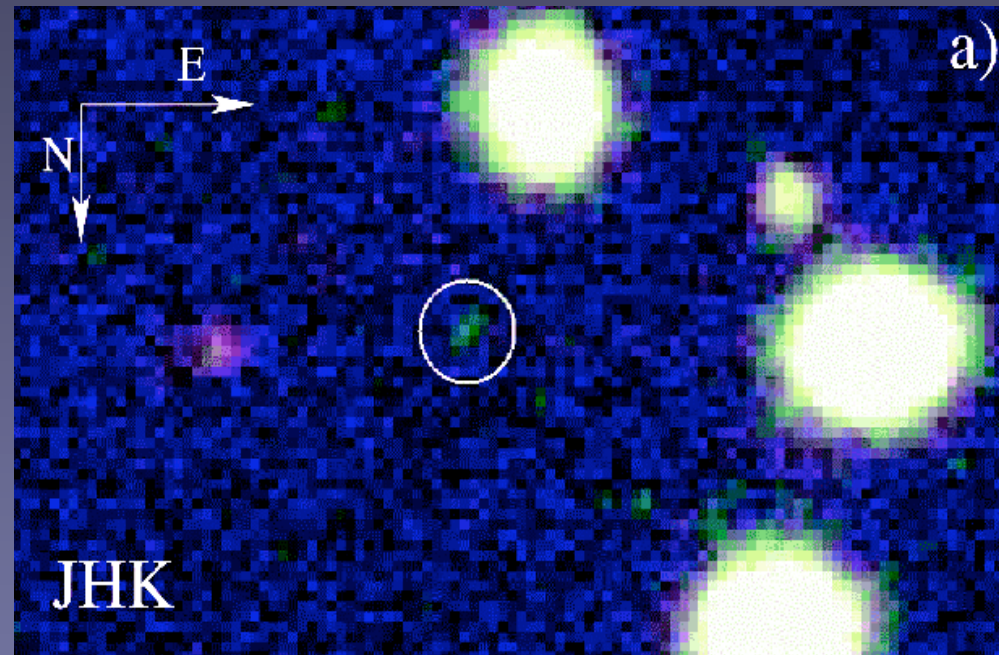
Pelló et al., 2004:



Our reduced data:



Results



Pelló et al., 2004

The $z = 10$ galaxy was **not detected!**

Results of the “extra” work

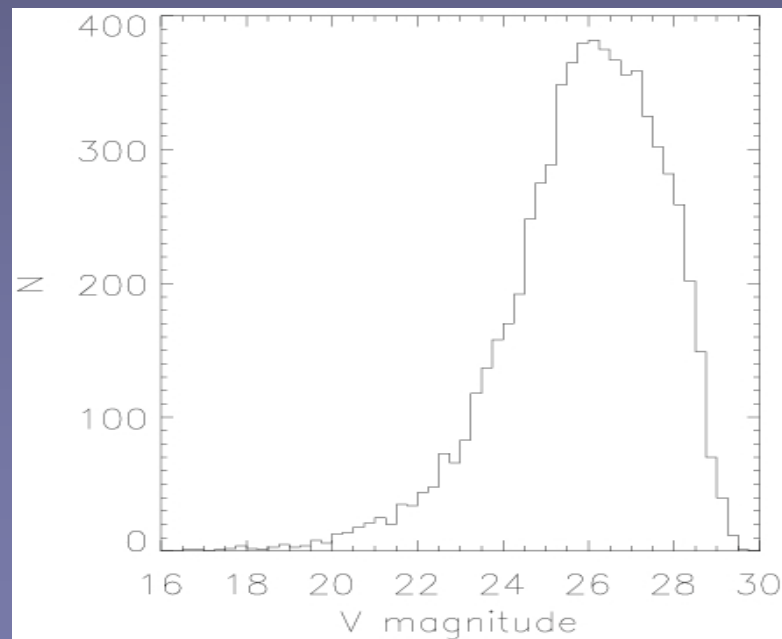
We ran SExtractor in order to determine the limiting magnitudes

| | |
|------------------|----------|
| DETECT_MINAREA | 4 |
| DETECT_THRESHOLD | 1 |
| DEBLEND_MINCONT | 0.000005 |

Limiting magnitudes
for the 5 bands:

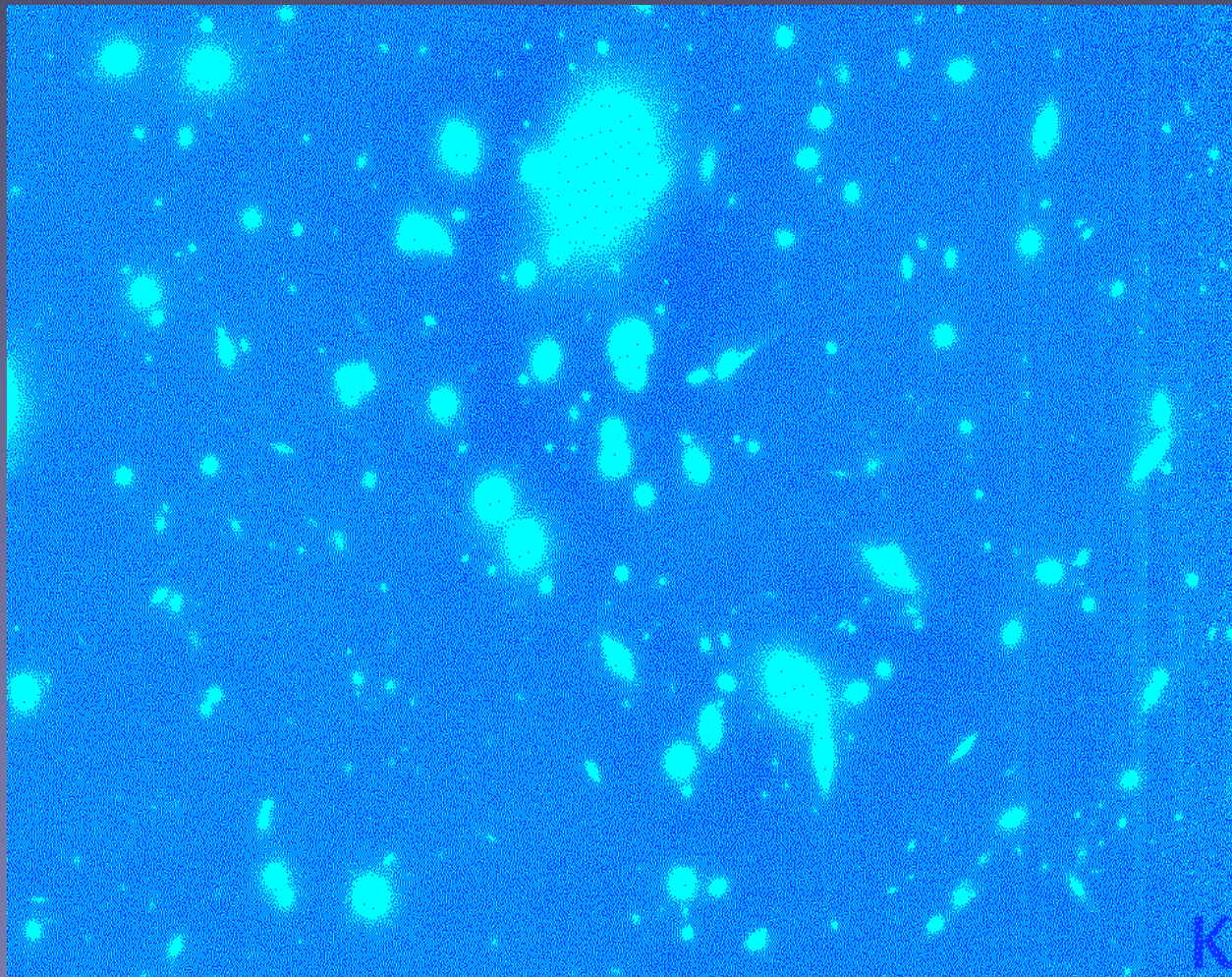
| | |
|----|----------|
| V: | 28.3 mag |
| Z: | 25.8 mag |
| J: | 26.8 mag |
| H: | 26.7 mag |
| K: | 25.5 mag |

Galaxy number counts

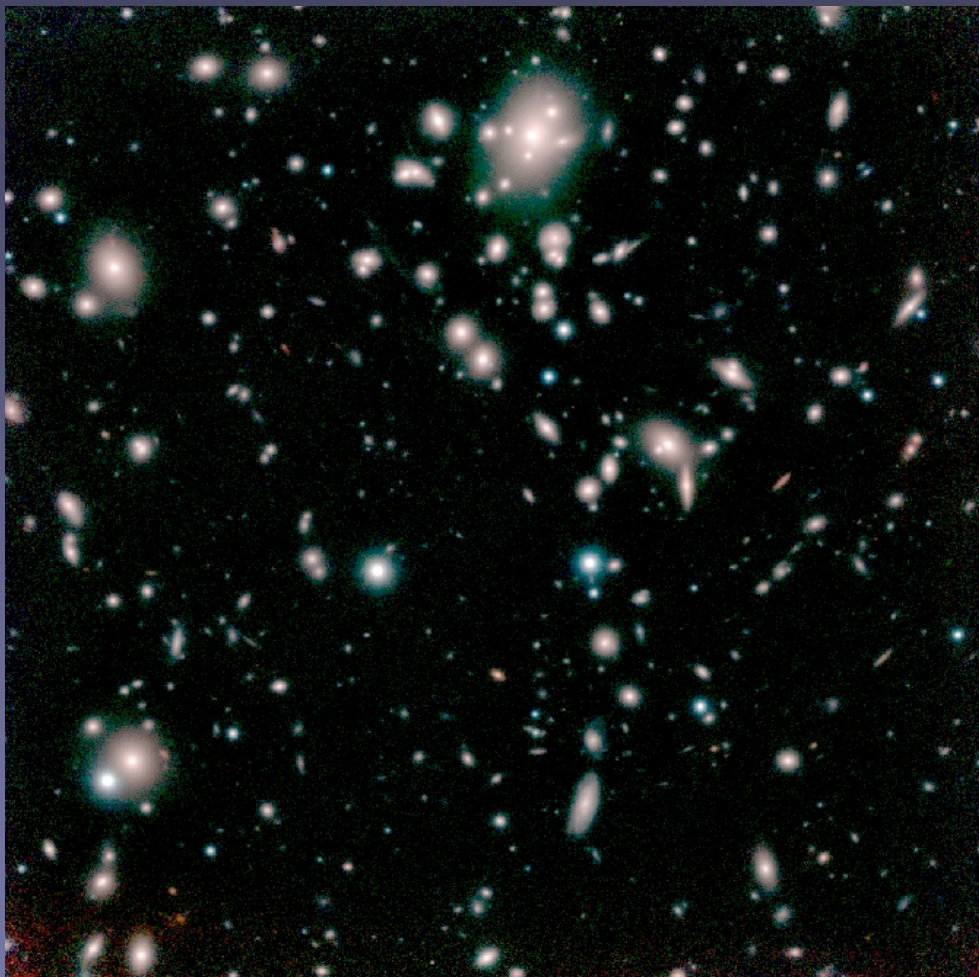


Results of the “extra” work

Search for drop-outs in different filters by blinking



Results of the “extra” work



ZJH color image

VJH color image

