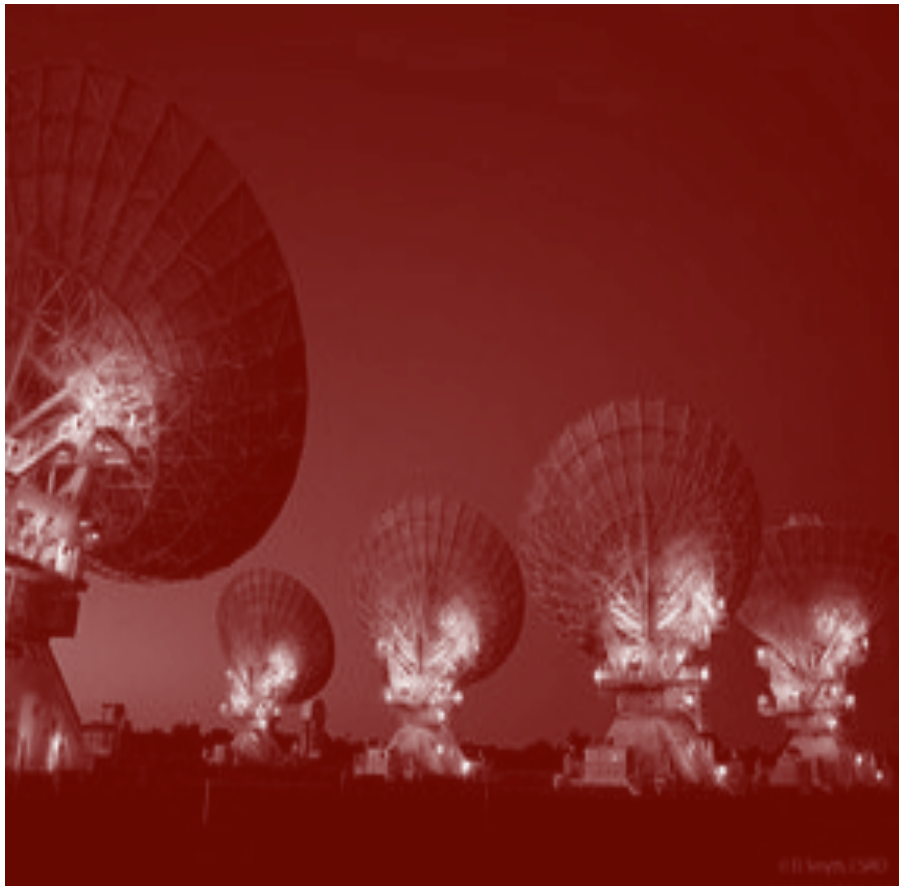
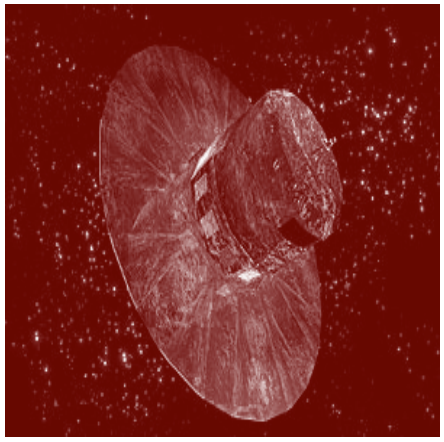




FACULDADE DE CIÊNCIAS
UNIVERSIDADE DE LISBOA

ENAA XXIII

Gaia Beacons

Ana Sofia Afonso

Under the Supervision of Doctor Sonia Antón

"[Blazars], my boy! Beacons of the future! Capsules with hundreds of bright little seeds in each, out of which will spring [a better] future."

Adapted from Arthur Conan Doyle, Sherlock Holms: The Complete Novels and Stories, Volume I

OUTLINE

- Blazars in the *Global Astrometric Instrument for Astrophysics* (GAIA) era
- A case study: the optical counterparts of ICRF2 (and a future extension)
- The outcome from 2-D image decomposition of quasi-'stars'
- Ongoing plans & Summary

MOTIVATION

Astrometry [the measurement of positions] is fundamental to, and the basis for, all other fields of Astronomy. Indeed, even our "holidays" are based on astrometry…

- The forthcoming Gaia ESA mission will observe the solar system, the galaxy, and extragalactic objects, of which at least 500 000 are QSOs.
- Objects with core radio morphology, absent proper motions, apparent point-like nature ensure a high degree of accuracy and stability of their coordinates.
- These kind of objects can help on the alignment between the sub-milliarcsecond radio frame (ICRF) with the existing and emerging optical reference frames of similar accuracy, constructed by astrometric satellites (GCRF).
- Our aim is to study one of the main difficulties in achieving this goal: the extended structures of quasar hosts.

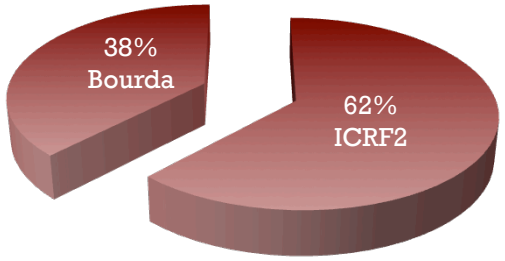
We performed a case study by finding optical counterparts to the ICRF 2 radio defining sources (and future extension - Bourda et al, 2011) in the SDSS DR 9.

DATA

- ICRF2 uses a set of 295 extragalactic sources distributed over the entire sky and selected on the basis of positional stability and the lack of extensive intrinsic source structure. The precision of the source coordinates is better than 1 mas.

- A sample of 105 optically-bright extragalactic radio sources as compiled (Bourda et al,2011) by cross-correlating optical and radio catalogs and in order to upgrade the defining sources in the current reference frame. The precision is around <200μas.

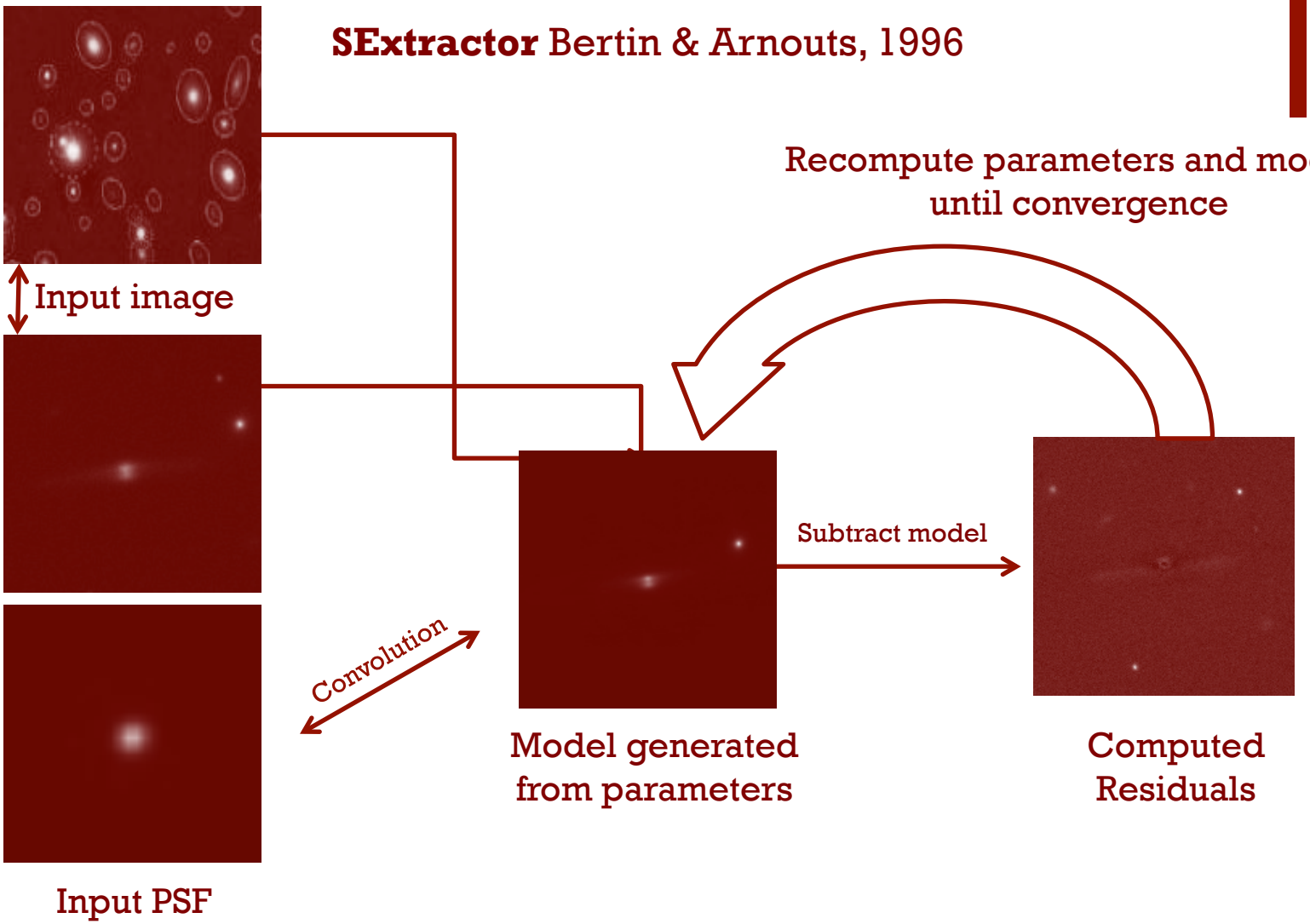
From our sample of 400 sources, only 198 have optical counterparts in the Sloan Digital Sky Survey Data Release 9.

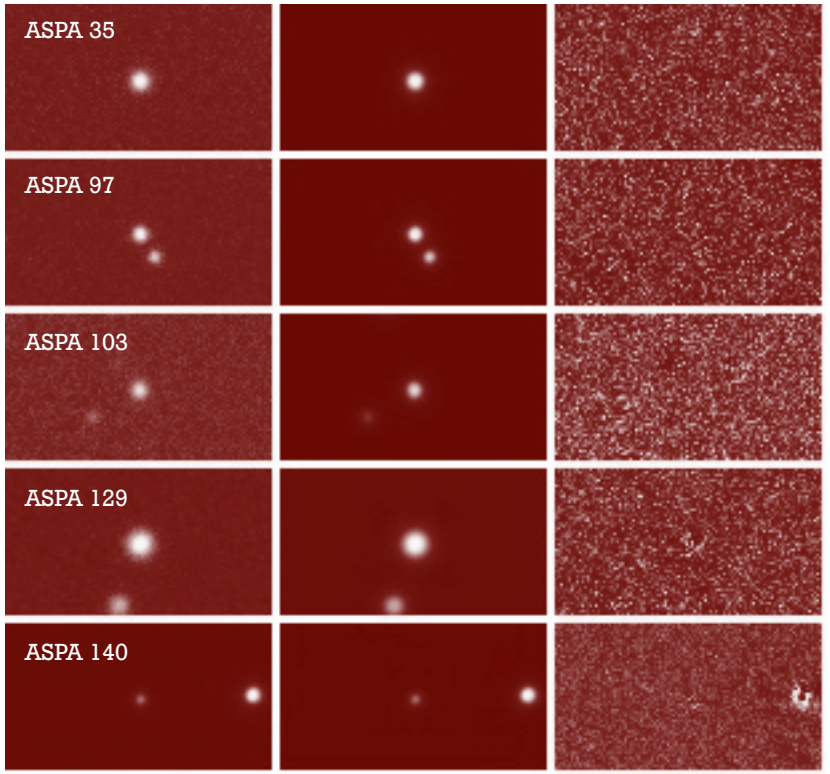


Peng et al. 2002, 2010

GALFIT

SExtractor Bertin & Arnouts, 1996



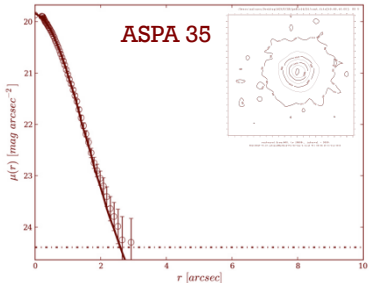


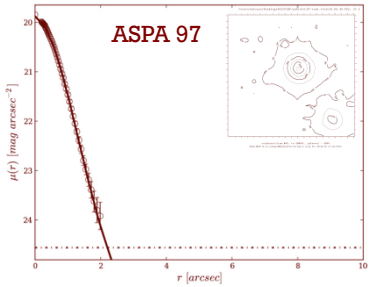
@r-band image @galfit model @residuals

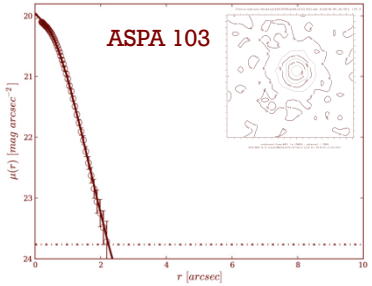
PSFs Profiles (134)

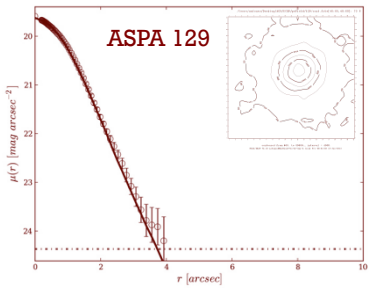
which adjusts the given PSF to the magnitude that better fits the object

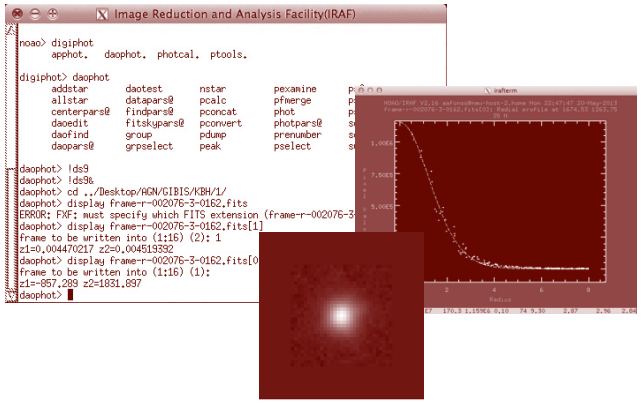
RESULTS

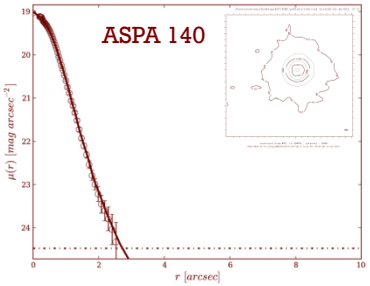






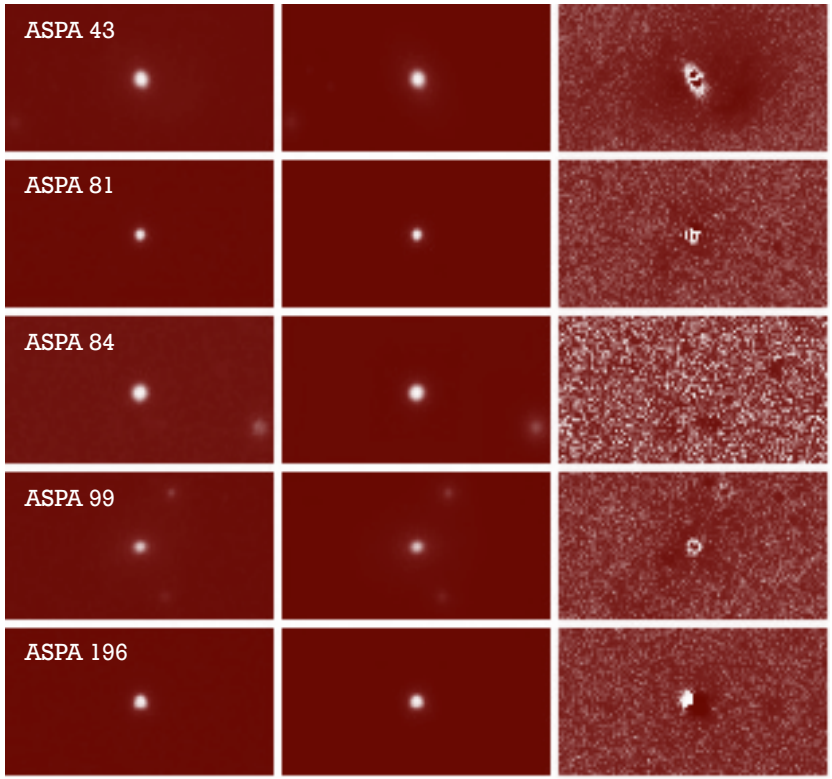






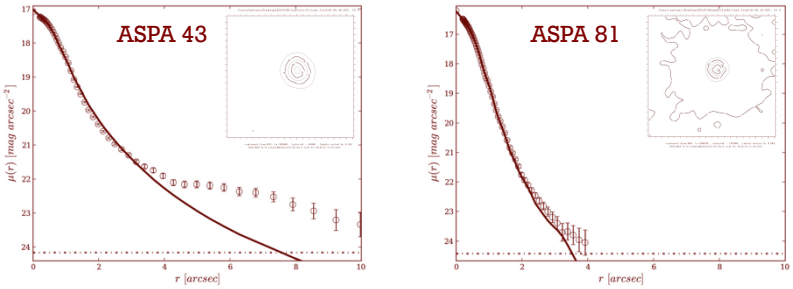
Sérsics Profiles (32)

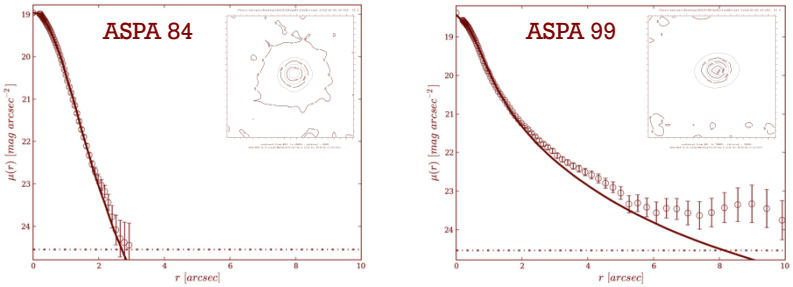
which adjusts the 7 free parameters to minimize the residuals after model subtraction

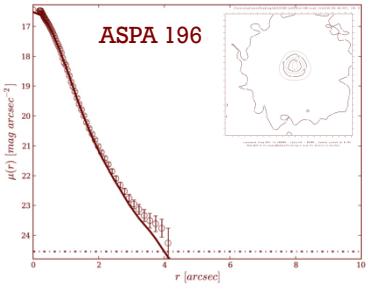


@r-band image *@galfit model* *@residuals*

$$\Sigma(r) = \Sigma_e \exp\left[-\kappa\left(\left(\frac{r}{r_e}\right)^{1/n} - 1\right)\right]$$





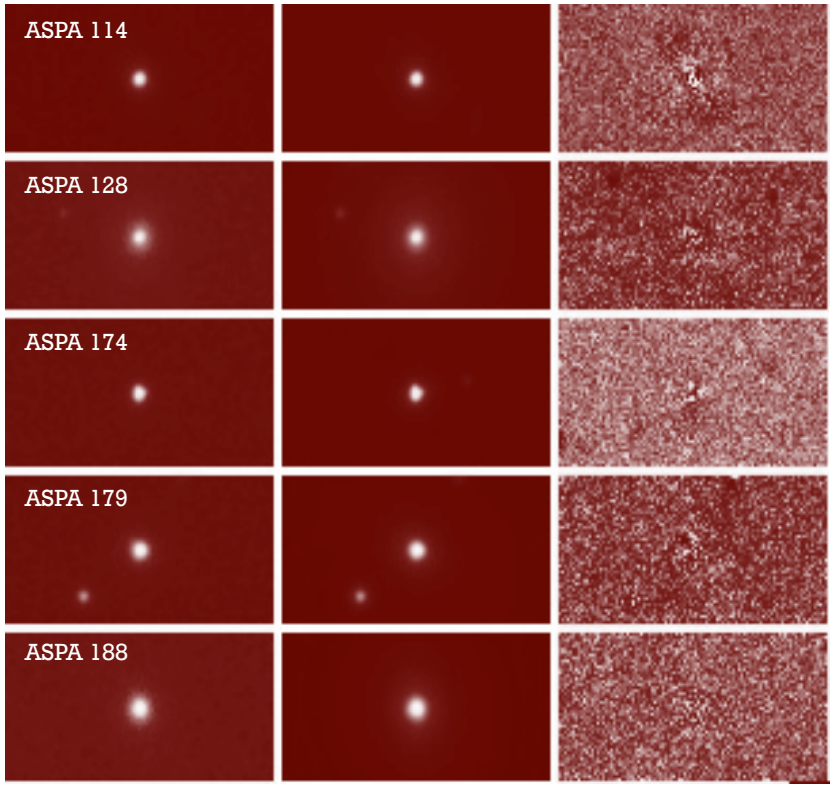


<u>Free parameters:</u> x-position; y-position; magnitude; effective radius; Sérsic index; ellipticity; position angle.

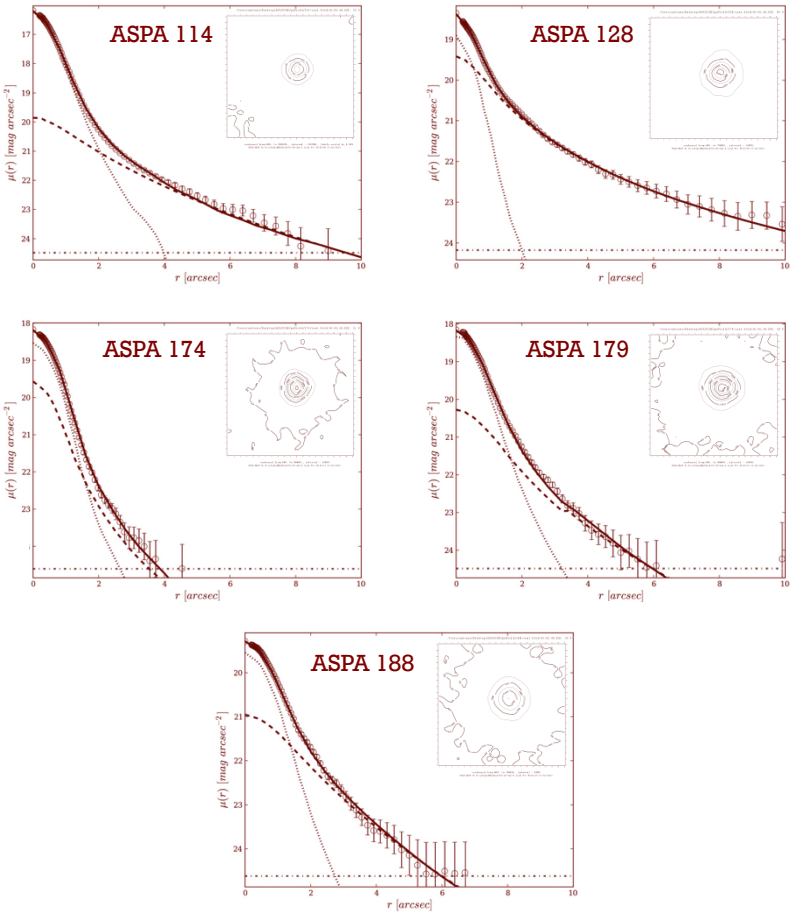
PSF+Sérsic Profiles (16)

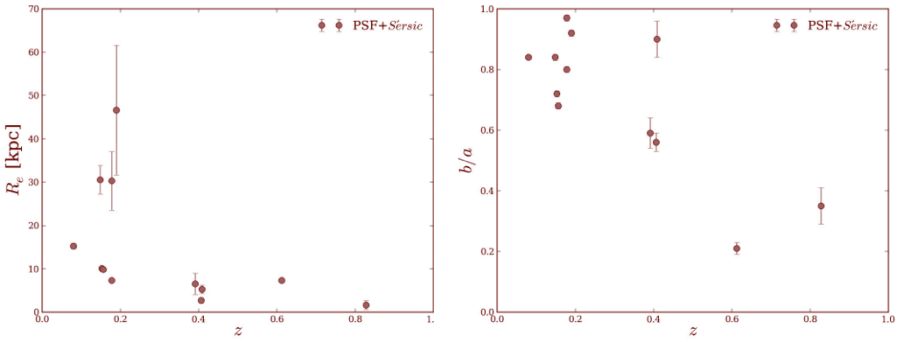
RESULTS

in order to fit the bright point source emission and the properties of the underlying host galaxy

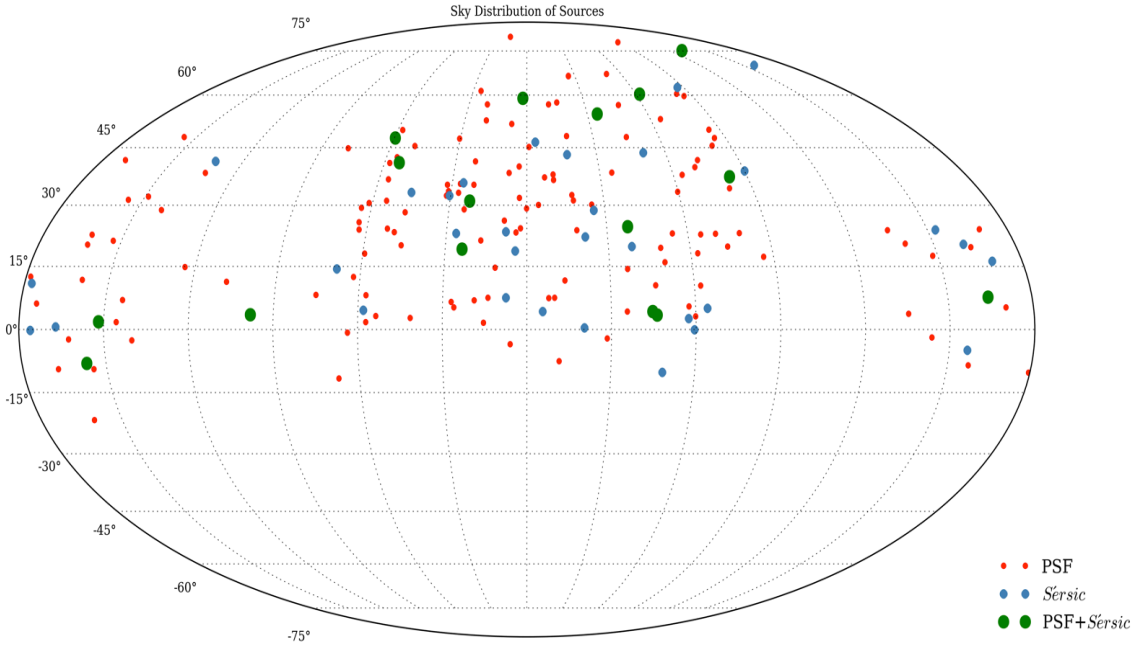


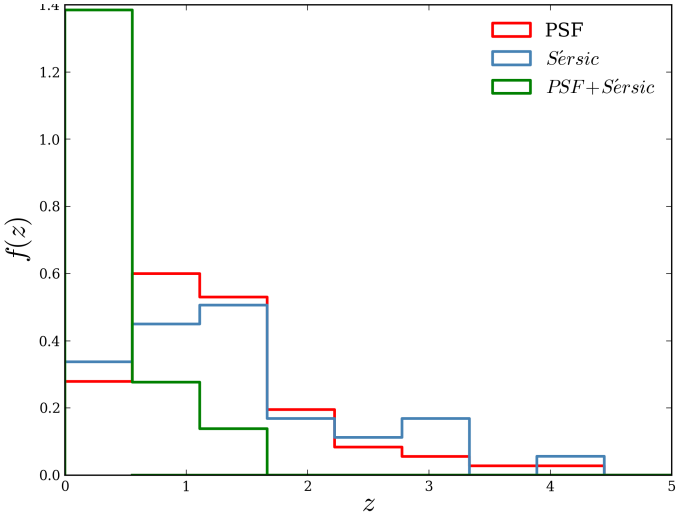
@r-band image *@galfit model* *@residuals*

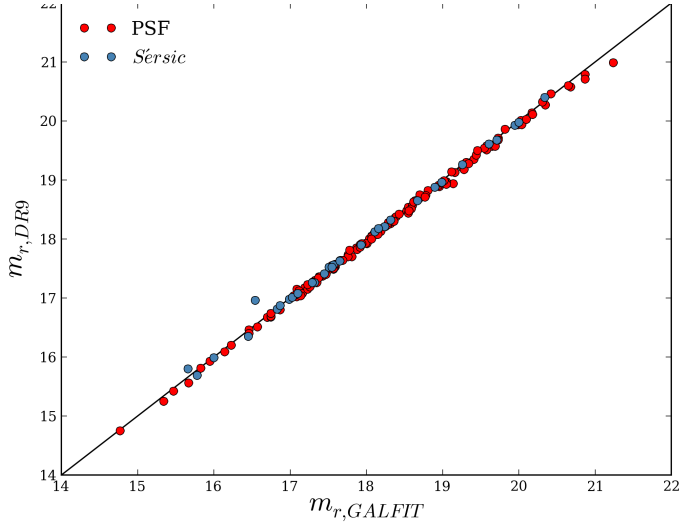




RESULTS

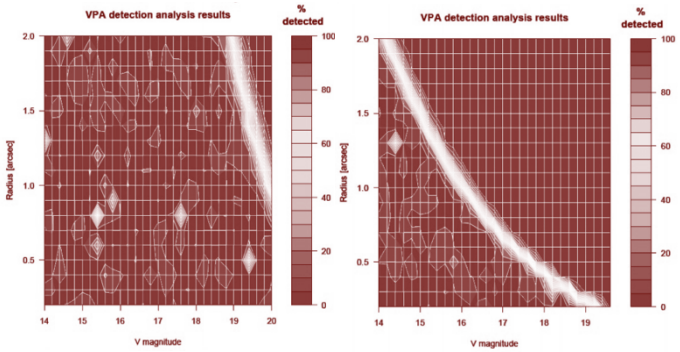

Sky Distribution of Sources
75°
60°
45°
30°
15°
0°
-15°
-30°
-45°
-60°
-75°
PSF
Sérsic
PSF+Sérsic


PSF
Sérsic
PSF+Sérsic
f(z)
z


PSF
Sérsic
$m_{r,DR9}$
$m_{r,GALFIT}$

ONGOING

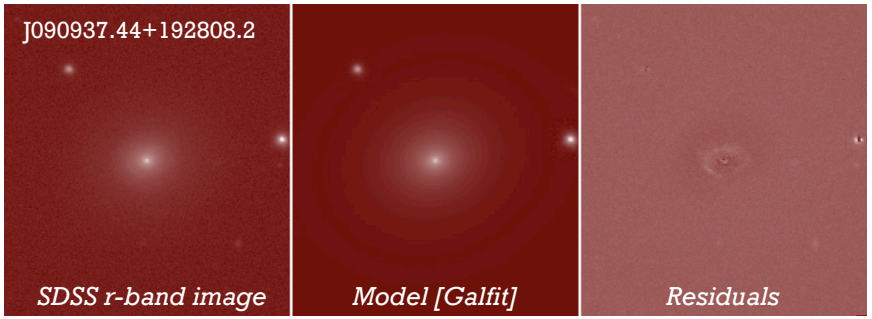
Gaia Instrument and Basic Simulator is a pixel-level simulator intended to simulate how Gaia instruments will observe the sky, using realistic simulations of the astronomical sources and of the instrumental properties.

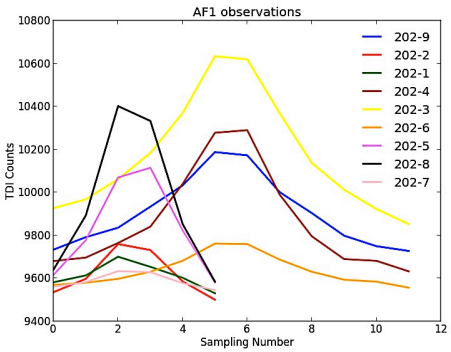


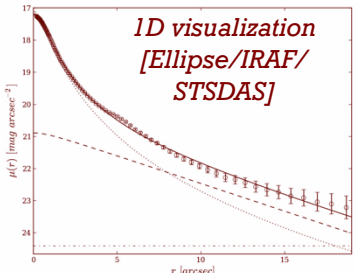
By Alberto Krone-Martins

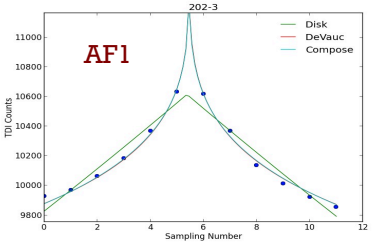
$G_{lim} = 20$ mag

Object apparent size (300mas)









We aim to analyze the ICRF2+ objects by asserting on their detectability through GIBIS and, if possible, inferring their morphological parameters as seen by GAIA simulated data.

SUMMARY

The combination of Gaia optical astrometry and accurate radio astronomy will probe directly the geometry and physics of the targets as never done before, which holds promises for new discoveries…

The detailed analysis of the images can permits to pinpoint an extended component (host galaxy), which may be a source of error for centroid determination, if detected by Gaia.

Answer (for this sample): 9%. Guess (for now): +17%.

Thank you for your attention and have a nice lunch ☺