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Title:A detailed gravitational lens model based on submillimeter array and Keck adaptive optics imaging of a Herschel-ATLAS submillimeter galaxy at z = 4.243
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Abstract:We present high-spatial resolution imaging obtained with the Submillimeter Array (SMA) at 880 μm and the Keck adaptive optics (AO) system at the K_S-band of a

gravitationally lensed submillimeter galaxy (SMG) at z = 4.243 discovered in the Herschel Astrophysical Terahertz Large Area Survey. The SMA data (angular resolution ≈ 0."6) resolve the dust emission into multiple lensed images, while the Keck AO K _S -band data (angular resolution ≈ 0."1) resolve the lens into a pair of galaxies separated by 0."3. We present an optical spectrum of the foreground lens obtained with the Gemini-South telescope that provides a lens redshift of z_{lens} = 0.595 ± 0.005. We develop and apply a new lens modeling technique in the visibility plane that shows that the SMG is magnified by a factor of μ = 4.1 ± 0.2 and has an intrinsic infrared (IR) luminosity of L_{IR} = (2.1 ± 0.2) × 10¹³ L_⊙. We measure a half-light radius of the background source of r_s = 4.4 ± 0.5 kpc which implies an IR luminosity surface density of Σ_{IR} = (3.4 ± 0.9) × 10¹¹ L_⊙ kpc⁻², a value that is typical of z > 2 SMGs but significantly lower than IR luminous galaxies at z ~ 0. The two lens galaxies are compact (r_{lens} ≈ 0.9 kpc) early-types with Einstein radii of &thetas;_{E1} = 0.57 ± 0.01 and &thetas;_{E2} = 0.40 ± 0.01 that imply masses of M_{lens1} = (7.4 ± 0.5) × 10¹⁰ M_⊙ and M_{lens2} = (3.7 ± 0.3) × 10¹⁰ M_⊙. The two lensing galaxies are likely about to undergo a dissipationless merger, and the mass and size of the resultant system should be similar to other early-type galaxies at z ~ 0.6. This work highlights the importance of high spatial resolution imaging in developing models of strongly lensed galaxies discovered by Herschel .

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