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OzDES Reverberation Mapping Program: Stacking analysis with Hβ, Mg II and C IV

by U. Malik et al. (including J. Asorey)

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Plaza de las Ciencias, 1 28040 Madrid, Spain

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Abstract

Reverberation mapping is the leading technique used to measure direct black hole masses outside of the local Universe. Additionally, reverberation measurements calibrate secondary mass-scaling relations used to estimate single-epoch virial black hole masses. The Australian Dark Energy Survey (OzDES) conducted one of the first multi-object reverberation mapping surveys, monitoring 735 AGN up to z~4, over 6 years. The limited temporal coverage of the OzDES data has hindered recovery of individual measurements for some classes of sources, particularly those with shorter reverberation lags or lags that fall within campaign season gaps. To alleviate this limitation, we perform a stacking analysis of the cross-correlation functions of sources with similar intrinsic properties to recover average composite reverberation lags. This analysis leads to the recovery of average lags in each redshift-luminosity bin across our sample. We present the average lags recovered for the Hβ, Mg II and C IV samples, as well as multi-line measurements for redshift bins where two lines are accessible. The stacking analysis is consistent with the Radius-Luminosity relations for each line. Our results for the Hβ sample demonstrate that stacking has the potential to improve upon constraints on the R–L relation, which have been derived only from individual source measurements until now.

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