

# Galaxy Cluster Flowdown

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# Galaxy Cluster Flowdown

Galaxy-Clusters (GC) Science Goal:

For galaxy cluster searches, achieve a lower mass limit that is below  $10^{14} M_{\text{sun}}$  at  $z \sim 2$ .

Motivation: Galaxy clusters in the local Universe appear to have formed the bulk of their stars at  $z \sim 2-3$ . A catalog at these redshifts will provide new views on the astrophysics of galaxy clusters. This sensitivity will allow views of clusters similar to massive clusters that we see at  $z \sim 0.5$ , but at an earlier stage in their development when they were forming their stars.

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Galaxy-Clusters (GC) Science Goal:

For galaxy cluster searches, achieve a lower mass limit that is below  $10^{14}$  Msun at  $z \sim 2$ . **Sharpen this target.**

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What's been done.

Analytic cluster count predictions (Srini, Mat M, Nick).

- Varied telescope aperture size, and soft optimization on the frequency coverage (proper optimization will need sims)

Improvements to flow down:

- Is the frequency allocation determination fully robust?

- Has a sufficient model space for foregrounds (e.g., CIB, correlations) been explored?

- How much of the 70% of the sky can we use for various analyses?

- Include the deep region delensing region

- Measurement systematics exploration

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What analysis tools need to be developed?

(Luckily many of the tools already exist in for clusters in the Stage-3 experiments)

- **Find Clusters:** Matched filter cluster finder (SPT, ACT finders should suffice)
- **Characterize Clusters:** If we care about cluster masses, then we also need a CMB Halo Lensing pipeline (something like what Srini's, Mat's, or Eric's)
- **Test Algorithms:** Sky sims (Websky, Argonne)
- **Confirmation:** Outside of the S4 experiment we'll need follow-up redshift campaign and Optical to NIR data reduction pipeline.

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What sims are needed?

- **Extragalactic Sky Sims:** These will include the tSZ cluster signal (including relativistic corrections), all the correlated extragalactic foregrounds (kSZ, CIB, radio, etc), Galactic Foregrounds, & CMB. These simulations need to cover the nominal S4 frequency bands in intensity with simulated scans and noise levels. They also need to include lensing. Some mocks already exist e.g., Websky or Argonne.
- **Systematics:** Including systematics like beams variation or uncertainty, frequency band mis-matches that would be great and a big step forward.

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By when?

- Many of the tools/sims already exist in some form.
- A good/achievable goal would be to gather all the tools in one place. Run them on the current sky sims. Get the sims + systematics ready to go by next collaboration meeting. This would be a year in advance of CD1 and PDR and 8 months ahead of baseline document.

What input will you be requesting from the technical council or from data management?

- Getting beams and band systematics into the sky sims.

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What are the key questions to be addressed with these analysis tools and sims?

- Is the frequency allocation determination fully robust?
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**Sources Breakout Session Tomorrow Afternoon**