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Hot Gas, Cold Gas, and Stars: Mapping the Halo Baryon Budget in the Local Universe

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Feedback processes, particularly from active galactic nuclei (AGN), play a crucial role in redistributing baryons within dark matter halos. These mechanisms can displace gas to halo outskirts or eject it entirely, resulting in baryon fractions significantly below the cosmic mean—especially in low-mass systems where feedback energy can rival halo binding energy. While simulations such as TNG, SIMBA, and EAGLE predict strong mass-dependent baryon loss, observational constraints remain limited, particularly for low-mass halos.

In this talk, I present a systematic empirical analysis of the baryon content of halos in the local universe across a wide mass range ($10^{10} - 10^{15} M_{\odot}$). Using a compilation of literature measurements and new stacking analyses with eROSITA and ASKAP, we quantify the contributions of hot gas, stars, and cold gas to the total baryon budget. These data enable construction of baryonic mass-to-halo mass scaling relations across all phases, extending down to $10^{10} M_{\odot}$ via individual galaxy measurements.

By combining these relations with the halo mass function, we derive the baryon mass distribution and the cosmic mass densities of stars, HI, and hot gas in bound halos. These results provide new observational constraints on the efficiency of feedback mechanisms across mass scales and inform models of baryon retention, redistribution, and depletion in both group and galaxy-scale systems.

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