Broad Line Variability on Long Timescales

A Complex BLR Response

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BLR response to continuum changes
▶ MgII 2798Å: variability range
▶ Mrk 110: a tracker for the EUV continuum
Different types of MgII behaviour

J224829:

J022556:

MacLeod et al. MNRAS 547 (2016)
- New observations for a sample of highly variable AGN: $|\Delta g| > 1$, searching for new CLQs
- Subsample of 15 objects for which $f_{MgII}$ could be measured
- Object J022556 was covered by Stripe 82; total of 15 spectra
- Maximum MgII flux change by a factor $\sim 11$
• Line Flux vs. Continuum flux for the entire sample
Line responsivity in Mrk 110

- Mrk 110: Seyfert I at z=0.0355
- Observations over several decades, ~100 spectra

[Graph showing spectral lines and flux density over wavelength in QSO Restframe (Å) and flux density in erg cm⁻² s⁻¹ Å⁻¹]
- Line fluxes against the continuum at 5100Å
- Fluxes normalised to a single date

- Compare normalised line fluxes to HeII 4686 flux
- Approximate behaviour with a simple fitting function

Lawrence et al. (2017, in prep.)
• On shorter timescales, the responsiveness can deviate
• Results from separate RM studies:
- Empirical fitting function
- Apparent cut-off in line responsivity
- Correlation with known lags from RM
Summary

- Range in broad MgII response
  - Clear difference with short timescales (RM)
- Large number of spectra allows better analysis for Mrk 110
- The responsiveness of broad lines appears to diminish for higher EUV continuum values
- Possible connection:
  - high state versus low state responsiveness
Additional Notes on Individual Objects

3.2. The BLR Size–Luminosity Relation

The BLR size–luminosity relation (Fig. 10) shows the relation for our detections, with red open circles representing the 44 local RM AGN compiled in Bentz et al. (2013) and blue filled circles representing the 15 preliminary RM AGN from Feng et al. (2014). The black dots and gray points indicate the locations of previous lag detections. Our new lags are consistent with the locations of previous detections. The data for previous lag measurements in this work probe a new regime in the parameter space, providing direct SMBH masses over half of cosmic time. While our analysis demonstrates that the majority of these results in the redshift–luminosity coverage of RM experiments, our lag detections are shown to be consistent with trends in the redshift–luminosity plane. The red open circles are the 44 local RM AGN compiled in Bentz et al. (2013) and the blue filled circles represent the 15 preliminary RM AGN from Feng et al. (2014). The black dots and gray points indicate the locations of previous lag detections. Our new lags are consistent with the locations of previous detections. The data for previous lag measurements in this work probe a new regime in the parameter space, providing direct SMBH masses over half of cosmic time.

Finally, Fig. 10 demonstrates the improvement of our results in the redshift–luminosity coverage of RM experiments. Our lag detections are shown to be consistent with trends in the redshift–luminosity plane. The red open circles are the 44 local RM AGN compiled in Bentz et al. (2013) and the blue filled circles represent the 15 preliminary RM AGN from Feng et al. (2014). The black dots and gray points indicate the locations of previous lag detections. Our new lags are consistent with the locations of previous detections. The data for previous lag measurements in this work probe a new regime in the parameter space, providing direct SMBH masses over half of cosmic time.
Observed Wavelength (Å)

\( f_{\lambda} (\text{erg cm}^{-2} \text{s}^{-1} \text{Å}^{-1}) \)

SDSS: 2001
WHT: 2016
\( z: \sim 0.7 \)

J111348

\( \text{J111348} \)
Fit results: slope versus lag

![Graph showing the relationship between slope and RM Lag (days).](image)