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The dark clump near Abell 1942: dark matter halo or statistical fluke?

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Abstract
Using HST WFPC2 mosaic imaging, deep Chandra observations, and the original CFHT imaging, we investigate the case for the dark clump candidate originally presented by (Erben et al. 2000, A&A, 355, 23). We show that the original detection is well reproducible in the CFHT data, and can confirm the presence of an alignment signal at the dark clump position in the HST data. The HST signal strength, however, is weaker than in the ground-based data. A comparison of the ellipticity measurements from the space-based HST data and the ground-based CFHT data on an object-by-object basis shows a remarkable agreement on average, demonstrating that weak lensing studies from high-quality ground-based observations can yield reliable results. In the vicinity of the dark clump position, however, there is a notable disagreement in the ellipticity measurements tangential to it, which leads to the discrepant lensing results. Despite a detailed investigation, the cause of this disagreement remains unclear. In the deep HST observations, we find a significant number overdensity of galaxies close to the dark clump, but due to lacking redshift estimates it is unclear whether this corresponds to a coherent structure. Deep Chandra observations of the dark clump fail to reveal significant extended emission, in contrast to the original putative ROSAT detection. Altogether, the current data render the hypothesis of a dark matter halo similar to that of a massive cluster unlikely. Yet there remains evidence that the alignment signal is caused not solely by intrinsic galaxy ellipticities. Likely explanations are thus a superposition of the lensing signal of a less massive system with a noise peak, or a filament along the line-of-sight.

Key words: gravitational lensing -- cosmology: dark matter -- galaxies: clusters: general