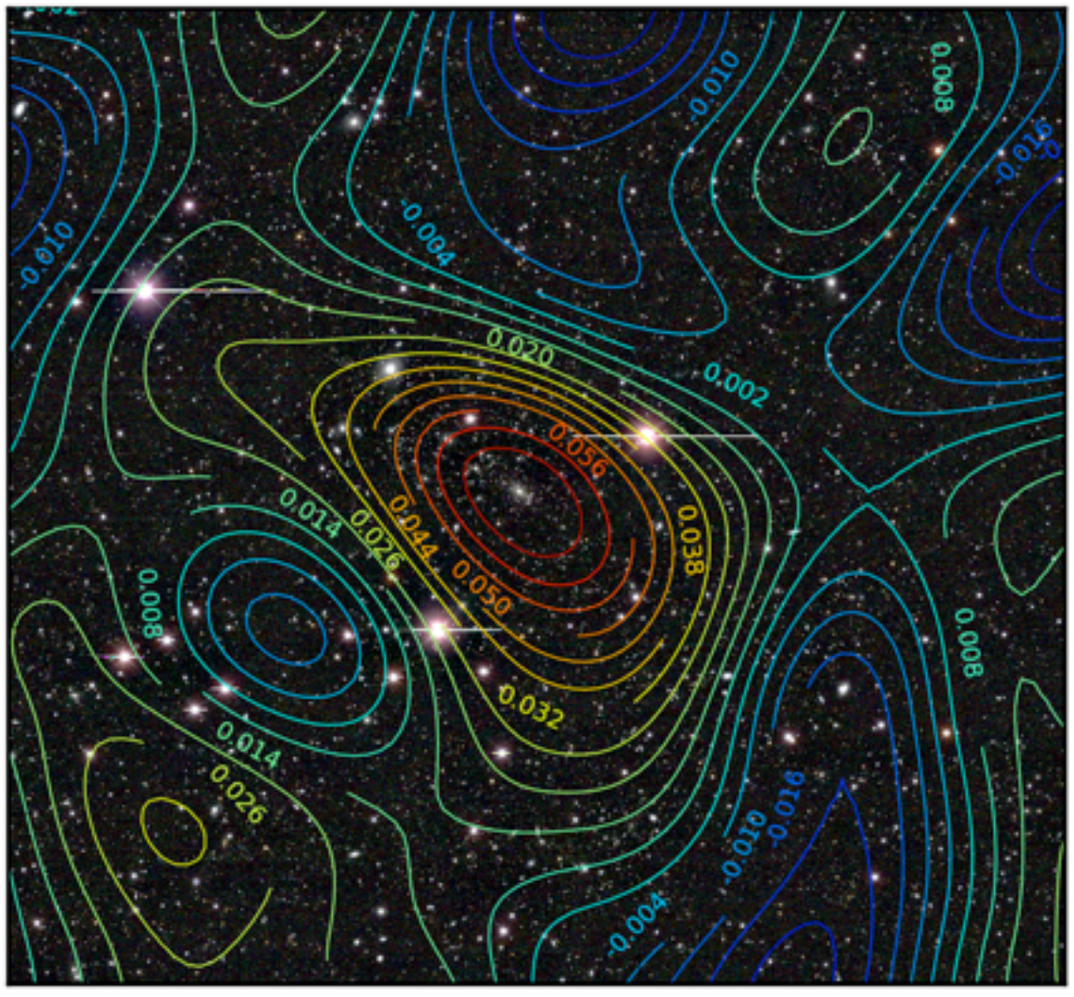
Can we do lensing with DECam?



Eric Suchyta

THE OHIO STATE UNIVERSITY

Bob Armstrong
David Bacon
Keith Bechtol
Sarah Bridle
Fabrice Brimioulle
Joseph Clampitt
Daniel Gruen
Michael Hirsch
Klaus Honscheid
Eric Huff
Bhuv Jain
Mike Jarvis
Stephanie Jouvel
Tomasz Kacprzak
Elisabeth Krause
Huan Lin
Peter Melchior (lead)
Niall McCrann
Ken Patton
Andres Plazas
Barnaby Rowe
Eduardo Rozo
Eli Rykoff
Stella Seitz
Rafal Szepietowski
Vinu Vikram
Harry Wilcox
Julia Young
... and the DES SV squad

Clusters in Science Verification

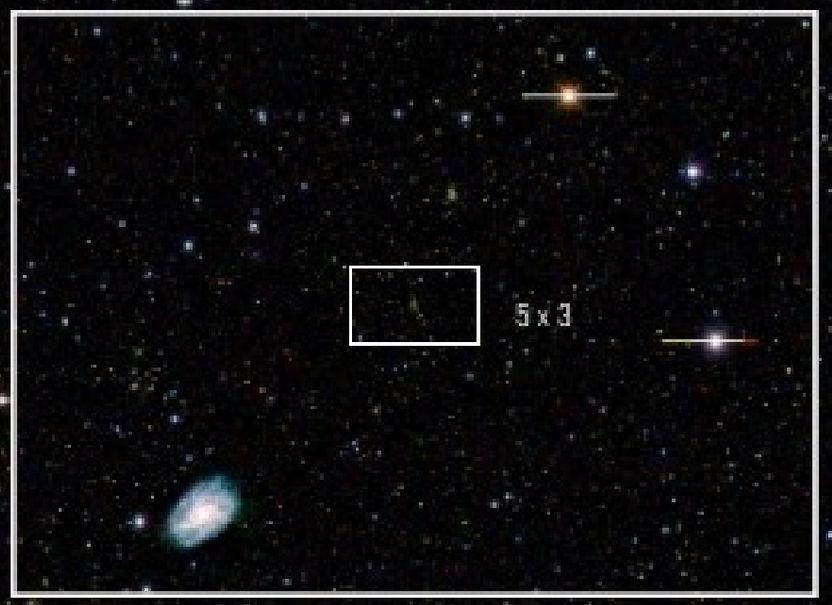
1. validate the data quality delivered by DECam for the purpose of galaxy cluster and lensing studies

2. utilize the large FoV of DECam to create light and mass maps over more than 2 square degrees around massive clusters


5 x 3 arcmin

5 x 3

30 x 20 arcmin



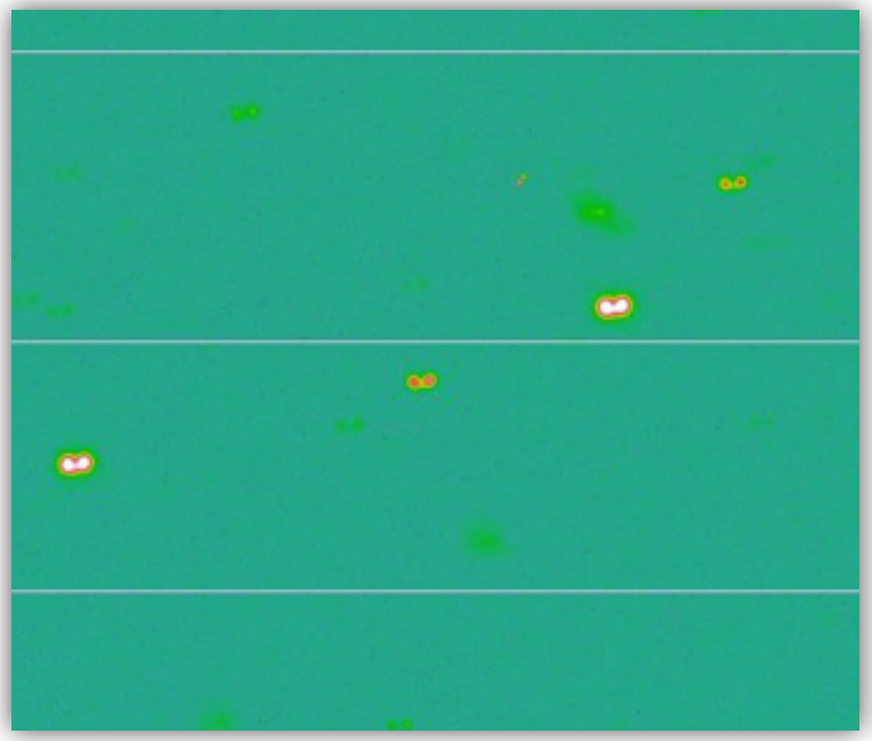
30 x 20

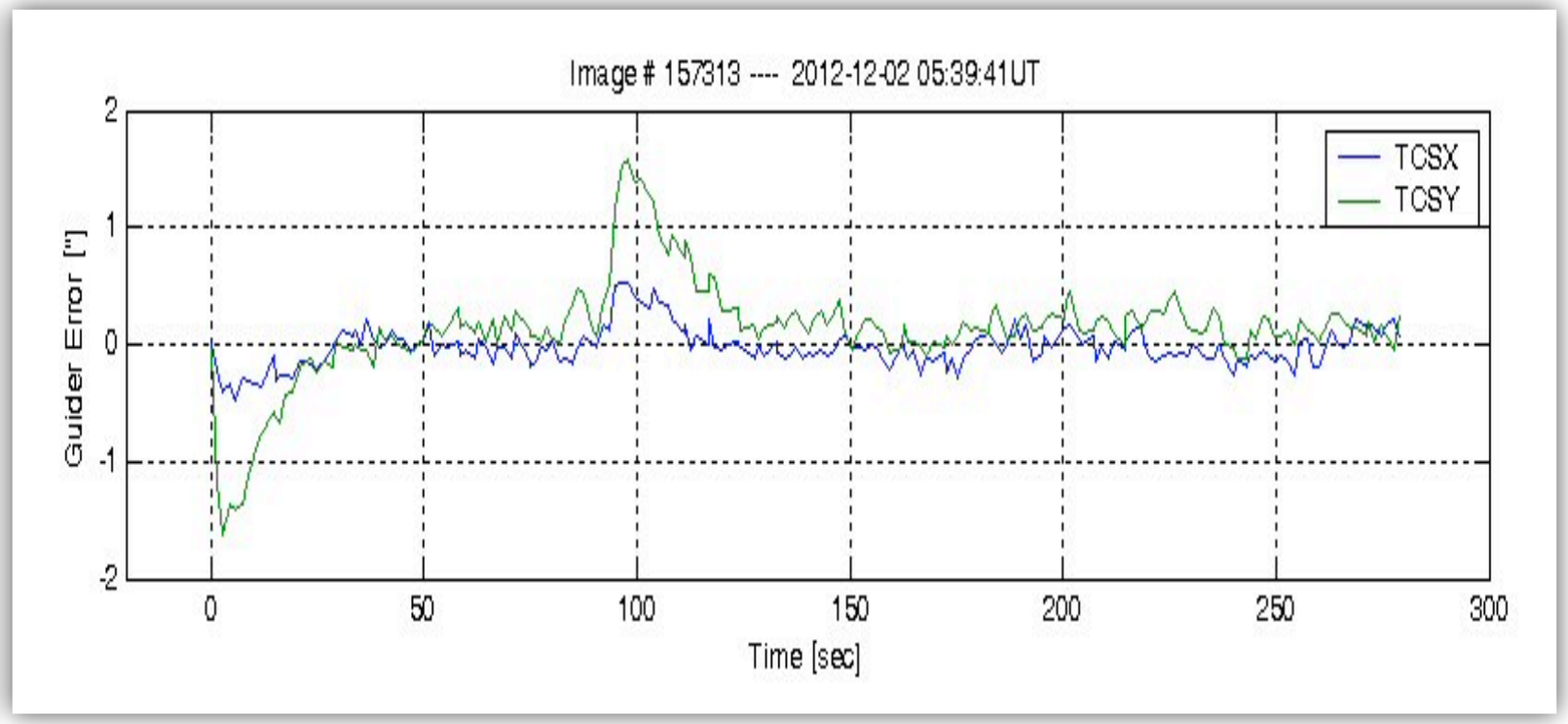
90 x 60 arcmin

30 x 20

90 x 60 arcmin

Early data issues

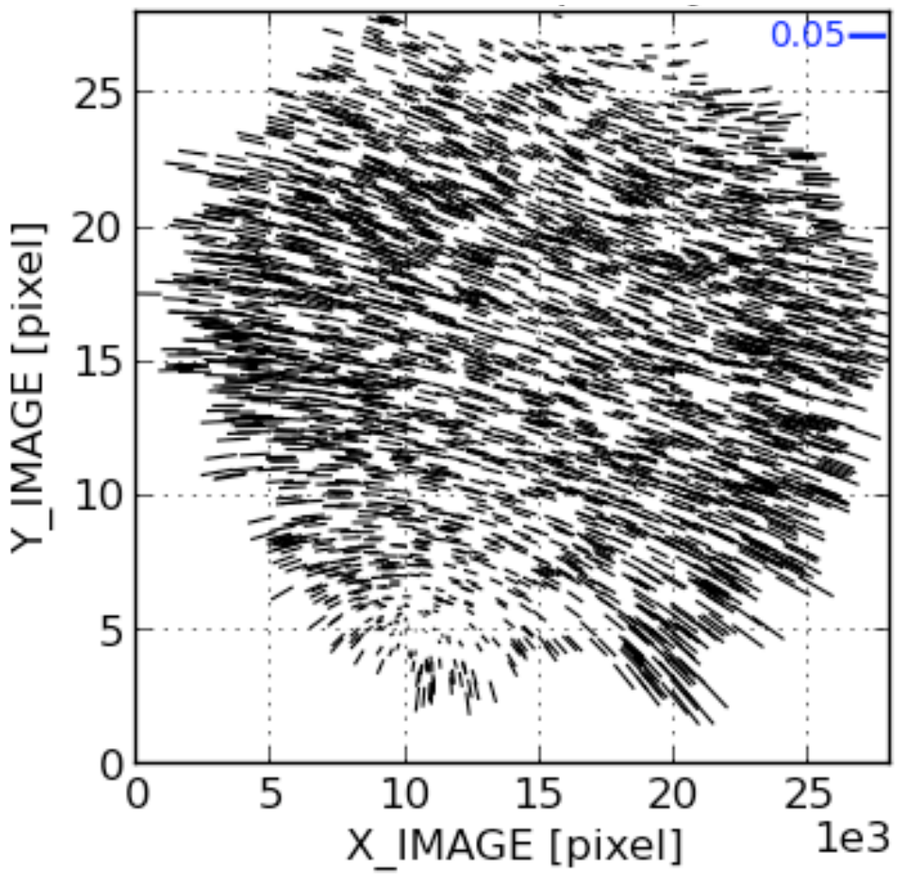




November 2012:

- early data affected by “guider jumps”
- tracking performance not as desired

Early data issues



November 2012:

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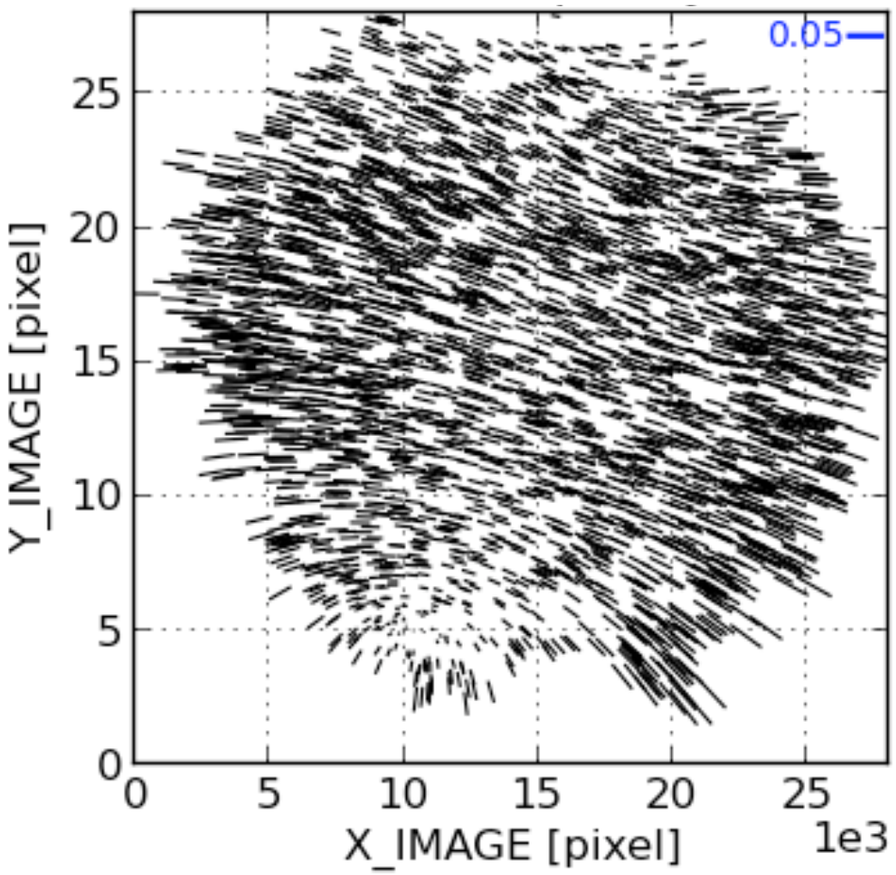
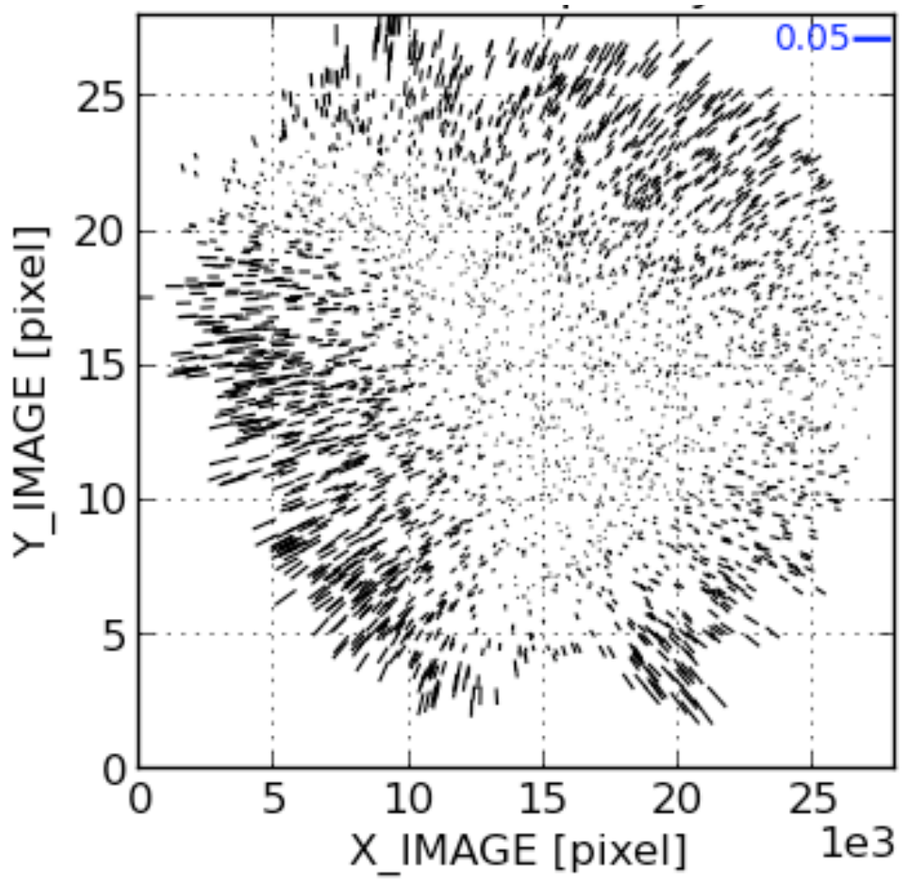
- tracking performance not as desired

Early data issues



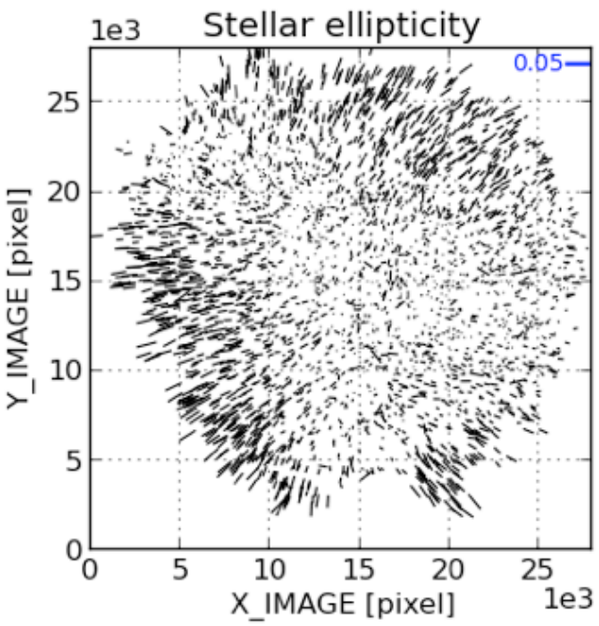
November 2012:

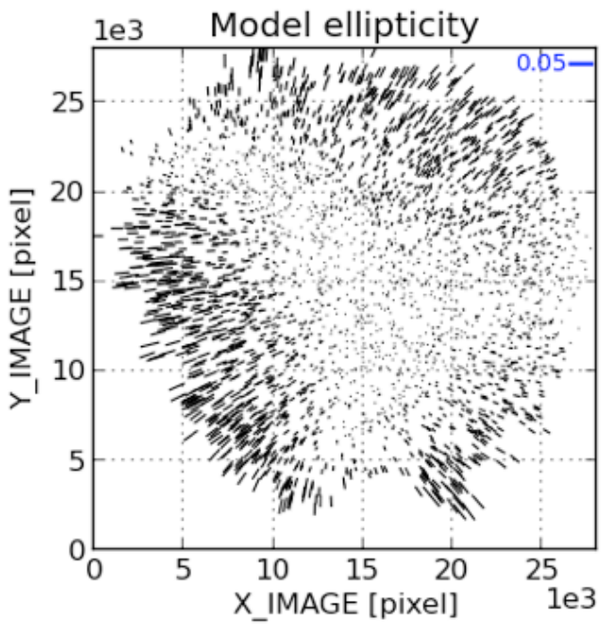
- early data affected by “guider jumps”
- tracking performance not as desired

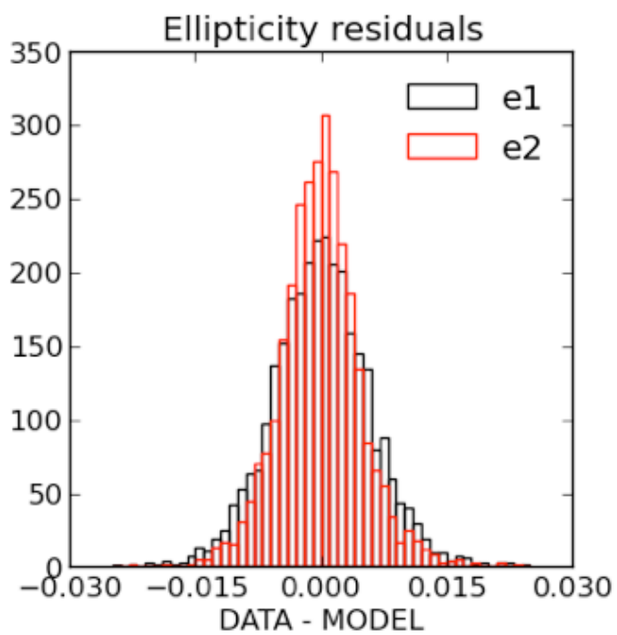


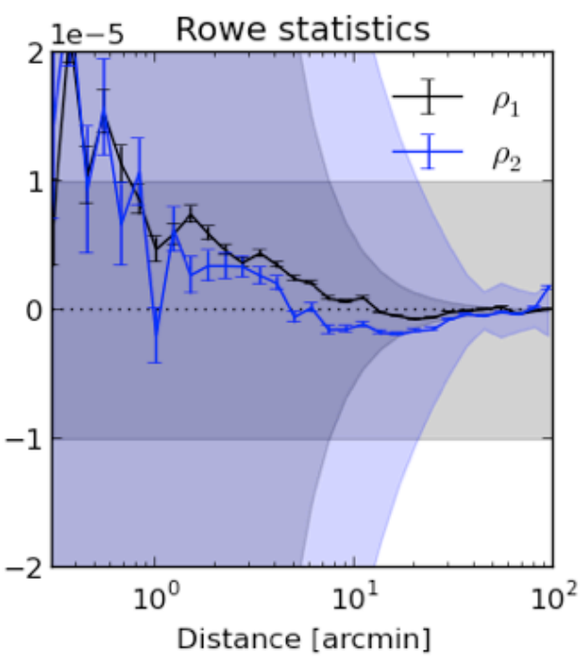
December 2012:
clearly improved image quality

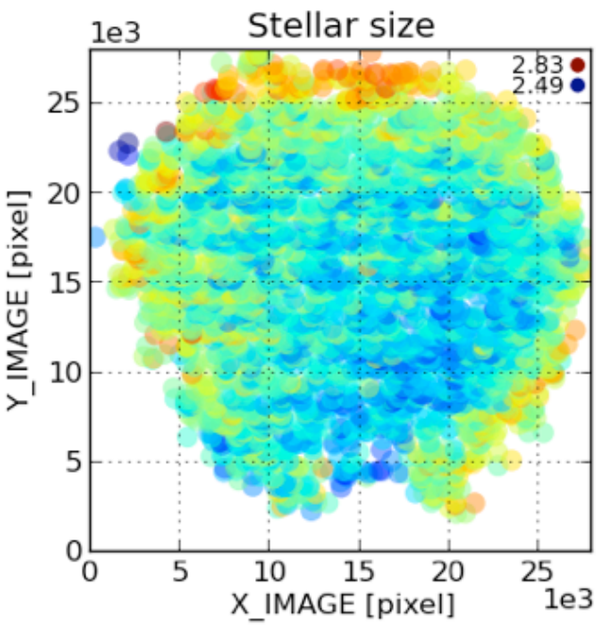
PSF modeling

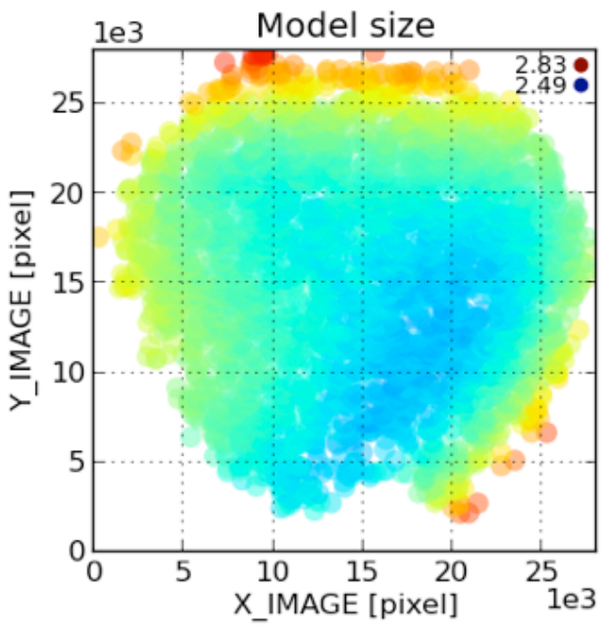


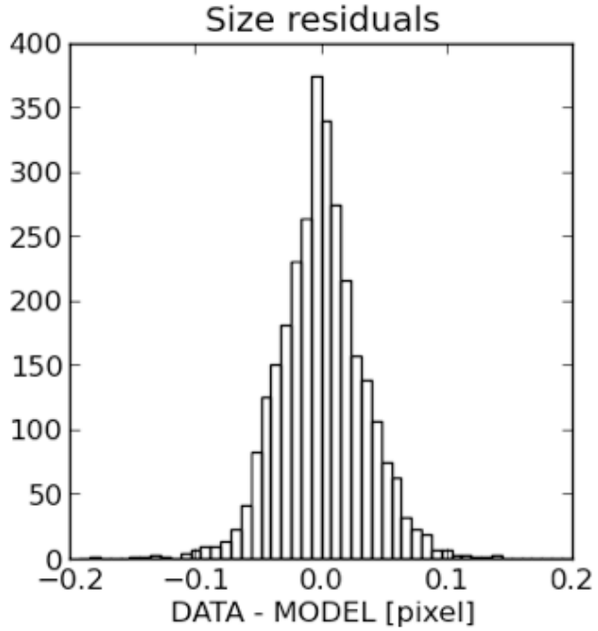


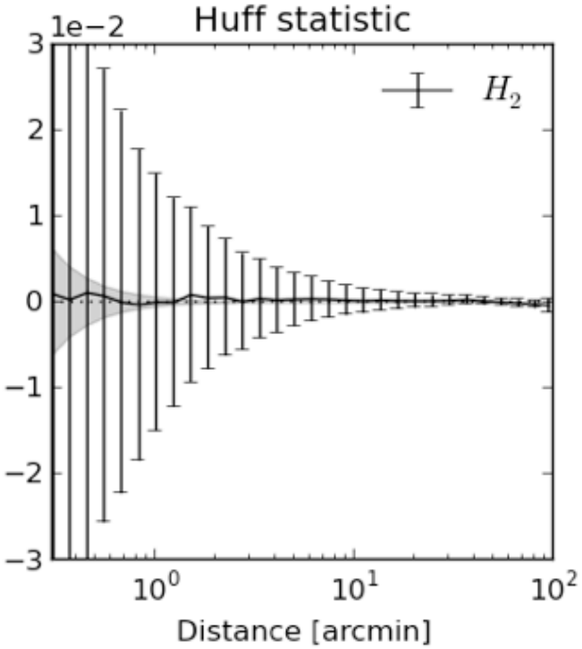




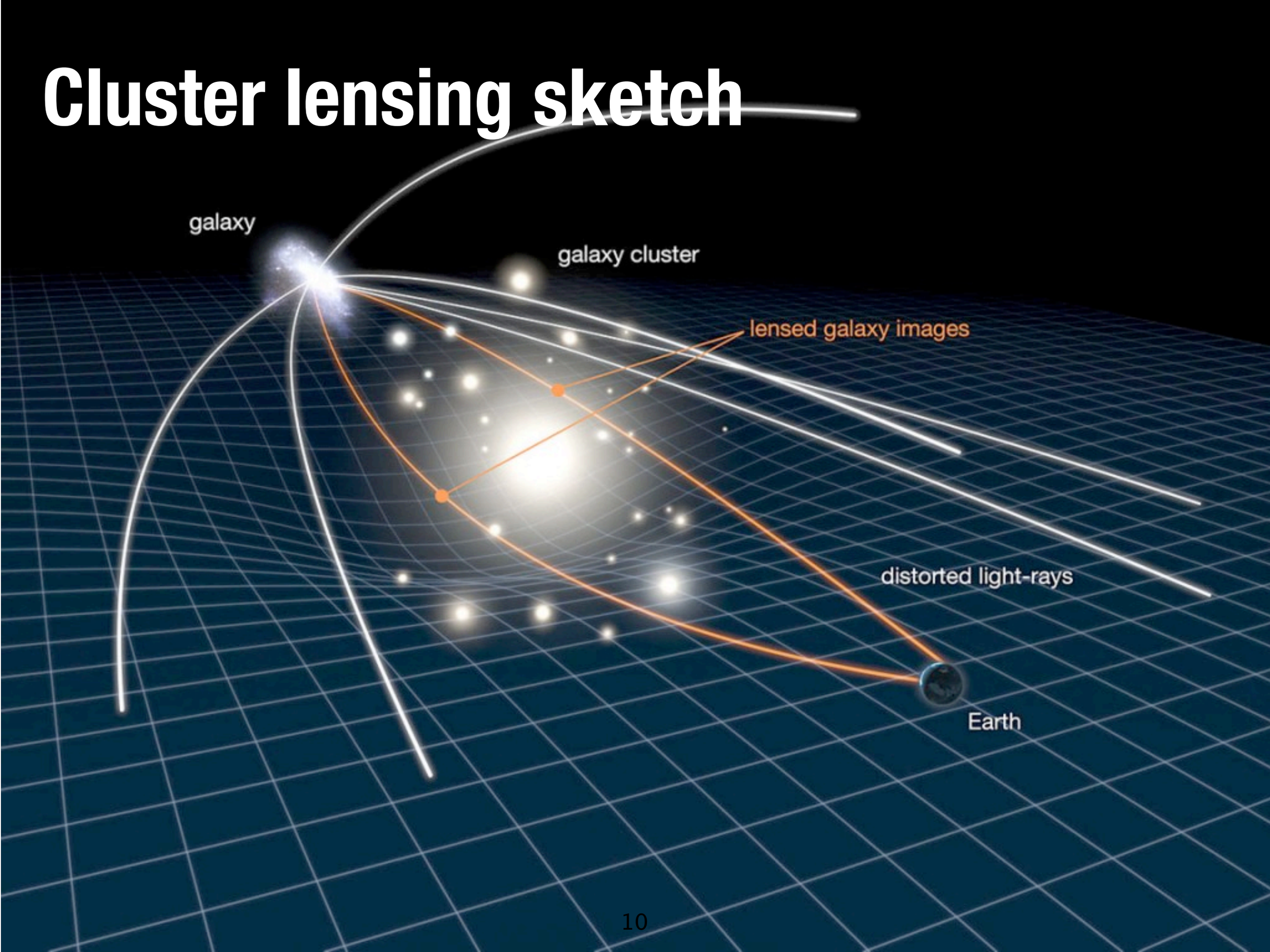








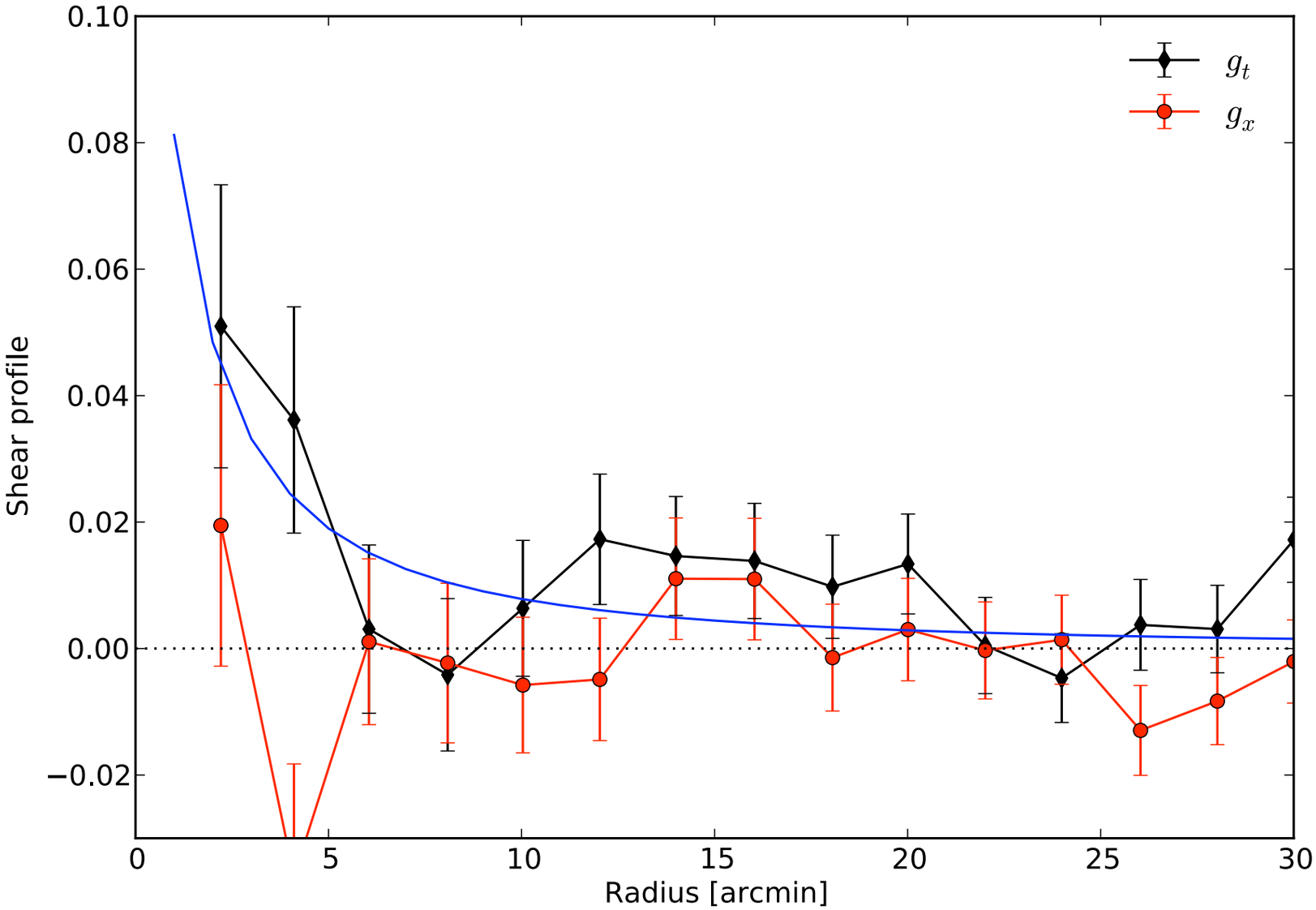
Cluster lensing sketch



Cluster lensing in (HST) reality

From strong to weak lensing

Shear = tangential orientation



Several methods:

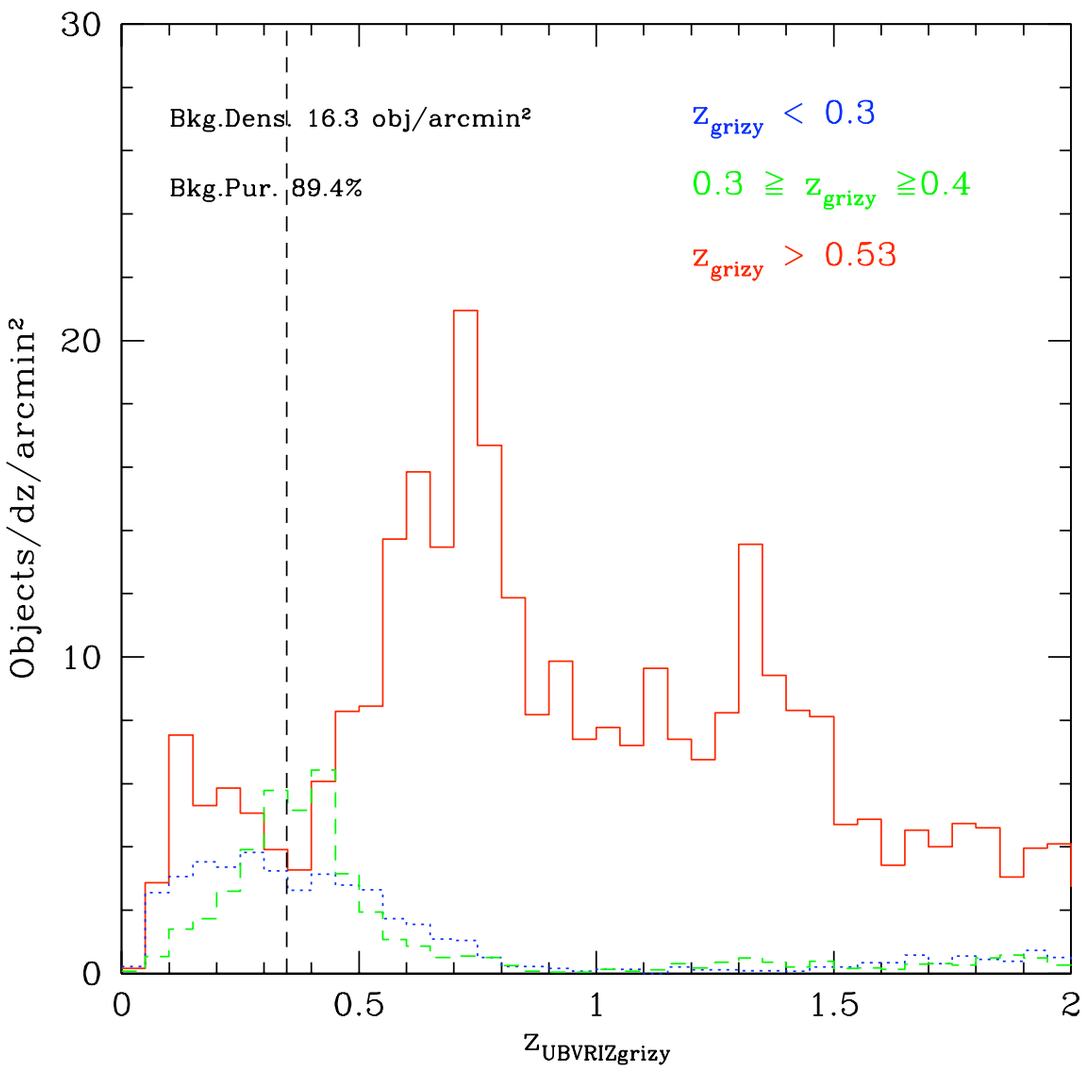
- KSB
- shapelet
- DEIMOS
- im3shape

n_{gal} ~ 15 / sq. arcmin

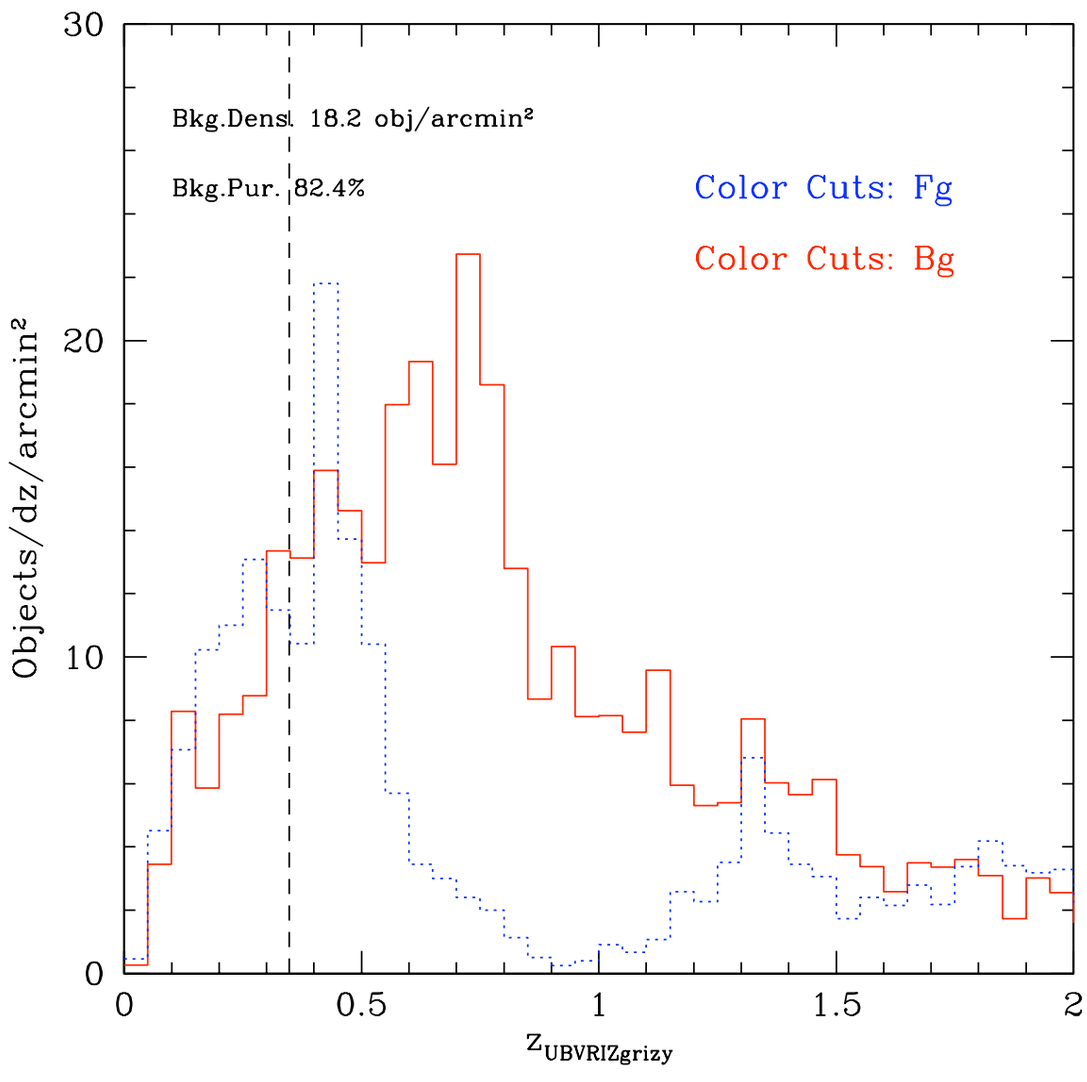
Photometric catalogs

DARK ENERGY SURVEY

Foreground / Background selection based on color cuts and photo-zs



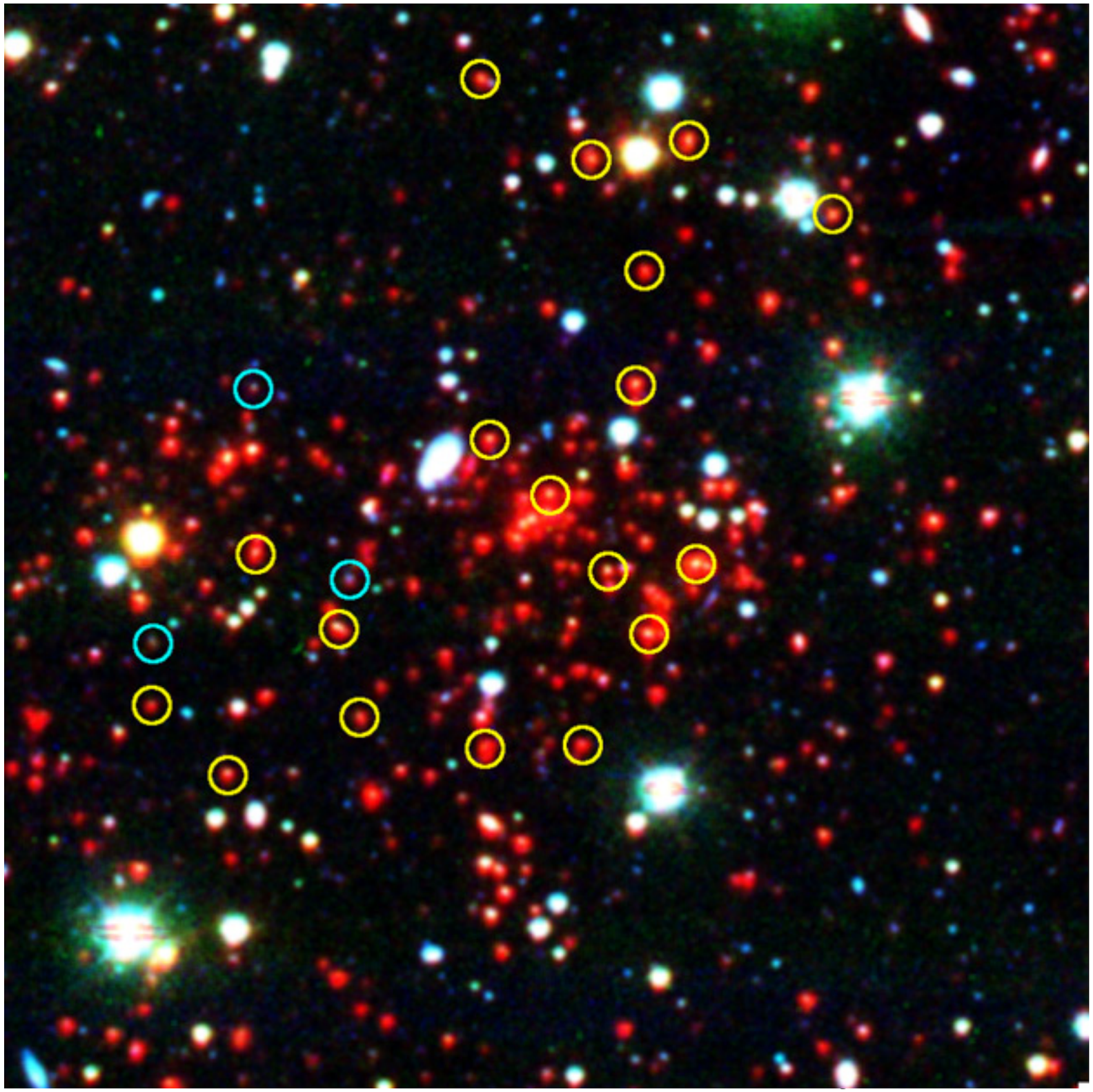
DES photo-z selection



color-cut selection

Cluster member selection

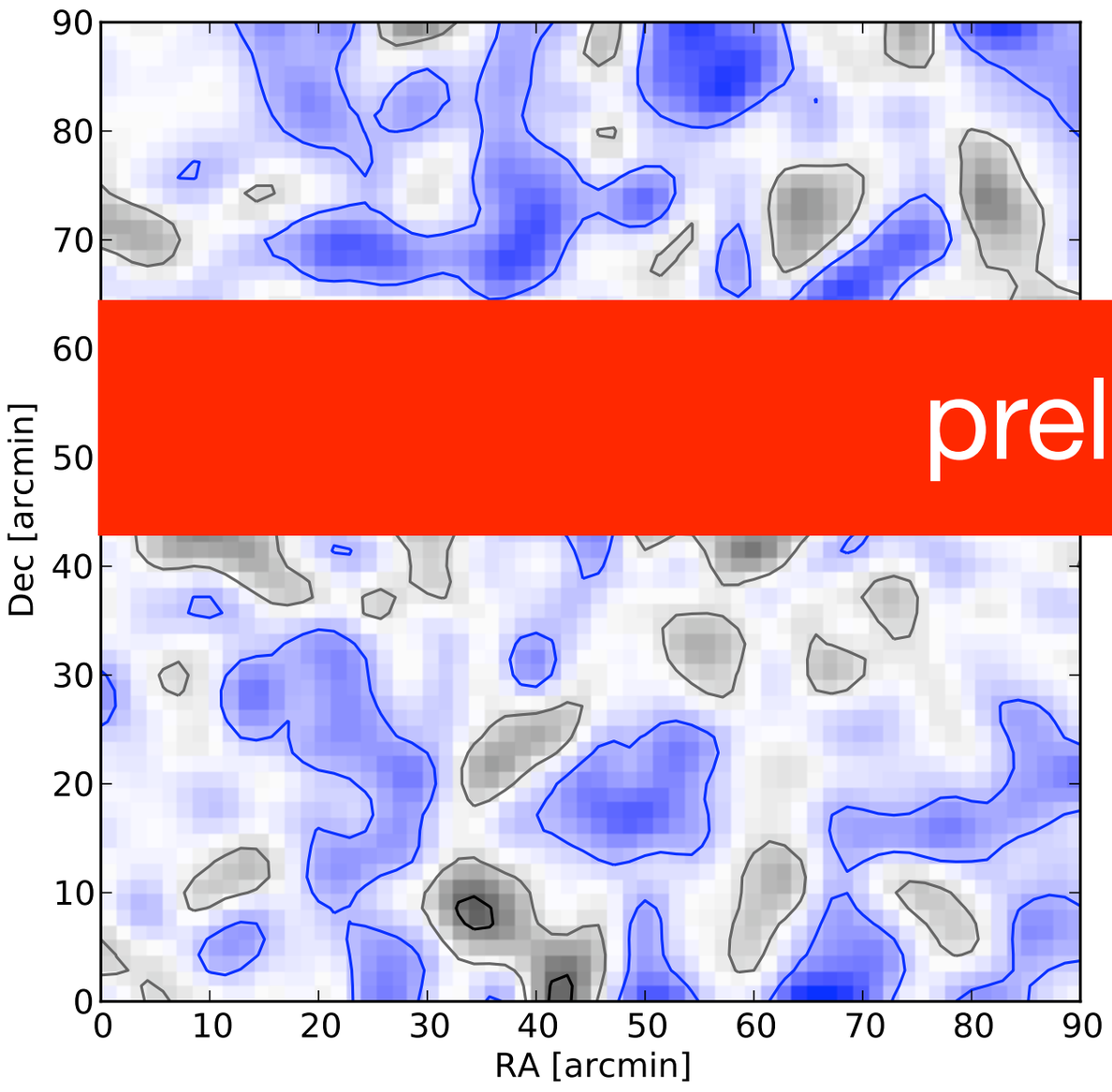
DARK ENERGY SURVEY

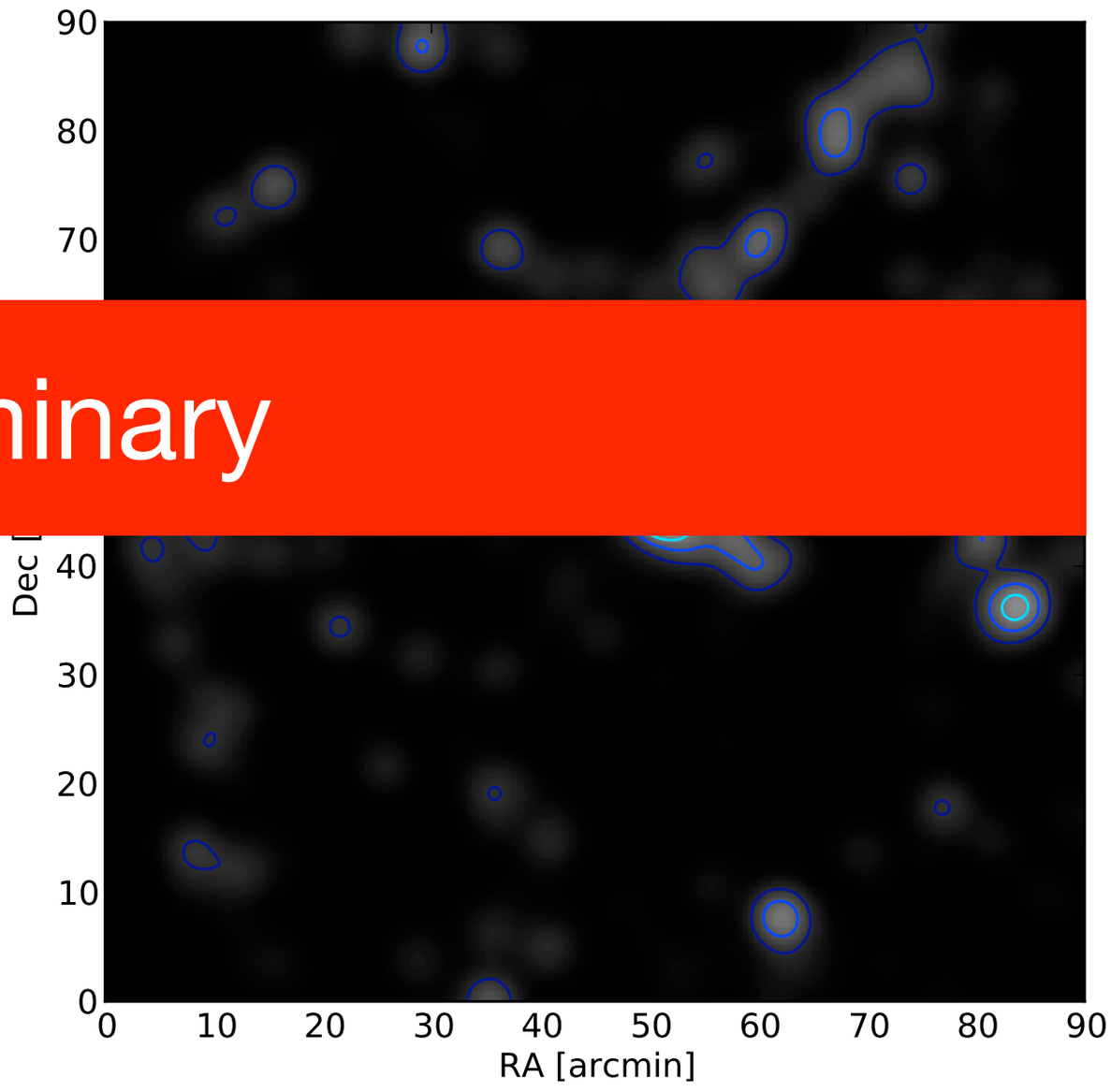


RedMaPPer:
red-sequence cluster finder

knowing the redshift, it can map galaxies that look like cluster members

Mass & light maps



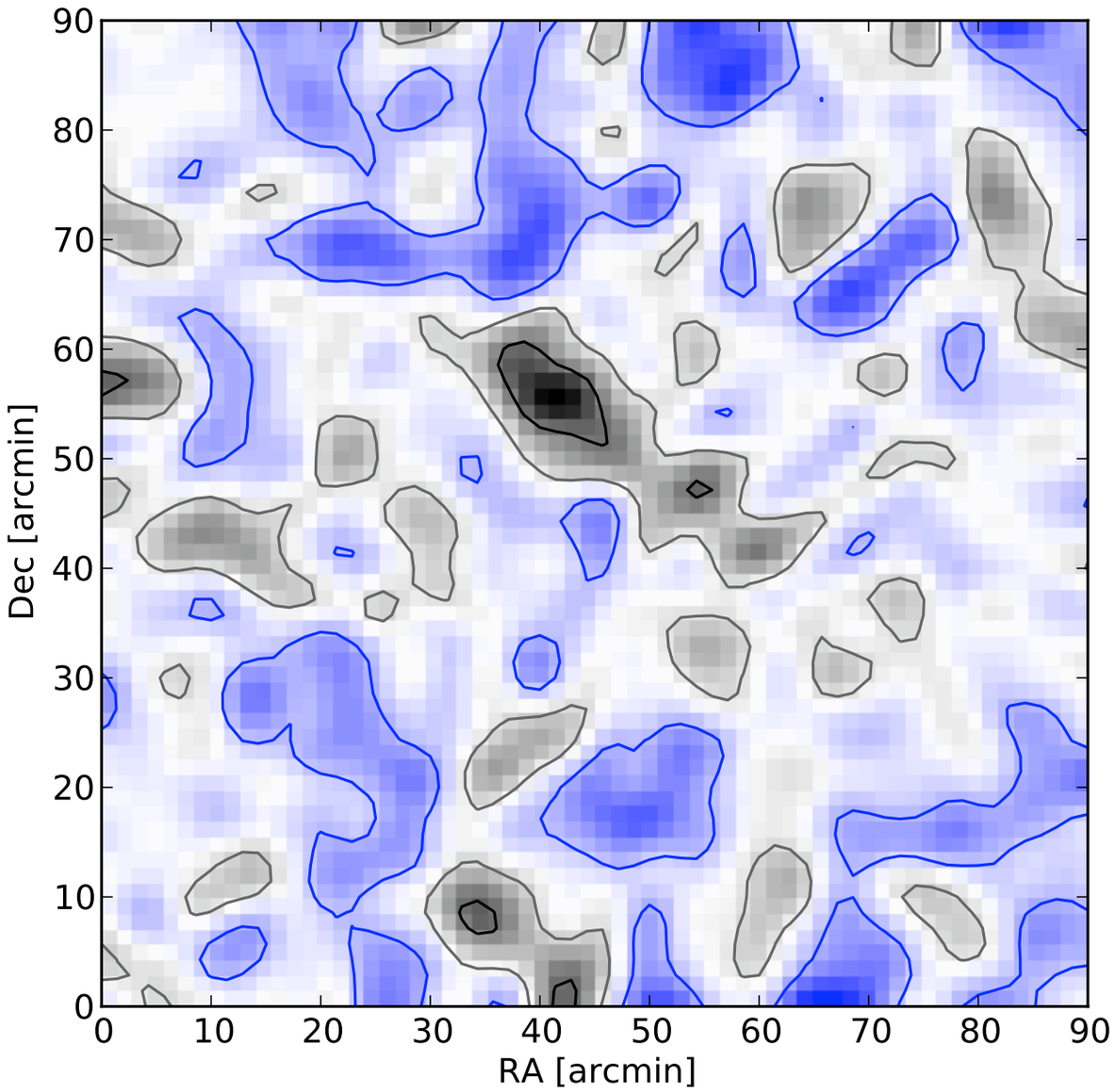


preliminary

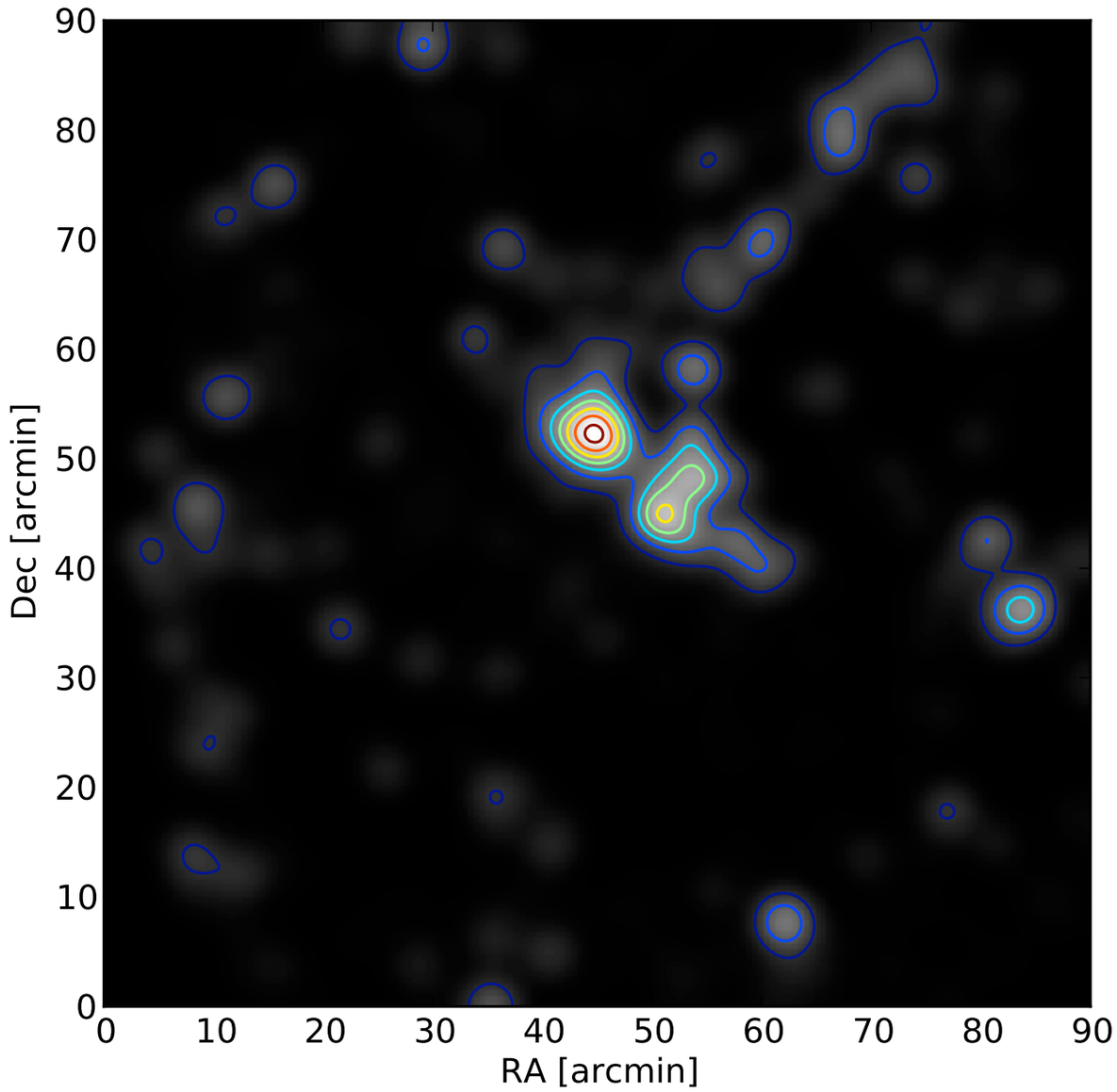
SaWLens WL mass reconstruction

redMaPPer galaxy distribution at z=0.35

Mass & light maps

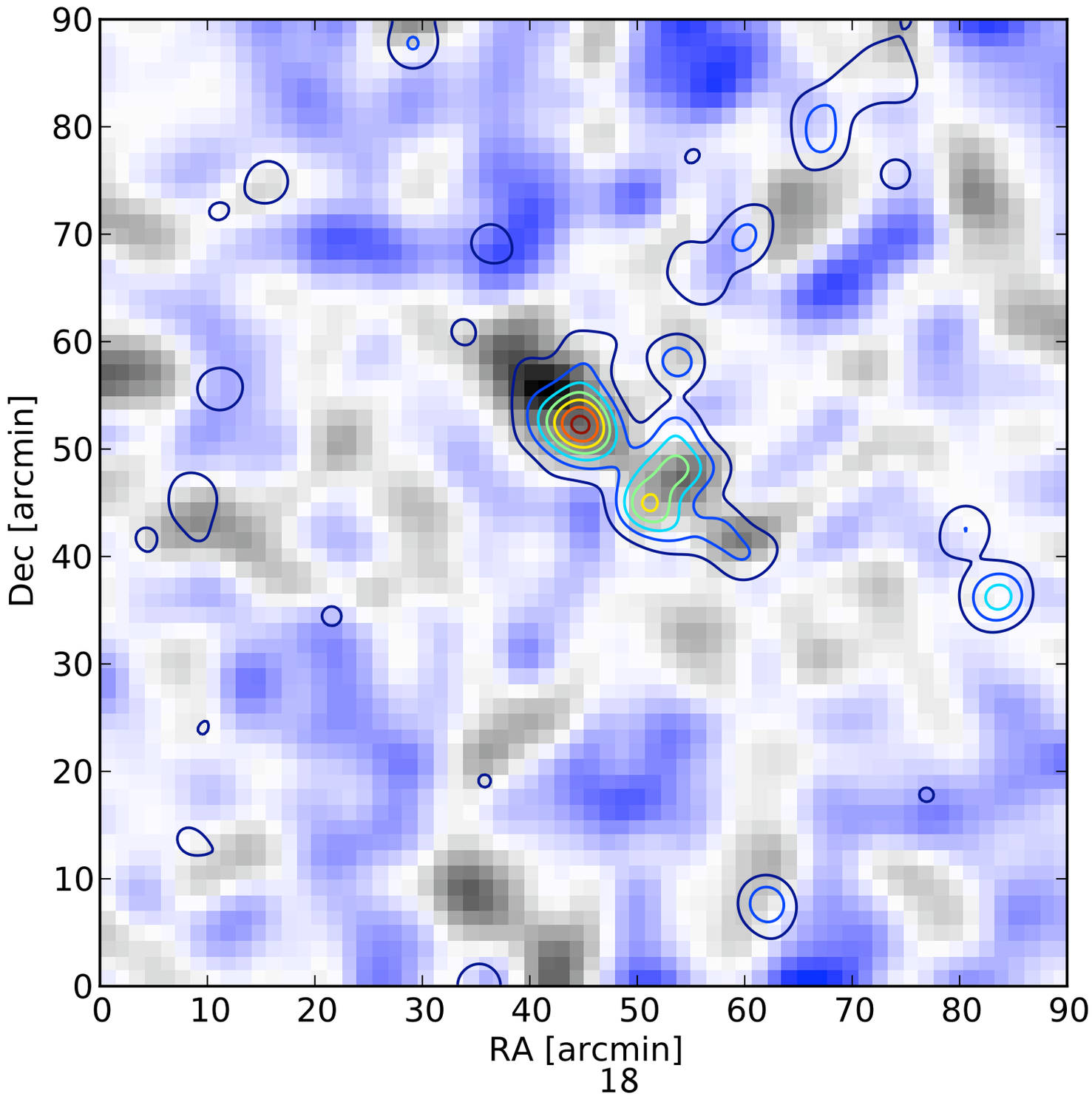


SaWLens WL mass reconstruction



redMaPPer galaxy distribution at z=0.35

Mass & light maps



Summary/Outlook

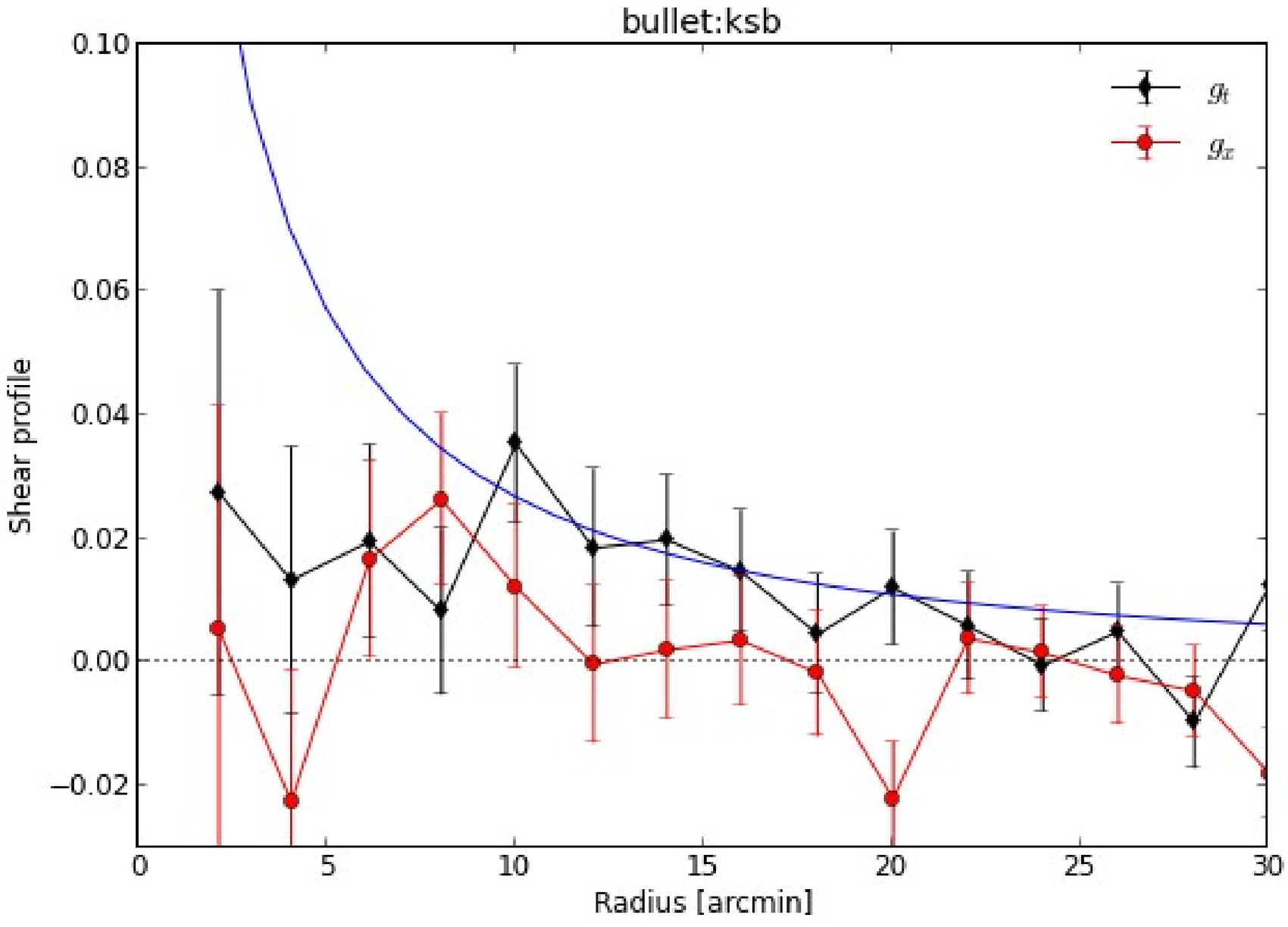
- DECam data has improved considerably
- Testing many, many systematic we have learned valuable lessons to improve our lensing measurements

Remaining Work

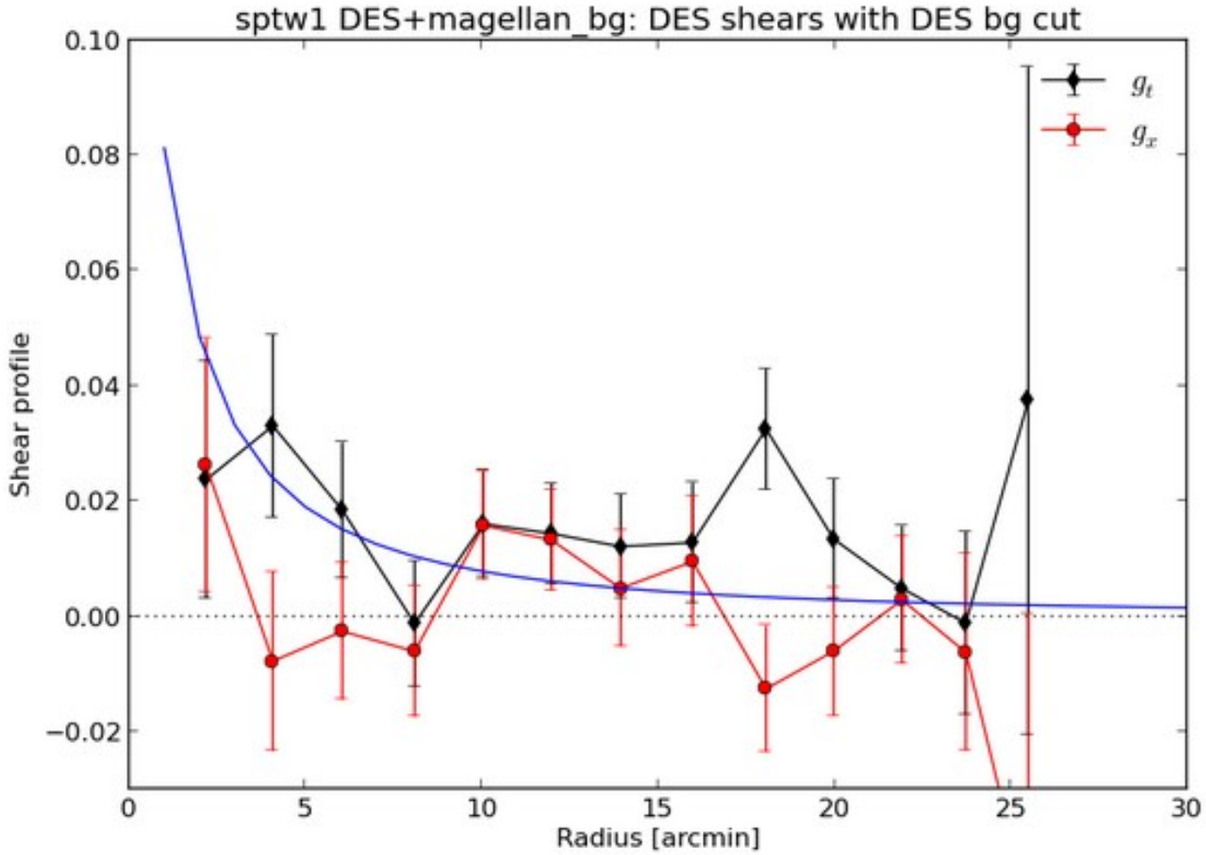
- Analyze more clusters to improve our limited statistics (5 done so far)
- Some difficulties of shear under-measurement in the most massive clusters ~10^{15} M_{solar}
- Indications of flux-dependent PSF, understand this
- Paper in prep

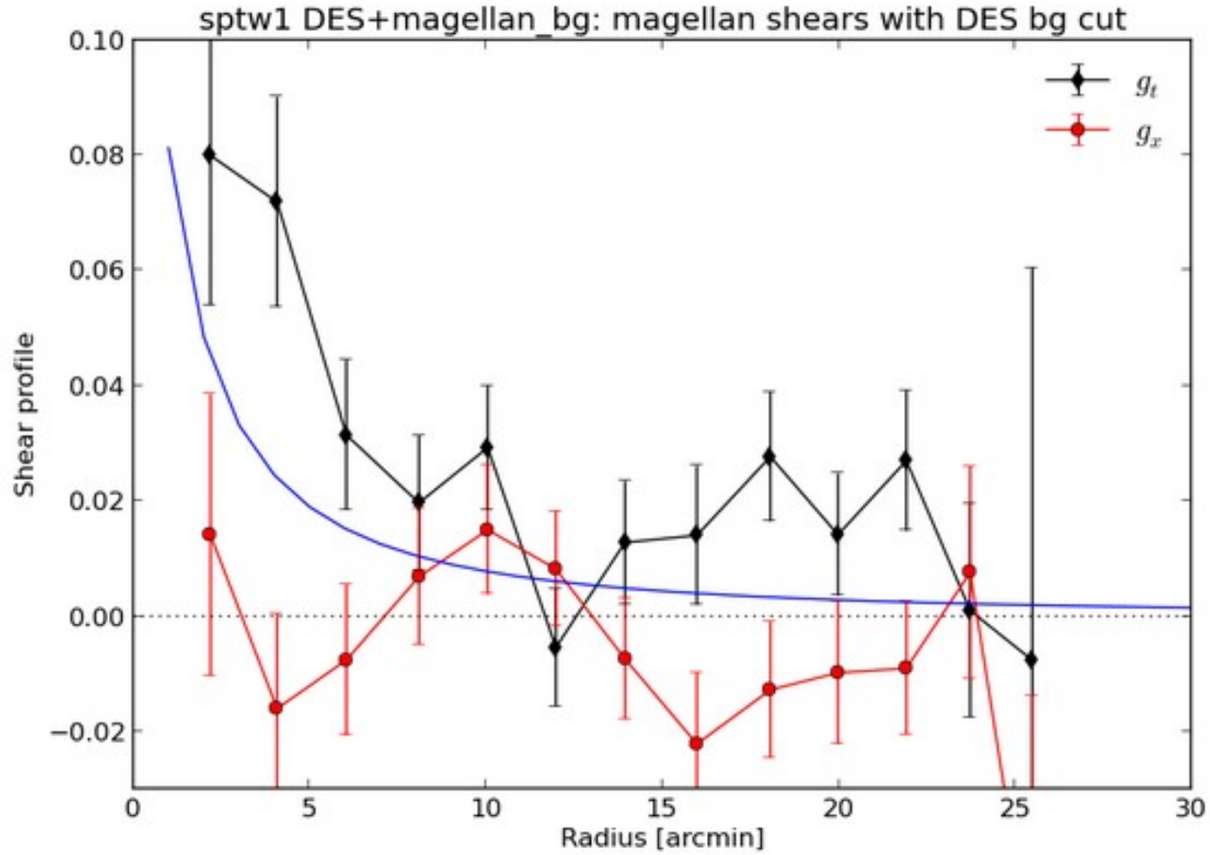
Extra Slides

Shear deficit near center for ~10^{15} M_{solar} clusters

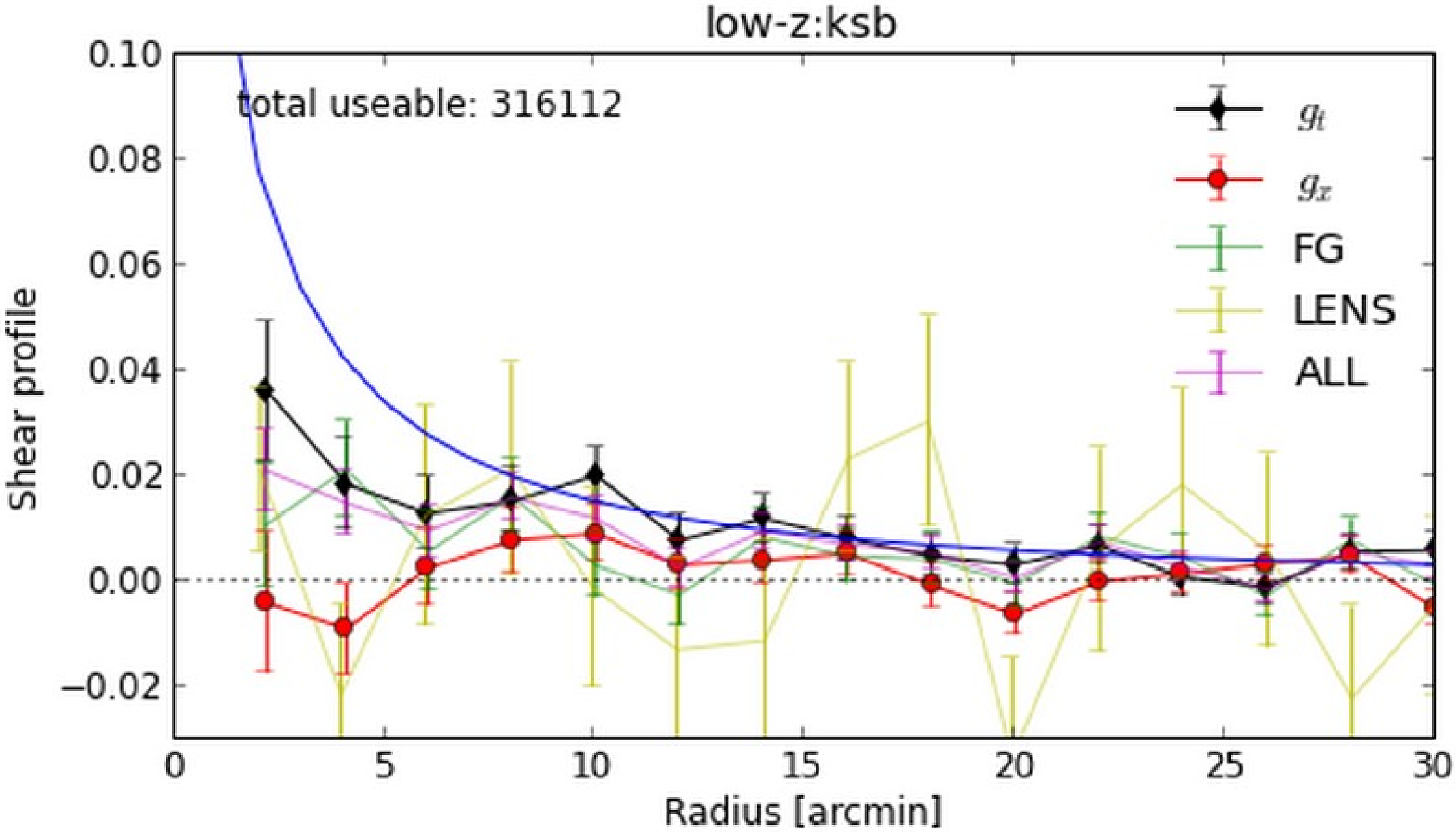


Shear profile comparison to external data

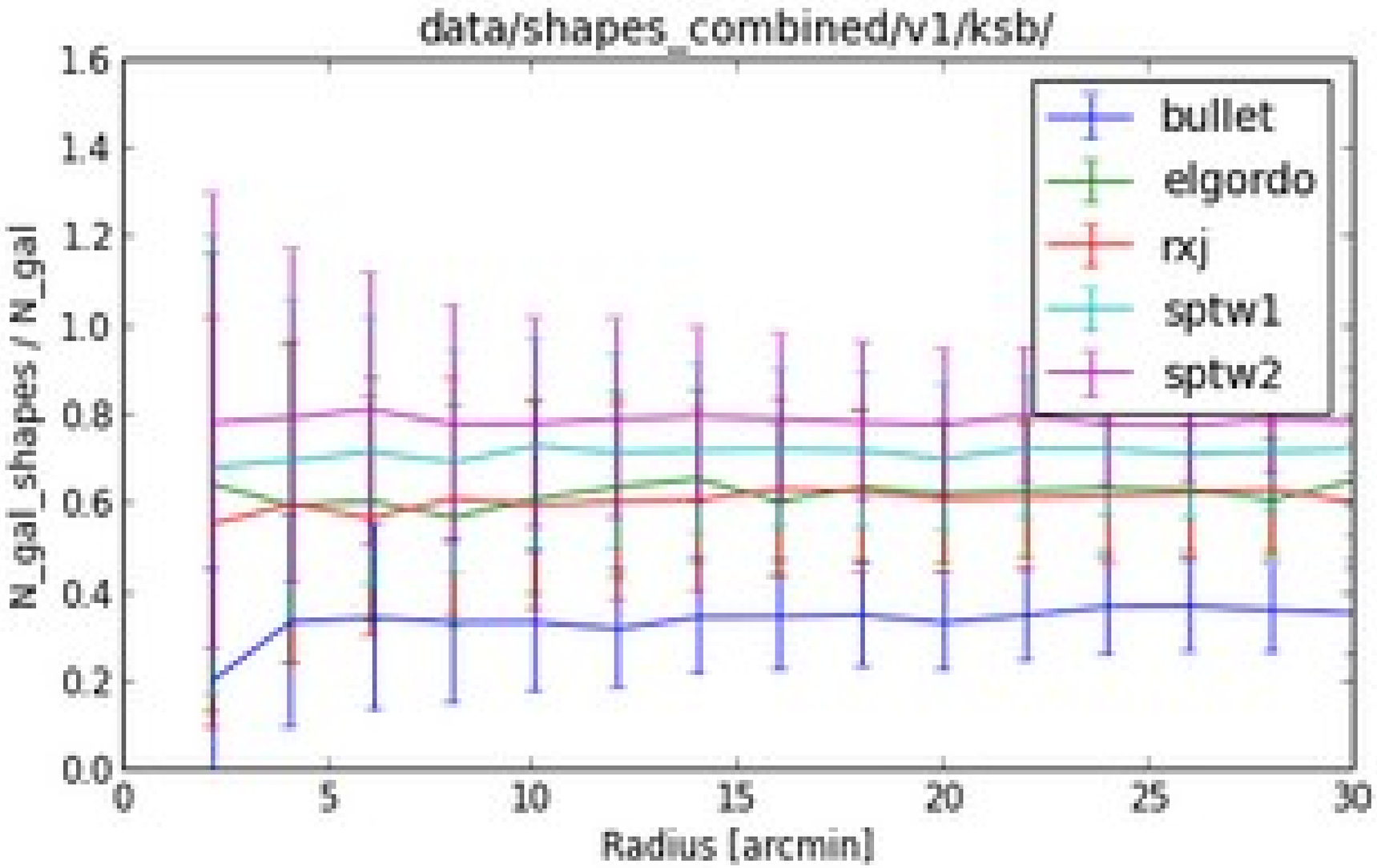




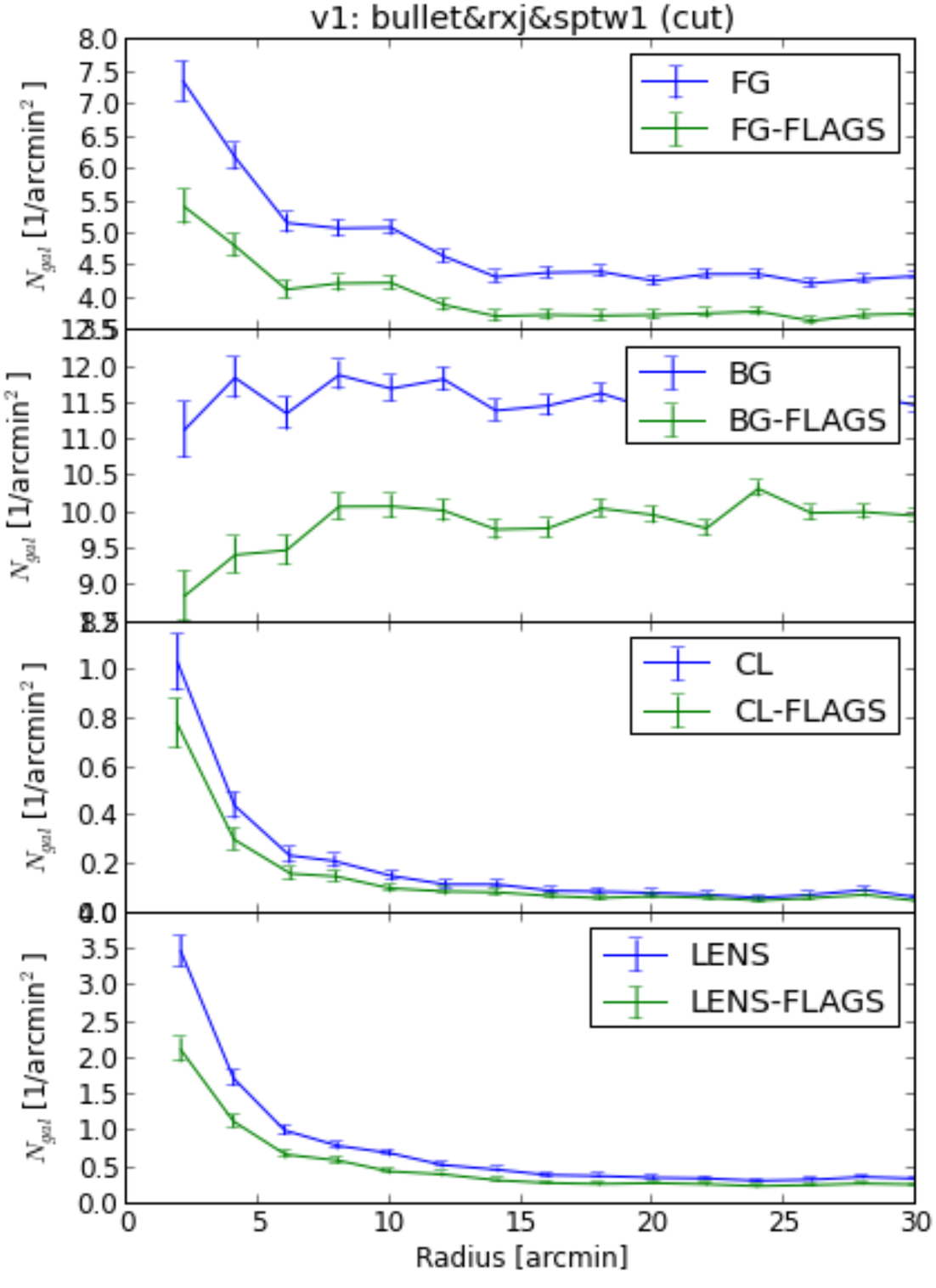
Shear profile under different selections



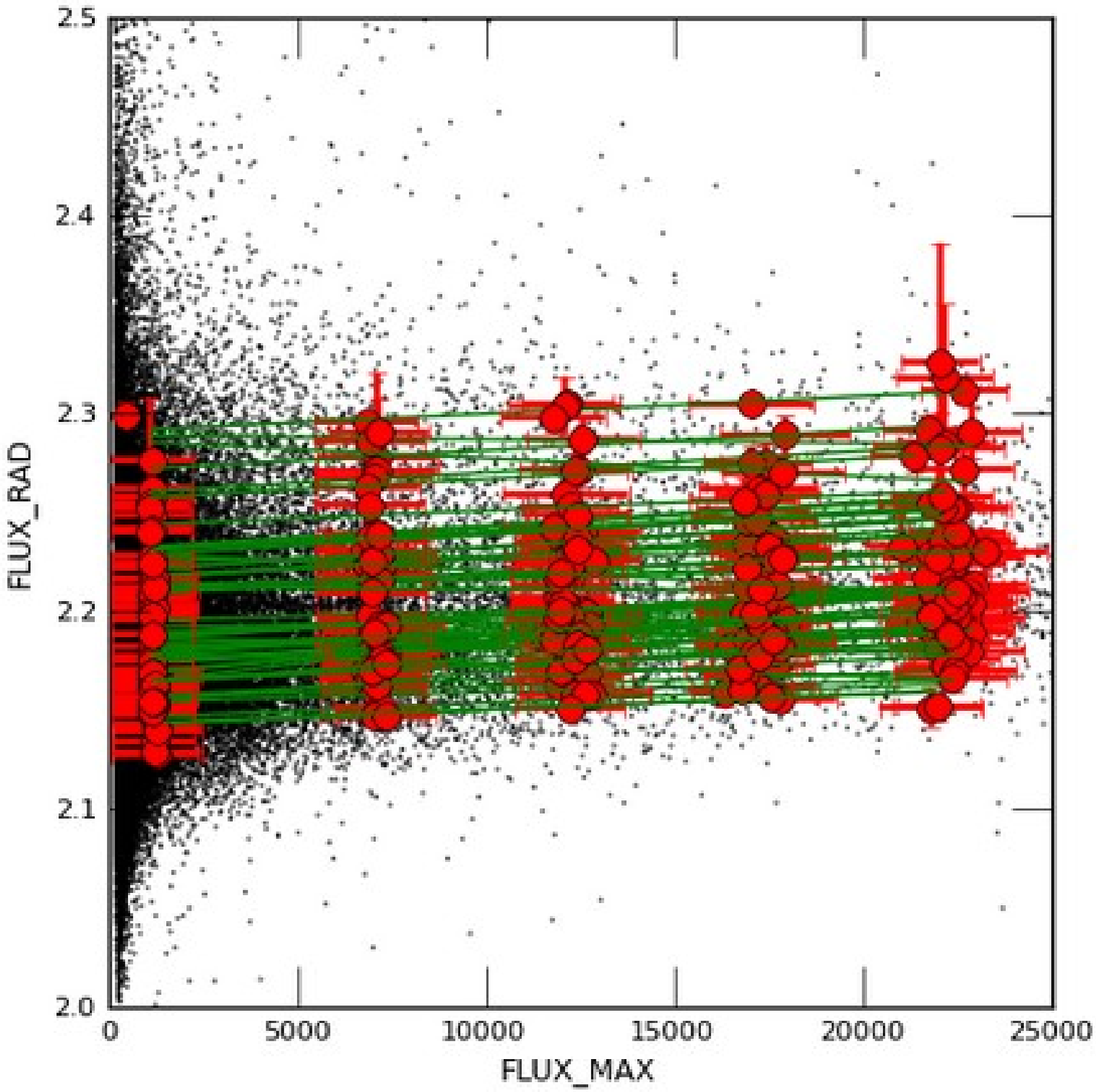
Profile of galaxies with shape measurements



Stacked number density profiles



Flux dependent PSF

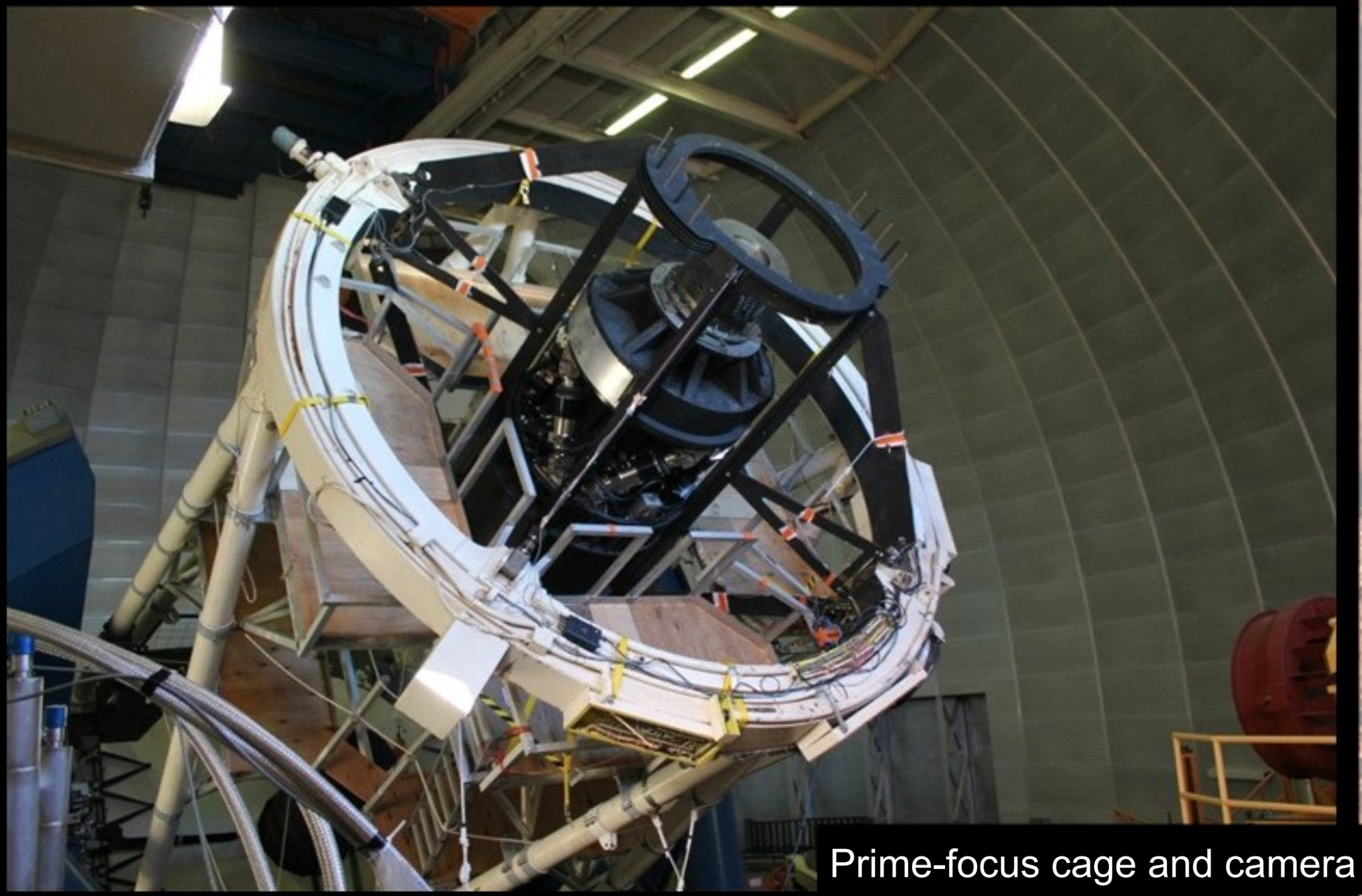


Dark Energy Survey

Cerro Tololo Inter-American Observatory

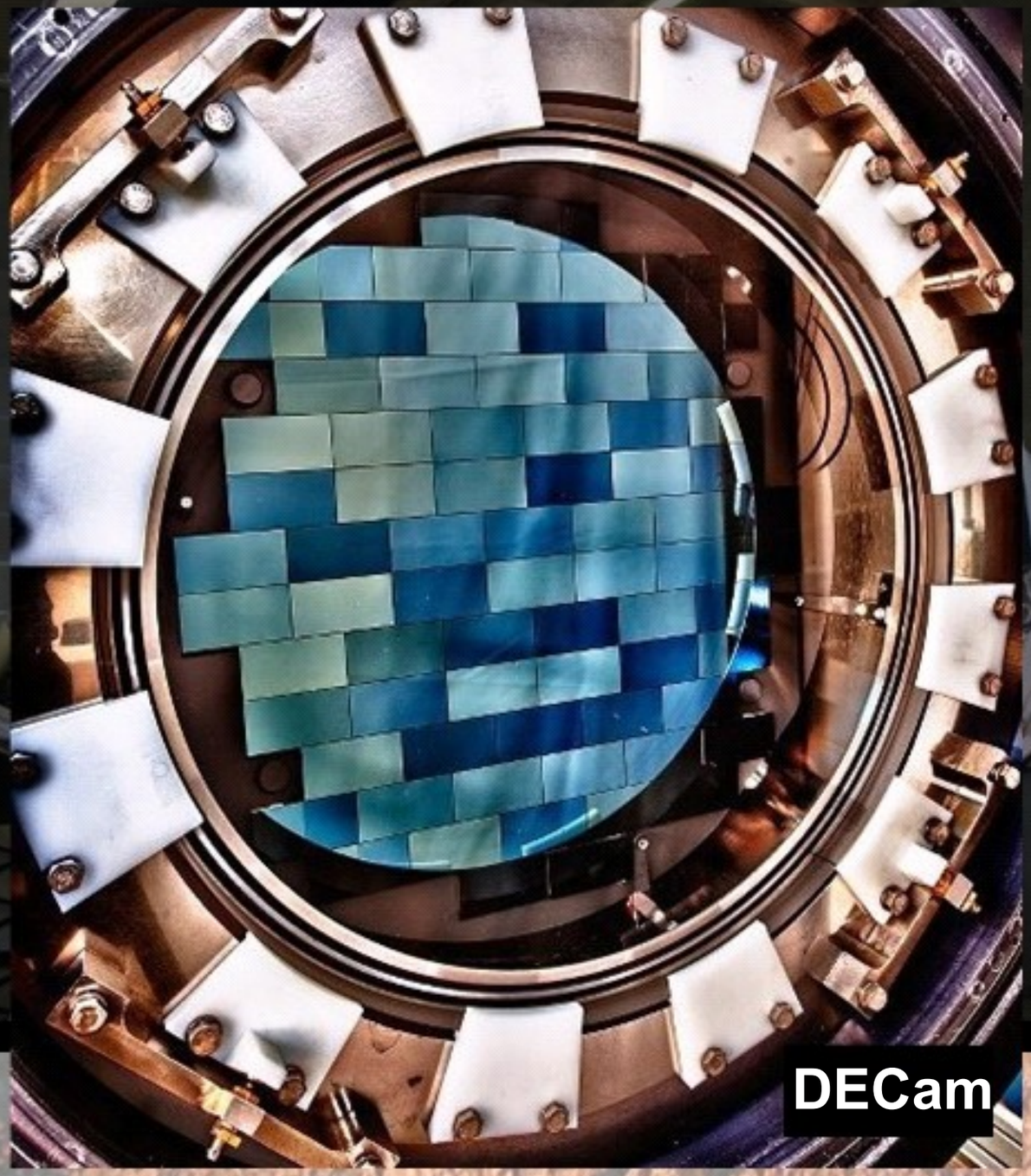
Dark Energy Survey

DARK ENERGY SURVEY



Prime-focus cage and camera

Dark Energy Survey



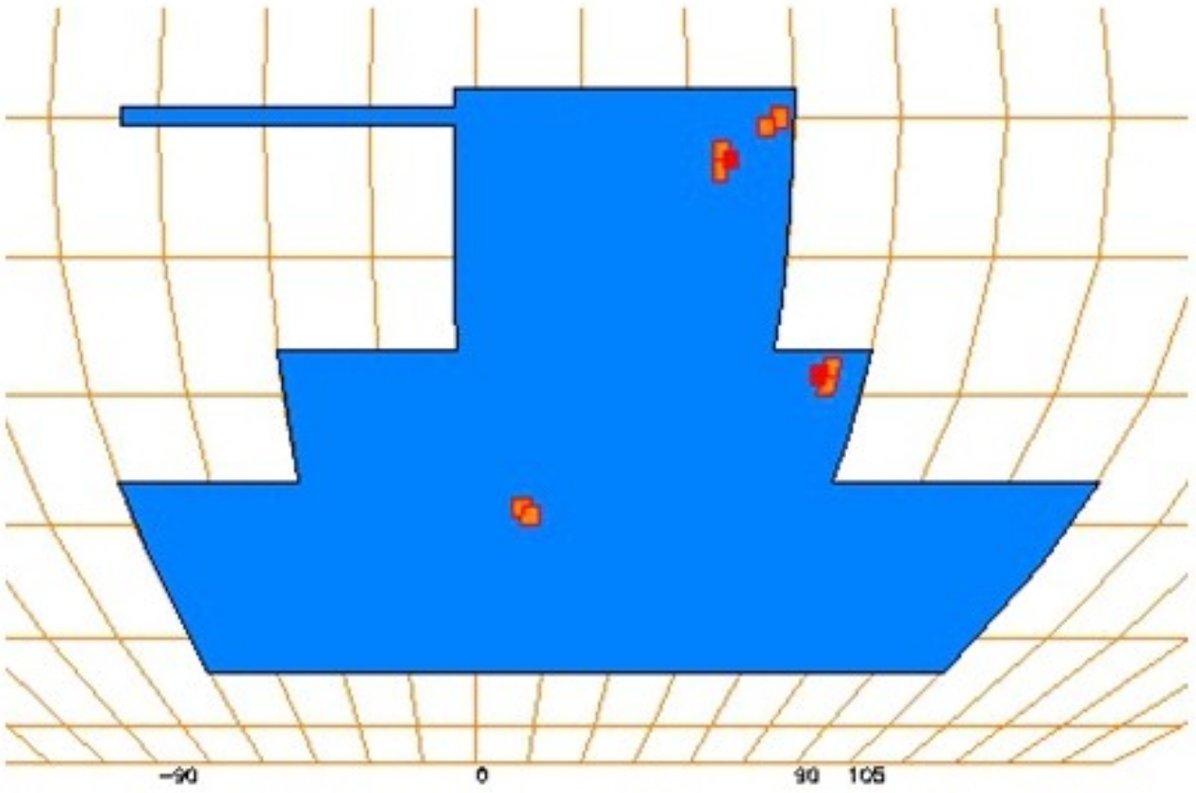
DECam

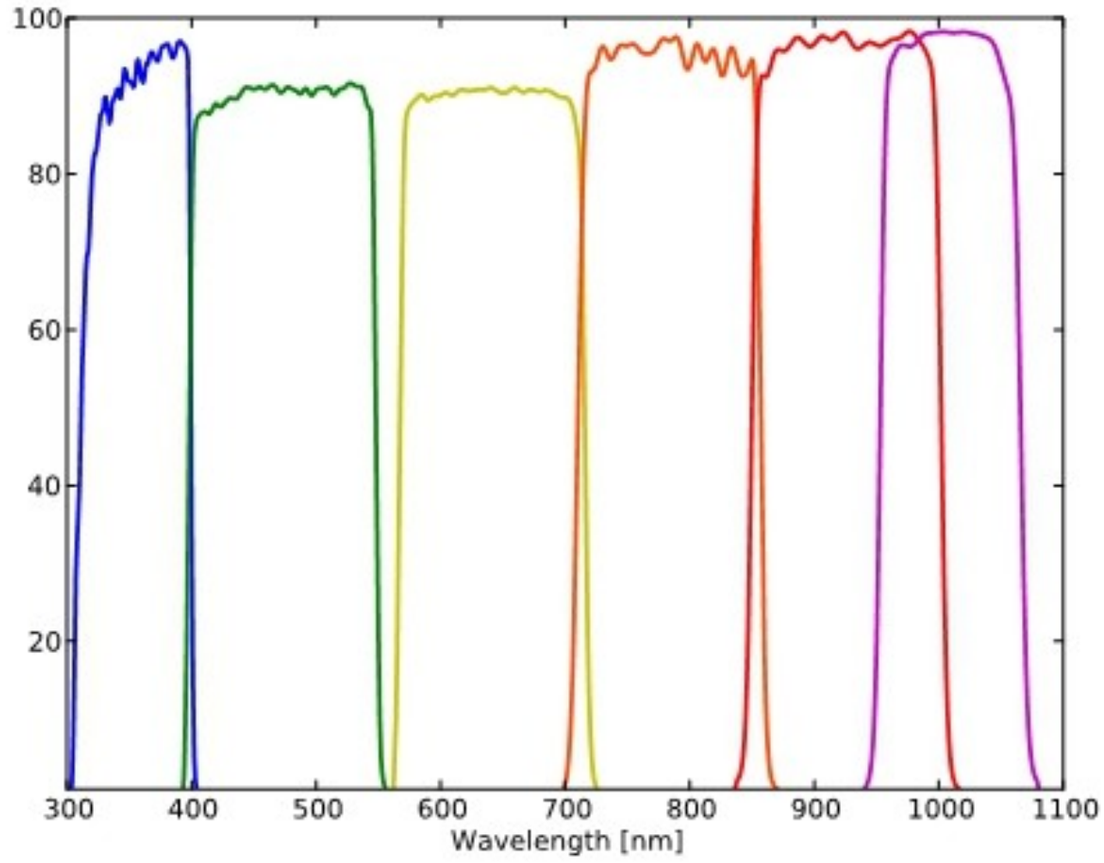
Dark Energy Survey

DARK ENERGY SURVEY

g-filter installation

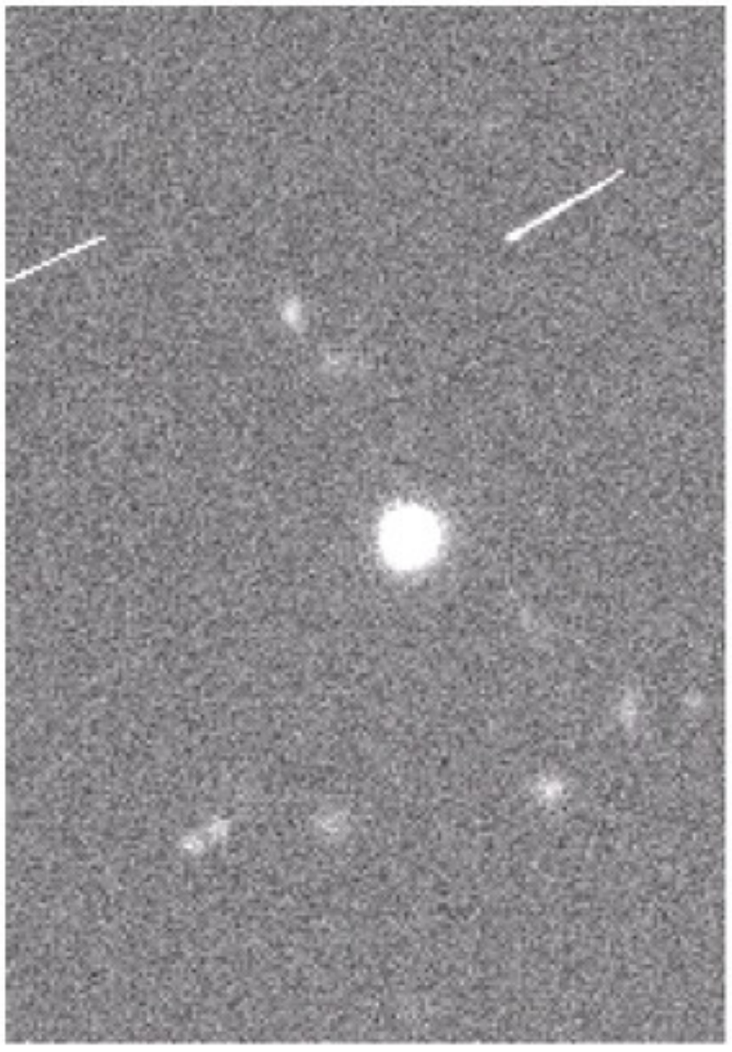
Survey characteristics



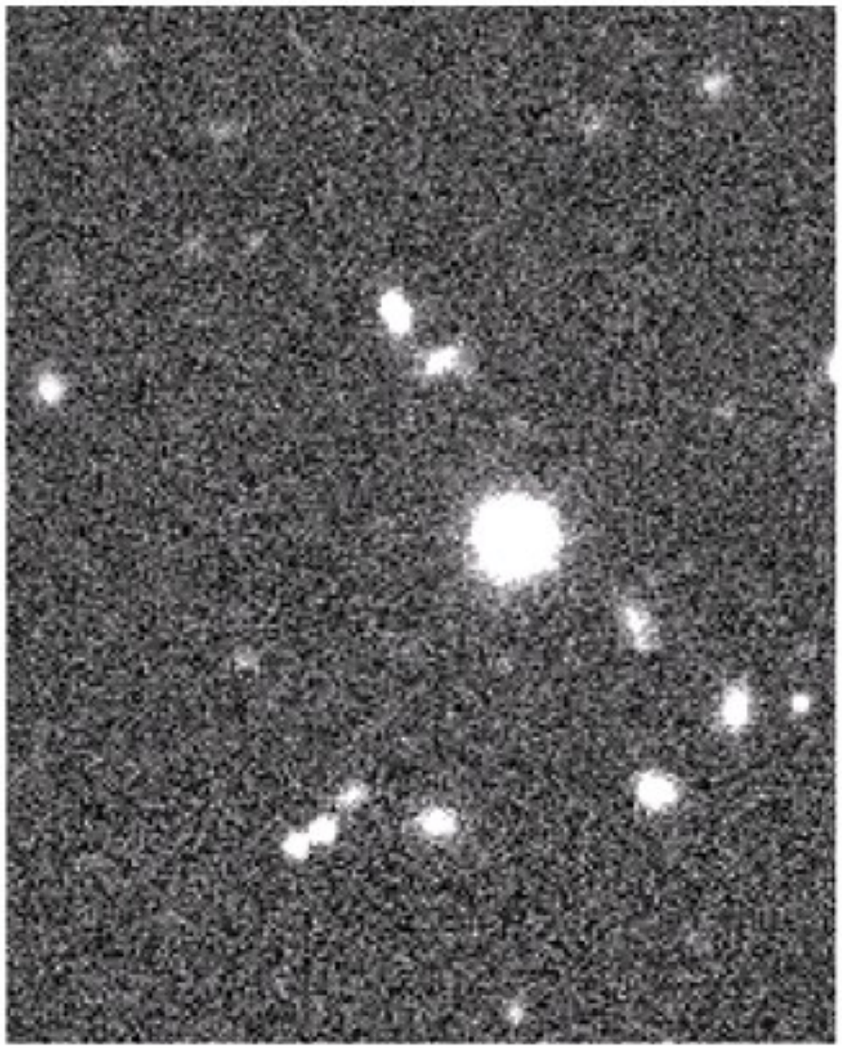


5000 sq. degrees
filters: grizY + U
10 x 90 seconds
limiting magnitudes: 25.2 (g) .. 23.4 (z)

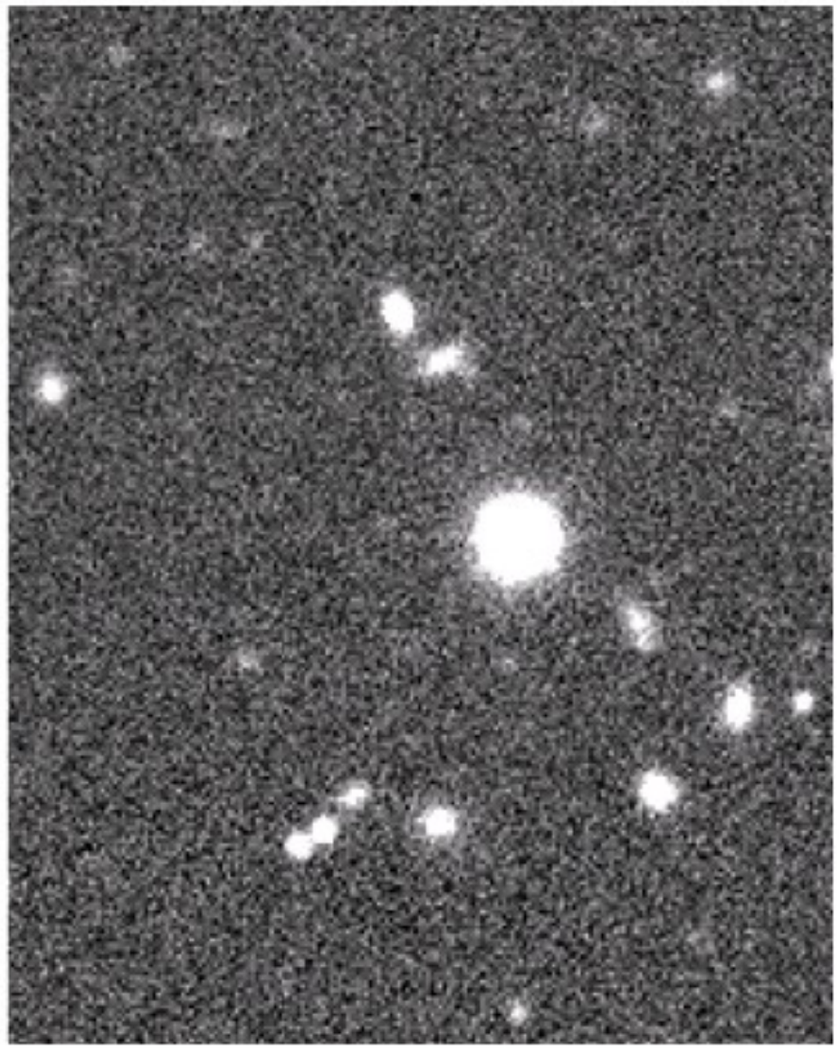
Coadds



single i-band exposure

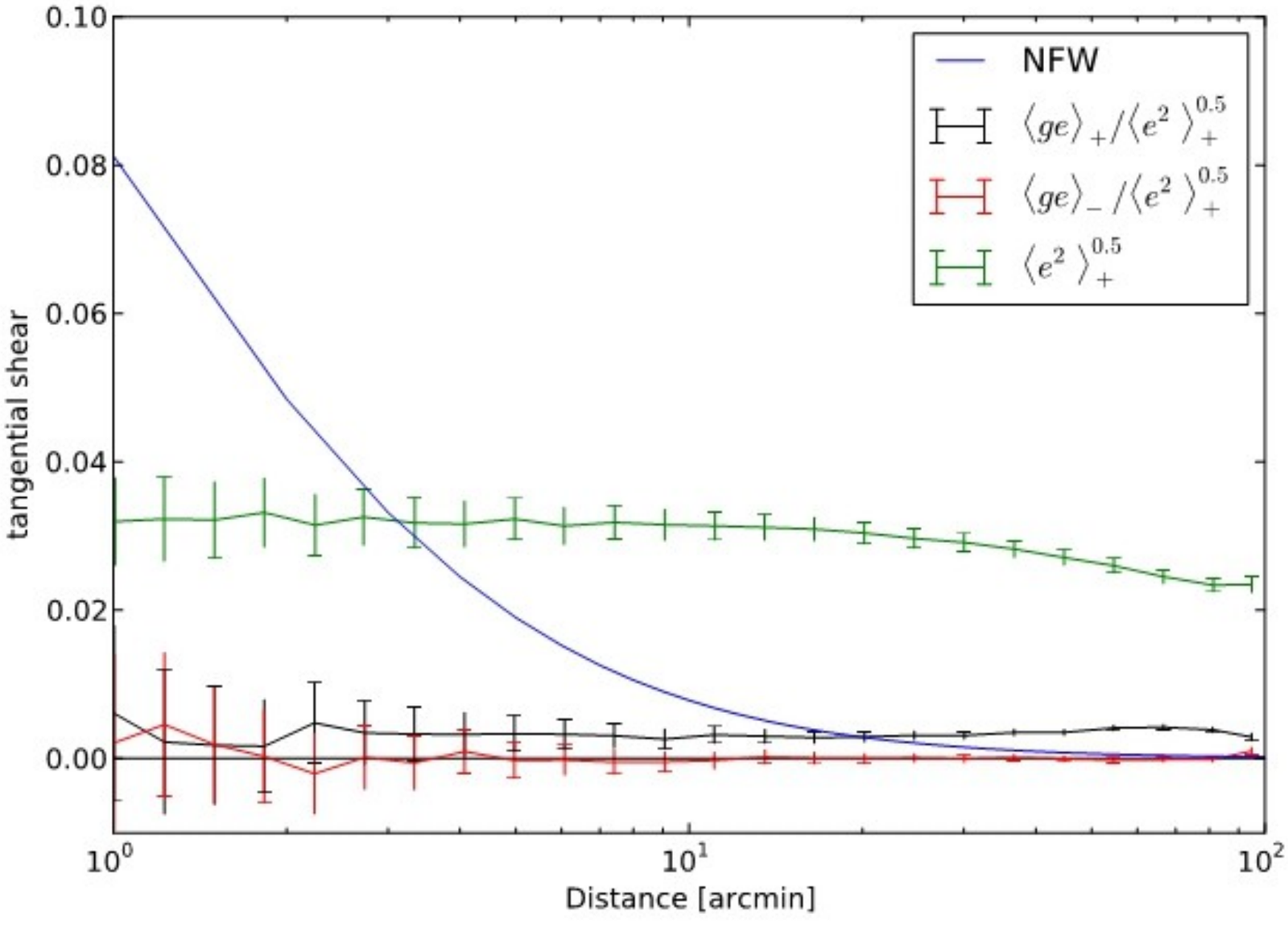


Swarp: median coadd of 10 exp.
n_{gal} = 21 / sq. arcmin



mean coadd+outlier rejection
n_{gal} = 25 / sq. arcmin

Star-galaxy correlation function



- KSB
- shapelet
- DEIMOS
- im3shape

Cluster member selection

DARK ENERGY SURVEY

based on color cuts and redMaPPer