

1. Scientific Motivation

Why study AGN in BCGs?

- BCGs host the most massive black holes
- AGN regulate cooling in cluster cores
- Feedback maintains the heating-cooling balance



Key questions:

- What fraction of BCGs host AGN?
- Which accretion mode dominates?
- Does AGN activity depend on halo mass or cosmic epoch?

2. Sample and Data

BEAMS Programme; Multiwavelength Data: SALT spectroscopy • DES photometry • WISE mid-IR • ASKAP RACS radio • Stellar masses and SFRs from X-CIGALE SED modelling
Sample: 171 BCGs in SZ-selected clusters at $0.3 < z < 0.8$

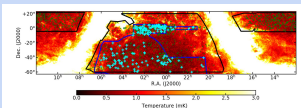


Fig. 1. AdvACT cluster sample used in this study.

3. AGN Identification

Three diagnostics methods:

- Optical
 - [OIII] 5007 Å emission
- Radio
 - Radio excess relative to IR-radio correlation
- Mid-IR
 - WISE colours

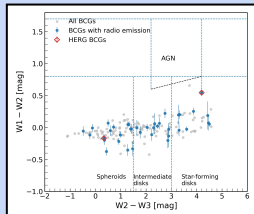


Fig. 2. WISE colour-colour diagram of BCGs. No BCG lies within the MIR AGN selection region.

4. Key Results

171 BCGs
 ↓
 38 radio AGN (26%)
 → 95% LERGs
 → 5% HERGs

Host Galaxy Trends

Radio AGN BCGs are extremely massive systems.

- Median stellar mass, $\log(M/M_{\odot}) \approx 11.56$
- SFR increases with redshift, but remains below the star-forming main sequence

Accretion Properties

Eddington ratio:

- Quasar mode
 - $\lambda_{\text{Edd}} \sim 0.1 - 1$
- BCG AGN (this work)
 - $\lambda_{\text{Edd}} \sim 10^{-3} - 10^{-1}$ →

Radiatively inefficient maintenance-mode feedback

Radio Properties

- Moderate L_{radio} -SFR correlation, driven by redshift evolution. Therefore:
- Jet power is not directly linked to star formation

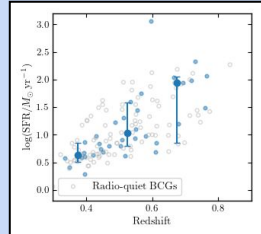
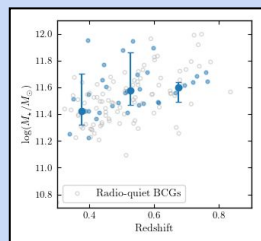


Fig. 3. Top: Stellar mass of BCG hosts vs redshift. Radio AGN occur in extremely massive galaxies. Bottom: Star-formation rate of BCG hosts vs redshift. SFR increases toward higher redshift.

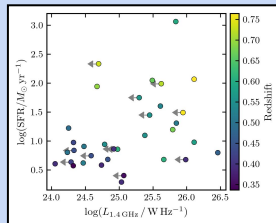


Fig. 4. Radio luminosity vs star-formation rate. Trend largely driven by redshift evolution.

5. Comparison with Field AGN

Comparison with general radio AGN population from MIGHTEE COSMOS field (Whittem et al. 2022):

- Field LERGs $\log(M/M_{\odot}) \approx 10.6$
- BCG LERGs $\log(M/M_{\odot}) \approx 11.5$

→ BCG AGN are the high-mass extreme of the LERG population

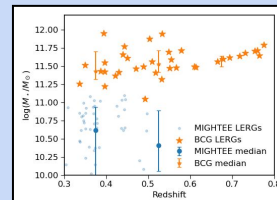


Fig. 5. Stellar mass of radio AGN hosts vs redshift.

6. AGN Feedback in Cluster Cores

BCGs are powered by self-regulated AGN feedback

Self-regulated cooling-feedback cycle diagram: Cooling ICM → Gas accretion → SMBH → Radio jets → Heating of ICM

Cooling gas fuels the SMBH, while jets prevent runaway cooling

- AGN activity regulated by gas supply in cluster cores
- Weak dependence on cluster halo mass
- Same AGN physics as field LERGs (high-mass extreme)

7. Main Conclusions

- 26% of BCGs host radio AGN
- Activity dominated by LERGs
- Accretion efficiency increases with redshift
- AGN fueling regulated by cluster core gas
- High-mass extreme of LERG population