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Revealing the Structure of the Lensed Quasar Q 0957+561

We use signatures of microlensing (induced by stars in the foreground lens galaxy) on different wavelength regions in the gravitationally lensed quasar Q 0957+561 to infer the size of the accretion disk and to study the structure and kinematics of the broad-line region (BLR). We analyze the well-sampled 21-year GLENDAMA optical light curves of the double-lensed quasar (which so far has provided the longest available light curves of a gravitational lens system) and multiple spectroscopic observations obtained between April 1999 and January 2017, and from the statistics of microlensing magnifications we use a Bayesian method to derive the size of the regions emitting the continuum and the C IV, C III], and Mg II lines. The relatively low strength of the magnitude differences between the images indicates that the quasar has an unusually big optical accretion disk. In several epochs of observation we found clear differences between the line profiles of images A and B in the high-ionization line C IV. Measuring the amplitude of microlensing in different velocity bins in the wings of C IV and C III], we conclude that they are produced in at least two spatially distinct regions, the most compact one giving rise to the broadest component of the line. These regions have different geometries (the more extended one being spherically symmetric) and hence, do not share the same kinematics. We also intend to use the impact of microlensing on the Fe IIIλλ2039-2113 emission line blend together with a measure of its gravitational redshift to estimate the mass of the quasar's central supermassive black hole (SMBH). We obtain a mass for the central SMBH of M_BH = 1.5×10^9 M_sun, consistent within uncertainties with previous mass estimates based on the virial theorem.

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