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Explaining the H_0 Tension via the Local Hole and CMB Lensing

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Observational evidence for a large local galaxy underdensity goes back to the 1990's and, like the "Hubble tension", remains unexplained by standard Λ CDM. Wong et al (2022) show that this "Local Hole" covers $>90\%$ of the sky out to ~ 200 Mpc with an ~ 20 - 30% underdensity, consistent with previous observations (e.g. Keenan, Barger and Cowie, 2014). We have speculated that this underdensity could explain the H_0 tension but an even larger/more underdense "Hole" would be required, uncomfortable given that the current Local Hole is already a 4σ deviation from Λ CDM. However, recall that we are only measuring galaxy density and biasing has to be taken into account. Crucially, Kaur et al (2025) find that galaxy-CMB lensing results from Planck+ACT give significantly higher amplitudes at 2-halo scales than predicted. These results argue for an anti-bias that increases the local mass underdensity to $\sim 50\%$ over 200 Mpc, enough to explain the Hubble tension (eg Huterer 2023), although remaining in disagreement with Λ CDM.

References

"The local hole: a galaxy underdensity covering 90 per cent of sky to ≈ 200 Mpc", Wong J.H.W., Shanks T., Metcalfe N. and Whitbourn J.R., 2022, MNRAS, 511, 5742.

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