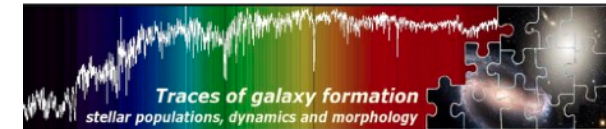


The Sloan Digital Sky Survey extended point spread functions, a summary

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Abstract: A robust and extended characterization of the point spread function (PSF) is crucial to extract the photometric information produced by deep imaging surveys. Here we present the extended PSFs of the Sloan Digital Sky Survey (SDSS), extending over 8 arcmin in radius for all filters (u, g, r, i, z). We illustrate with an example how the PSF models can be used to remove the scattered light field produced by the brightest stars in the central region of the Coma cluster field. This particular example shows the huge importance of PSFs in the study of the low-surface brightness Universe, especially with the upcoming of ultra-deep surveys, such as the Large Synoptic Survey Telescope (LSST). Following a reproducible science philosophy, the PSFs are made publicly available and can be obtained by anyone from scratch. For more, see [Infante-Sainz et al. 2020](#).



Context of the research

The low surface brightness studies (galaxy streams, haloes, dust cirri, etc.) is one of the most challenging area of the astronomy. Very high accuracy in the correction of the systematics is necessary to reach the necessary level of depth.

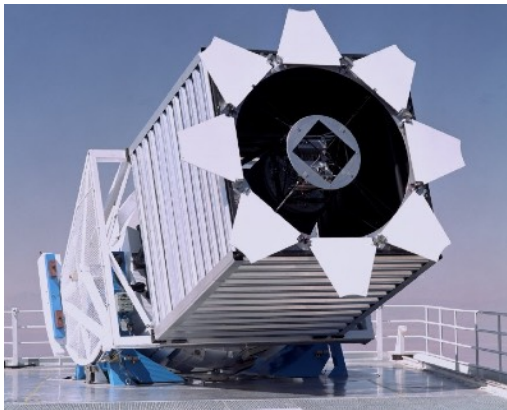
One critical issue is the Point Spread Function (PSF) effects. The goal is to create the extended PSFs for the SDSS survey, and develop the necessary techniques for future surveys like the Large Synoptic Survey Telescope (LSST).

SDSS

$D = 2.5 \text{ m}$

$P = 0.396 \text{ arcsec/pixel}$

Bands = u g r i z



LSST

$D = 8.4 \text{ m}$

$P = 0.20 \text{ arcsec/pixel}$

Bands = u g r i z Y

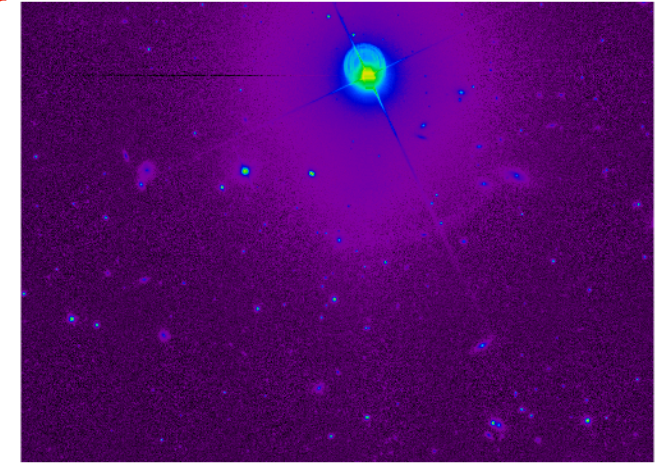


SDSS is the perfect training set for next generation of surveys.

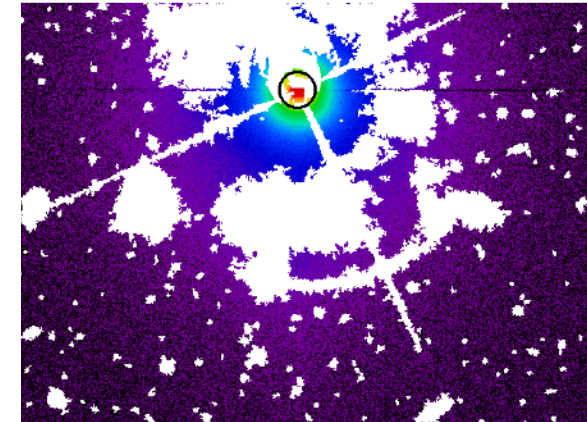
Description and methodology

1. USNO-B1 Catalog is used for selecting very bright stars
2. Each star is masked and normalized
3. Finally, all images are stacked to obtain the PSFs

1. Very bright star
($m_r \sim 5$ mag)

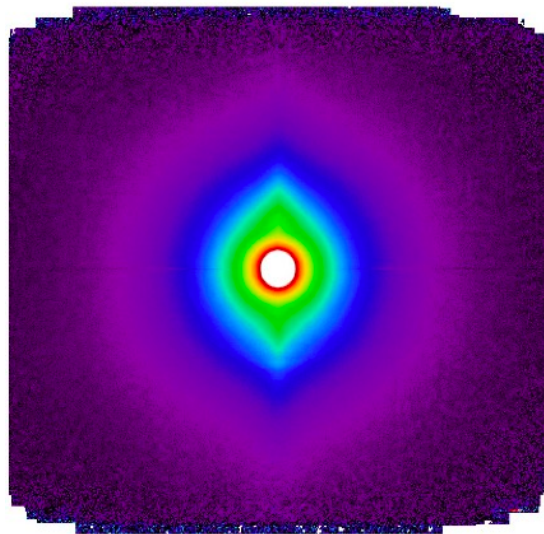


2. Mask and
normalize

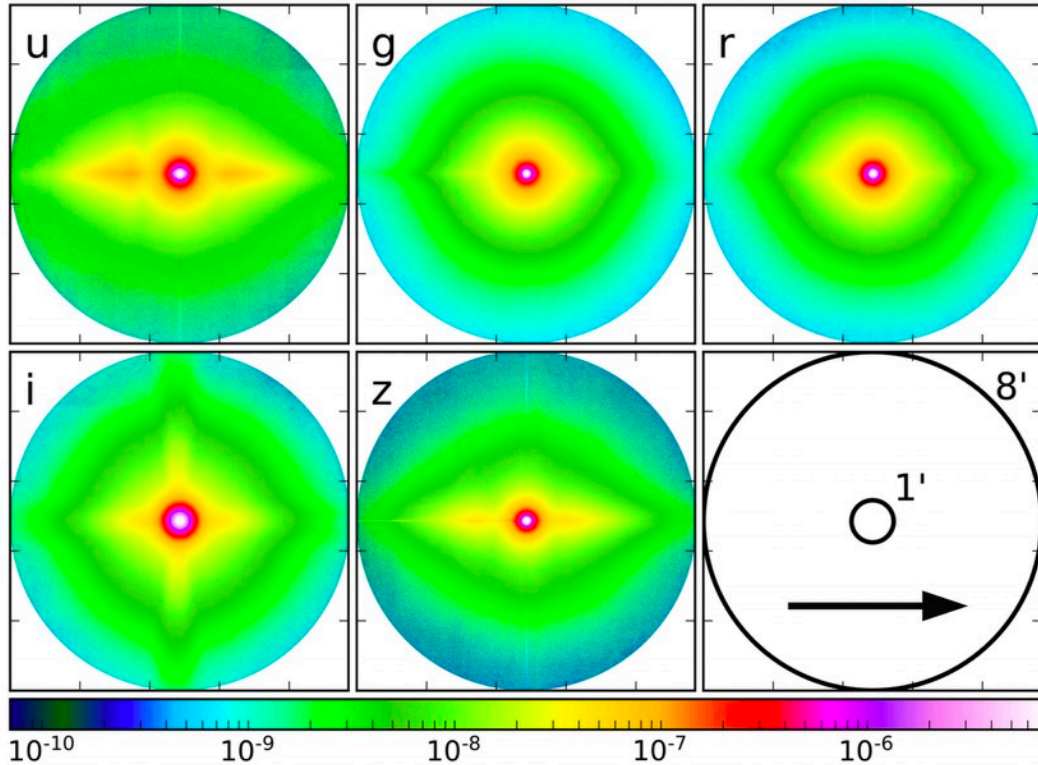


3. Stacking
~1000 images

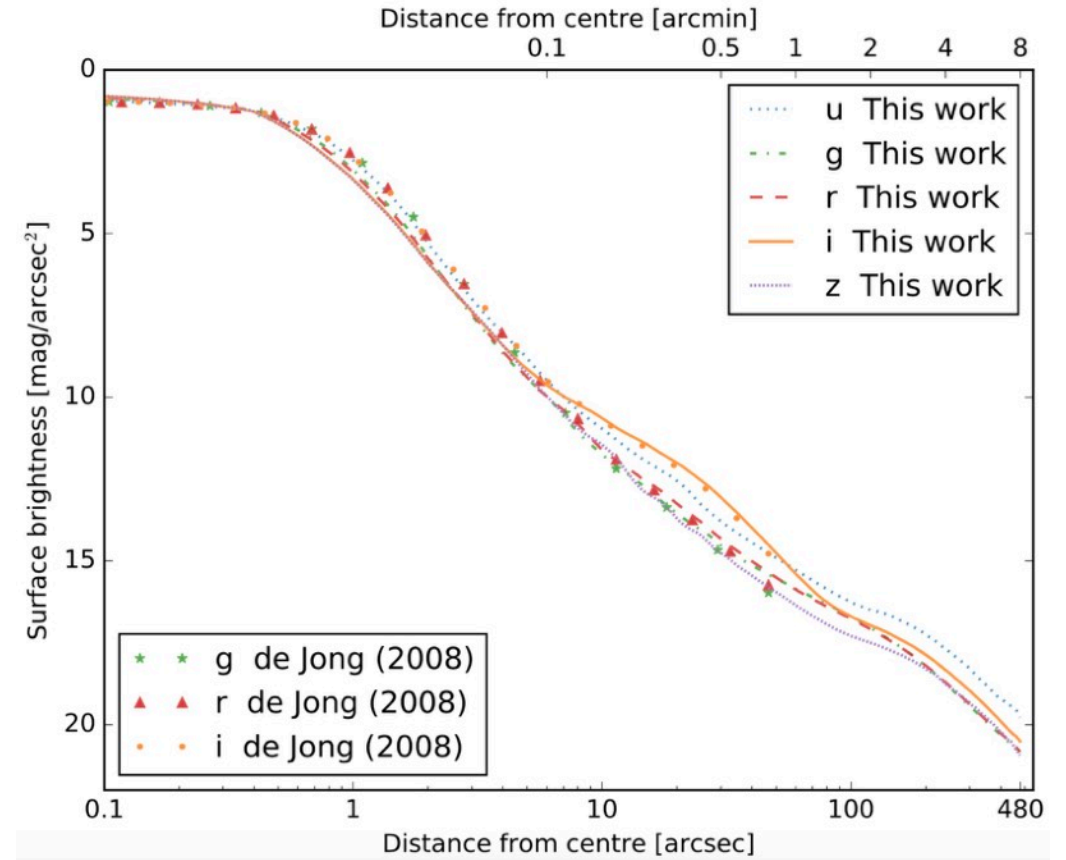
PSF r-band



PSF images

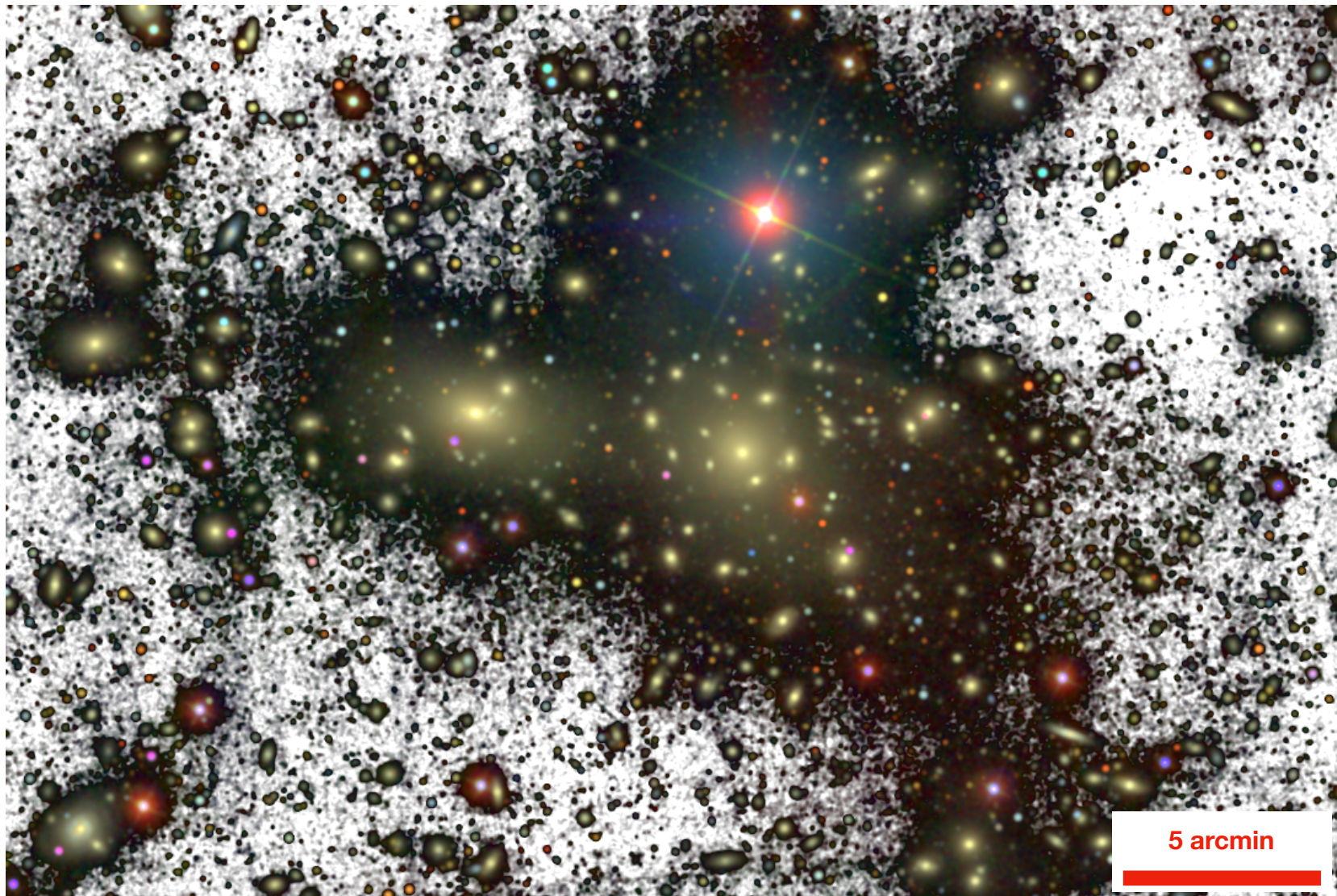


PSF radial profiles



2D PSF images in a reproducible paper (Infante-Sainz et al. 2020, MNRAS 491, 5317)
using Maneage (Akhlaghi et al. 2020, arXiv:2006.03018)

Coma cluster of galaxies (original)



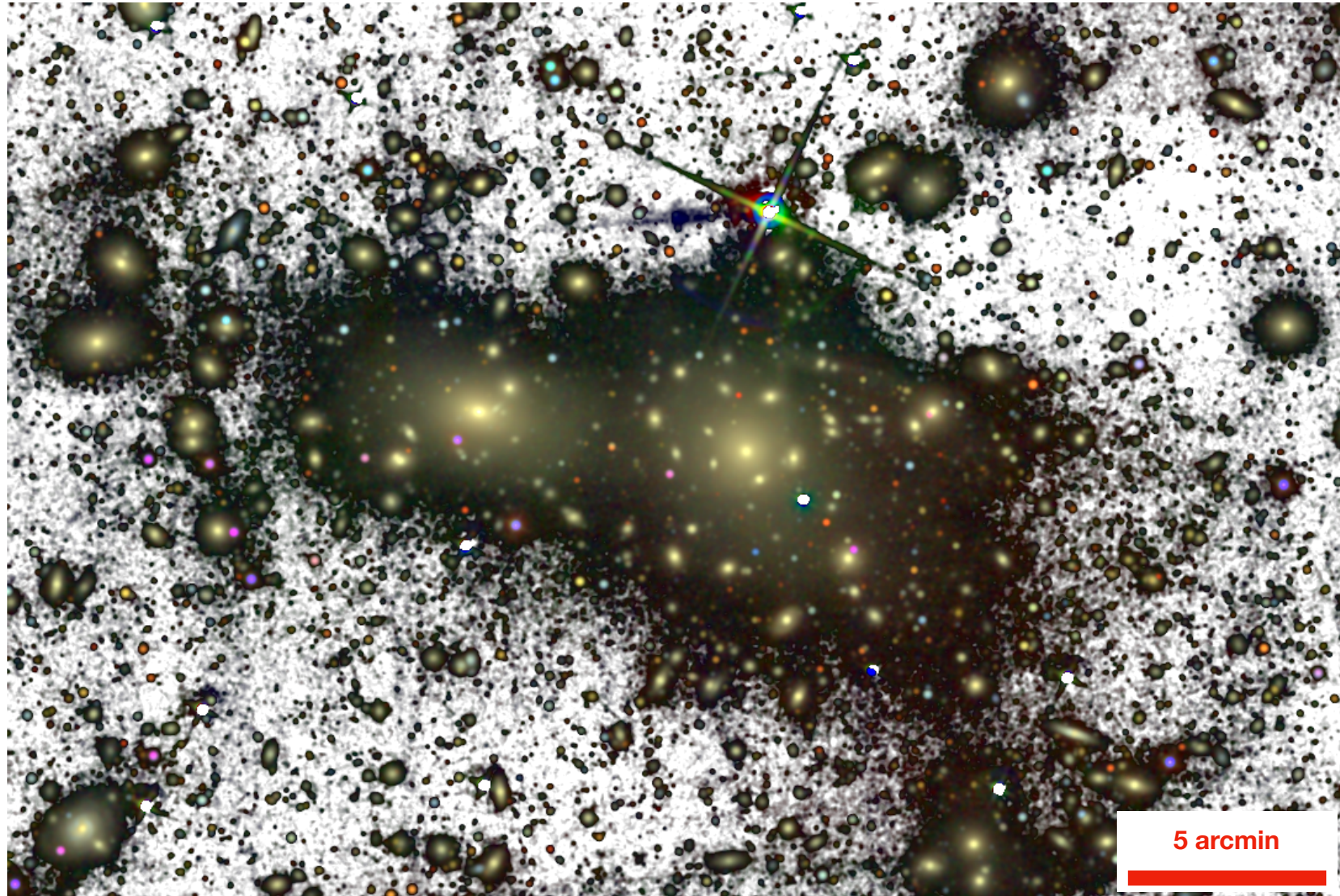
Why extended PSFs are important?

Let's study the low surface brightness features of this cluster of galaxies.

That is impossible due to the scattered light of very bright stars.

Using the PSFs it is possible to model the scattered light field and subtract it.

Coma cluster of galaxies (stars removed)



Very bright stars have been removed and now it is possible to study the intra cluster light, ultra diffuse galaxies, etc.!

For the future, it is also possible to use the PSFs to model galaxies and other objects.

Apply same techniques in future deep surveys.