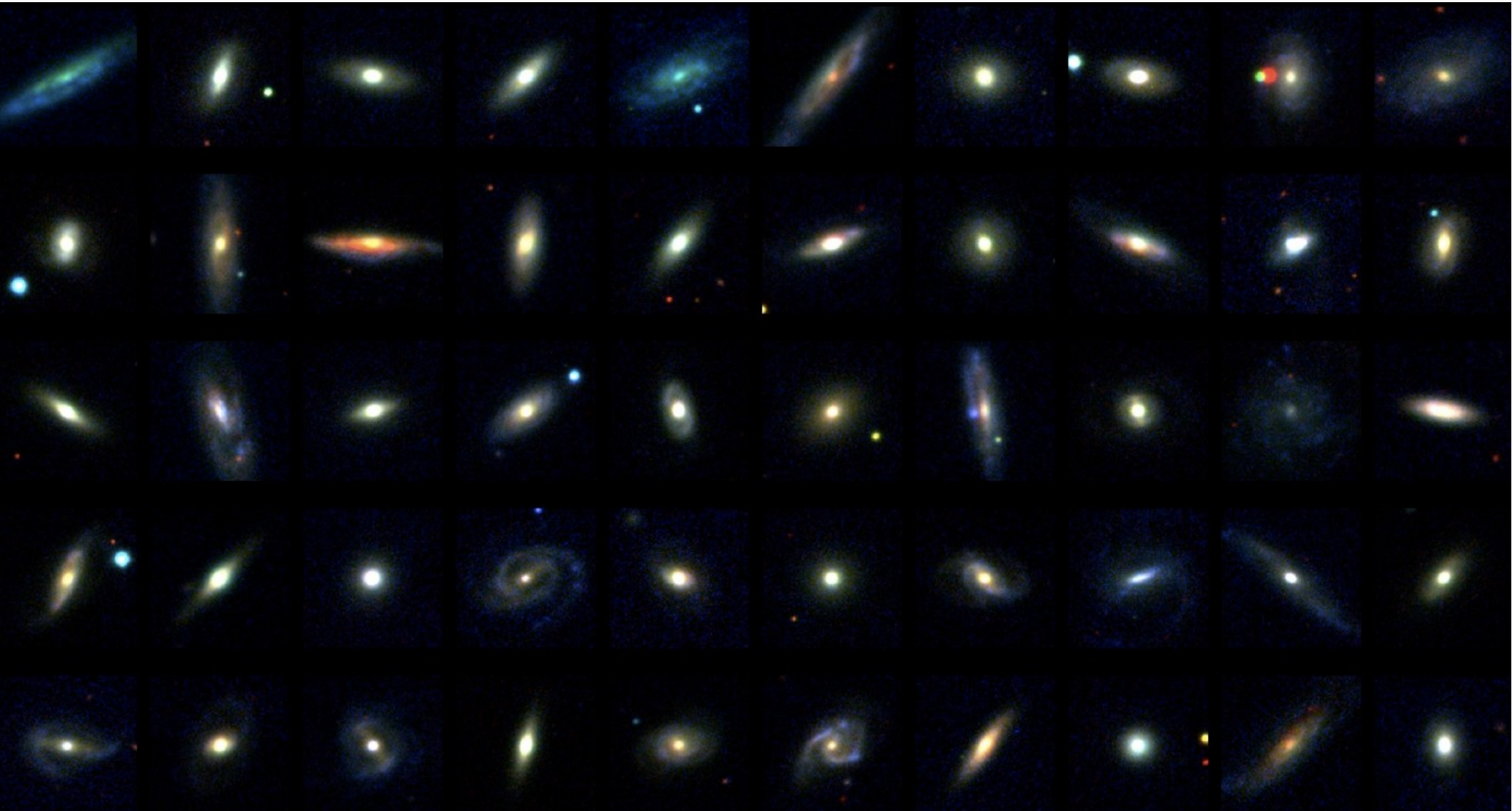
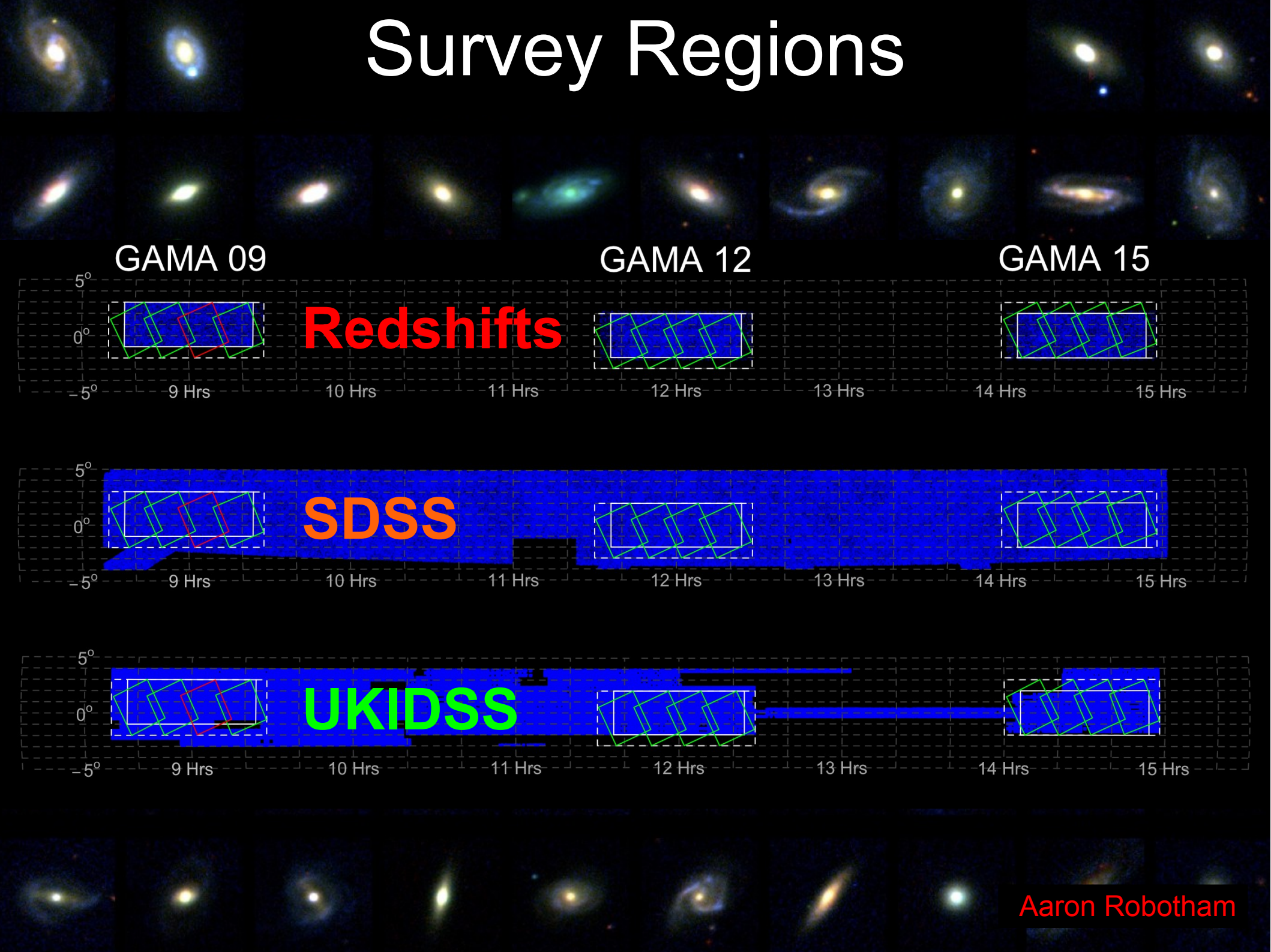
GAMA-SIGMA: Single-Sérsic Galaxy Fitting

Lee Kelvin, ICRAR, March 2011



Survey Regions



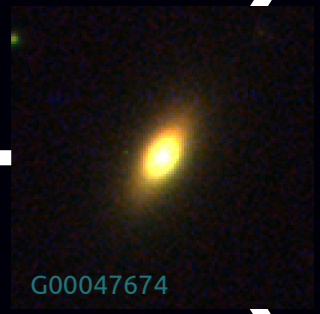
Aaron Robotham

Galaxy And Mass Assembly (GAMA)
Hubble Tuning-Fork

Groups/ Mergers

Unbarred Spirals

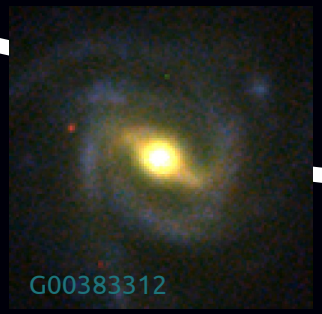
Ellipticals



GAMA

Irregulars

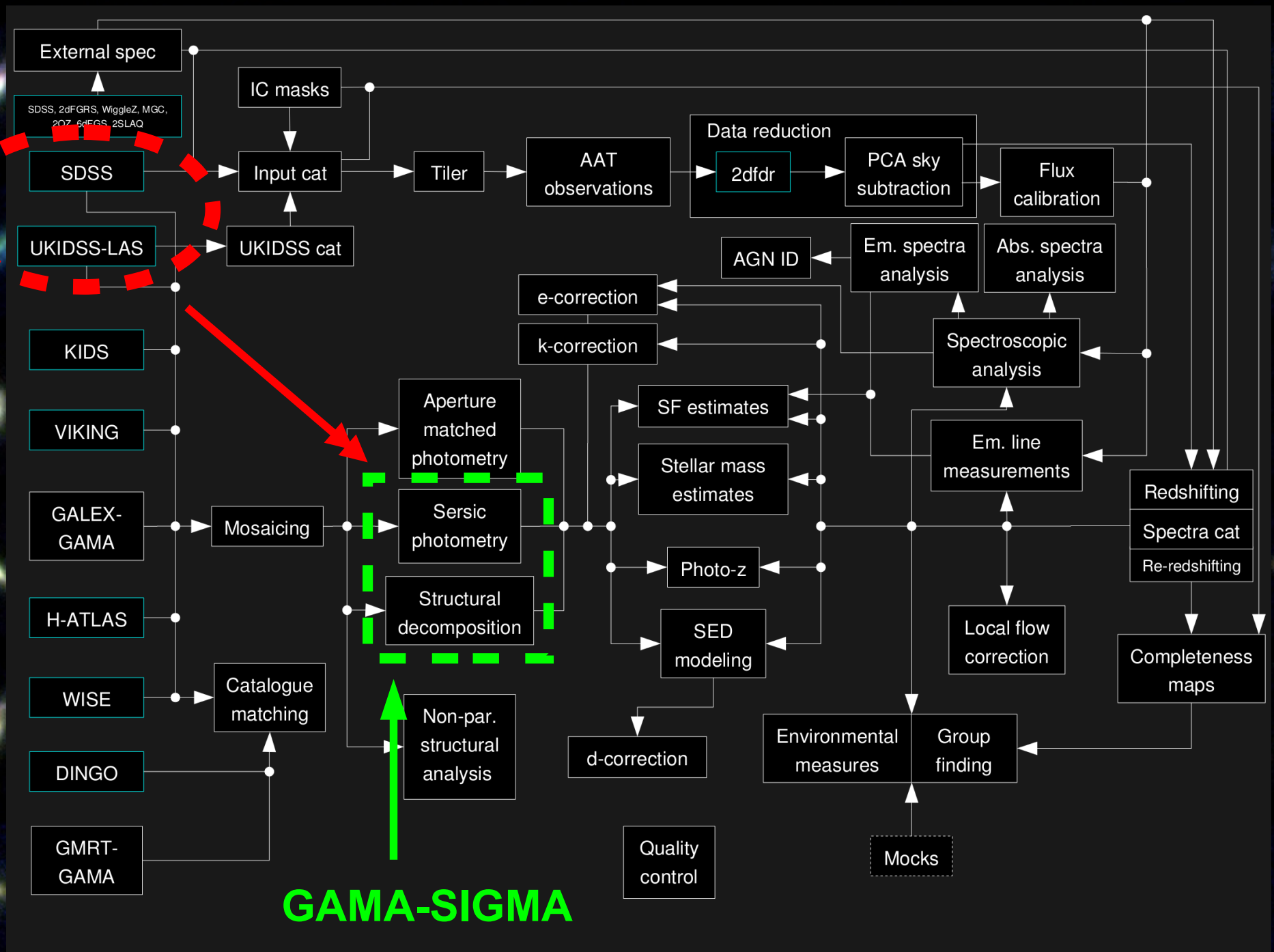
Edge-on Spirals



Barred Spirals

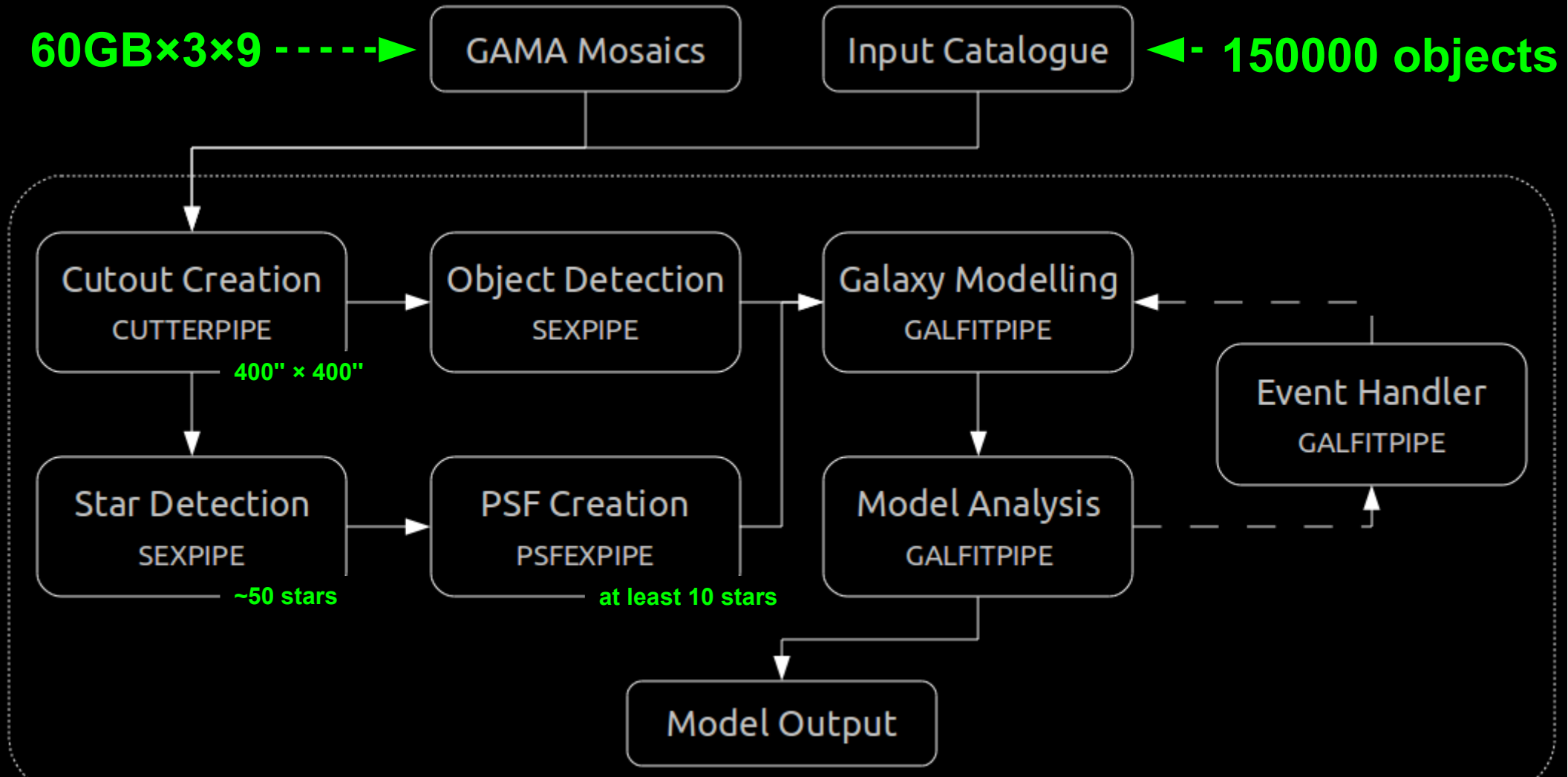
Kru 40"×40"

Dataflow

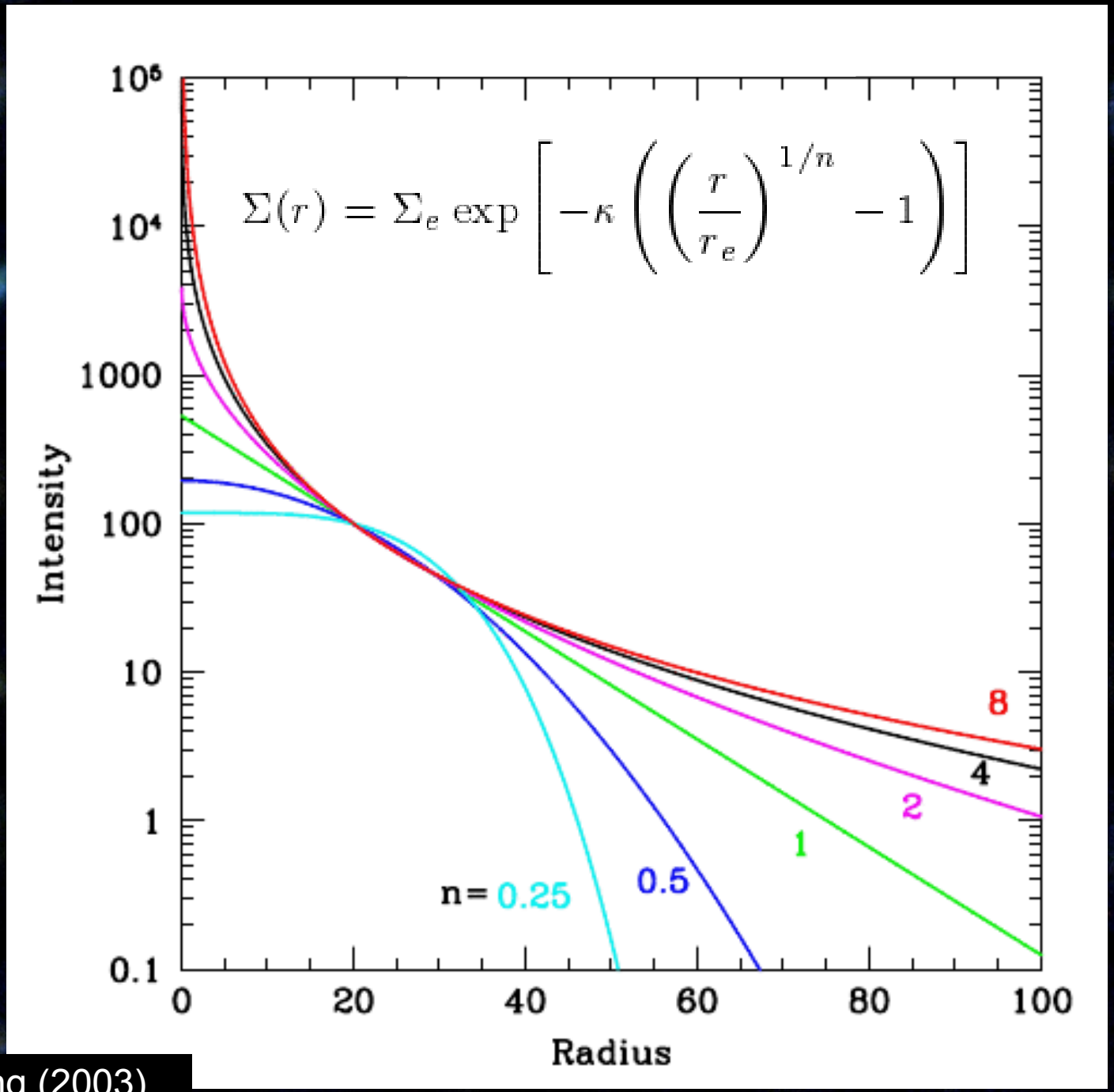

External spec
SDSS, 2dFGRS, WiggleZ, MGC, 2QZ, 6dFGS, 2SLAQ
IC masks
SDSS
Input cat
Tiler
AAT observations
Data reduction
2dfdr
PCA sky subtraction
Flux calibration
UKIDSS-LAS
UKIDSS cat
AGN ID
Em. spectra analysis
Abs. spectra analysis
e-correction
k-correction
Spectroscopic analysis
KIDS
Aperture matched photometry
SF estimates
VIKING
Em. line measurements
Stellar mass estimates
Redshifting
GALEX-GAMA
Mosaicing
Sersic photometry
Spectra cat
Re-redshifting
Photo-z
H-ATLAS
Structural decomposition
Local flow correction
SED modeling
Completeness maps
WISE
Catalogue matching
Non-par. structural analysis
d-correction
Environmental measures
Group finding
DINGO
GMRT-GAMA
Quality control
Mocks
GAMA-SIGMA

GAMA-SIGMA

- SIGMA: *Structural Investigation of Galaxies via Model Analysis*
- → Written in R
- → Run time: 20 sec!



The Sérsic Profile

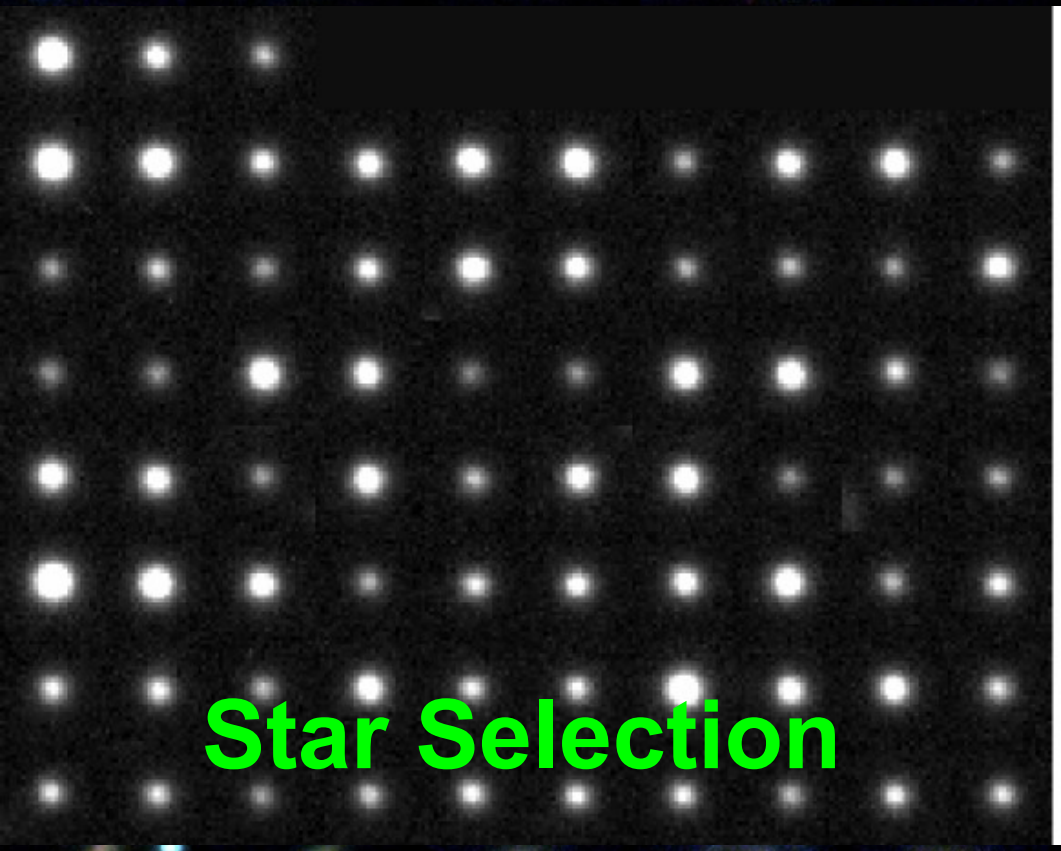


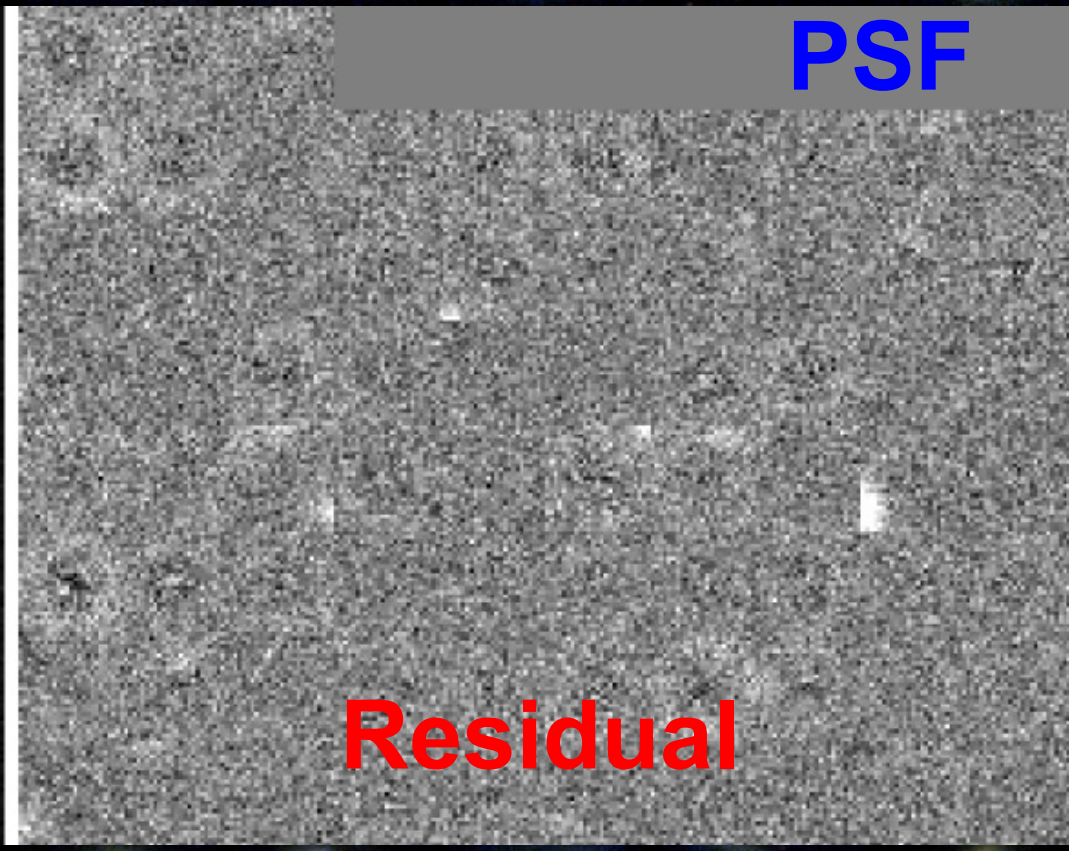
Jose Luis Sérsic, 1963

Peng (2003)

PSF Extractor

- Empirical point-spread function creator





- Pros:
  - Extremely Fast
  - High fidelity PSF's
- Cons:
  - ~~Short on documentation~~

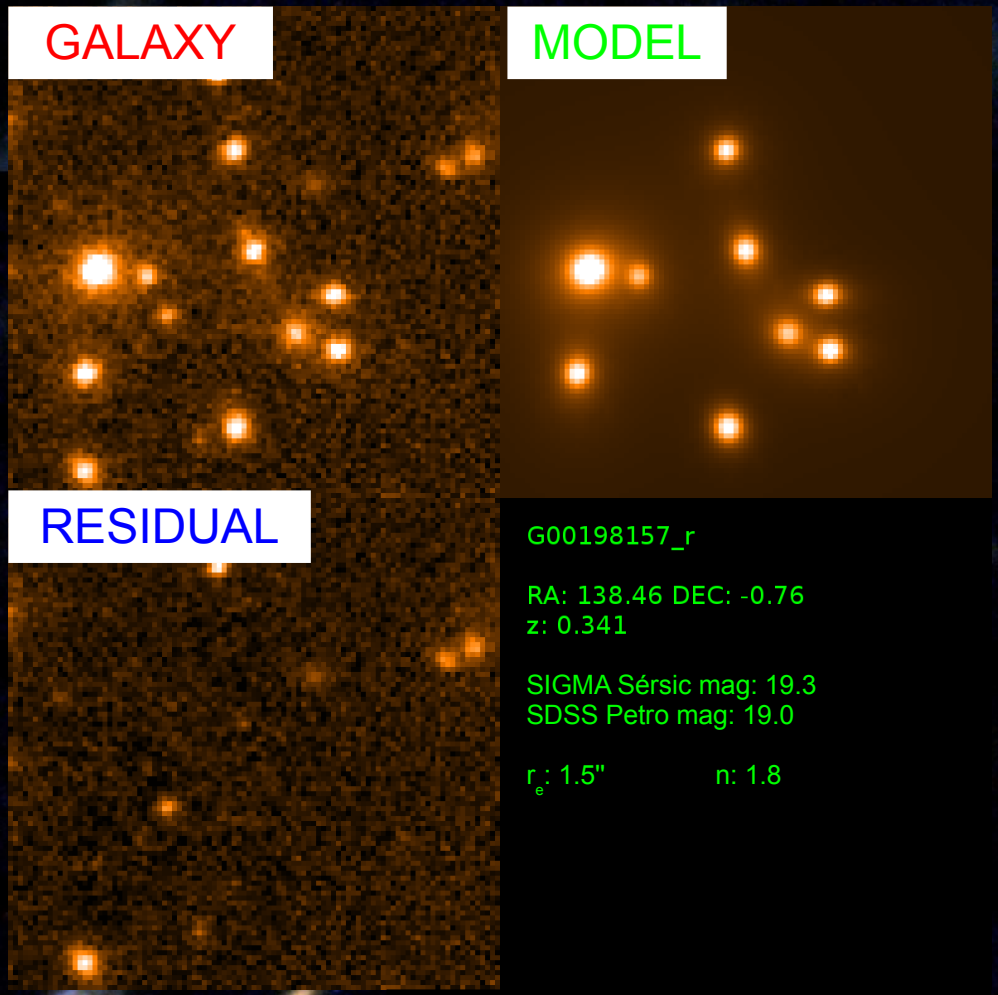
PSFEx: Emmanuel Bertin

GALFIT 3.0

- Galaxy fitting algorithm that fits 2D parameterised, axisymmetric functions to images.

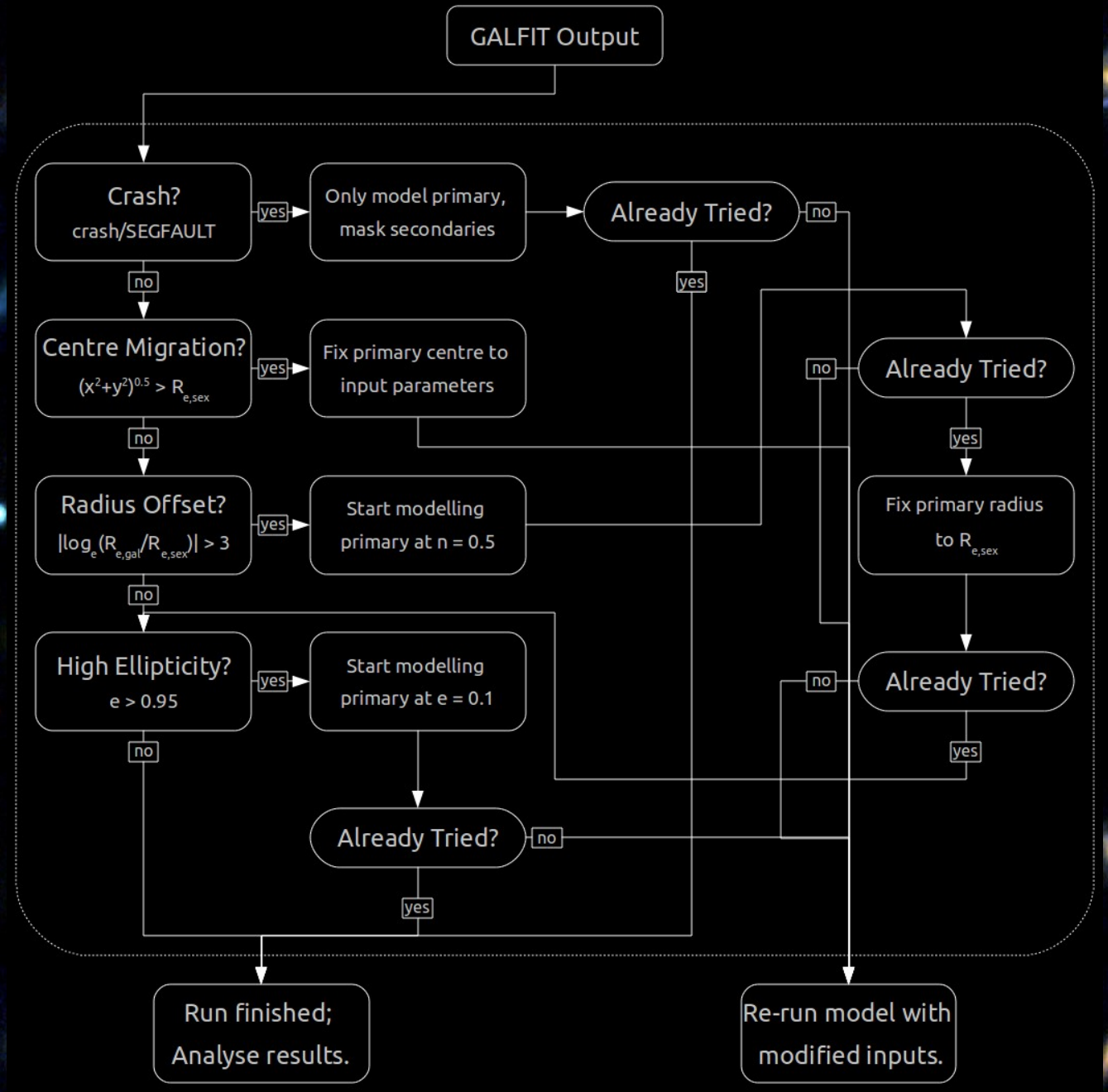
Functions;
- → Exponential
- → de Vaucouleurs
- → Sersic
- → Ferrer / Nuker
- → PSF (& Moffat)

Able to vary;
- → Magnitude
- → Sersic Index / Power
- → Re / Rs
- → Position angle
- → Ellipticity



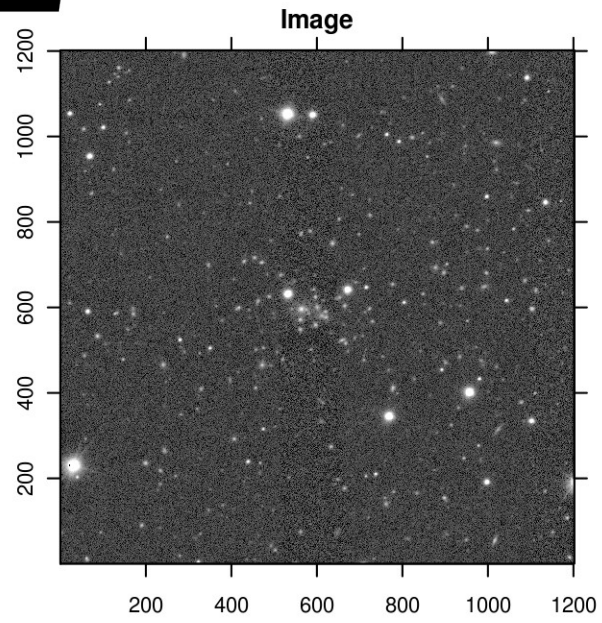
GALFIT: Chien Peng

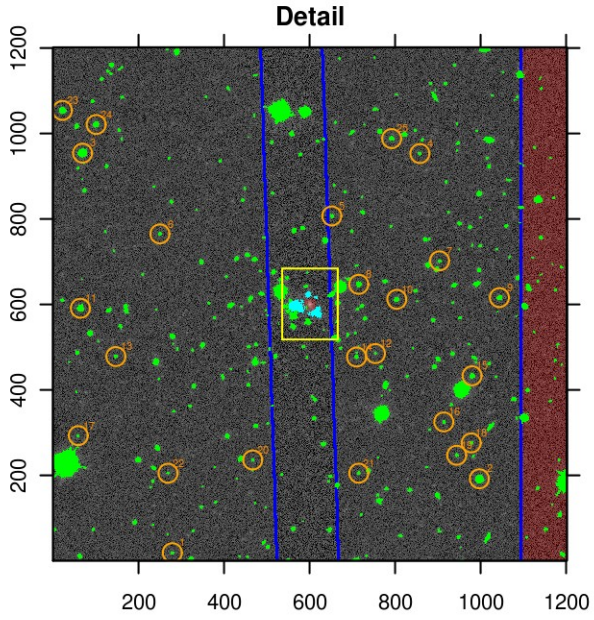
GAMA-SIGMA

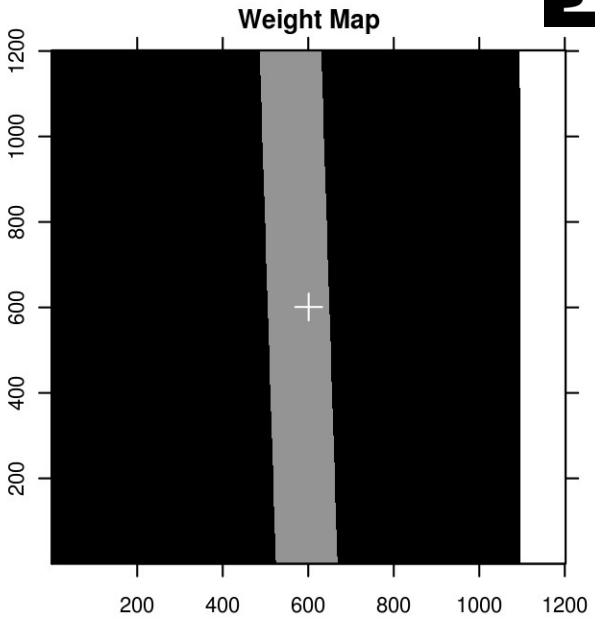


* Scan for problems
* Attempt to fix them
* Assign a binary history flag
* Assign a quality flag (eg - high sersic index, bad chi^2).

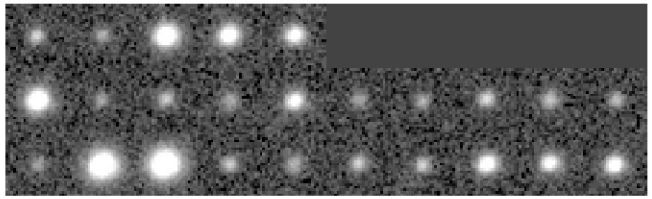
GAMA-SIGMA



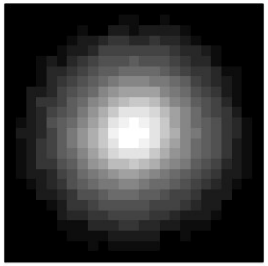




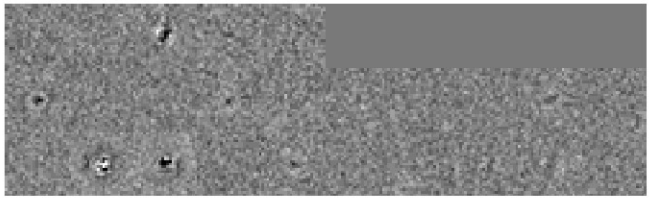
PSF Star Sample

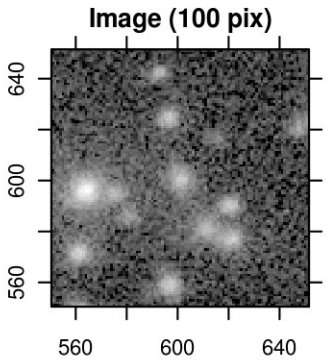


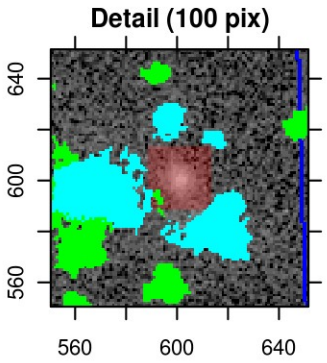
PSF



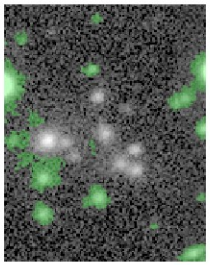
PSF Star Residuals



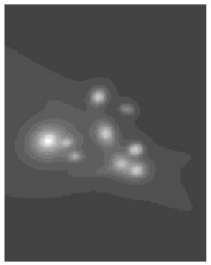




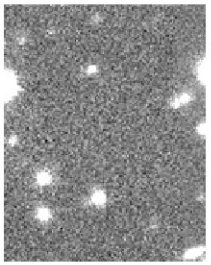
Fitting Region



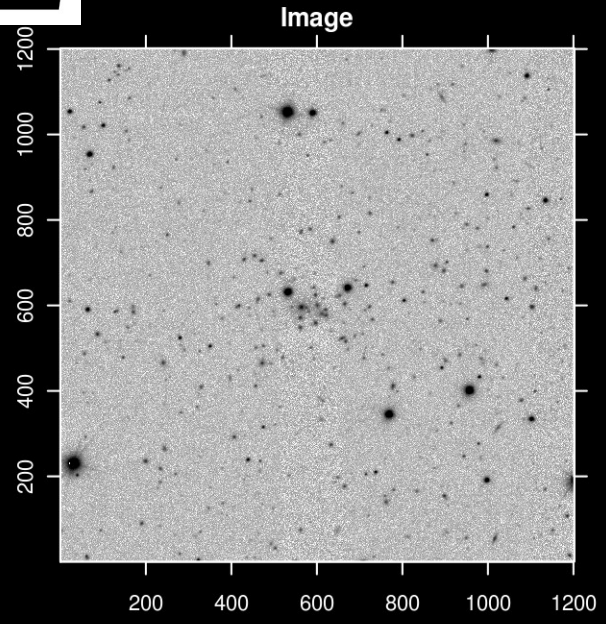
Model

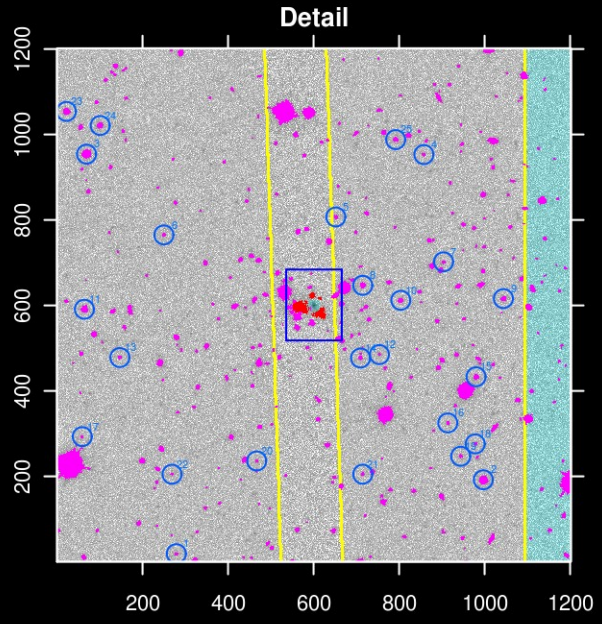


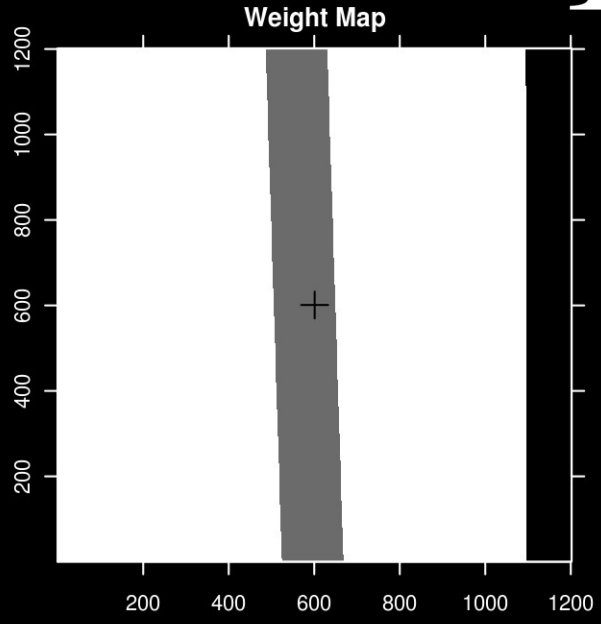
Residual



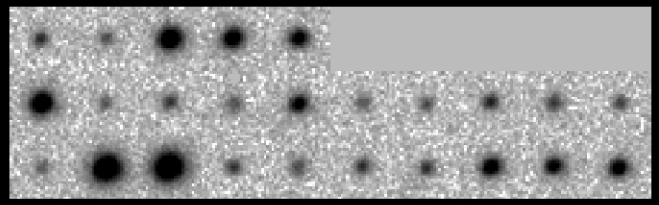
GAMA-SIGMA



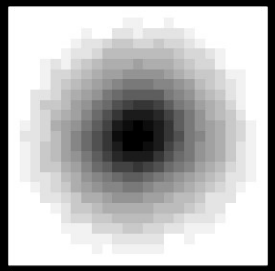




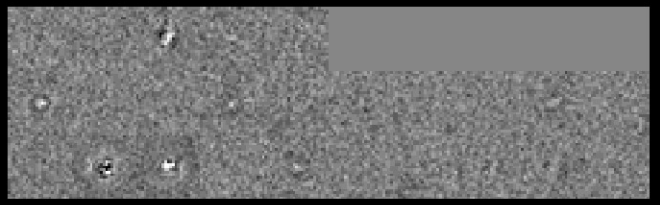
PSF Star Sample

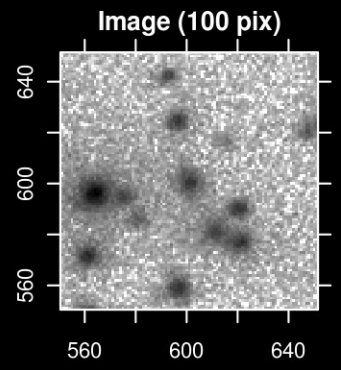


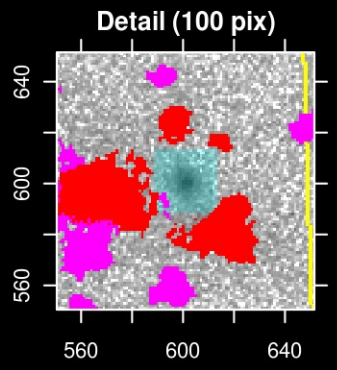
PSF



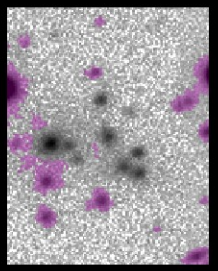
PSF Star Residuals



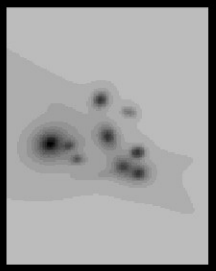




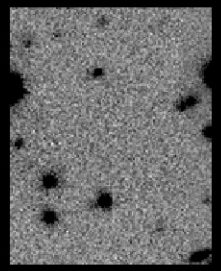
Fitting Region



Model



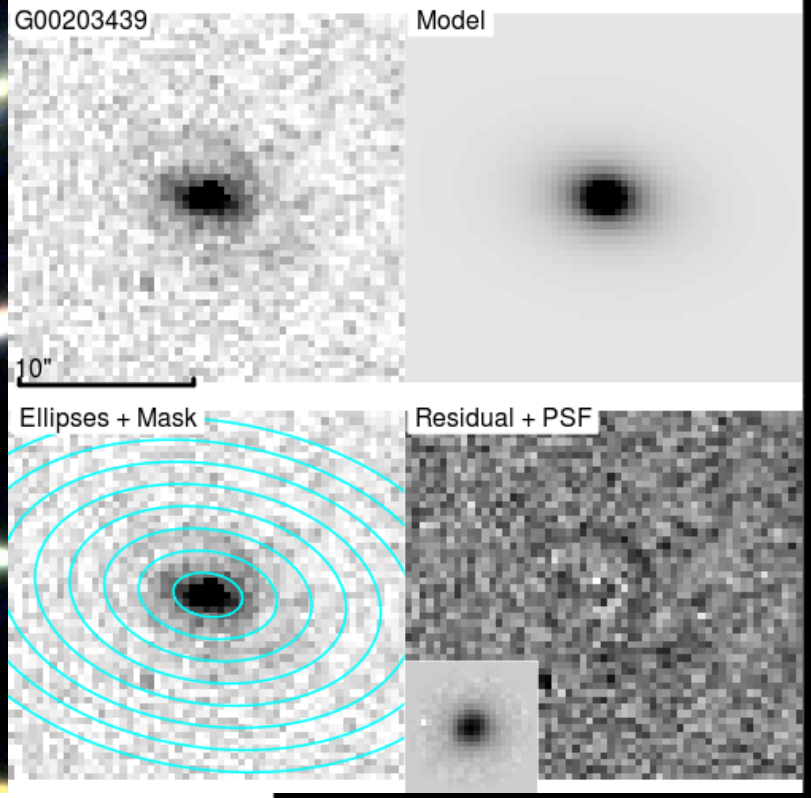
Residual

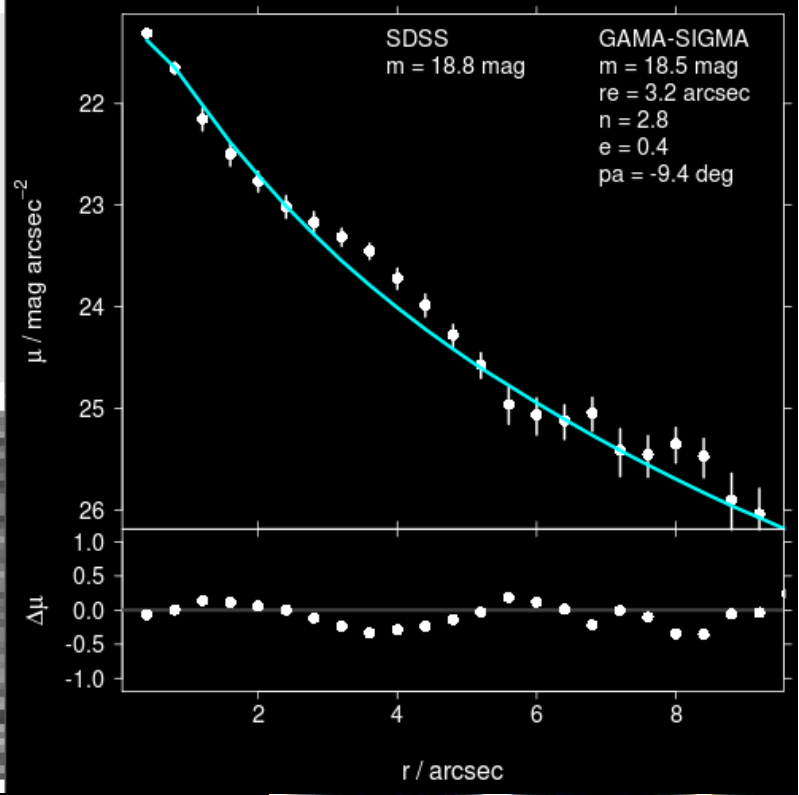


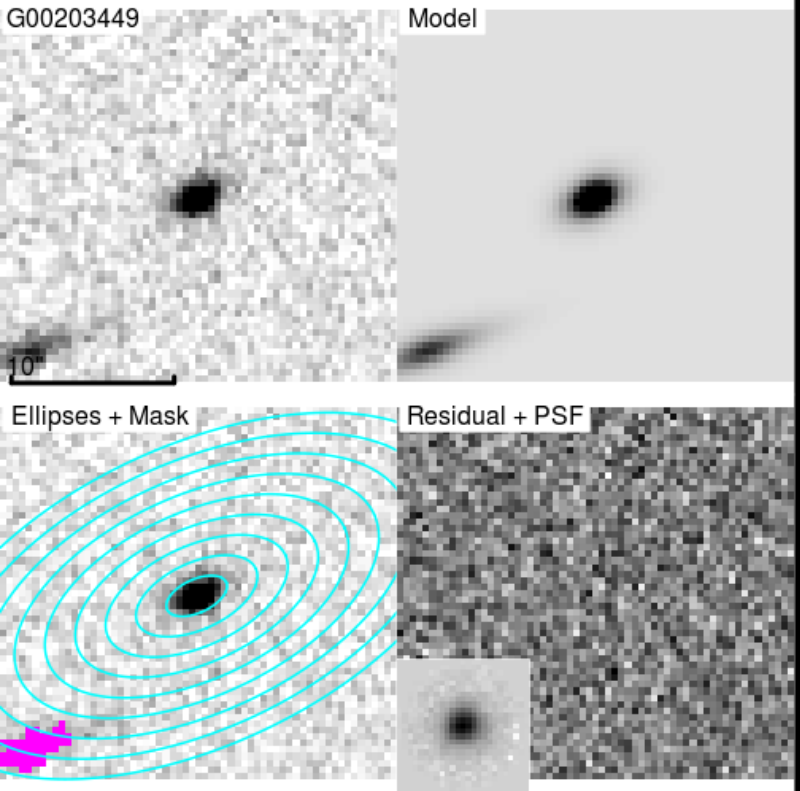
Single-Component

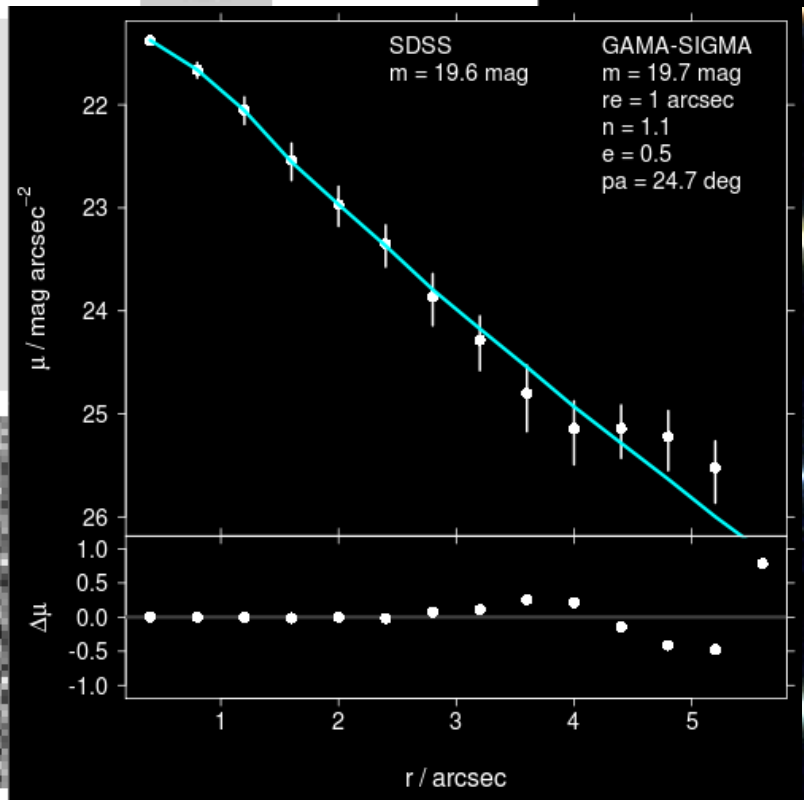
Brighter:

$r_{sérsic} < r_{petro}$





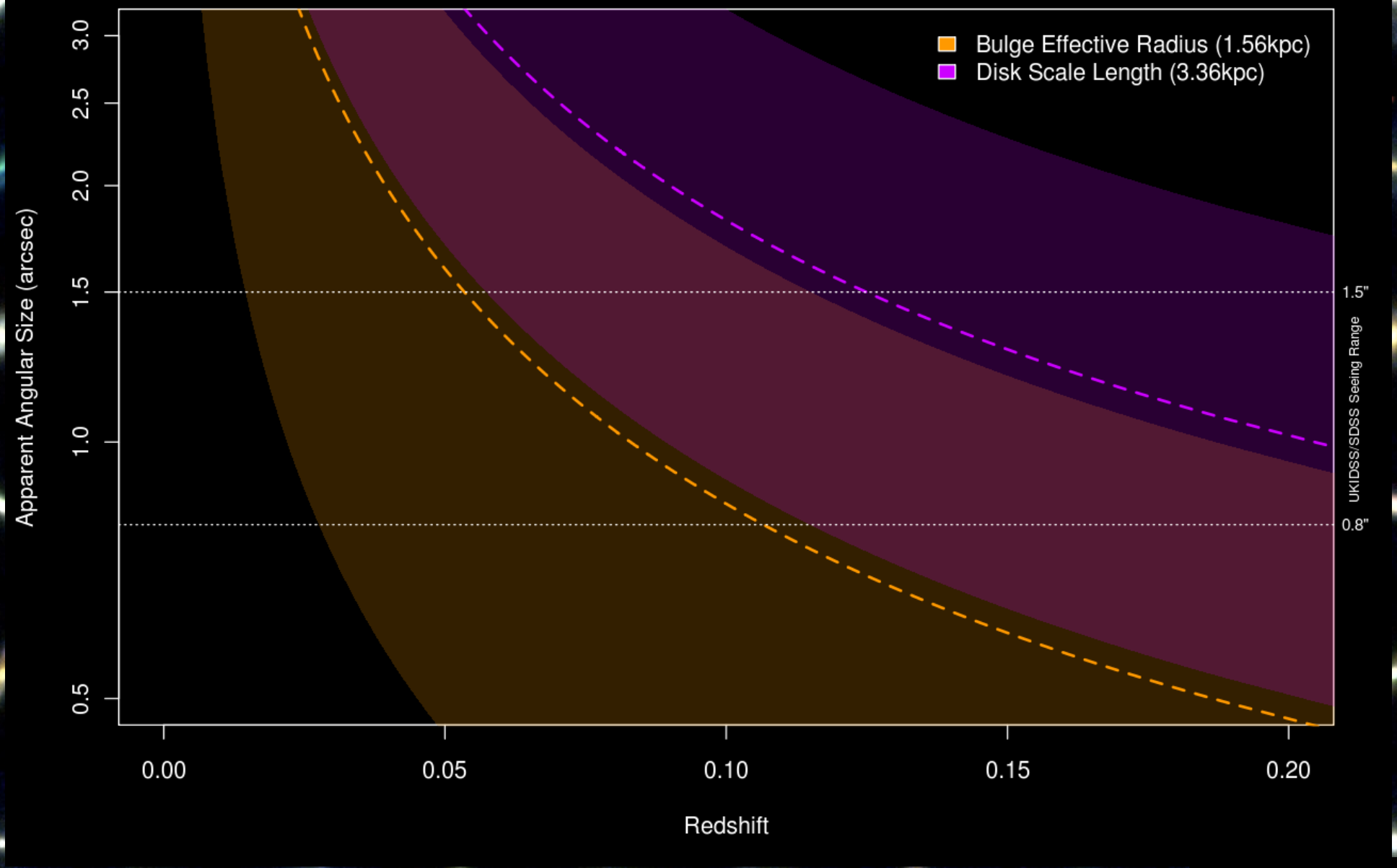




Fainter:

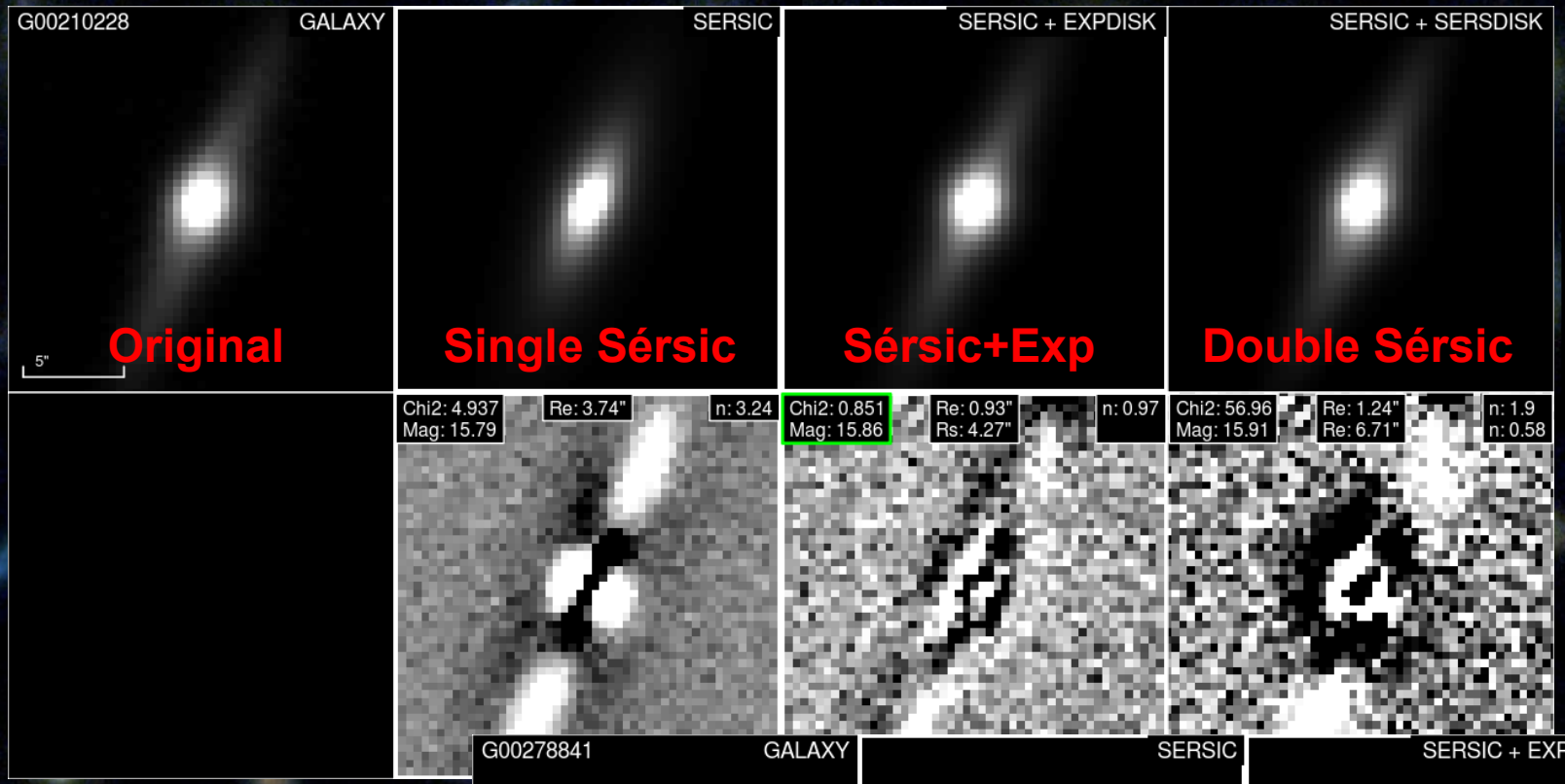
$r_{sérsic} > r_{petro}$

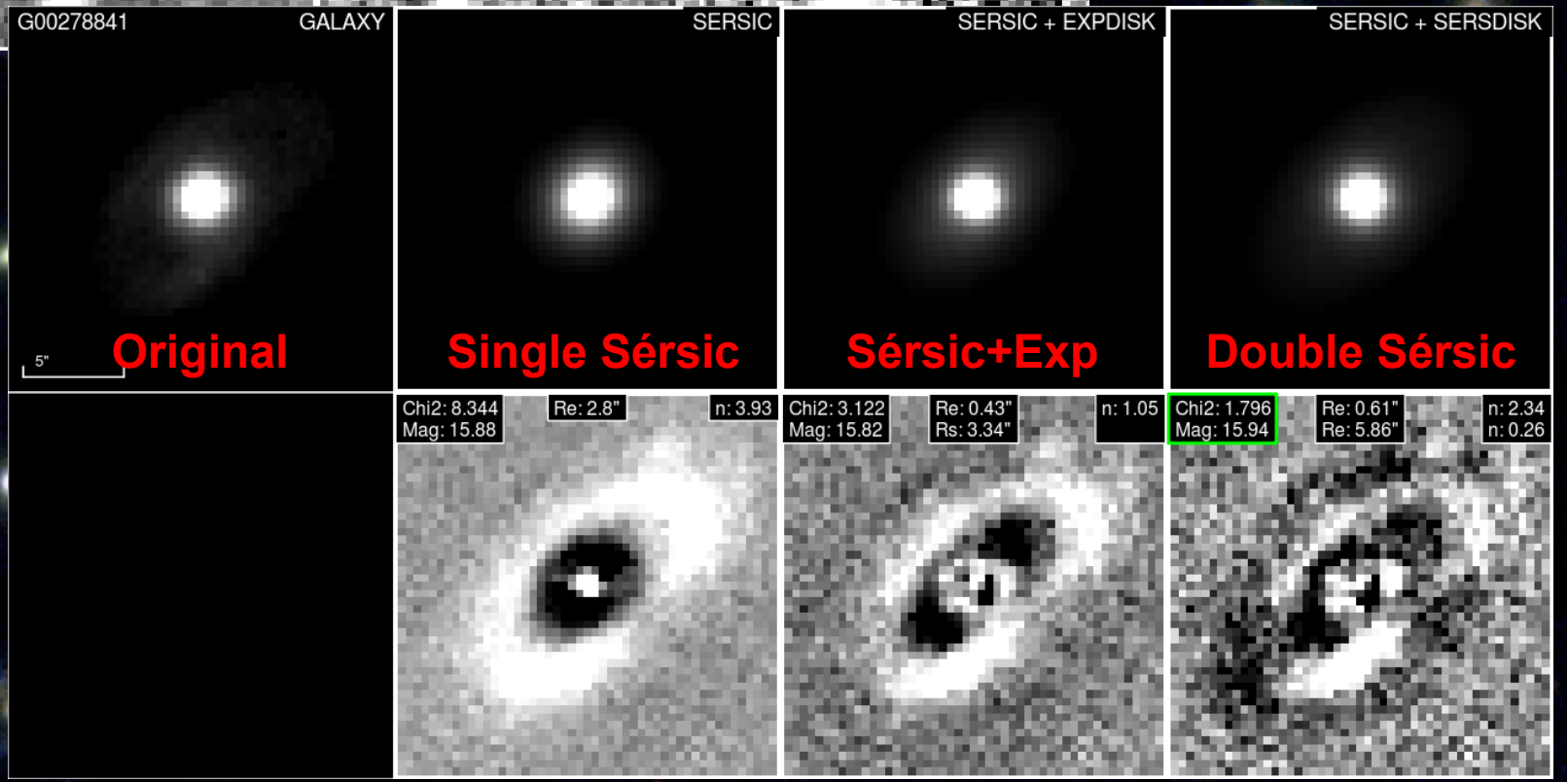
Multi-Component Modelling



data from MGC

Multi-Component





Pros:

- Easy to model multiple components

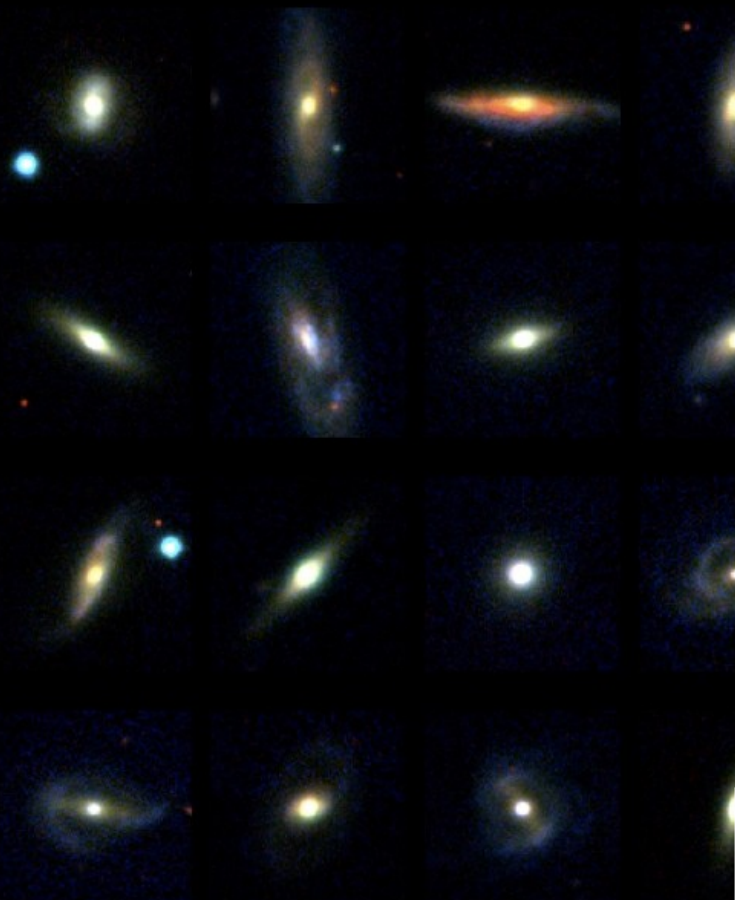
Cons:

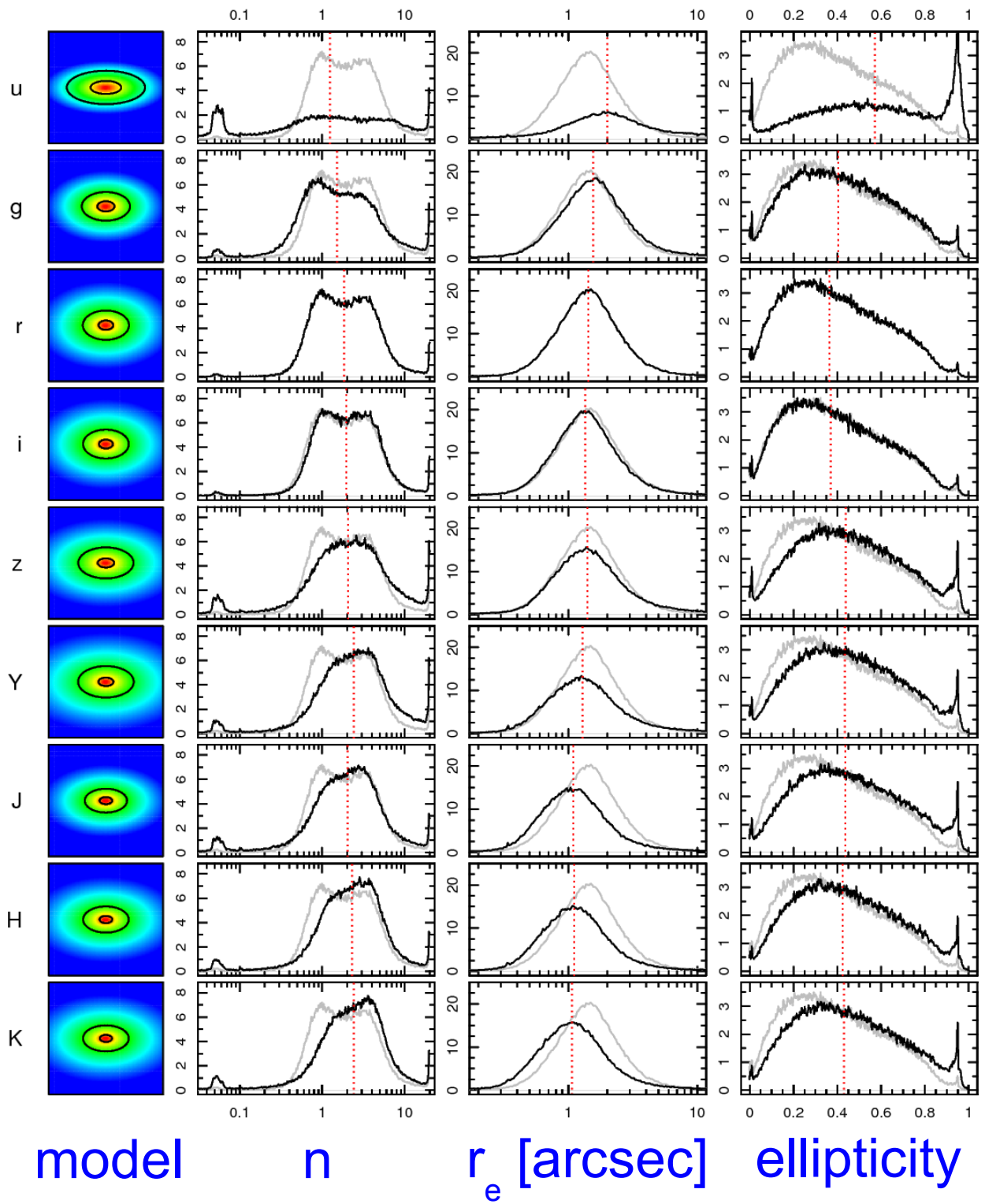
- Tricky choosing correct fit in an automated fashion

Global Outputs

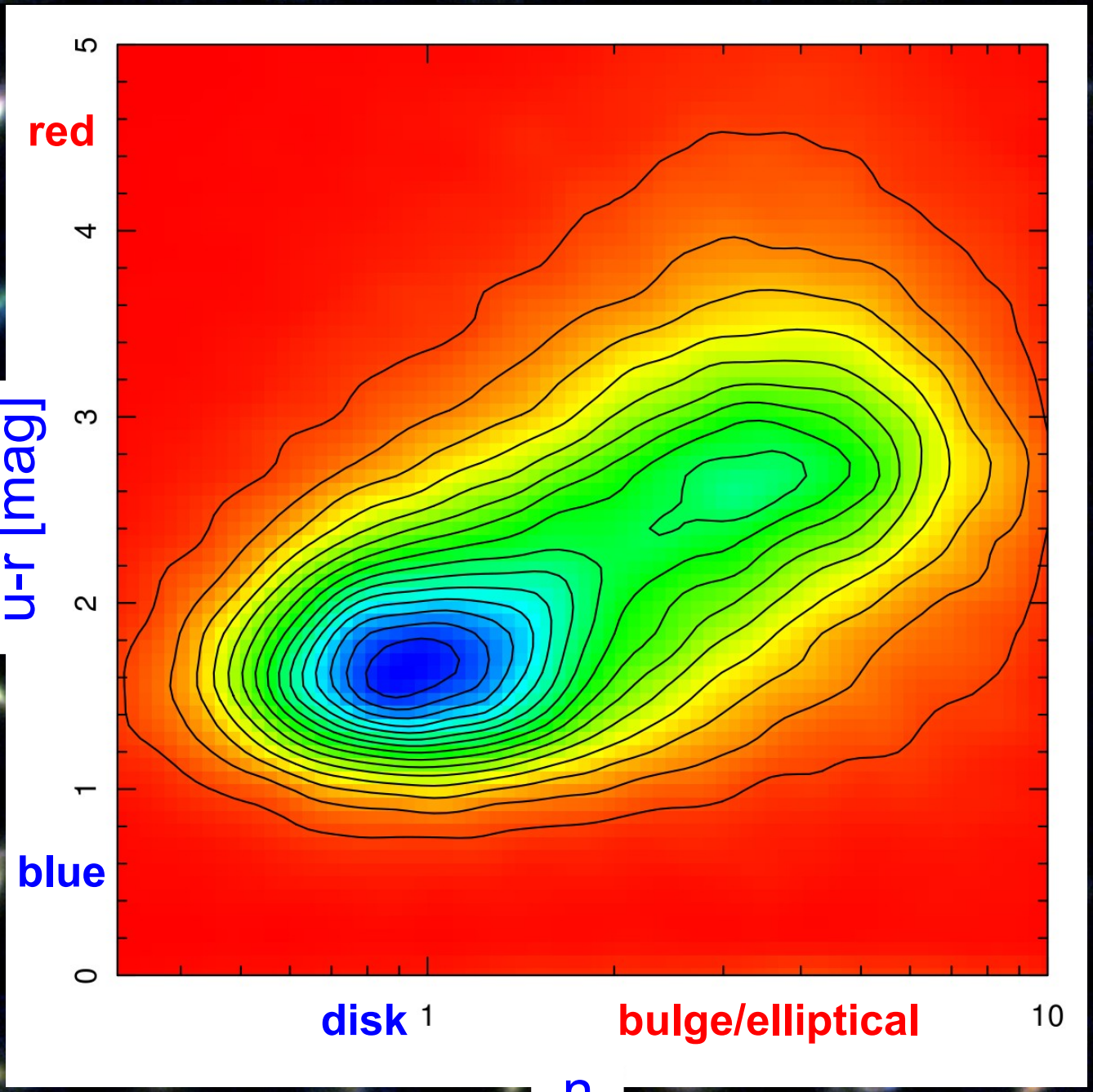
u → K:

- increasing n
- decreasing r_e
- stable e (1-b/a)





Sérsic Index – colour relation

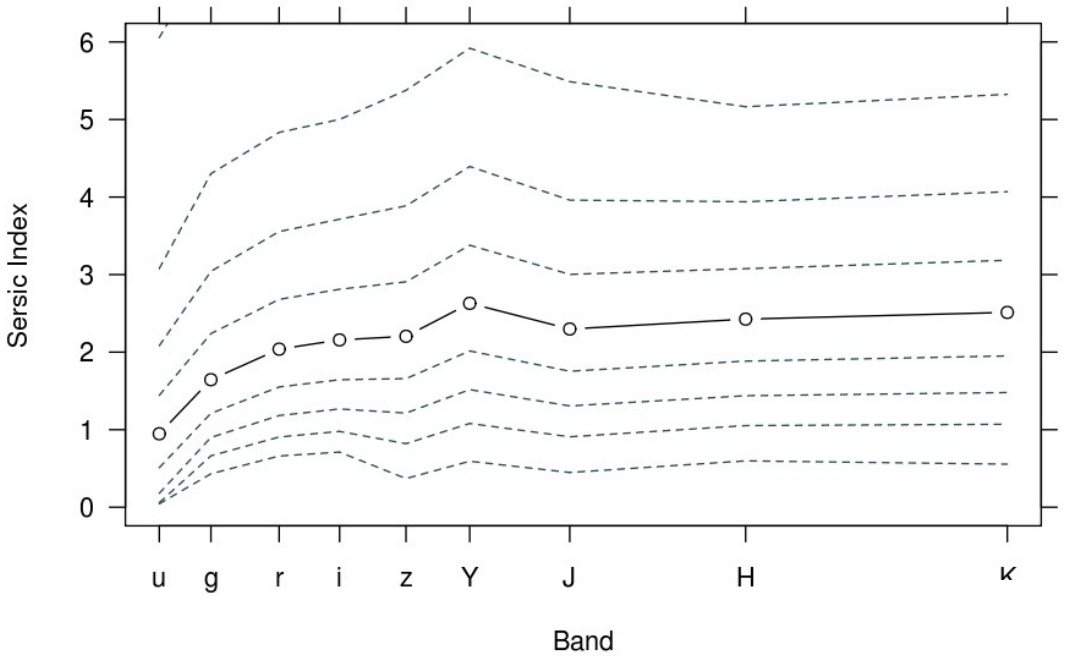


Bimodal:

> n=1 (disk-like)

> n=4 (spheroid-like).

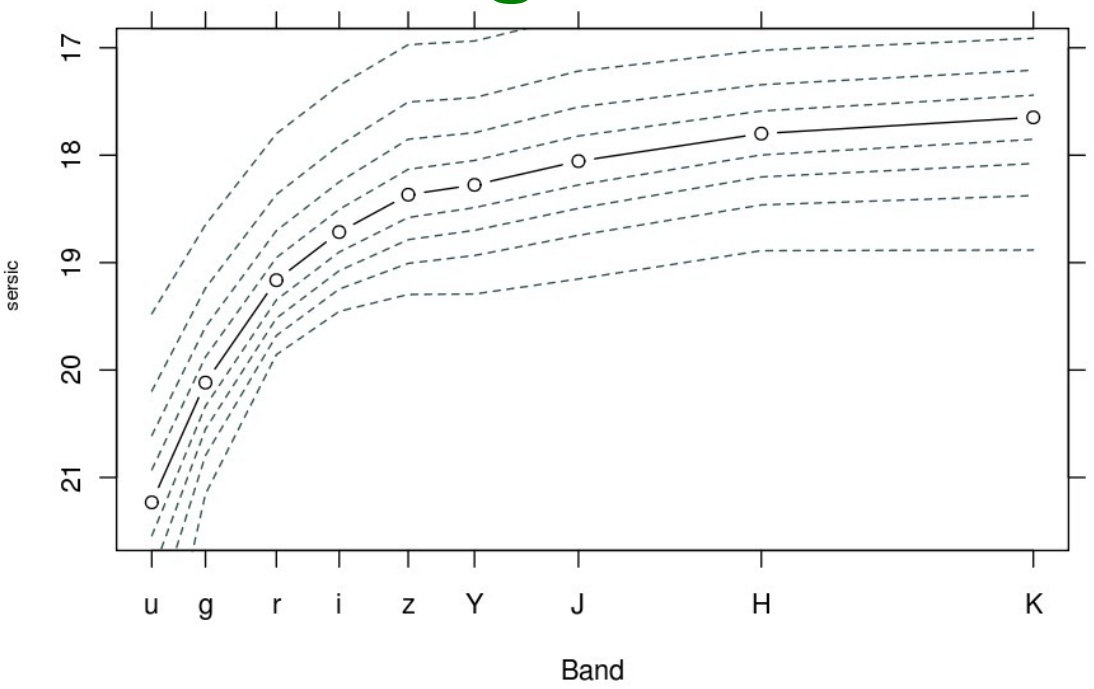
Sérsic Index



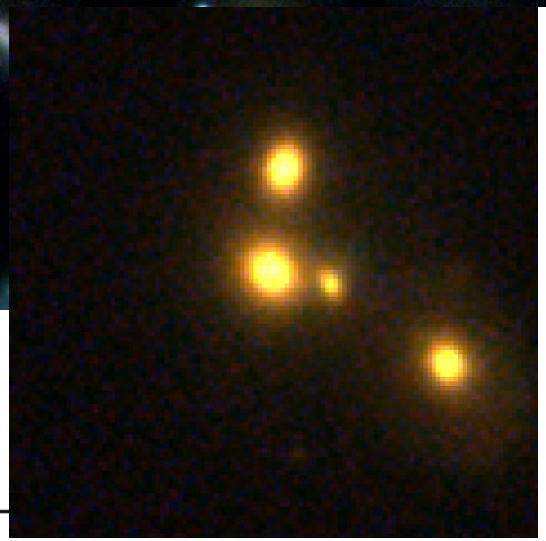
Wavelength dependency on recovered parameters

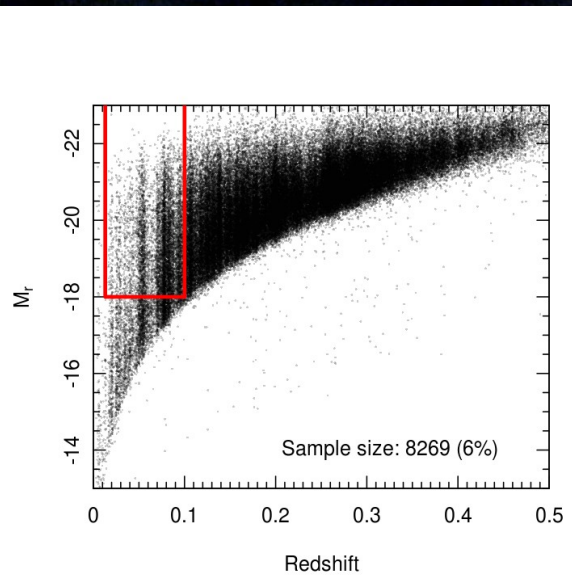
'Predictions' can be calculated to convert into other bands

Magnitude

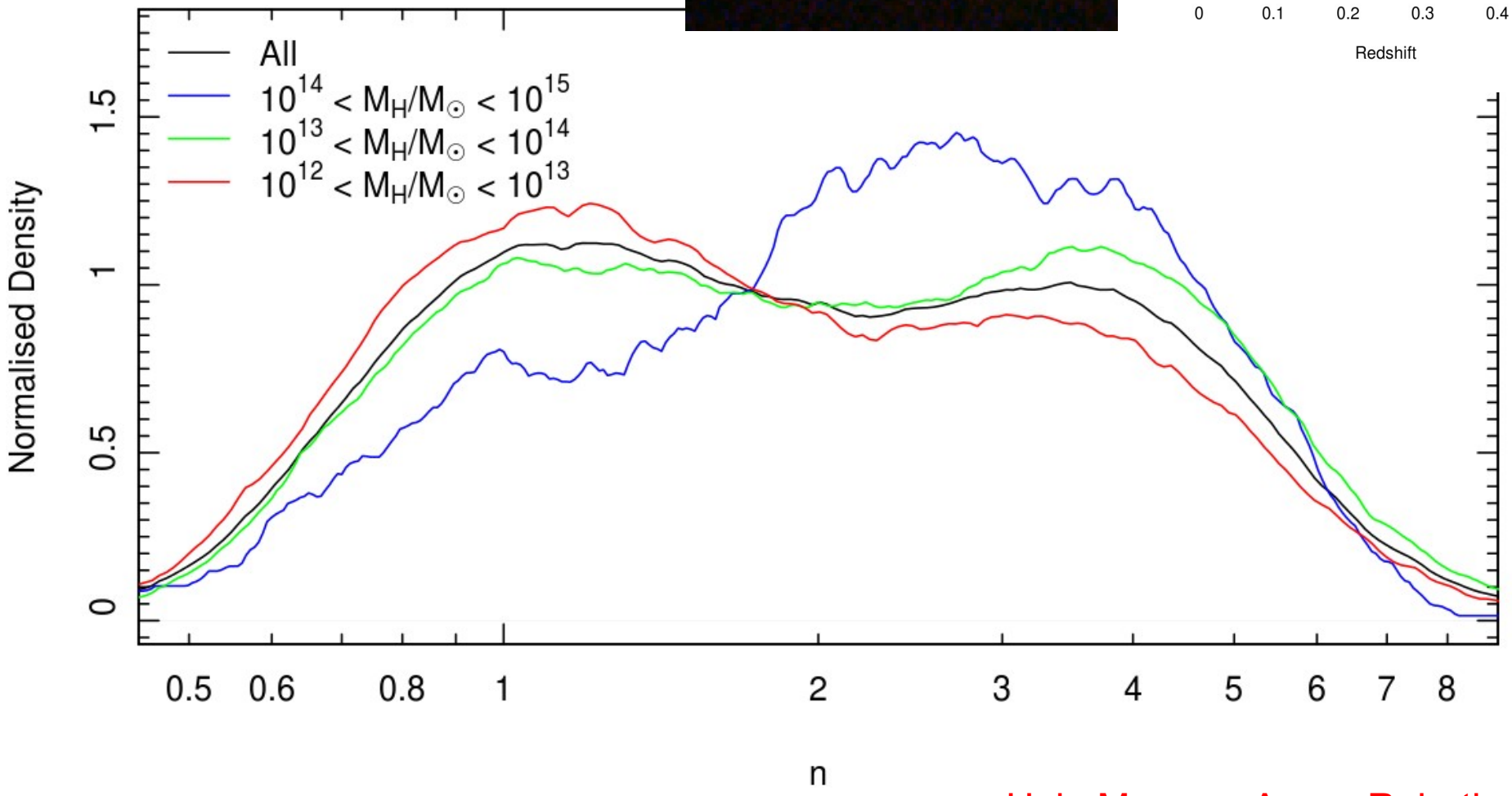


Cool Plots





Sérsic Index - Halo Mass



Halo Masses: Aaron Robotham

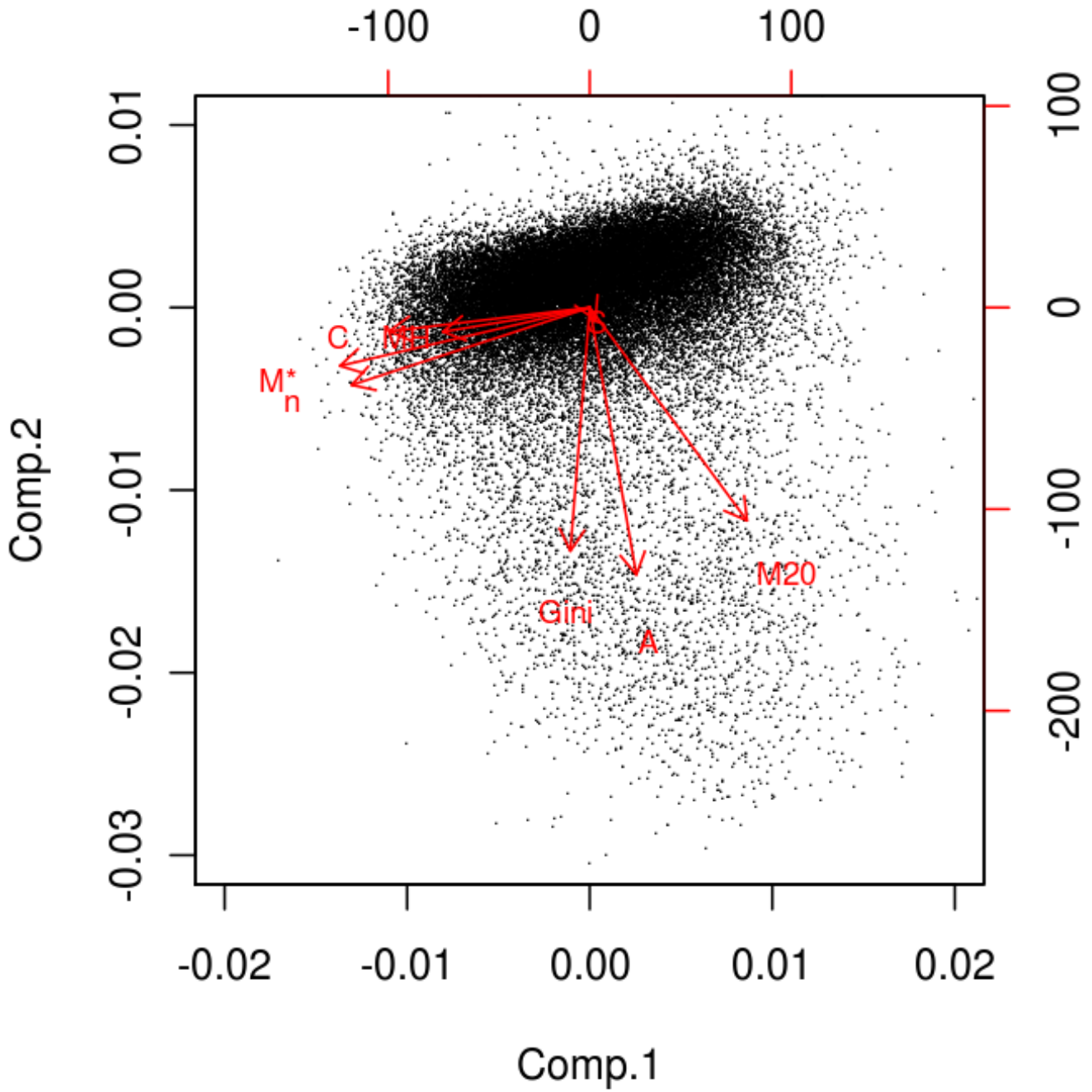
Cool Plots

Halo Masses
- Aaron Robotham

CAS/Gini/M_{20}
- Chris Conselice

Stellar Masses
- Ned Taylor

Principle Component Analysis



Summary

- Single-Sérsic photometry recovers flux that traditional methods cannot.
- Multi-component provides even better results but there are limitations.
- Important to use multi-wavelength data and find an improved dust model.

What Now?

SersicCat:

- A high-fidelity sample of ~150,000 galaxies with measurements of effective radii, sérsic indices, sérsic magnitudes and other physical properties.
- > 95% success rate
- Awaiting QC approval!

What Next?

- Full structural decomposition!
  - ➔ Which multi-component model is the 'best'?
- Exploration of how physical properties (e.g.: Sérsic index, size) relate to Stellar Mass/Environment/Morphology.
- Study of the evolution of spheroidal and disk like structures – do bulges have a similar formation mechanism to ellipticals?