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Progress Report

HUNTING FOR PLANET-MASS OBJECTS IN EXTRAGALACTIC SYSTEMS

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Quasar microlensing serves as a unique tool to probe discrete objects within galaxies and galaxy clusters. Recent developments have enabled us to constrain the planet-mass objects beyond our home galaxy by studying the microlensing signatures in the X-ray emission line emerging from the innermost region of the supermassive black hole of a high redshift quasar. We implement this technique to impose effective constraints on the planet-mass distribution within two lens systems, Q J0158−4325 ($z_l = 0.317$) and SDSS J1004+4112 ($z_l = 0.68$), using Chandra monitoring observations for two gravitationally lensed quasars. The observed variations of the emission line peak energy can be explained as microlensing of the FeKα emission region induced by planet-mass microlenses. To confirm, we perform microlensing simulations to determine the probability of a caustic transiting the source region and compare this with the observed line shift rates. Our analysis yields constraints on the substellar population, with masses ranging from Moon ($10^{-8} M_\odot$) to Jupiter ($10^{-3} M_\odot$) sized bodies, within these galaxy or cluster scale structures, with total mass fractions of $\sim 3 \times 10^{-4}$ and $\sim 1 \times 10^{-4}$ with respect to halo mass for Q J0158−4325 and SDSS J1004+4112, respectively. Our analysis suggests that unbound planet-mass objects are universal in galaxies, and these objects are conjectured to be either free-floating planets or primordial black holes. This work presents the first-ever constraints on the substellar mass distribution in the ICL of a galaxy cluster. Our results provide the most stringent limit on the mass fraction of primordial black holes at the mass range.