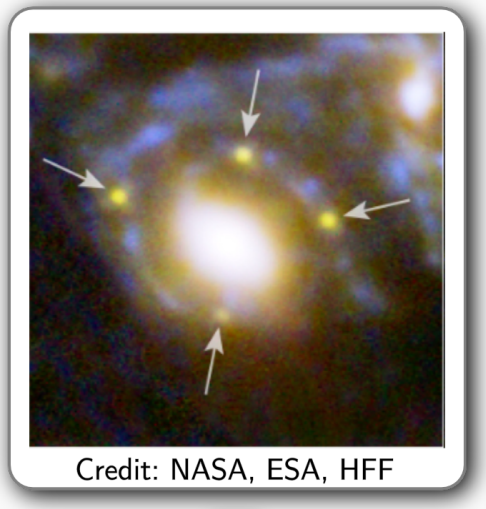
Multi-wavelength views on the mass distribution of galaxy clusters

Benjamin Beauchesne

Mass constraints in cluster lenses

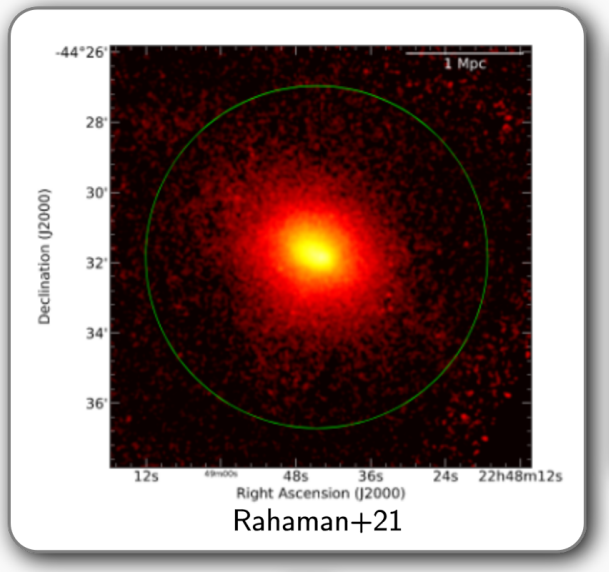
Strong Lensing



Credit: NASA, ESA, HFF

Cluster total mass

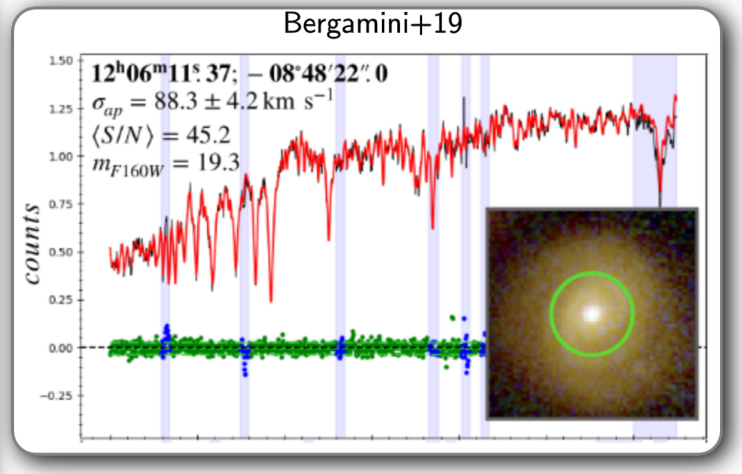
X-ray Observations



Rahaman+21

Intra-cluster gas mass

Photometry & Spectroscopy



Galaxy stellar mass & total mass

All major mass components can be disentangled

Multi-probe mass model

Mass model

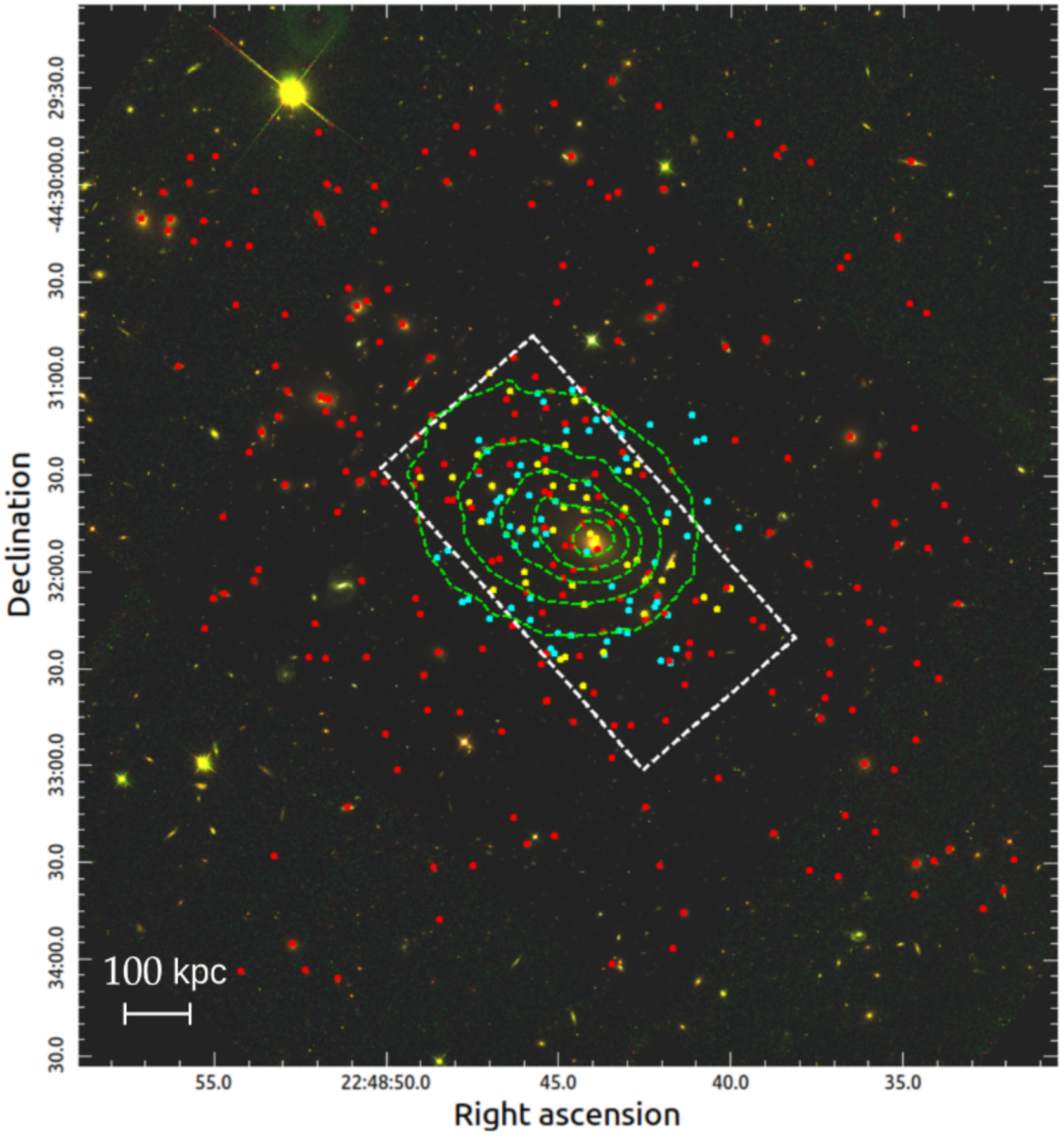
Dark Matter (cluster-scale) *dPIEs*	**Intra-cluster Medium** (cluster-scale) *dPIEs*	**Cluster Members** (galaxy-scale) *2 dPIEs per object: Baryons and DM*	**Intra-cluster stars and BCG** (cluster-scale) *MGE & dPIE*

Constrained by

$\mathcal{L}_{SL} \times \mathcal{L}_{BCG-kin}$	$\mathcal{L}_{X-ray} \times \mathcal{L}_{SL} \times \mathcal{L}_{BCG-kin}$	$\mathcal{L}_{SL} \times \mathcal{L}_{BCG-kin} \times \mathcal{L}_{CM-kin}$	$\mathcal{L}_{SL} \times \mathcal{L}_{BCG-kin}$

Beauchesne+25, in prep

Abell S1063 ($z = 0.348$)



- X-ray emission contour
- MUSE FoV footprint
- Multiply-imaged systems
- Cluster members without spectra
- Cluster members with spectra

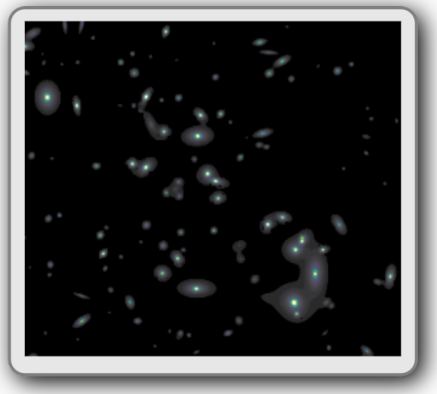
→ Deep multi band imaging with HST

→ Full MUSE coverage of the core

→ Deep Chandra observations

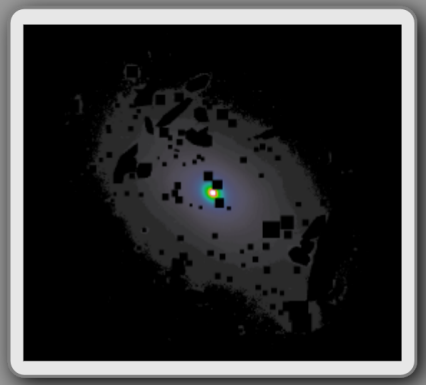
BCG & ICL modelling - 1

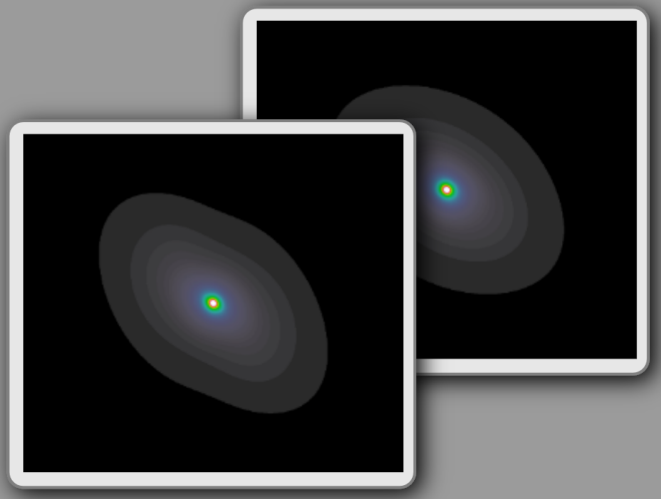
Galaxy profiles model

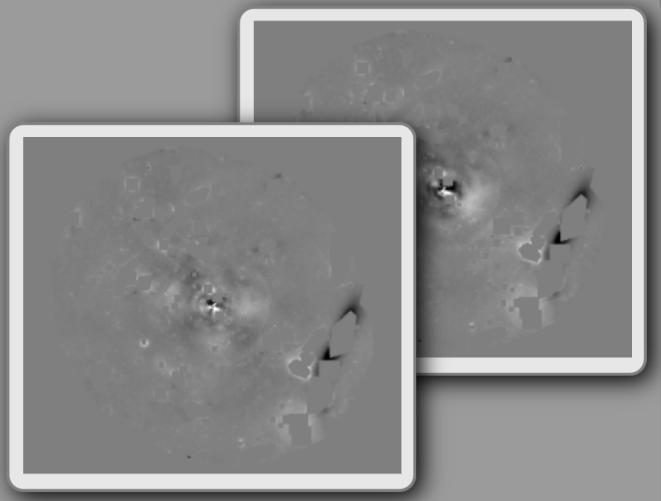


Model subtraction & Manual masking

MgeFit (Cappellari+02)







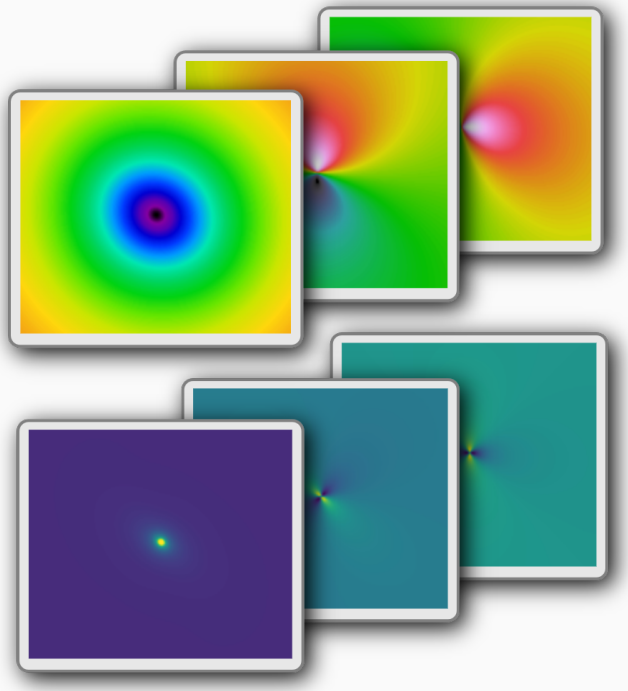
Observation
bkg & model subtracted

Best-fit model:
Twisted & normal MGE

Residual:
Twisted & normal MGE

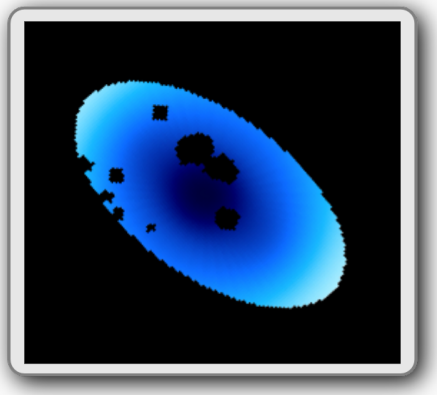
BCG & ICL modelling - 2

Twisted MGE



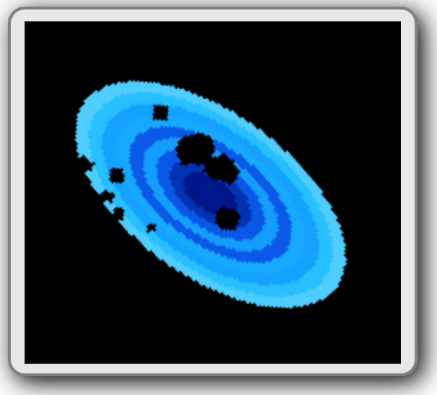
Lensing quantities:
Potential, deflection angles, convergence & shear
FFT

Normal MGE



Kinematic model
JamPy
(Cappellari+08)

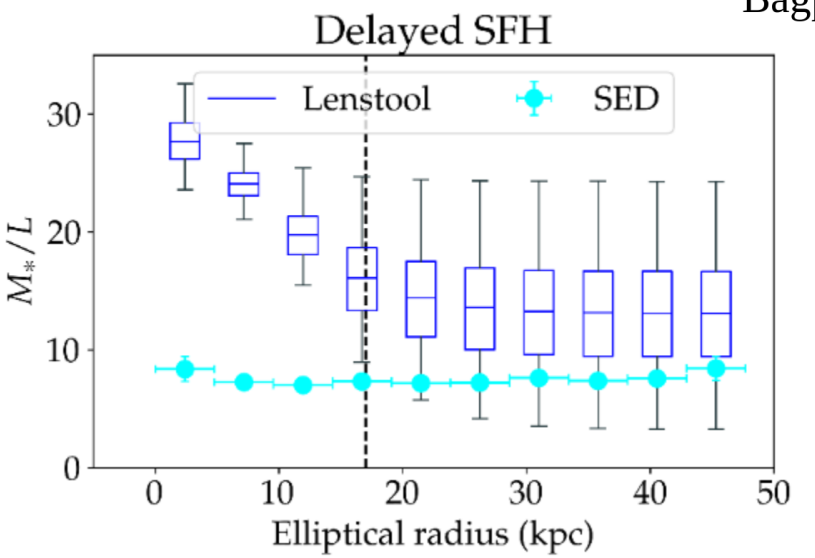
Normal MGE:
Ellipticity
&
Position angle

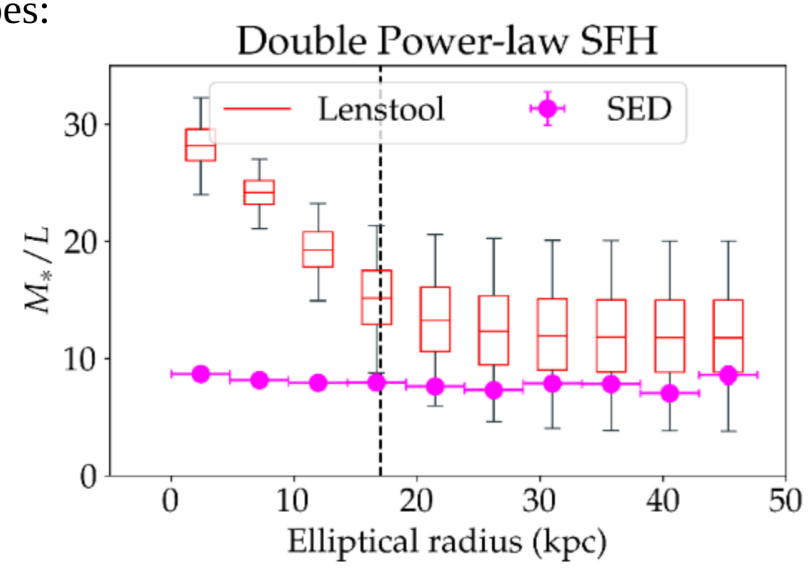


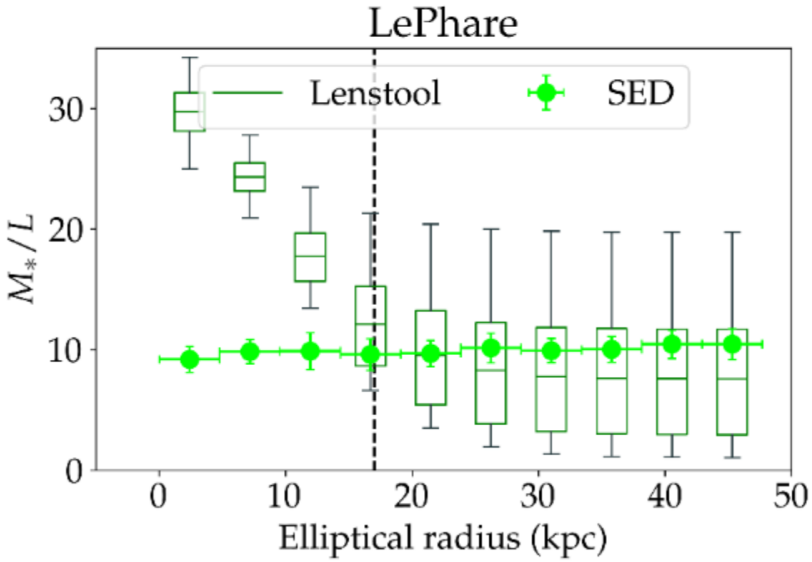
Kinematic measurement
pPXF, MPDAF & MultiNest

BCG & ICL stellar masses

Bagpipes:







→ ICL stellar mass estimate agrees at 1 or 3 sigma between SED (MW IMF) and the mass model.

→ Discrepancies in the BCG as expected from ETG kinematic studies.

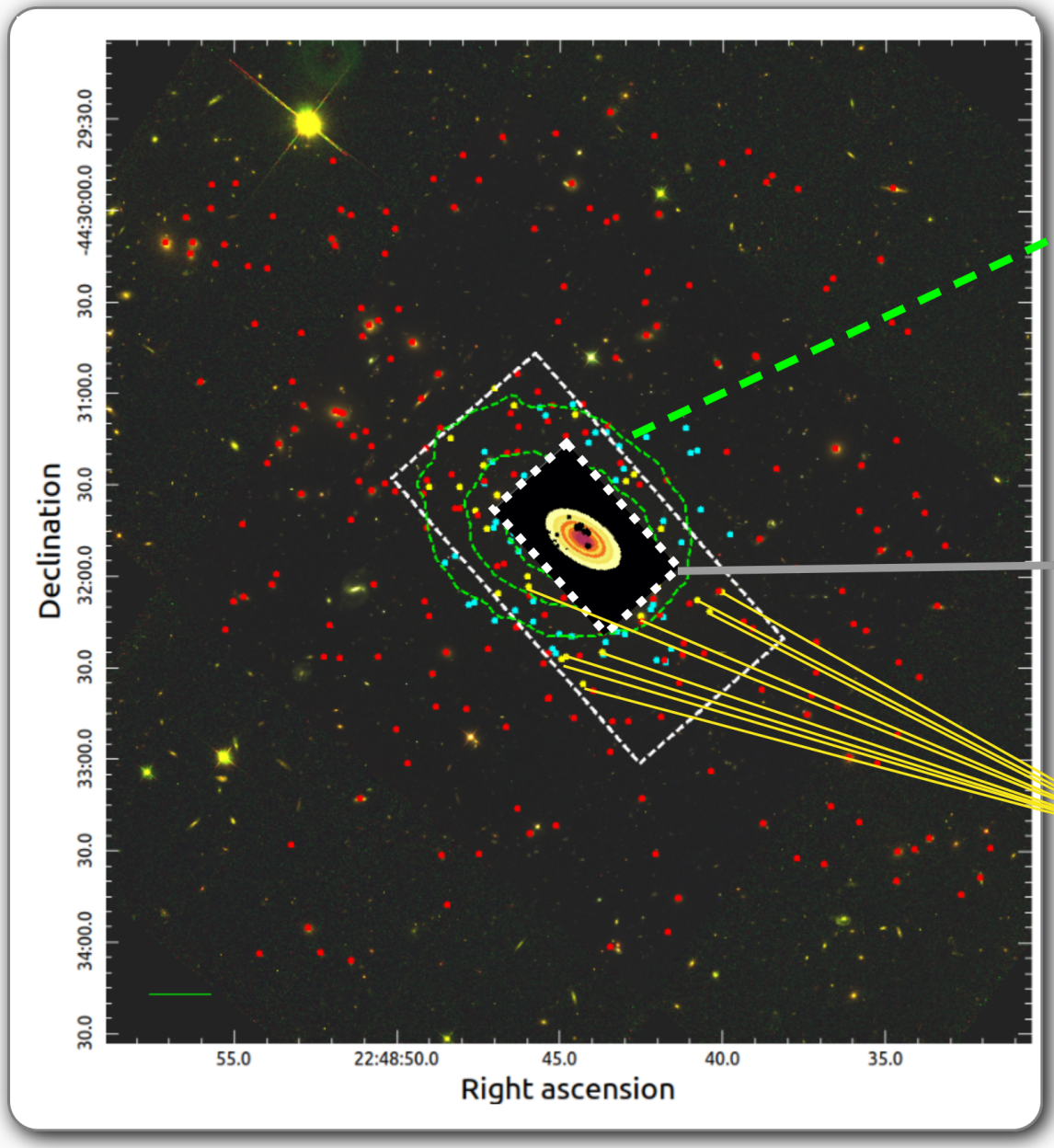
Conclusion

Key points

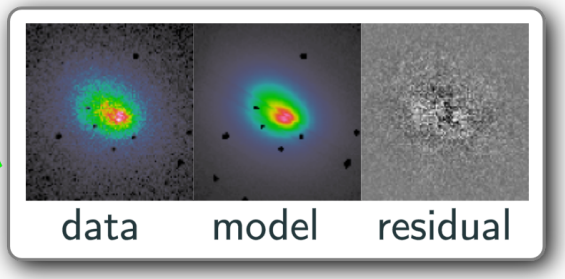
- Cluster mass model with each cluster component modelled with separate mass profiles.
- Mass constraints from $\sim 5\ \mathrm{kpc}$ to $250\ \mathrm{kpc}$
- ICL stellar mass estimates agrees between SED (Milky-way IMF) and the mass model

Thank you for listening

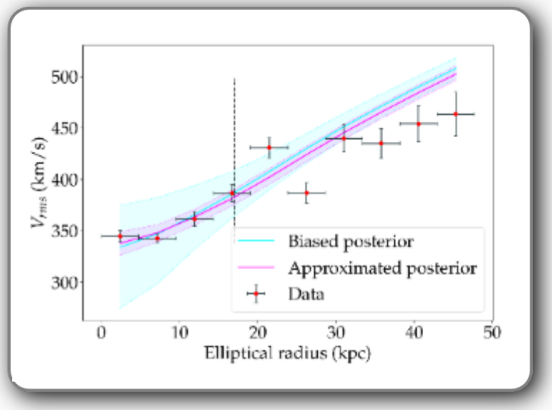
Abell S1063 : Constraints reproduction



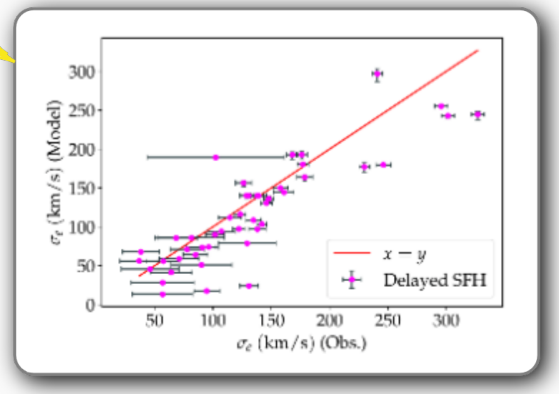
X-ray reconstruction



BCG kinematics



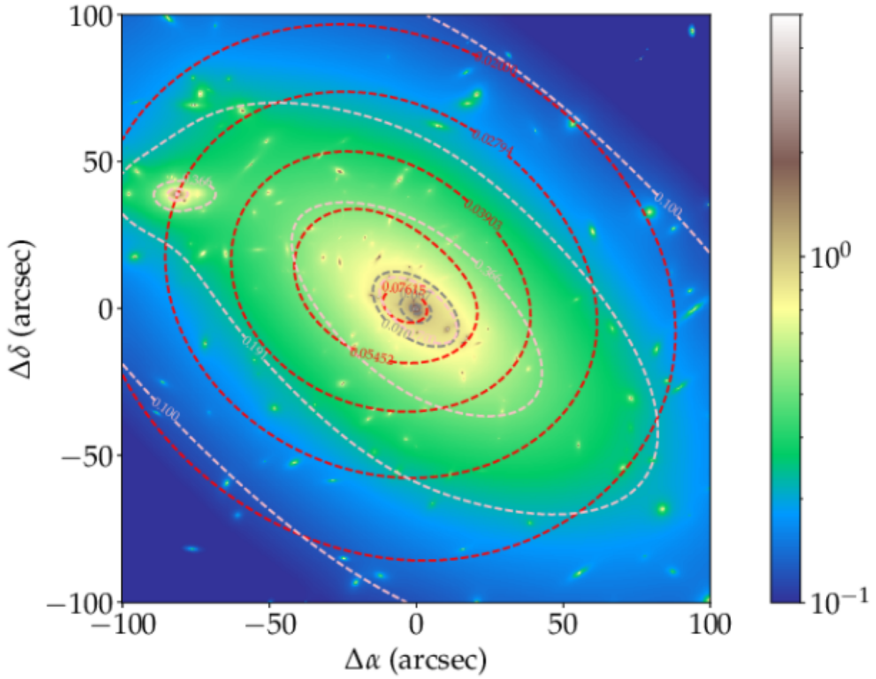
Cluster member kinematics

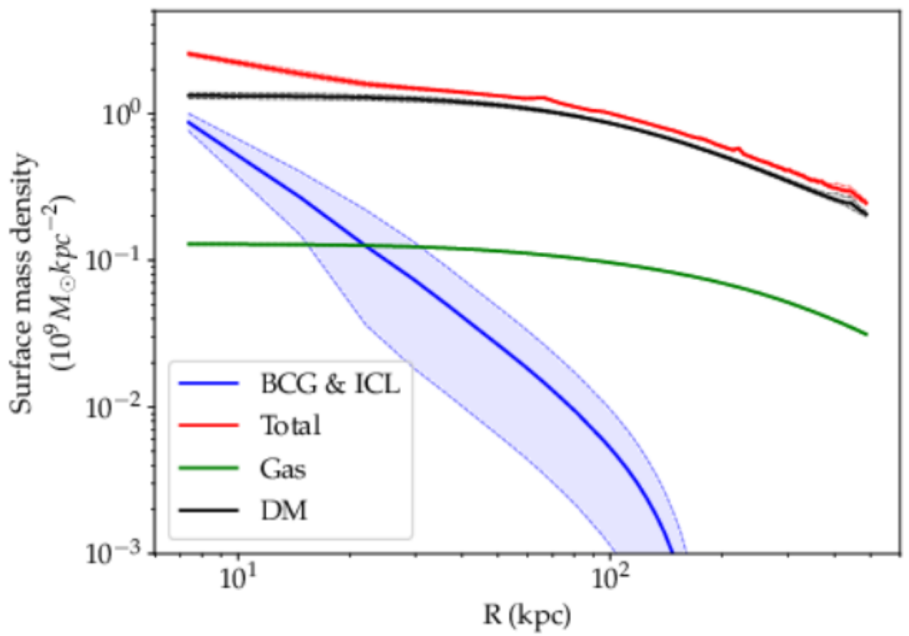


Mass distribution from a multi-probe mass model

2D mass distribution

Mass profile





Beauchesne+25, in prep