Variability of AGN Broad Emission Lines Responsiveness on Long Timescales

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AGN: SMBH masses, galaxy evolution, cosmic structure

- Variable in continuum and emission lines
- The response of broad emission lines is an important diagnostic for AGN



C. Ricci: www.isdc.unige.ch/ \sim ricci

- Reverberation Mapping: tracking broad lines response
- MgII (2798) is largely unresponsive on timescales of ${\sim}100$ days, unlike e.g. Ly α



DeRosa et al. ApJ 806 (2015); Cackett et al. ApJ 810 (2015)



- On timescales of years structural changes could occur in the BLR
- Changing Look Quasars
 - ▶ Change between type I and type II AGN
 - ▶ Associated with large change in optical flux
 - Occurs inside the BLR itself

- Some objects show a strong MgII broad line response
- Possible correlation with Balmer lines: similar ionisation energies



MacLeod et al. MNRAS 547 (2016)

- Object J022556 was covered by Stripe 82; total of 15 spectra
- Maximum MgII flux change by a factor ${\sim}11$



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- Subsample of ten objects for which f_{MqII} could be measured



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- Mrk 110: multi-epoch spectroscopy since 1987
- Large variability in both Balmer and Helium lines



- HeII (4686) is a recombination line from HeIII
- Ionisation energy HeII is 54.4 eV \rightarrow tracks EUV continuum



- Line response depends on AGN state more responsive for lower flux
- Locally Optimally Emitting Clouds model, Baldwin et al.
 - ▶ Line emission dominated by selection effects
 - Natural stratification of BLR

If the selection effects are properly understood, the line response now depends on few BLR parameters

• Cloud covering factor in terms of radius and density

$$\begin{array}{ll} f(r) \propto r^{\beta} & \beta = 1.2 \\ g(n) \propto n^{\gamma} & (\gamma = -1) \end{array}$$

Baldwin et al. ApJL 455 (1995); Korista & Goad ApJ 536 (2000)

Conclusions

- Broad MgII line more responsive than previously thought
- MgII response varies between objects and over time
- Initial level of ionising flux influences line response
- LOC model offers possible insights

- ► Improved estimation of AGN parameters (BH mass)
- ▶ Opportunity to investigate BLR configuration directly



Shen et al. APJ 818 (2016)

J022652

