Emission Lines in Active Galaxies: New Methods and Techniques
ASP Conference Series, Vol. 113, 1997
B.M. Peterson, F.-Z. Cheng, and A.S. Wilson (eds.)

The HST Sample of Radio-Loud Quasars: Emission Lines from Lyα to Hβ

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We have obtained *HST* and ground-based spectrophotometry of a sample of ~61 radio-loud quasars from shortward of Lyα to longward of Hβ. The aim was to investigate the dependence of quasar properties on orientation of the central engine axis to the observer's line of sight. As an approximate measure of inclination we use the radio core-dominance, i.e., the ratio of beamed radio-core emission to the emission in the extended lobes at 5 GHz rest frequency. About half the radio sources have core-dominance greater than unity (jet or axis pointed close to our line of sight). Quasar pairs were matched in radio lobe luminosity and redshift to reduce bias caused by strong dependences on intrinsic luminosity.

Observation and reduction techniques were standard, and the spectral resolution is equivalent to 230–400 km s^{-1} (Wills et al. 1993). We have performed correlation analyses among emission-line and continuum parameters, as well as spectral principal-component analyses (SPCA, Francis et al. 1992).

Figure 1 shows preliminary SPCA results, expanded on the right to show detail. The top panel shows the mean of 48 spectra between Lyα and Hβ. The second panel shows the standard deviation spectrum. Note that some emission features contribute more to the fluctuations than others. The next panel shows the 'first principal component' spectrum. This accounts for $\sim$ 25% of the variations from the mean. The emission-line shapes and strengths appear similar

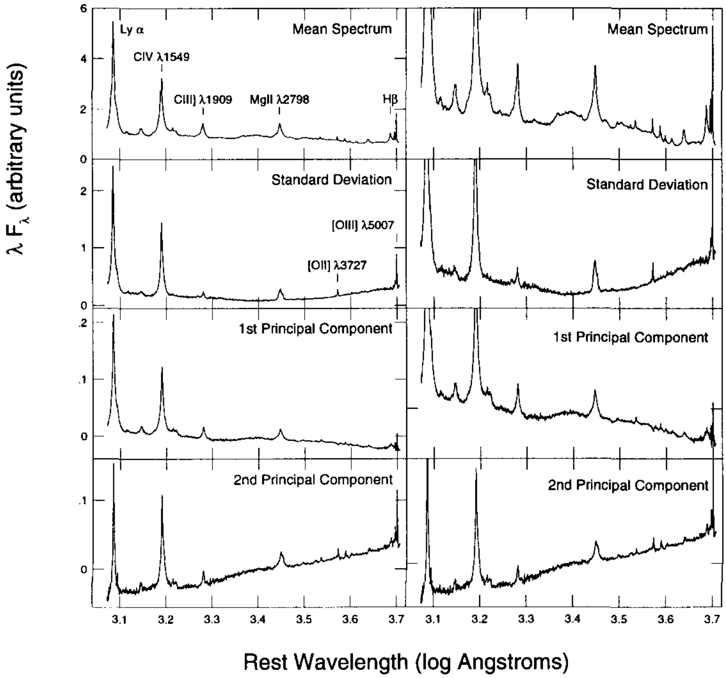

Figure 1. Mean, standard deviation, and principal-component spectra.

to those of the mean spectrum, showing, not surprisingly, that the ratios of line strengths, and their profiles, are quite similar from one quasar to another even as the line-to-continuum ratio changes. Two differences are that the 'continuum' of the first principal component increases towards shorter wavelengths, and the narrow lines are quite weak — there is even a 'dip' at the position of [O II] λ3727 — suggesting an anti-correlation of its strength with the UV continuum and broad lines of this component. Shown in the next panel is the spectrum of the 'second principal component', which contributes ~ 11% of the spectrum-to-spectrum variation. In contrast, it is increasingly positive to the red, and the narrow lines are stronger and positive.

In order to interpret these results further, we examine the direct correlations of other directly measured quantities with the weights of the first and second principal components for each individual spectrum (Wills et al. 1997).

References

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Wills, D., et al. 1997, this volume.

https://doi.org/10.1017/S0252921100039737 Published online by Cambridge University Press