Structure of Brightest Cluster Galaxies and Intracluster Light

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Open Questions?

- How similar are BCGs to regular Ellipticals?
  - Do they extend the scaling relations for ellipticals?

- How much ICL is there?
  - Go deep!

- Simulations predict remnants of accretion events at low surface brightnesses
  - Find them in real data!

Kormendy+ (2009); Bender+ (2015)

Harris+ (2017)
Previous BCG/ICL Surveys

![Graph showing the relationship between depth [g' mag arcsec⁻²] and sample size for various surveys, including Seigar (2007), Krick (2005), Gonzalez (2005), Patel (2006), Schombert (1986), Bernardi (2007), Postman (1995), and Lauer (2014). Kluge (2019) is highlighted in red.](image)
Background flatness

sky subtraction

30'

Before foreground stars removal

Field of view: 0.7 sq. degree
Background flatness

sky subtraction

30'

After foreground stars removal

100"

Field of view: 0.7 sq. degree
Background flatness

Sky subtraction

30'

Field of view: 0.7 sq. degree

After foreground stars removal

100''

$mag_g$ arcsec$^{-2}$
Surface Brightness profiles

Abell 1177

$\Delta SB$

$SB$ [mag$_g$, arcsec$^{-2}$]

$a^{1/4}$ [arcsec$^{1/4}$]

- 70cm JBRT L
- 2m WWFI g'

sky brightness
PSF de-broadening

$r_e : 12\%$ too large
$SB_e : 0.25 \text{ mag arcsec}^{-2} \text{ too faint}$
$n : 6\%$ too large
Results:

accretion signatures
Accretion signatures:

Tidal Streams  (in 22% of BCGs)

Abell 1257

Abell 1213
Accretion signatures:

Shells (in 9% of BCGs)

AWM 1

Abell 2197

Harris+ (2017) Simulation
Accretion signatures:

Multiple Nuclei  (in 23% of BCGs)
BCG / ICL decomposition using two Sérsic functions

71% of BCGs

29% of BCGs

Abell 2029

Abell 1177
BCG / ICL decomposition using two Sérsic functions

Remus+2017 (Magneticum Simulation)
Average SS and DS profiles

$r^{1/4}$ [kpc$^{1/4}$]

$SB$ [mag, arcsec$^{-2}$]

$\epsilon = 1 - b/a$

$\Delta P^A [^\circ]$
Accretion signatures

![Graph showing fraction of SS or DS BCGs for different accretion signatures: Two BCGs, Shells, Tidal Streams, Multiple Nuclei, and Any. The graph compares SS BCGs (red) and DS BCGs (gray).]
Scaling Relations

1) Brightest Cluster Galaxies differ from regular Ellipticals in their scaling relations:
   - Broken slopes in Kormendy-, M–SB and size–brightness relations

2) Scaling relations are equivalent for SS and DS BCGs

3) ICL blends in with the clusters
BCG/ICL alignment with their host clusters
Summary

• large & deep photometric survey of 170 Brightest Cluster Galaxies with the Wendelstein Wide Field Imager

• Accretion signatures detected in 1/2 of observed BCGs

• Double Sérsic decomposition of SB profiles is in 1 / 2 cases incapable of decomposing BCG and ICL

• Scaling relations for BCGs differ from those of regular ellipticals due to ICL
  • ICL transitions smoothly into the clusters
Outlook

- color gradients

12 u'  171 g'  27 Ks

- IFU spectroscopy

7 VIRUS-P  1 VIRUS  74 LRS2