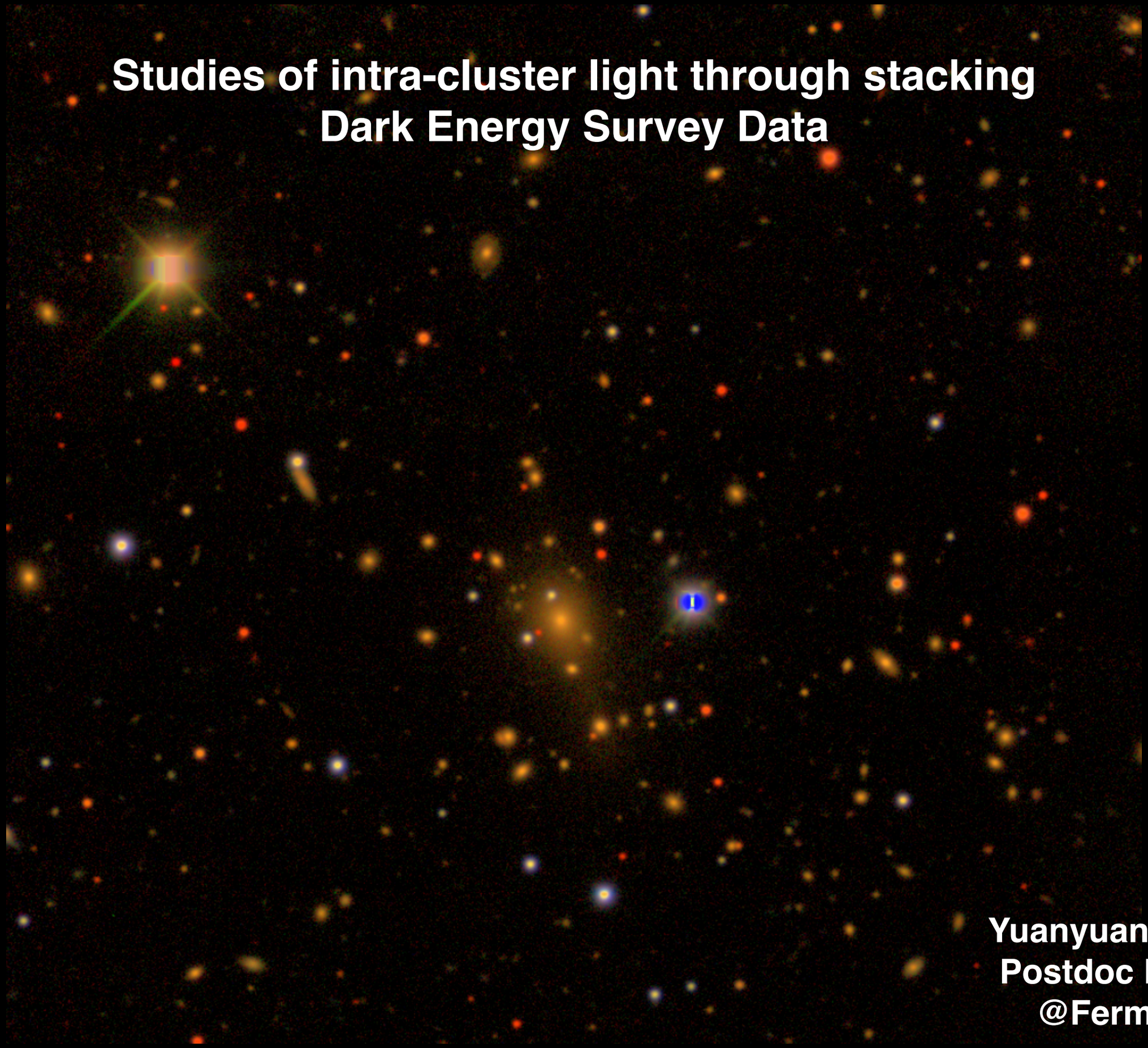
Studies of intra-cluster light through stacking Dark Energy Survey Data



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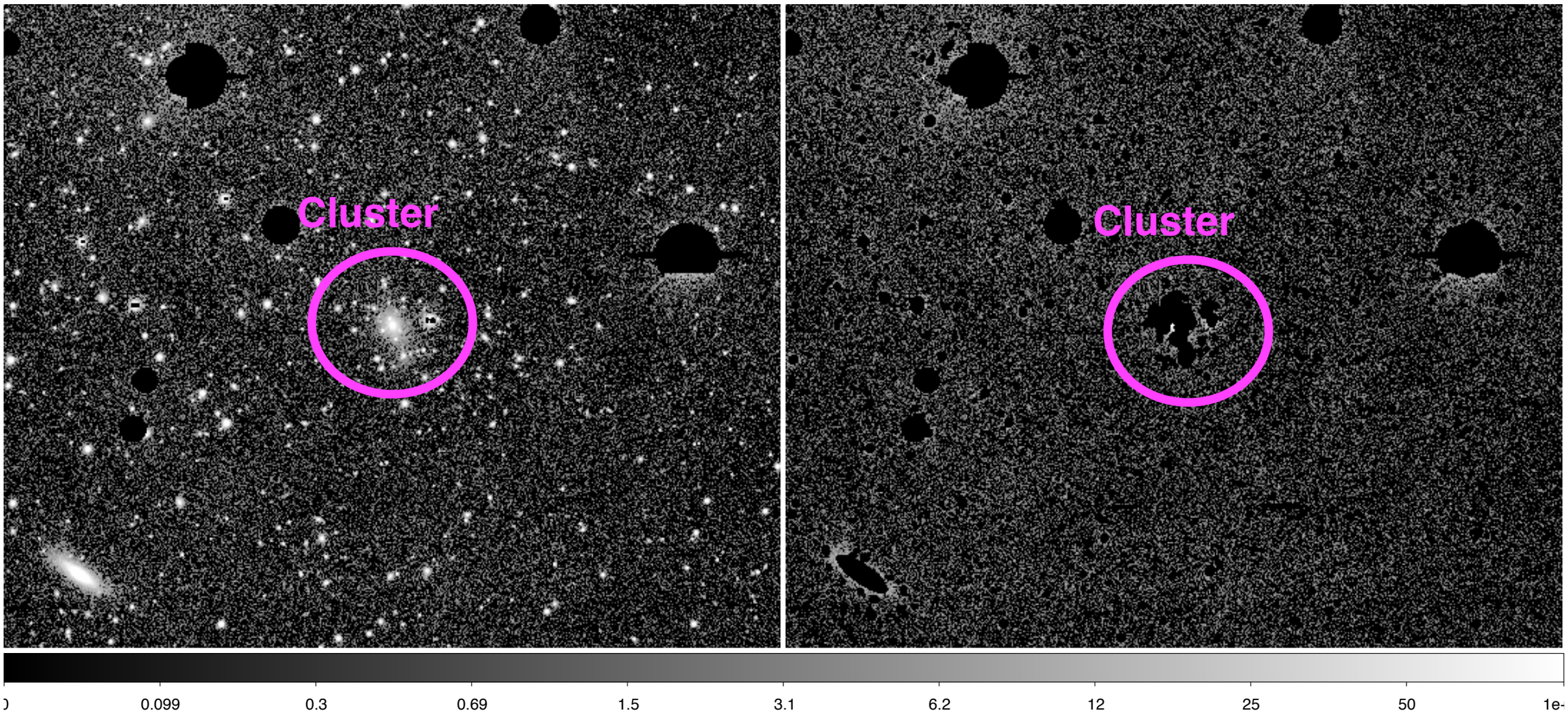
Step 1: Individual cluster images are co-added, background subtracted, and masked to detect ICL.

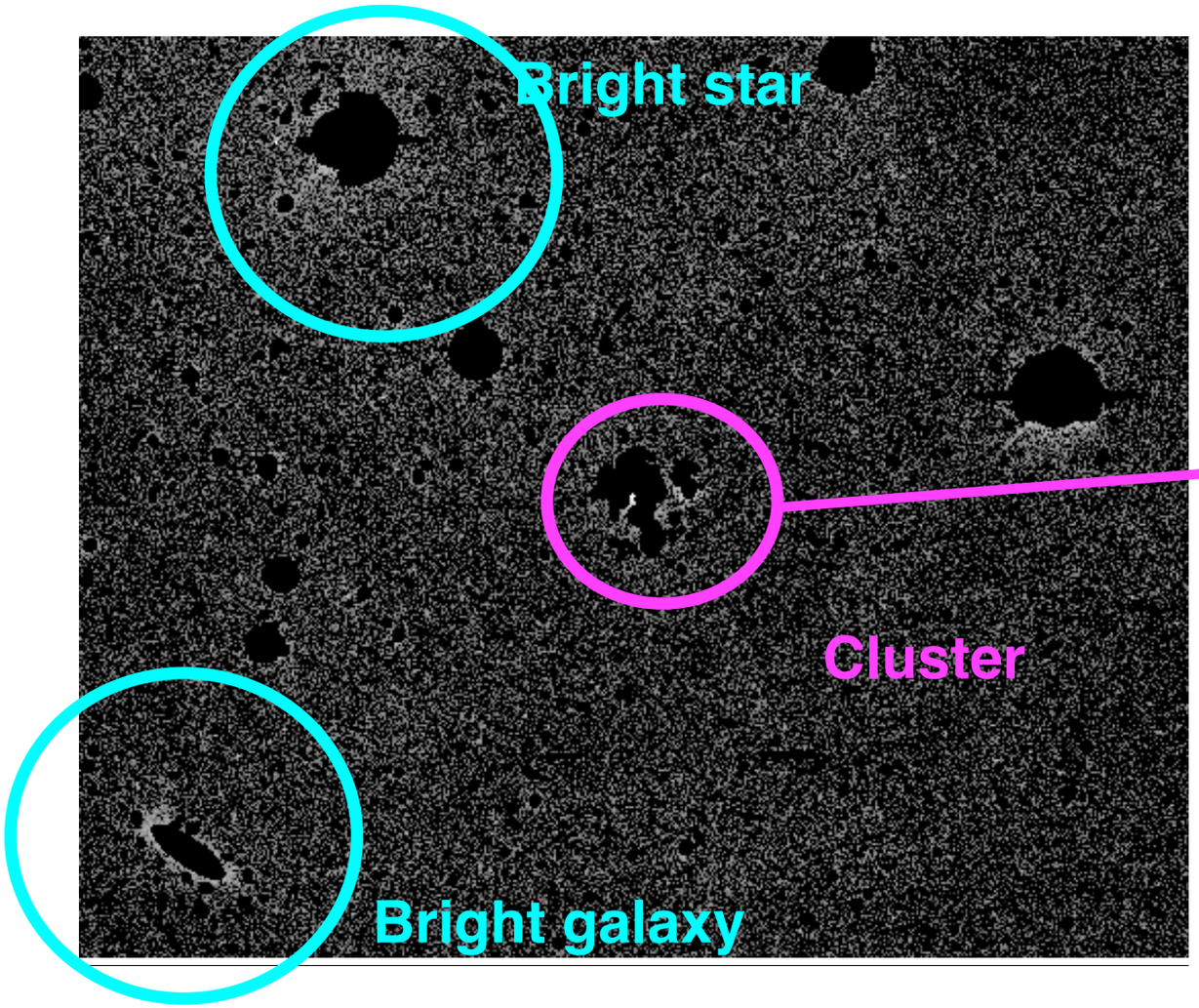


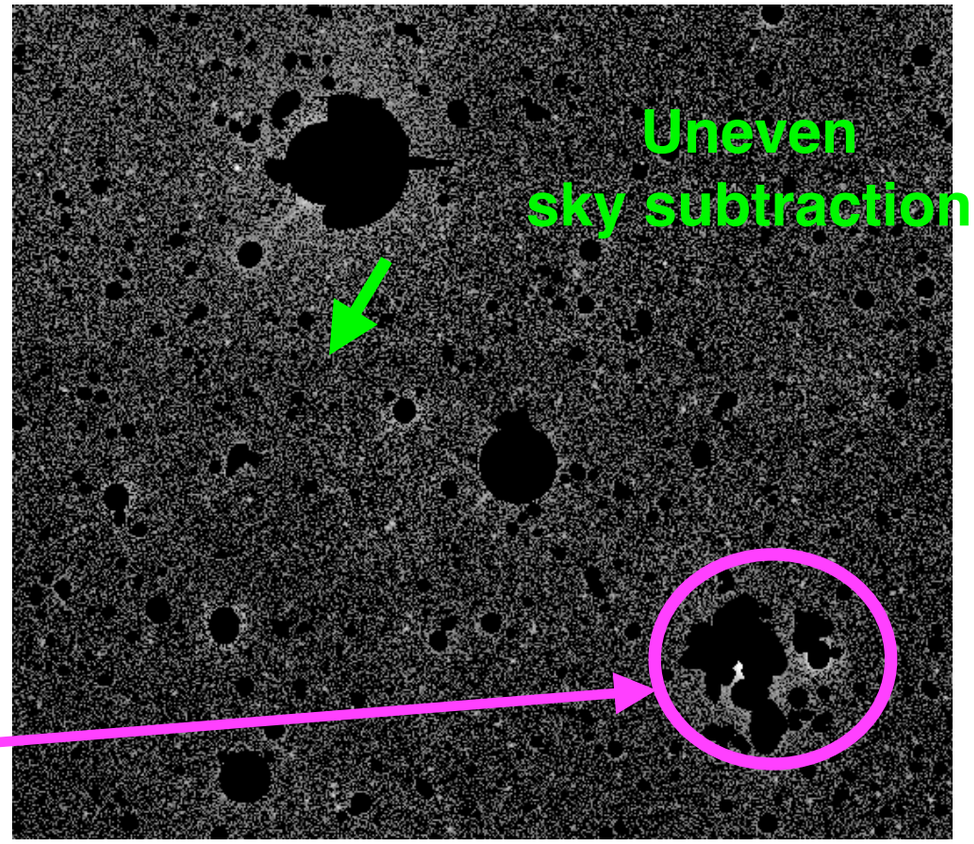
Based on DES Y3 data

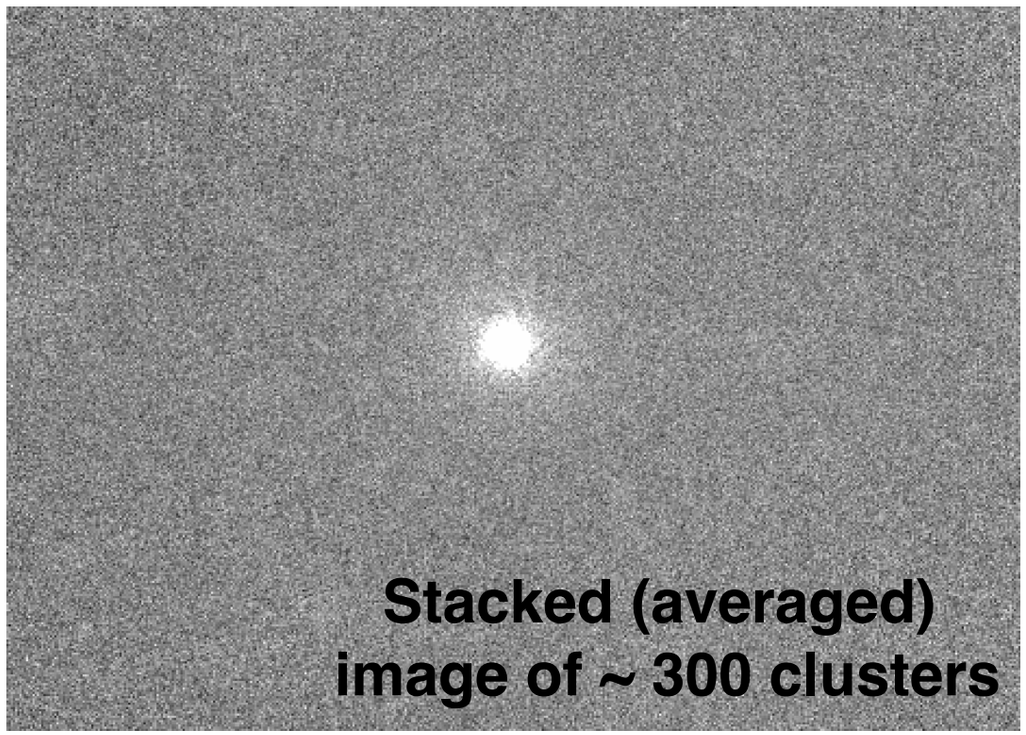
Image of one cluster,
of redshift 0.23, richness 57

Sky background is estimated over the whole FOV, ~ 3 deg^2 (Bernstein+2017).

Step 1: Many effects still persist, but “stacking/averaging” helps removing some of the un-correlated effects.

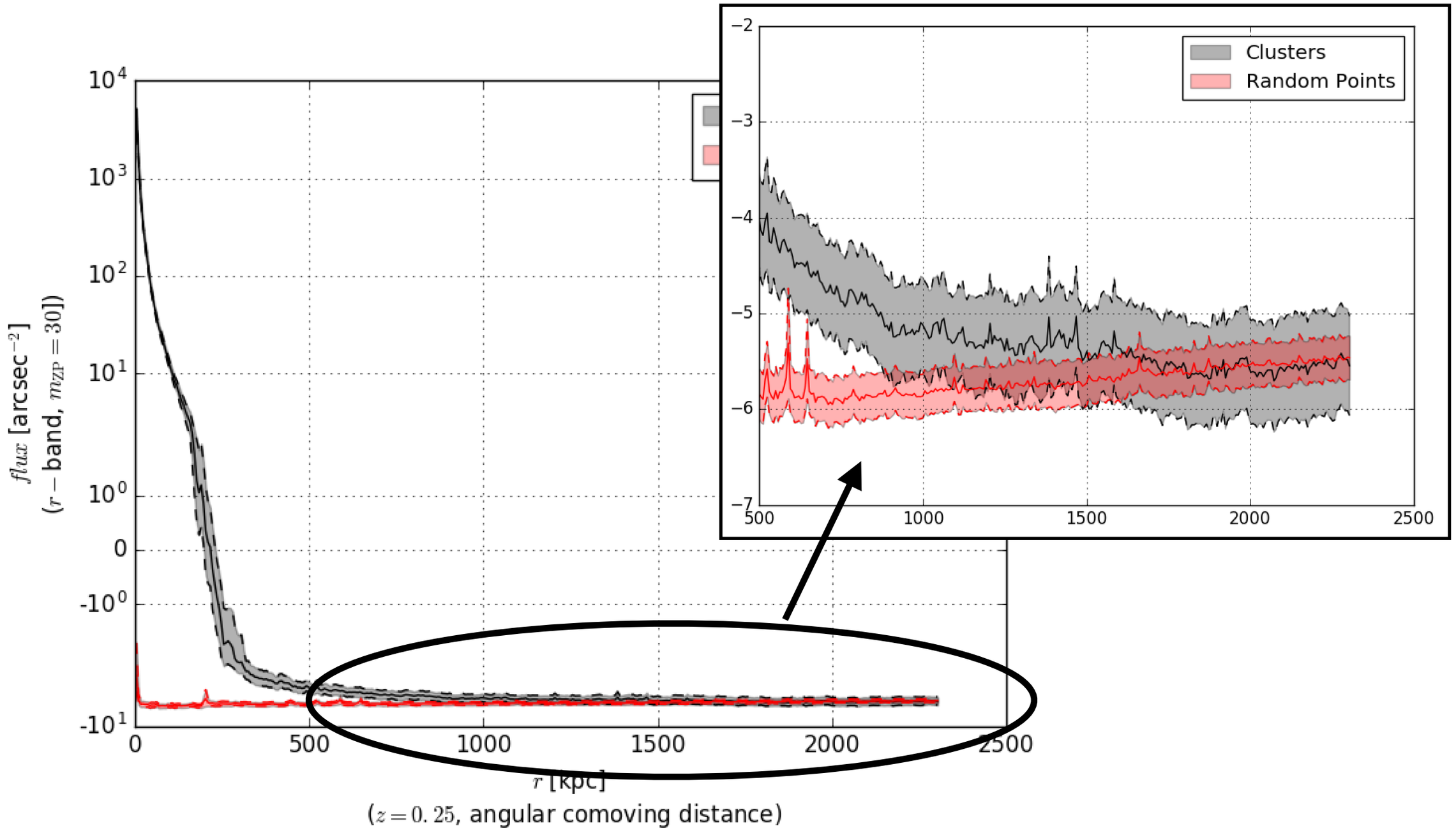






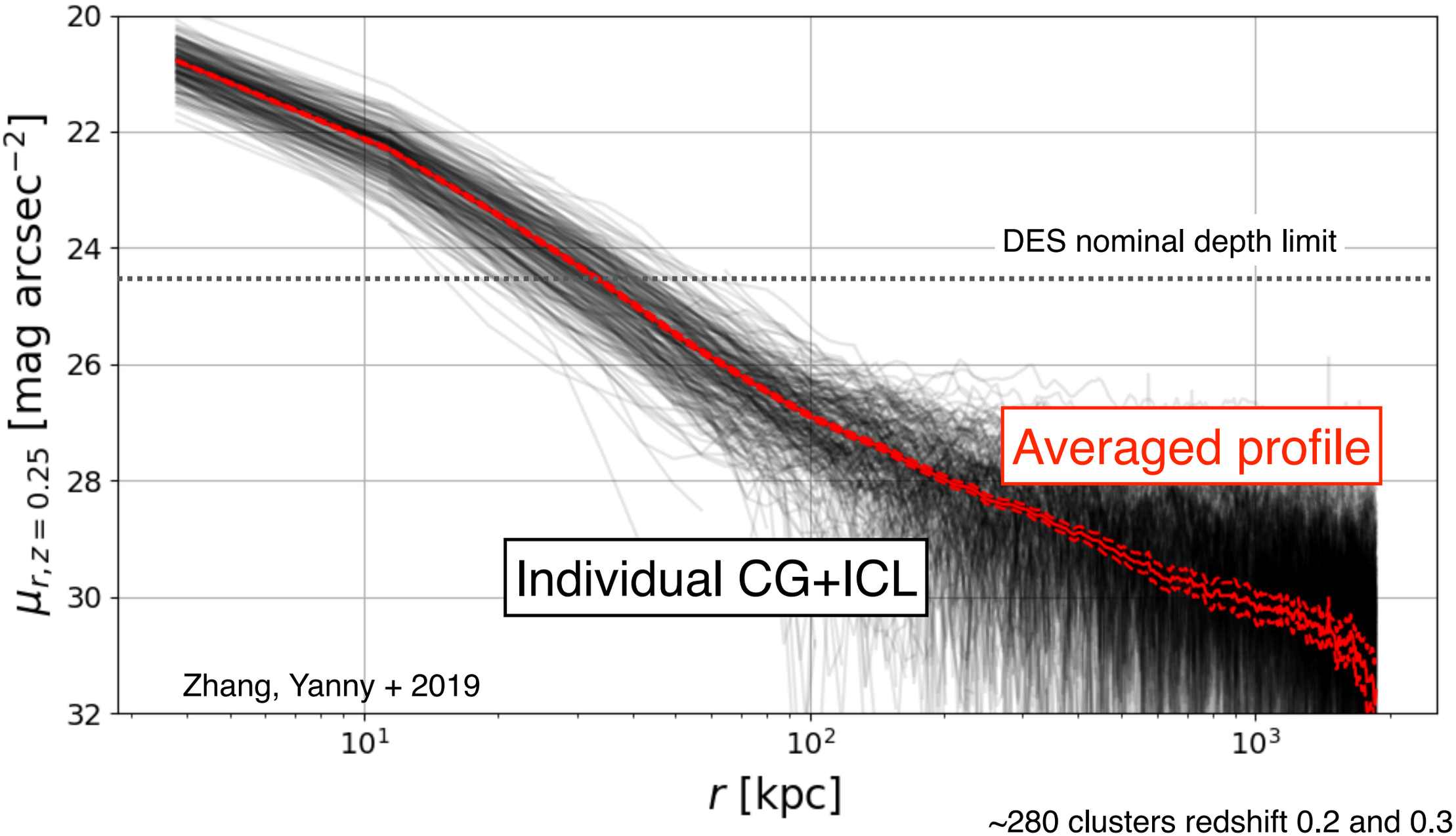
Based on DES Y3 data

Step2: Additional background flux from “systematic” effects, such as nearby bright stars/galaxies, still need to be removed.



Step2: A second “background” evaluated through stacking “random points” in the DES footprint, is further subtracted.

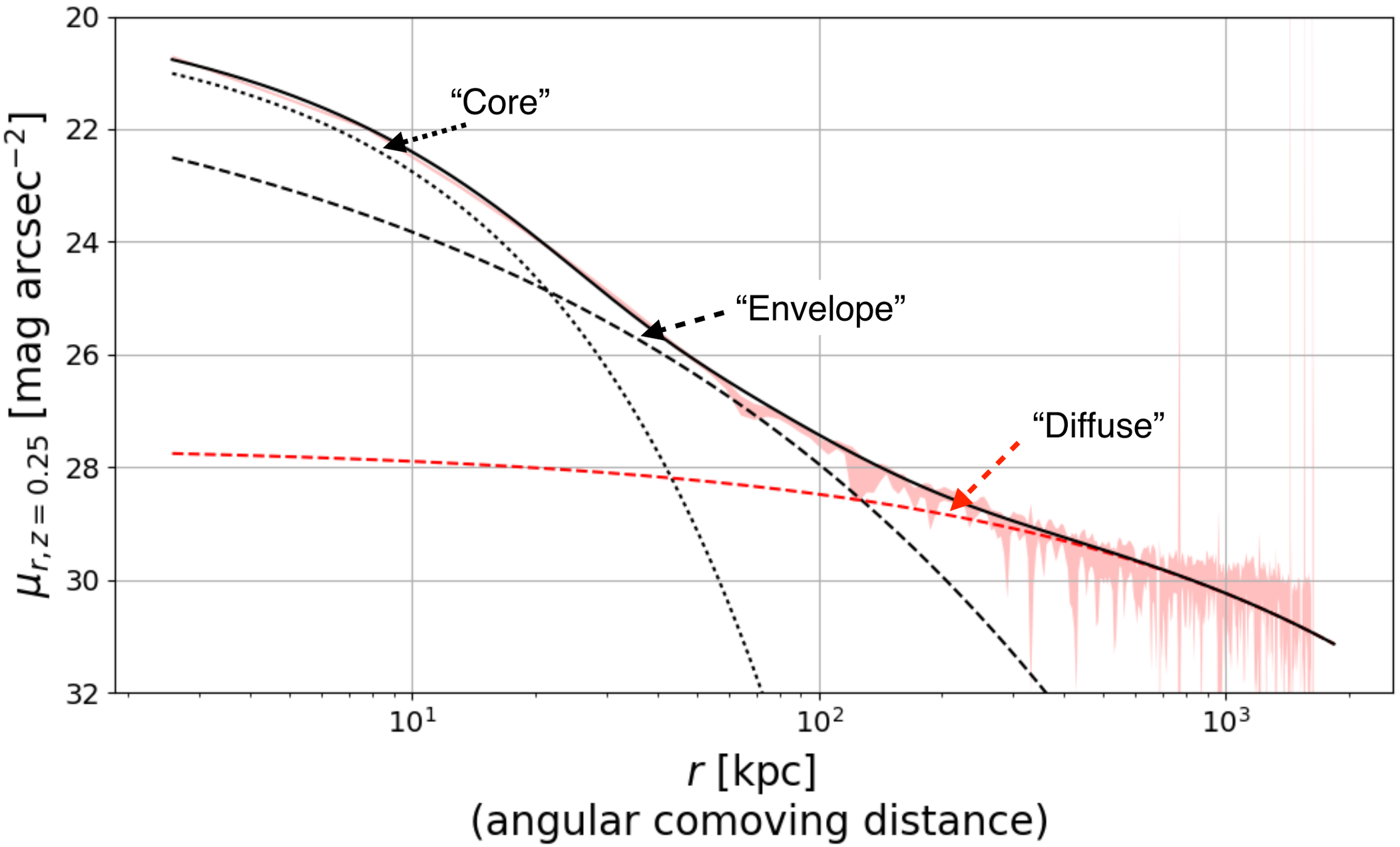
Thus, we were able to measure ICL out to ~1 Mpc from the cluster center and at a surface brightness level of 30 mag/arcsec^2.



~280 clusters redshift 0.2 and 0.3.
Based on DES Y3 imaging data.

Diffuse light can to be modeled by a composite of three **Sersic profile**s.

$$I(R) = I_e \exp\left\{-b_n\left[\left(\frac{R}{R_e}\right)^{1/n} - 1\right]\right\}$$



Summary and ongoing work

- **“Stacking” helps detecting ICL out to ~1 Mpc at redshift 0.2 to 0.3.**

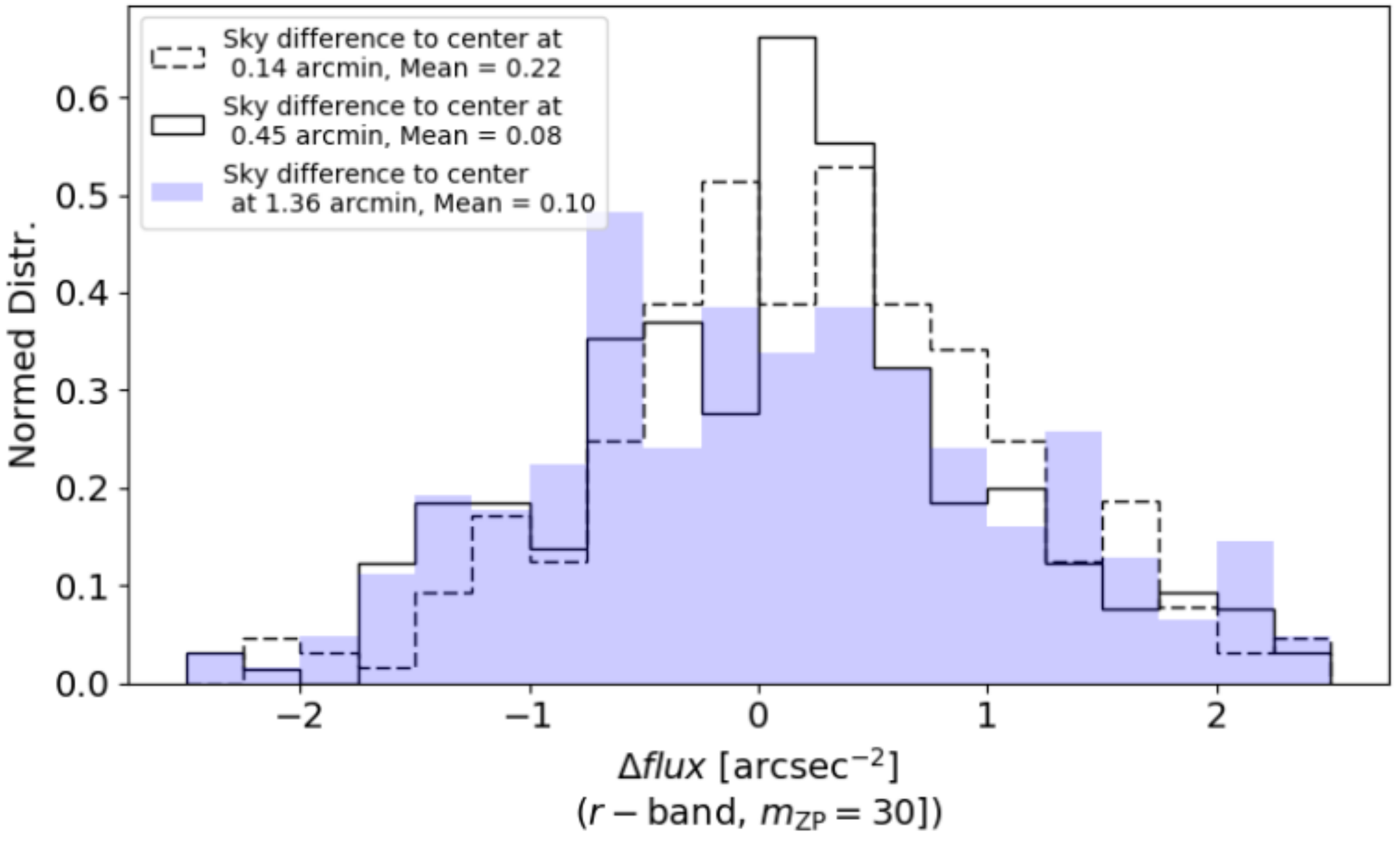
See more details (sky background, PSF, cluster galaxy, ICL test) in:

- ICL at redshift 0.2 to 0.3 — Zhang, Yanny + 2019, arXiv: 1812.04004
- ICL photo-z bias on lensing — Gruen, Zhang + 2018, arXiv:1809.04599
- Comparison of ICL to lensing — Sampaio-Santos, Zhang+ 2020, arXiv: 2005.12275
- Diffuse light profile of LRGs — Leung, Zhang+ 2020, arXiv: 2005.13467
- Paper data release (or scan QR code)

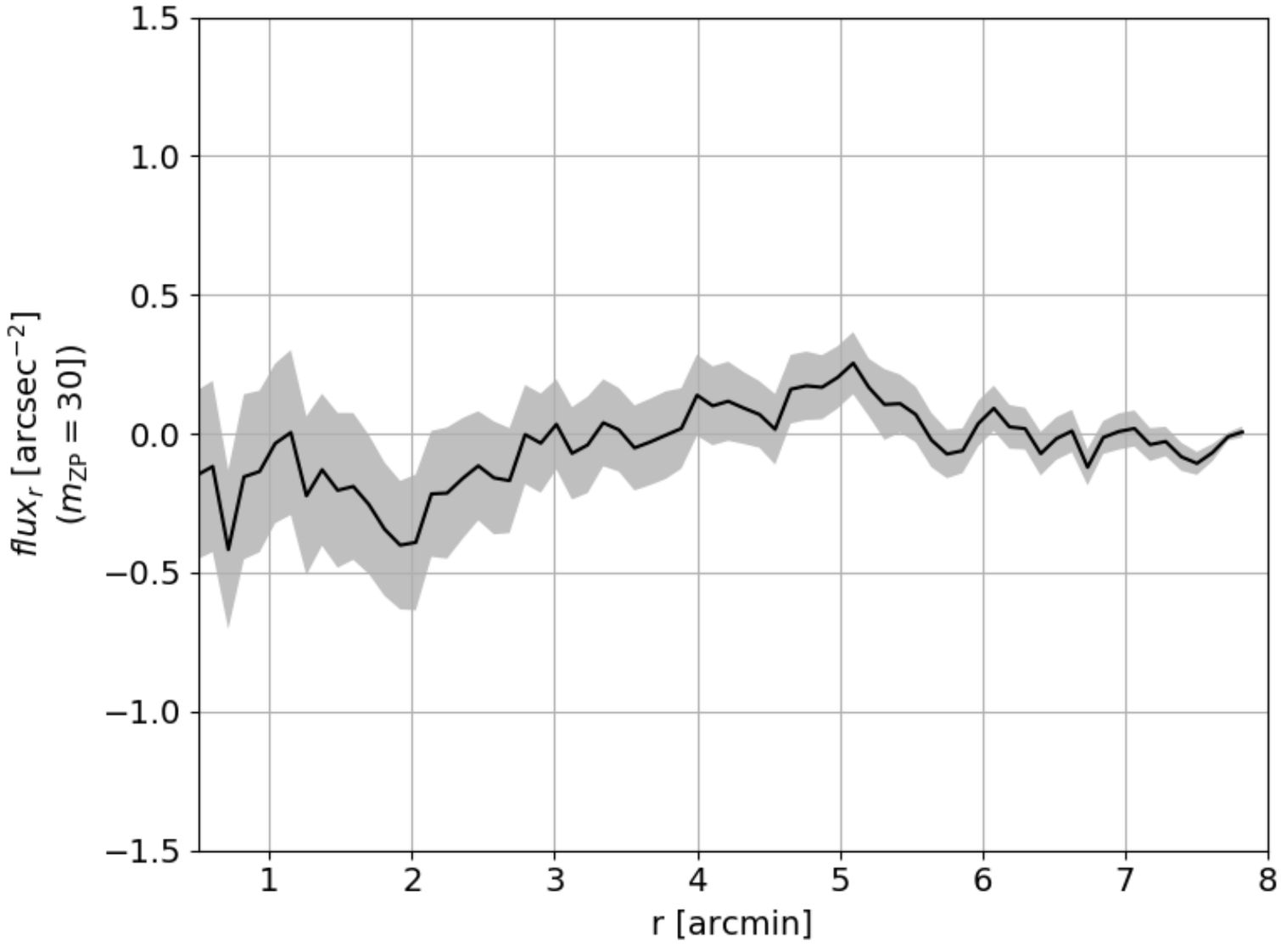
Ongoing work:

- ICL redshift evolution.

Sky background is estimated over the whole FOV, ~ 3 deg^2 (Bernstein+2017), and appears well-behaved inside clusters.

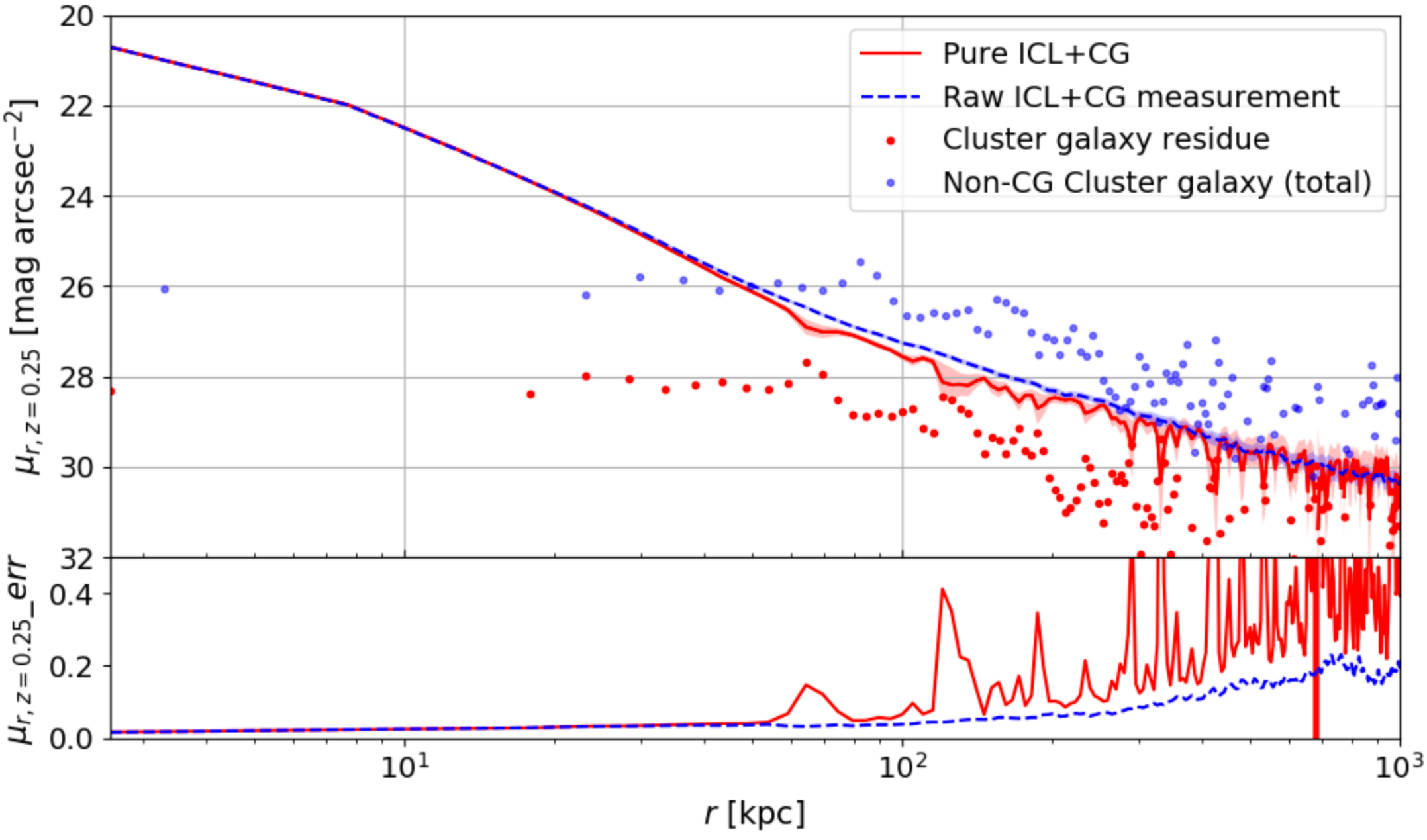


The measurement procedure is tested by “stacking random points”.



Stacking random points shows that the measurements are (relatively) bias-free.

Residual light of cluster member galaxies makes up
a small component (~10%) of the diffuse light measurement.



Yes, diffuse light is an important component of galaxy cluster.

diffuse light makes up $44 \pm 17\,\%$
of the total cluster stellar luminosity within 1 Mpc.