Precise astrometry in star clusters from century long observations: M15

Grigor Nikolov
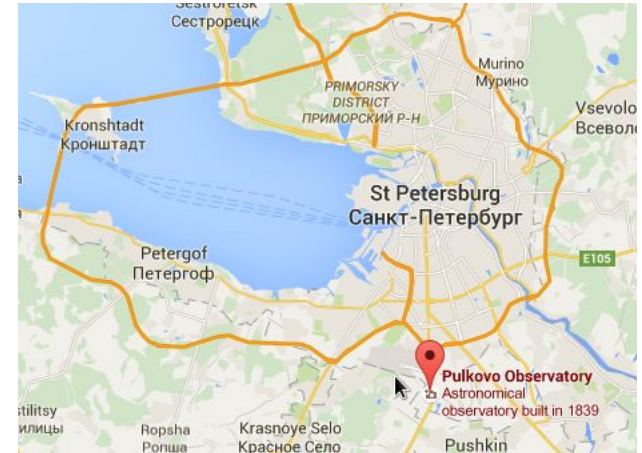Institute of Astronomy and National Astronomical Observatory, BAS

Data from Pulkovo Observatory

Normal Astrograph 1893, St.Petersburg

D = 330 mm, F = 3467 mm

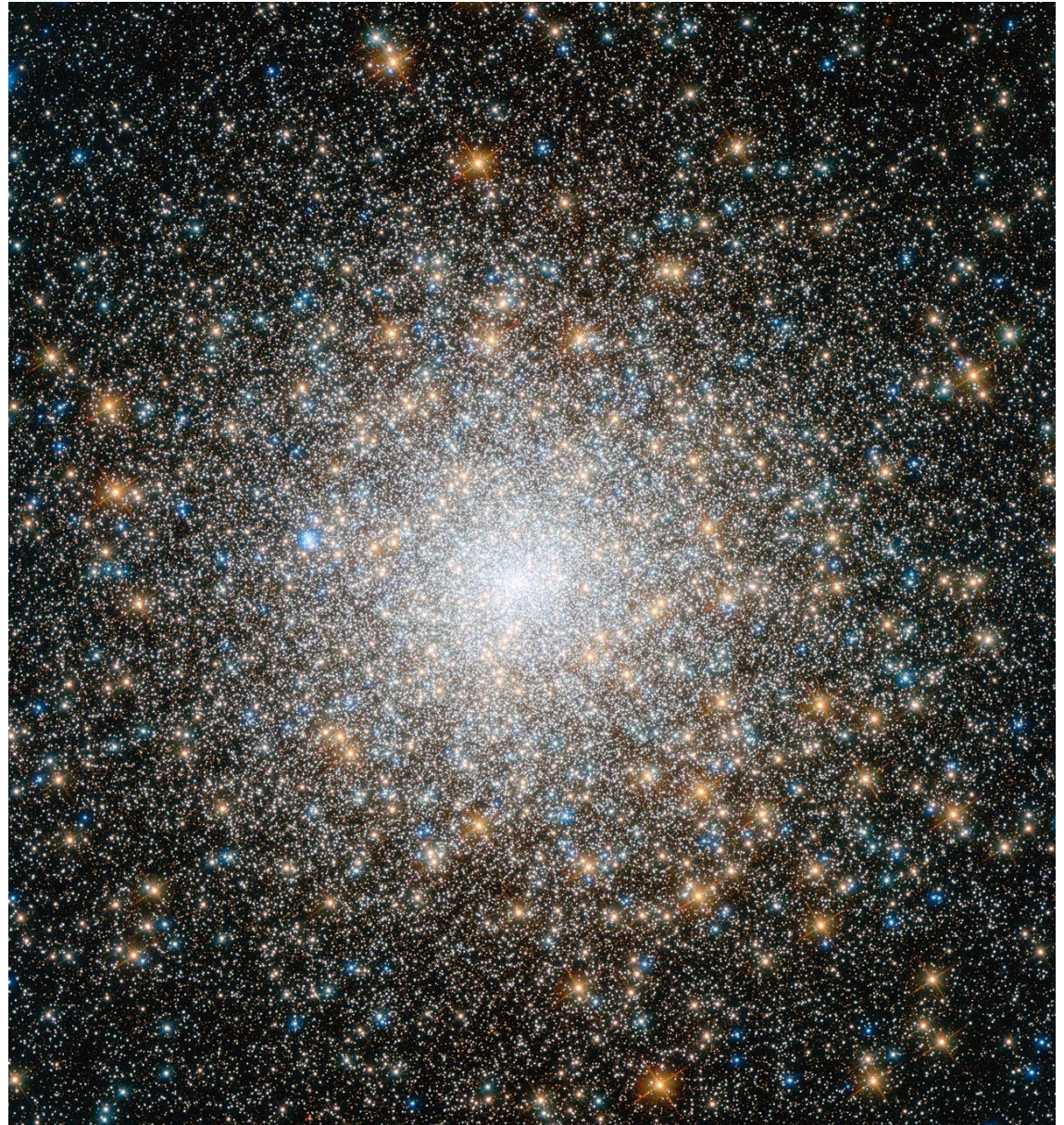**Plate 160 x 160 mm**

2° x 2° FOV (cropped to 50 x 50 arcmin)

M15

Age 12.5 Gyr

Distance 10.4 kpc

1 px = 0.155285 ly

Rc = 4.27 pc, Rt = 54.98 pc

RV = -107.0 (0.20) km/s

Data and scans

Emulsion = ORVO (ORWO)

Phot system = B

List of observations:

1935 11 22 PUL-241   60s

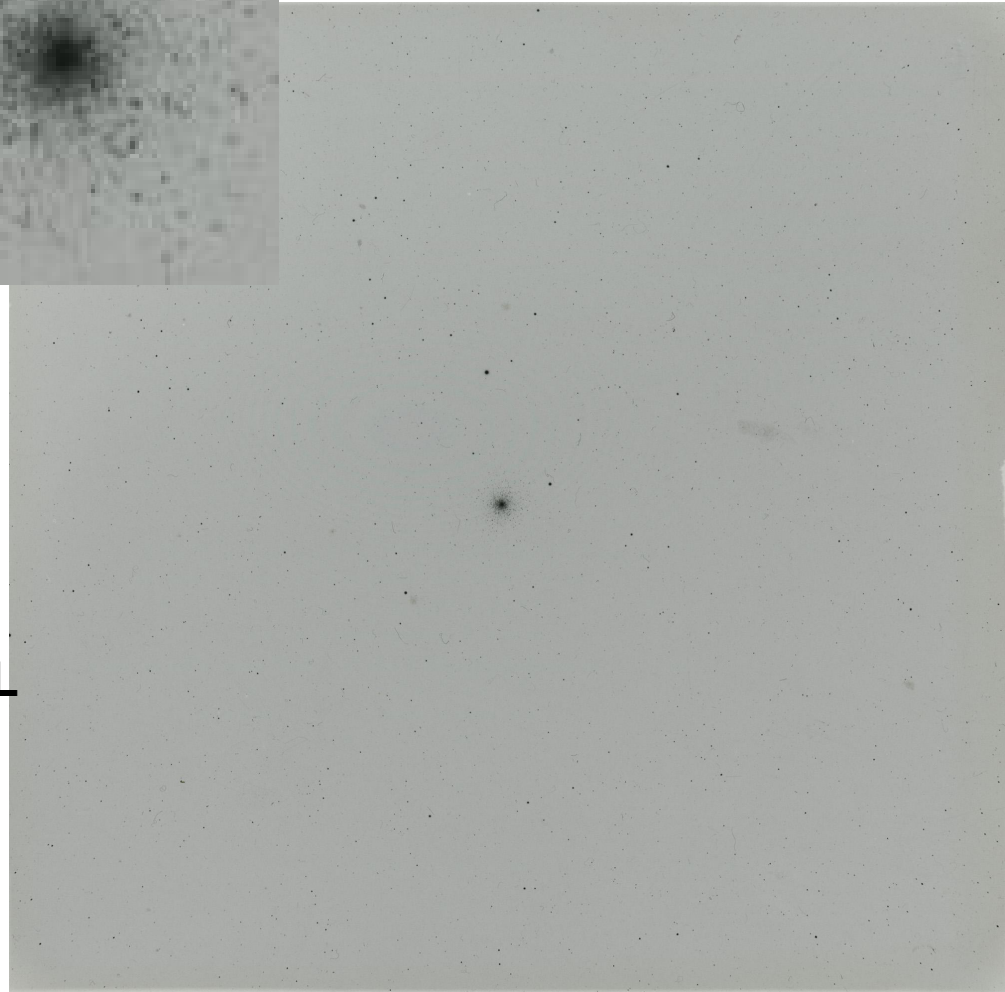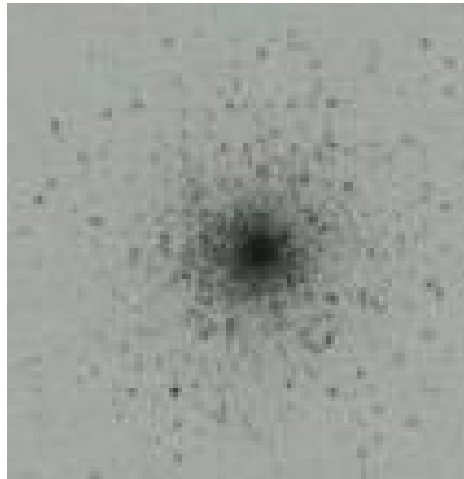**1937 10 23 PUL-419   60s**

1968 09 30 PUL-8741 35s

1979 12 08 PUL-12289 40s

1980- 08 08 PUL-12659 60s

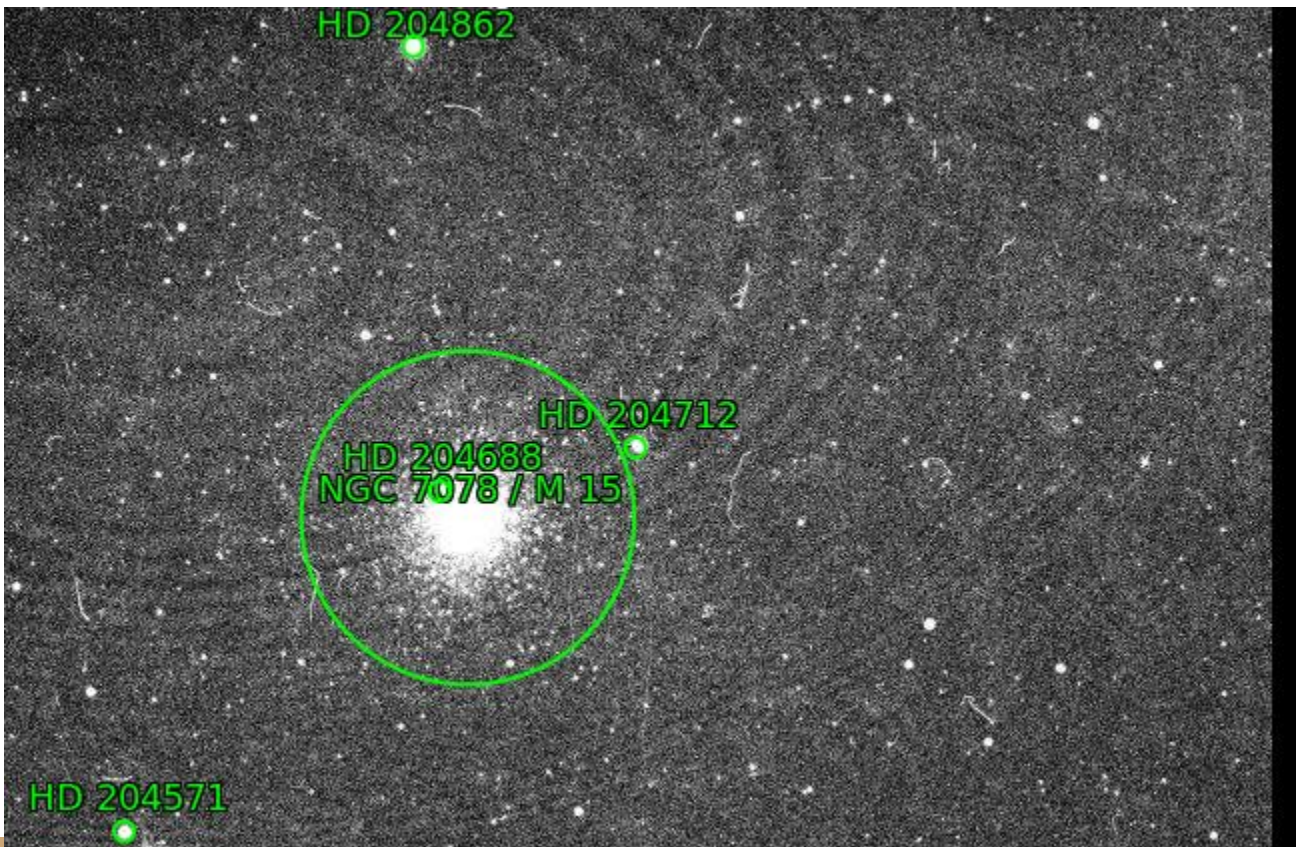**Scanner EPSON Expression 10000XL resolution 1600 dpi, ~8000 x 8000 px**

Scale 0.945 arcsec/px

Astrometry.net

Identification of cropped image

WCS headers

as " crop419.fits " (Submission 1034921)
under *Attribution-NonCommercial-NoDerivs 3.0 Unported*

publicly visible: yes | **no**

Job Status

Job 1508973:
Success

Calibration

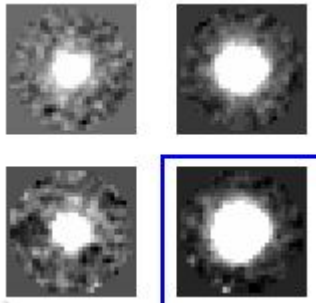|	
Center (RA, Dec):	(322.410, 12.267)
Center (RA, hms):	21^h 29^m 38.297^s
Center (Dec, dms):	+12° 16' 01.546"
Size:	47.3 x 47.3 arcmin
Radius:	0.557 deg
Pixel scale:	0.945 arcsec/pixel
Orientation:	Up is -90.9 degrees E of N

Photometry I
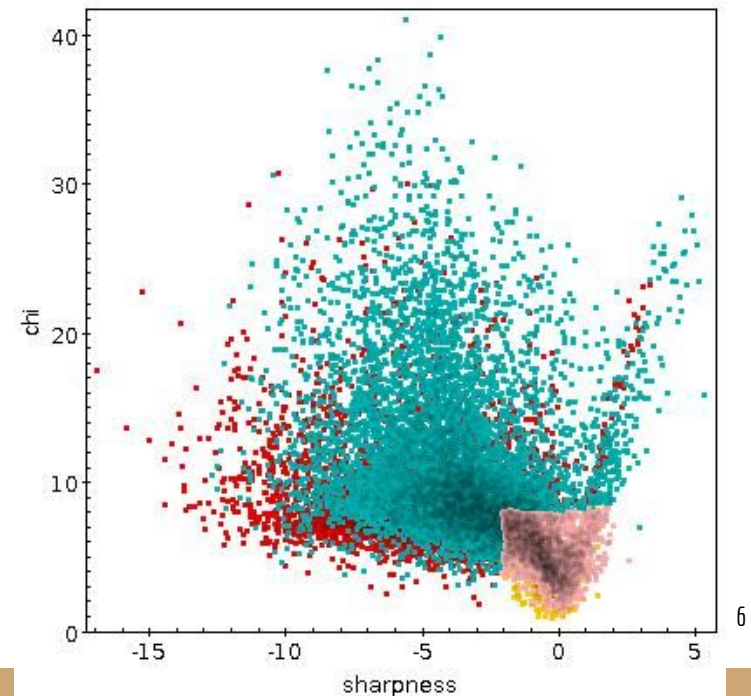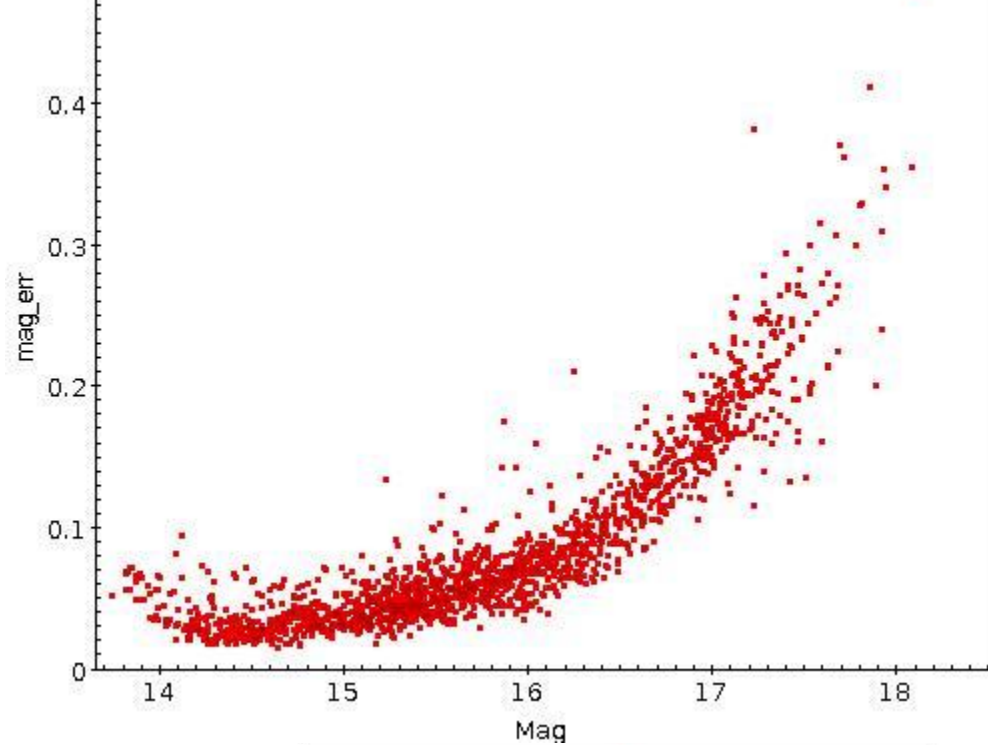
IRAF cropped

Precise positions of stars

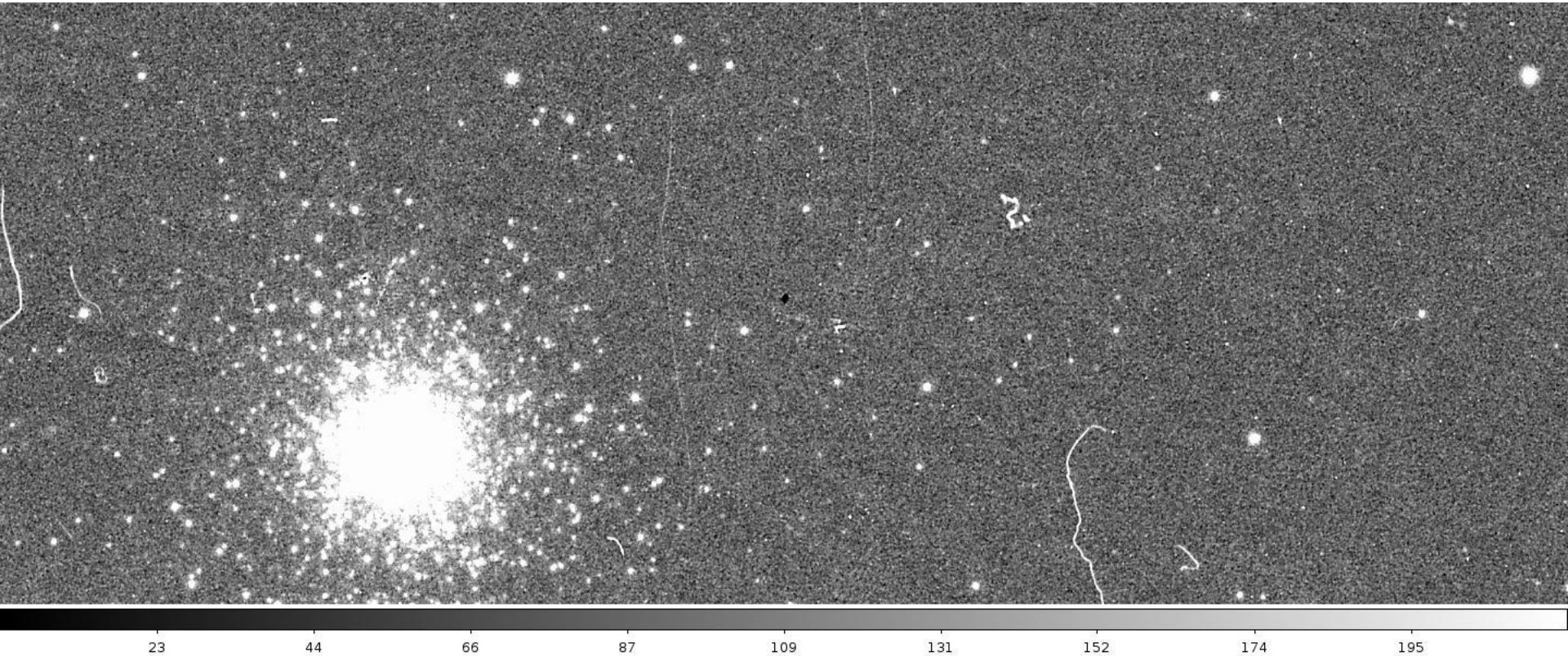**Individual PSF per image**

Varying PSF in 2D

Photometry of 5000-9000 objects

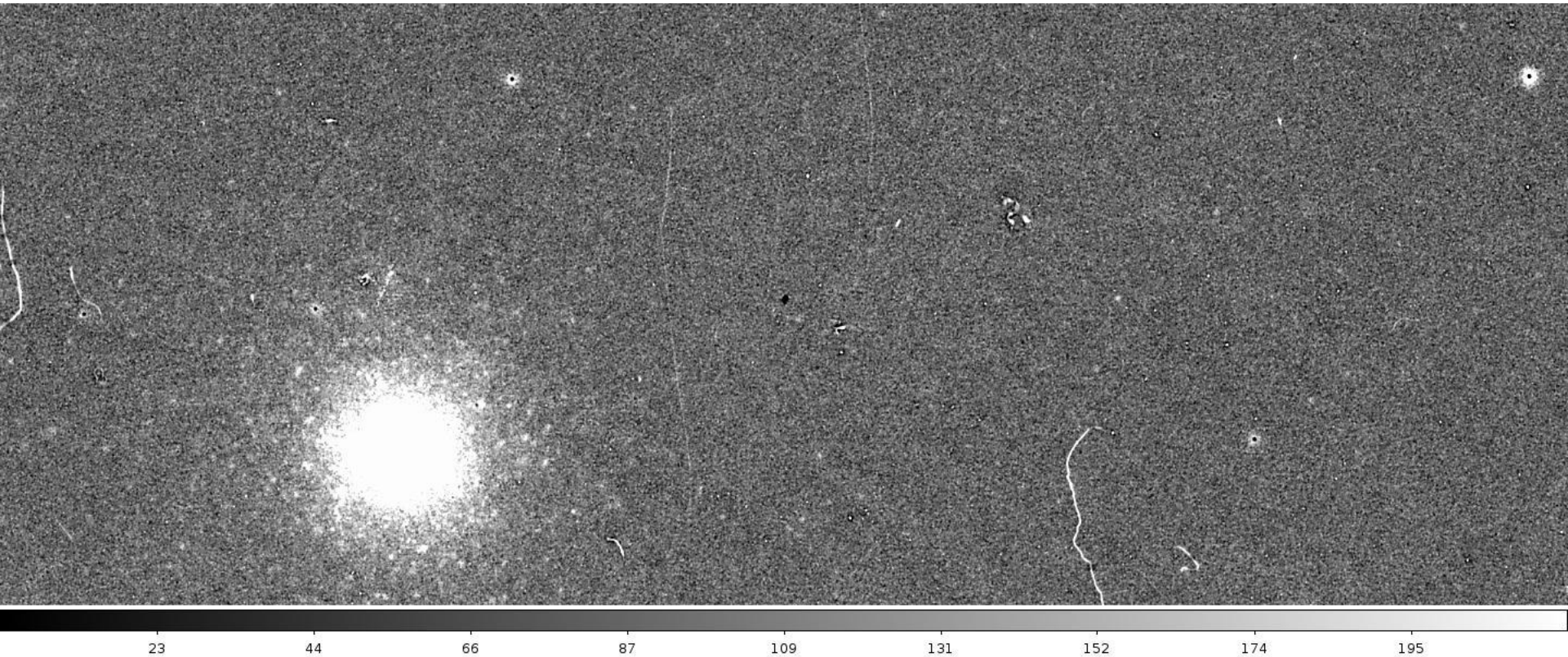**2000-3000 after quality cleanup**

Photometry II

Original

Photometry II

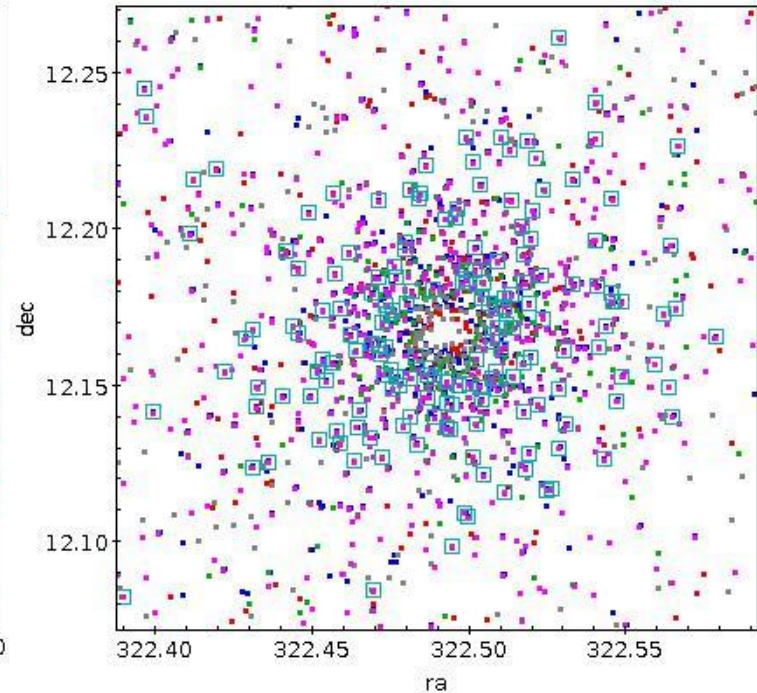**Detections**
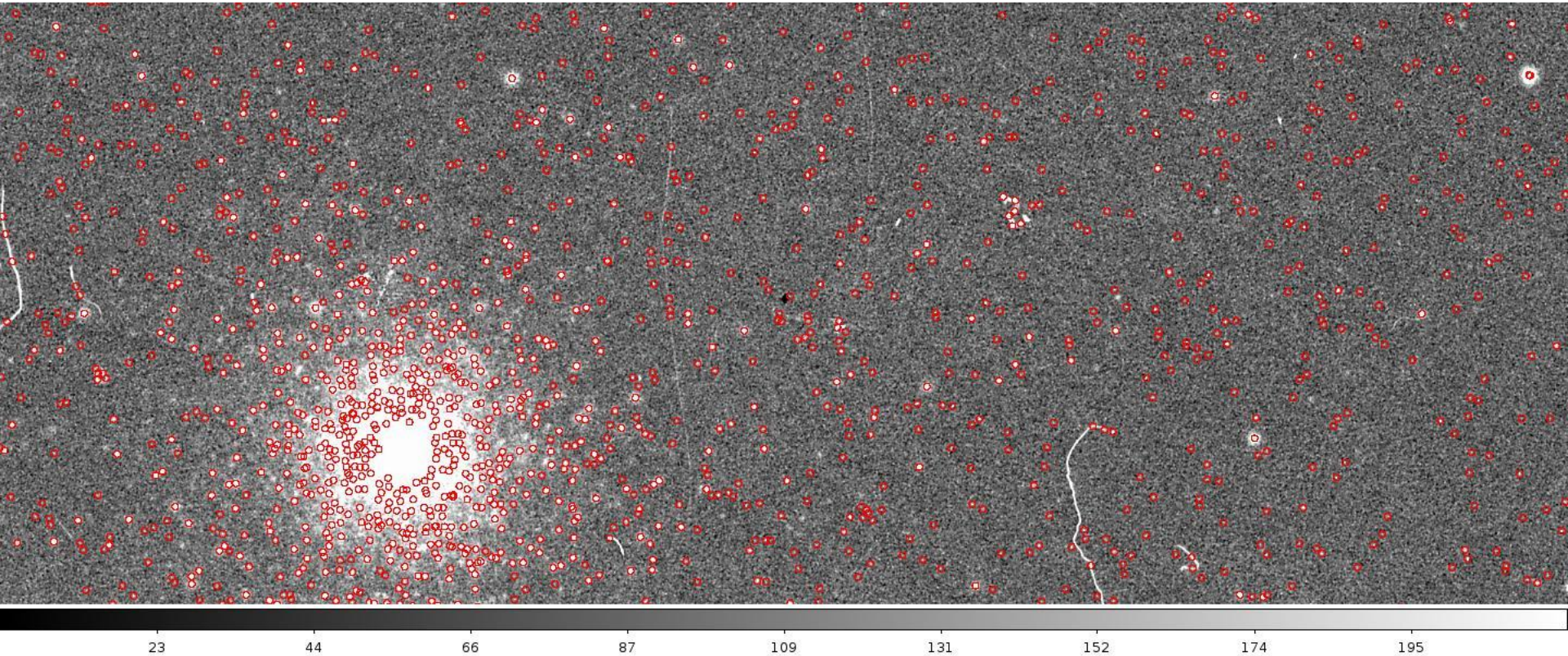
Photometry II

Stars subtracted

Matching

No bright ExGal objects in field

TopCat matching
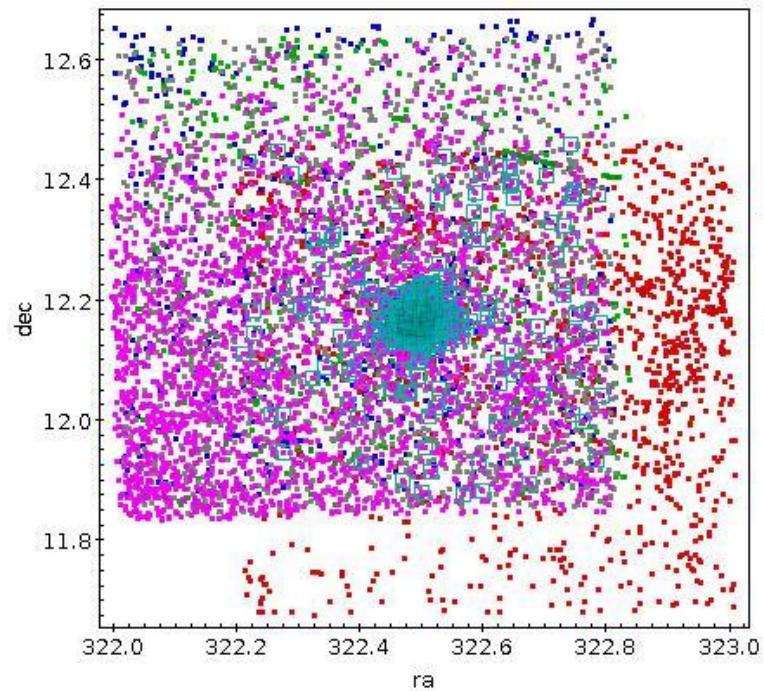
results

1937 Reference frame

Mean (arcsec):
1935: -0.57 0.14
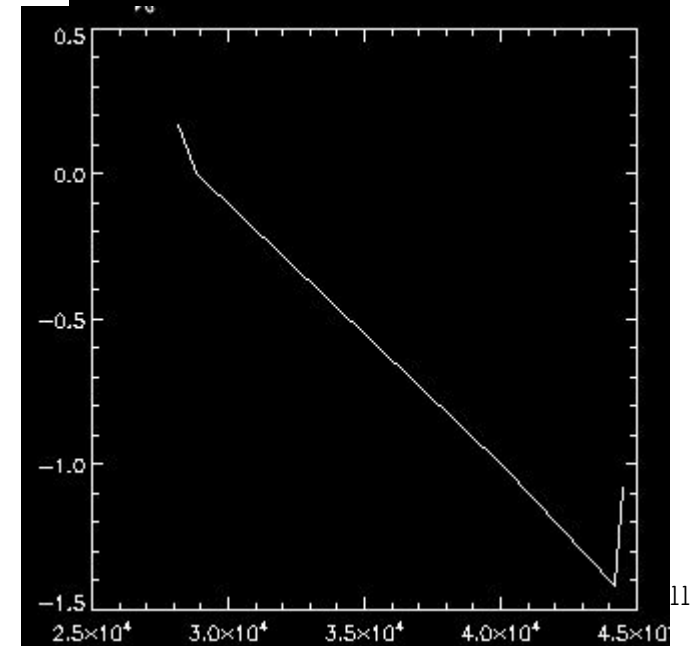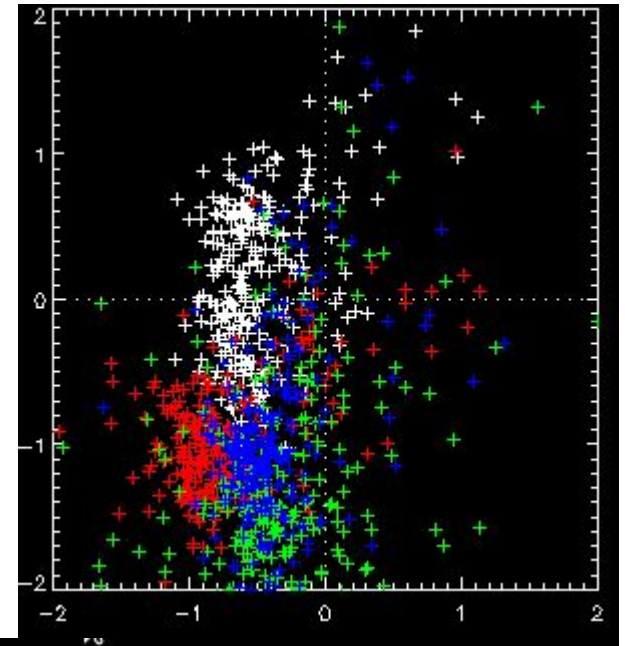**1968: -0.80 -0.95**

1979: -0.40 -1.29
1980: -0.45 -1.00 (poor seeing)

Kharchenko+, 2013: -0.46 -4.98 mas/yr

Conclusion

We are able to construct individual PSF for every single observation, taking into account guiding, seeing conditions.

Able to identify same stars and determine their differential positions.

Preliminary results: more targets available

Future work: complement with high spatial resolution images, ground/space based, VO

Thank you for your attention!

acknowledgements: