X31a Exploring the faintest end of mid-infrared luminosity functions up to $z \simeq 5$ with the JWST CEERS survey

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Mid-infrared (MIR) light from galaxies is sensitive to dust-obscured star-formation activities because it traces the characteristic emission of dust heated by young, massive stars. By constructing the MIR luminosity functions (LFs), we are able to quantify the overall dusty star formation history and the evolution of galaxies over cosmic time. In this work, we report the first rest-frame MIR LFs at 7.7, 10, 12.8, 15, 18, and 21 μm as well as the total IR LF from the James Webb Space Telescope (JWST) Cosmic Evolution Early Release Science (CEERS) survey. We identify 506 galaxies at $z = 0 - 5.1$ in the CEERS survey that also have optical photometry from the Hubble Space Telescope. With the unprecedented sensitivity of the JWST, we probe the faintest end of the LFs at $z = 0 - 1$ down to $L^* \sim 10^7 L_\odot$, ~ 2 orders of magnitude fainter than those from the previous generation of IR space telescopes. Our findings connect well with and continue the faint end of the MIR LFs from the deepest observations in past works. As a proxy of star formation history, we present the MIR-based luminosity density up to $z \simeq 4.0$, marking the first probe of the early Universe by JWST MIRI.