

# Study of the growth of massive galaxies based on their outer stellar populations

Emin Karabal

European Southern Observatory, Karl-Schwarzschild-Str. 2, 85748 Garching, Germany  
email: [ekarabal@eso.org](mailto:ekarabal@eso.org)

**Abstract.** The outskirts of early-type galaxies (ETGs) play a key role to shed light on the mass assembly of galaxies. Deep imaging has become one of the main tools to study these regions, however artificial halos caused by bright sources hampers the photometric analysis. To get around the problem, extended PSFs are built and deconvolution is performed on images.

**Keywords.** galaxies: stellar content, galaxies: interactions, galaxies: photometry, techniques: photometric

---

Stellar populations in the external halos of early-type galaxies trace the long term mass assembly of ETGs while fine structures (shells, streams, tails) give information on more recent merger events. The light and color profiles (despite of the age-metallicity degeneracy) change depending on the mass assembly scenario, as shown by simulations (Hirschmann *et al.* 2015).

Deep imaging techniques provide a way to study these extended regions, especially at distances where the resolved stellar population data is not available. Photometry on images acquired with such techniques can significantly suffer from artificial halos caused by bright sources, depending on the instrument used as they are produced by the internal reflections inside the camera. In our study, we have used Megacam on the Canada France Hawaii Telescope as a part of the MATLAS survey (Mass Assembly of early- Type GaLaxies with their fine Structures PI: Pierre- Alain Duc) (Duc *et al.* 2015). In these images where we study the fine structures and the outer halos of ETGs, we reach surface brightness limits of 28.5-29 mag.arcsec<sup>-2</sup> in *g* band.

The artificial halos of the bright stars, that neighbor and contaminate the galaxies' light profiles are modeled and removed manually (Karabal *et al.*, in prep). To remove artificial galactic halos, one may follow either model-convolution or deconvolution techniques: in our case, because of our sample characteristics and computing-time limitations, we have used a deconvolution technique based on PyOperators. Before deconvolving, we have built PSFs with large wings (up to 200'') for different seeing conditions and two bands. Extensive tests of the method have been made with simulated galaxies (Karabal *et al.*, in prep).

Our results show that depending on the brightness of the source, the galactic artificial halos can have dramatic or negligible effect on galaxies' light profiles. The difference in the PSFs of different bands causes changes in color profiles: the broader PSF in *r* band causes reddening in the extended region of the *g-r* color profiles. Our deconvolution technique removes this artificial reddening (Karabal *et al.*, in prep).

## References

- Hirschmann, M., Naab, T., Ostriker, J. P., *et al.* 2015, *MNRAS*, 449, 528  
Duc, P.-A., Cuillandre, J.-C., Karabal, E., *et al.* 2015, *MNRAS*, 446, 120