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Multiwavelength Studies of Strong Gravitational Lensing: The Case of HCOSMOS01

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Strong gravitational lensing is the dramatic, observed deflection of light in the presence of massive foreground lenses that perturb the surrounding spacetime. In general, strong gravitational lensing is a versatile probe of the mass distributions and dark matter content of the lenses that also offers a means of constraining the Hubble parameter and testing General Relativity [1]. We exploit high-resolution near-infrared images from the Hubble Space Telescope (HST) to model strongly lensed systems to recover the physical properties of the lenses and the lensed sources. We also explore the possibility of including theories of modified gravity in our lens modelling algorithms. In this work, we focus on the first strongly lensed system identified in the COSMOS field, HERMESJ100144+025709 (otherwise referred to as HCOSMOS01)[2]. The HST image of the system of interest, taken at 1.1 μm , formed part of proposal ID 12488 (PI: M. Negrello) in Cycle 19. Similar to proposal ID 15242 (PI: L. Marchetti) in Cycle 25, and proposal ID 16015 (PI: L. Marchetti) in Cycle 26, high resolution follow-up observations were conducted to confirm the lensing nature of 281 candidate systems identified in the wide-area extragalactic surveys conducted with the Herschel Space Observatory [3]. From our analysis, we present the results of modeling the surface brightness profile of the lens and the reconstruction of the lens and source. We also present the best estimates for the photometric and spectroscopic redshifts of the source, upon modelling the spectral energy distribution of the source as a modified greybody [4], using the available Atacama Large Millimeter/submillimeter Array (ALMA) data [5] and Dark Energy Spectroscopic Instrument (DESI) spectra [6]. Lastly, we provide a critical discussion on the use of lens modeling softwares, such as PyAutoLens [7], as a means of exploring how various dark matter distributions and mass profiles, including fiducial models derived from modified theories of gravity, affect the resultant lens modeling and source reconstruction.

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