OzDES Reverberation Mapping Program: Mg II Lags and R – L Relation

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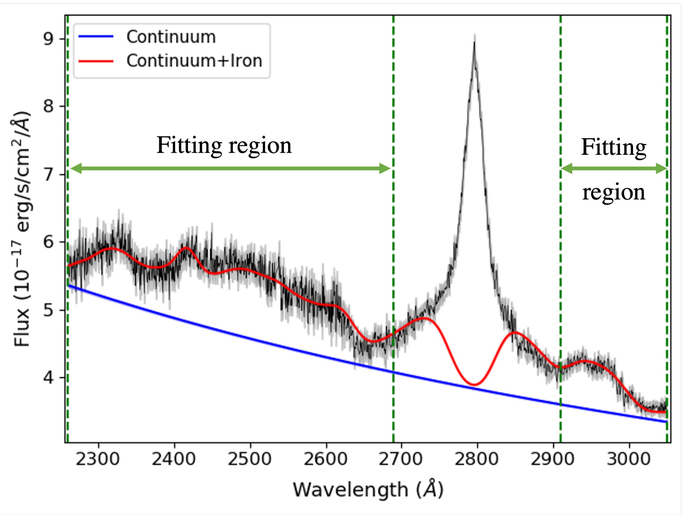
Introduction

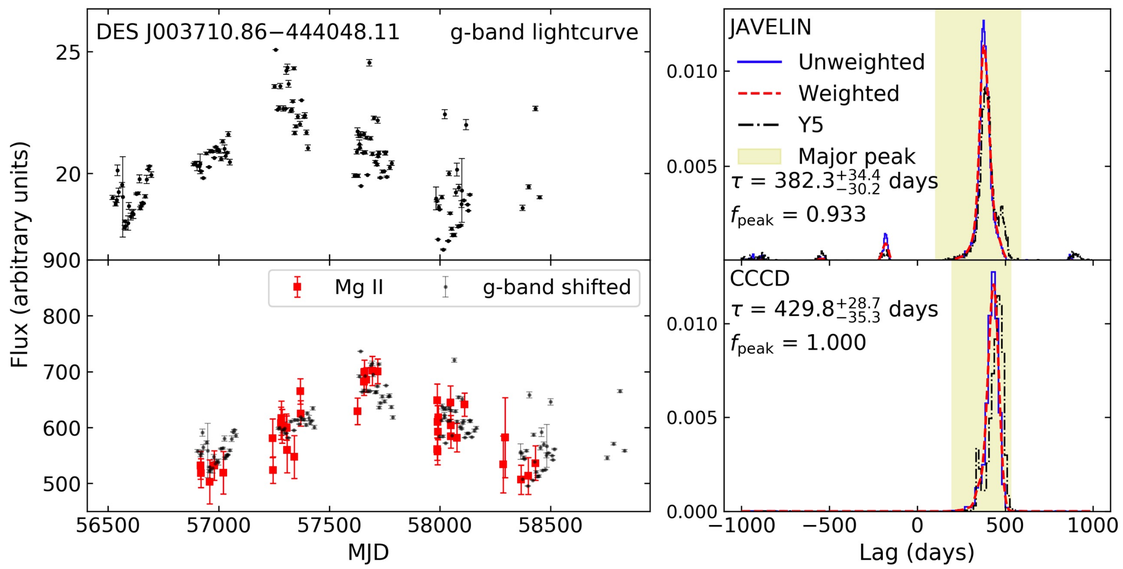
Accurate mass measurements for supermassive black holes (SMBHs) are critical for understanding their evolution over cosmic time. Outside of the local Universe, reverberation mapping (RM) of active galactic nuclei (AGN) is the most accurate method for measuring SMBH masses. RM measures the **time lag between the continuum and broad emission line region (BLR) variability of AGN**, which gives the virial mass when combined with the broad line width. I present the high-quality Mg II lags and **a new relationship between the Mg II BLR radius and the continuum luminosity (R-L relation)** from the Australian DES (OzDES) RM project. This relation is extremely important because it is widely used to estimate the masses for large numbers of SMBHs from single-epoch spectra at cosmic noon – the peak of AGN activity.

Continuum and Iron Modeling



We model the AGN continuum using a power-law and model the iron emission using literature iron templates convolved with a Gaussian kernel to account for the velocity broadening of BLR. The blue and red solid lines show the best-fit continuum and continuum + iron models, respectively.

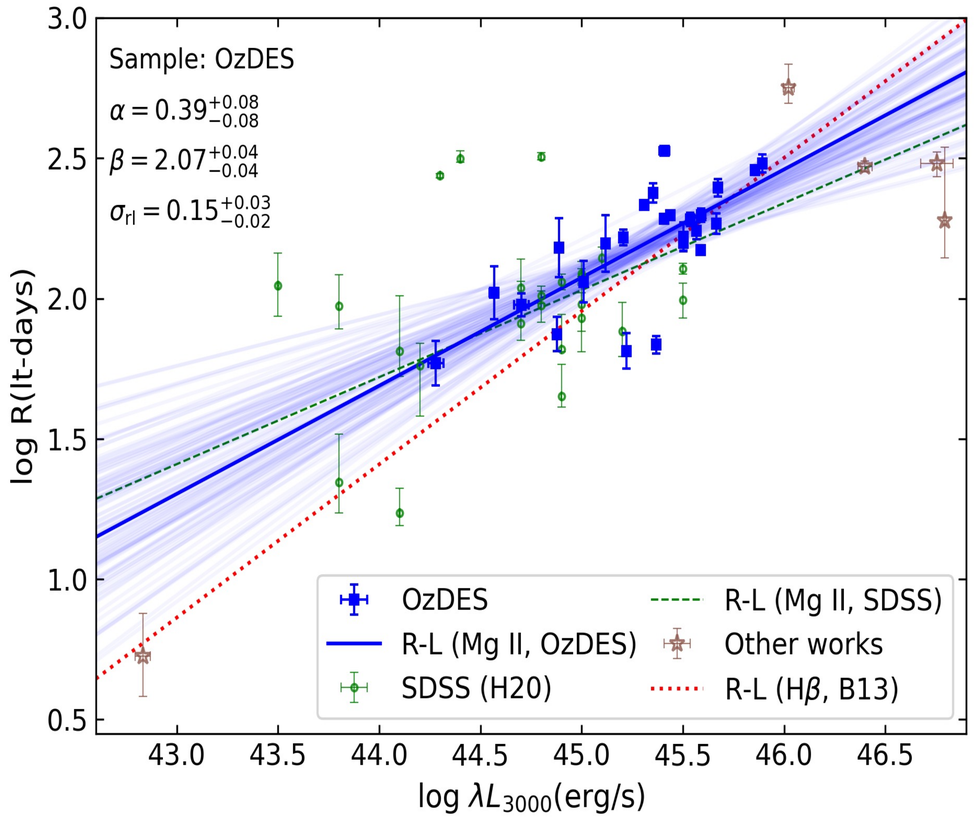
Lightcurves and Lag Measurements



An example of our lightcurves and lag measurements. The upper and lower panels of the left column show the g-band lightcurve and the Mg II line lightcurve, respectively. The right column shows the lag distributions from JAVELIN and ICCF in the upper and lower panels, respectively. Both algorithms find clear lag signals that are consistent within 2σ.

The lightcurves exhibit clear variability features. The black points in the lower left panel show the g-band lightcurve shifted by the best-fit lag. **The shifted continuum lightcurve well matches the line lightcurve**, which supports the reliability of the lag measurement.

Mg II R – L relation



We measured Mg II lags of 25 quasars. The bottom figure shows the continuum luminosity and redshift of our sample. Our sample **significantly increases the number of Mg II lags and extends the R – L relation to higher redshifts and luminosities.**

The left figure shows the best-fit Mg II R – L relation based only on our Mg II lags. **The slope is shallower than the Hβ R – L relation. The intrinsic scatter is substantially smaller than previous studies and comparable to the intrinsic scatter of the Hβ R – L relation.** Our new R – L relation will enable more precise single-epoch mass estimates and SMBH demographic studies at comic noon.