The BCG Progenitors:
Two Radio-detected AGN in a Complex Proto-structure at z ~ 3.3

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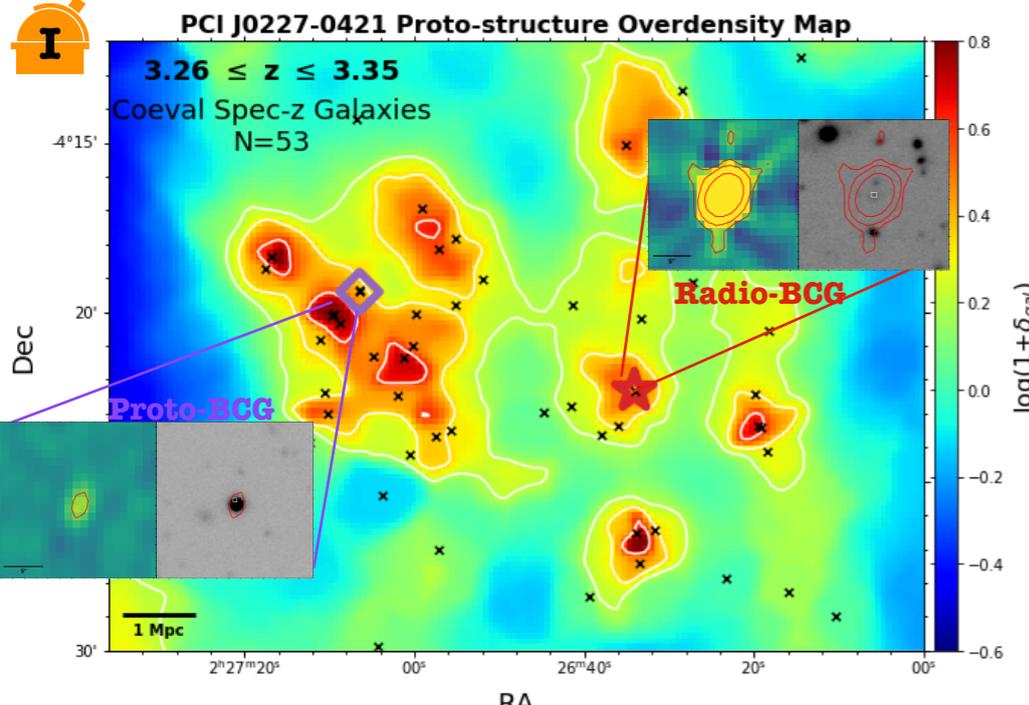
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Fig 1. Sky plot of the two RAGN (open colored markers) and spectroscopically-confirmed galaxies within the volume used to construct the proto-structure ("Coeval Spec-z Galaxies", black crosses). Plotted in the background is the 2D smoothed overdensity map with the color scaled by $log(1+\delta_{gal})$. White contours are 1.5, 2.5, 4.5σ of the overdensity map. The zoom-in pictures of RAGN are 1.4 GHz (left) and K-band (right), with 4, 16, 64σ radio contours overlaid.

The C3VO survey
Charting Cluster Construction with VUDS and ORELSE

An ongoing spectroscopy campaign with both DEIMOS/Keck and MOSFIRE/Keck, to provide a nearly complete mapping of the **five most significant overdensities at 2 < z < 5.** See Brian Lemaux's and Denise Hung's posters on more insight into C3VO! Also see more on ORELSEsurvey.com.

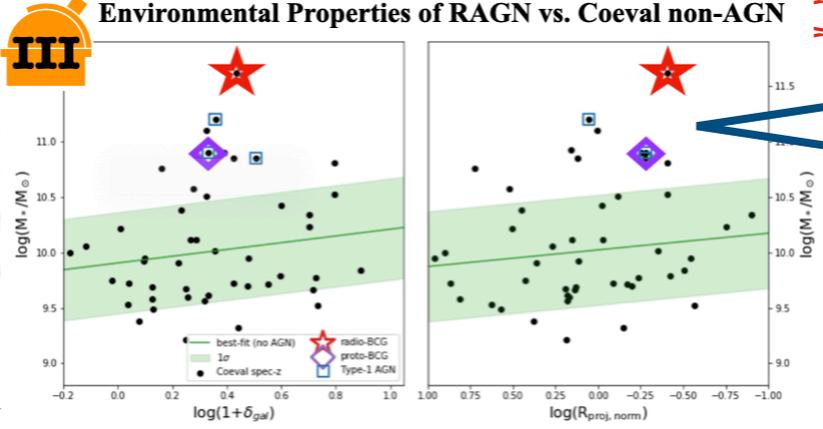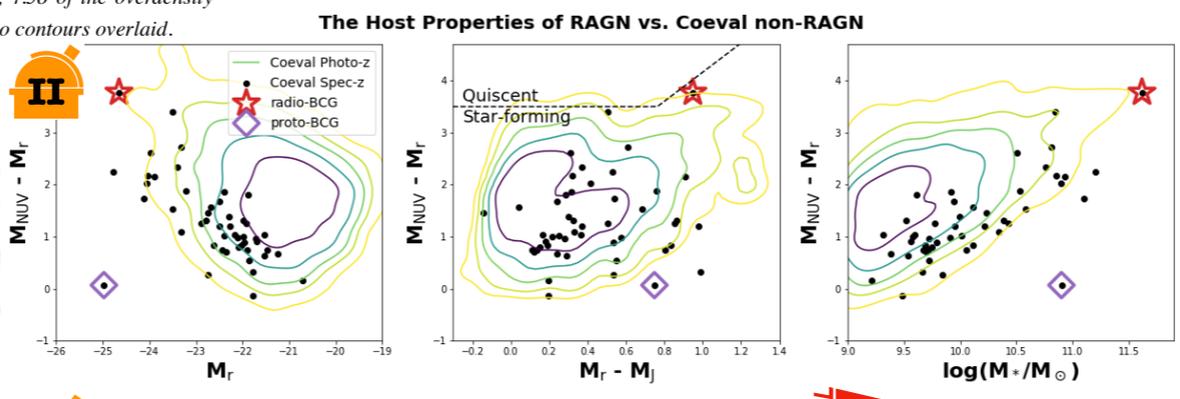
Cucciati et al. 2018

Lemaux et al. 2014
Shen et al. 2021

Lemaux et al. 2018

Proto-BCG ($L_{1.4GHz} = 10^{24.7}$ W/Hz)

- The **b**rightest optical/NIR **proto**cluster galaxy, the **BCG progenitor**;
- The bluest galaxy, obscured SFR of ~700M$_\odot$/yr
- Has **star-formation + AGN** activities, similar to the 'hybrid' radio galaxies (Shen et al. 2017, 2020a)

Radio-BCG ($L_{1.4GHz} = 10^{25.6}$ W/Hz)

- The **b**rightest **r**adio **proto**cluster **g**alaxy;
- The reddest and most massive galaxy, recent quenched, the **BCG progenitor**;
- In the least massive peak, an example of progenitor of z ~ 0 MMCG form **ex-situ**.

II — The Host Properties of RAGN vs. Coeval non-RAGN

Fig.2 The host properties of RAGN (open markers) vs. coeval non-RAGN in the rest-frame color-magnitude (left), color-color (middle), color-stellar mass (right) phase space diagrams. The colored contours are derived from photometry objects within the volume used to construct the proto-structure ("Coeval Photo-z Objects"). The black line in the color-color diagram is the division between the SF and quiescent galaxy populations adopted from Lemaux et al. 2014.

III — Environmental Properties of RAGN vs. Coeval non-AGN

Fig.3 The local density vs stellar mass of coeval spec-z galaxies and two RAGN. The best-fitted lines of coeval spec-z galaxies, excluding AGNa, are shown in green with 1σ envelope. The RAGN are significantly offset from the coeval spec-z galaxies.

Merging might have already happened, which lowered the local density and boosted the stellar mass of the AGN hosts.

General properties of protostructure

Barycenter of main density peak	02:27:06.6 -04:20:44.5
Number of spec-members	27
Median redshift	z = 3.306
Mean Overdensity	$\delta_{gal} = 1.314$
Volume	52951 cMpc^3
Total Mass	$M_{tot} = 2.6 \times 10^{15} M_\odot$

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*Fig.4 Evolution of δm for the porto-structure following with spherical collapse. **This proto-structure will be all virialised by redshift z ~ 1.6.***