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Strong Lensing Constraints on the Properties of Cluster Galaxies

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A recently discovered quadruply-imaged QSO, SDSS J1004+4112, in the core of a z = 0.68 galaxy cluster gives us a unique opportunity to study the central regions of this cluster. We present free-form reconstructions of the lens using recently-developed methods. The projected mass within 100 kpc is well-constrained as $(5 \pm 1) \cdot 10^{13}$ $M_{\odot}$, consistent with previous simpler models. Unlike previous work, however, we are able to detect structures in the lens associated with cluster galaxies. We estimate the mass associated with these galaxies, and show that they contribute not more than about 10% of the total cluster mass within 100 kpc. Typical galaxy masses, combined with typical luminosities yield a rough estimate of their mass-to-light ratio, which is in the single digits, implying that these galaxies consist mostly of stars, and possess little dark matter.

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