X24a Truth or Delusion? A Possible Gravitational Lensing Interpretation of the Ultra-luminous Quasar SDSS J0100+2802 at $z = 6.30$

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Gravitational lensing sometimes dominates the observed properties of apparently very bright objects. We present recent ALMA high-resolution (FWHM$\sim$0.″15) results of Fujimoto et al. (2020a) for an ultra-luminous quasar (QSO) at $z = 6.30$, SDSS J0100+2802, whose black hole mass $M_{\rm BH}$ is the most massive ($\sim 1.2\times10^{10} M_\odot$) at $z > 6$ ever known. We find that the continuum emission of J0100+2802 is resolved into a quadruple system within a radius of 0.″2, which can be interpreted as either multiple dusty star-forming regions in the host galaxy or multiple images due to strong gravitational lensing. The MgII absorption and the potential Lyα line features have been identified at $z = 2.33$ in the near-infrared spectroscopy towards J0100+2802, and a simple mass model fitting well reproduces the positions and flux densities of the quadruple system, both of which are consistent with the latter interpretation. Although a high-resolution HST/ACS map shows a morphology with an apparently single component, in our fiducial lens mass model it can simply be explained by a ~ 50 pc scale offset between the ALMA and HST emission regions. In this case, the magnification factor for the observed HST emission is obtained to ~ 450, reducing the intrinsic $M_{\rm BH}$ estimate to even below $10^9\,M_\odot$. We will also discuss recent views of the effect on the bright-end of the luminosity function and the possibility of the presence of additional extremely magnified QSOs at $z \gtrsim 6$ (Pacucci & Loeb 2020a).