SIGNATURE OF ACCRETION DISKS IN ACTIVE GALACTIC NUCLEI

ANURADHA KORATKAR
Space Telescope Science Institute
3700 San Martin Dr., Baltimore, MD 21218, USA

1. Introduction

One of the fundamental components of any theory of Active Galactic Nuclei (AGNs) is an accretion disk surrounding a supermassive blackhole. While most theories predict the formation of such a disk, fewer say anything about the observational consequences of the disk. Those studies which have addressed the observational signatures of accretion disks have found that the Lyman edge at 912Å is a powerful diagnostic feature for the physical characteristics of the disk. One of the important consequences of such disks is a feature at the Lyman edge (912Å). Spectroscopic investigations have found scant evidence for Lyman edge features arising in an accretion disk (Koratkar, Kinney and Bohlin 1992). Proving the existence of radiating disks in even a few AGNs would be a major step in our understanding of the phenomenon.

Spectropolarimetry of the Lyman edge provides information on the thermal/nonthermal emission mechanism and on the spatially unresolved geometry of the scattering region. Hence, we have investigated the polarization signature of the continuum from AGN accretion disks.

2. Accretion Disks in Polarized Light:

If disks have a electron scattering atmospheres, then the amount of polarization observed depends on the inclination angle. Accretion disk models predict polarization ranges from 0% for a face-on disk, upto ~12% for a edge-on disk. Further, the polarization is expected to be perpendicular to the disk axis. This signature is not seen in most AGNs. In fact, generally AGNs show low optical polarization parallel to the disk axis. If absorption

Y. Sofue (ed.), The Central Regions of the Galaxy and Galaxies, 469-470.

opacity is included in the disk models, polarization is expected to be wavelength dependent with a strong absorption or emission edge feature near the Lyman edge (Laor, Netzer and Piran 1990, Blaes and Agol 1996). This UV polarization signature should appear even when no Lyman edge feature is readily seen in total flux, according to Laor et al.

3. Polarimetry of the Lyman Edge Region:

HST/FOS spectropolarimetric observations of the Lyman edge region have now been obtained for 10 radio quiet quasars (Koratkar et al. 1995, Impey et al. 1995 and Koratkar et al. in prep). We draw the following conclusions:

(1) Only three objects (PG 1630+477, PG 1338+416 and PG 1222+228) show significant polarization for wavelengths shorter than the Lyman edge. In UM18 and 0405+123 there is marginal detection of polarization shortward of the Lyman edge. Thus we see that *$\sim$50% of the AGNs in our sample show a polarization signature which is inconsistent with any simple disk models, even those containing pure scattering atmospheres.* Blaes and Agol (1996) have been able to fit only the PG 1228+228 observations using their accretion disk model with an optically thick atmosphere and hydrogen bound-free opacity. Their model needs to be further refined since it cannot reproduce the steep rise in polarization observed in the other objects, specially PG 1630+477, which has the best signal-to-noise data.

(2) Only PG 1630+377 shows a dramatic rise in polarization (upto 20%) and also shows polarized Lyα emission line (7.3%$\pm$1.6%; see Koratkar et al. 1995). Therefore, we conclude that *high degree of polarization is rare in quasars.* Blandford and Lee (1996) postulate that the high polarization observed in PG 1630+477 could be due to resonance-line scattering which creates a pseudo continuum of line emission. The present data are insufficient to test this hypothesis.

(3) Only three objects (PG 1222+228, 0743-673 and 0117+213) show polarization (>3%) for wavelengths longer than 912Å. In the remaining objects polarization is consistent with zero at wavelengths longer than 912Å. This indicates that *AGNs not only show low optical polarization, but also low UV polarization.*

References

Blaes, O. and Agol, E. (1996), *Ap.J.*, **369**, L41
Blandford, R., and Lee, H.-W (1996), preprint.
Impey, C., Malkan, M., Webb, W., and Petry, C. (1995) *Ap.J.*, **440**, 80
Koratkar, A.P., Kinney, A.L., and Bohlin, R.C. (1992), *Ap.J*, **400**, 435
Koratkar, A., Antonucci, R. R. J., Goodrich, R. W., Bushouse, H., and Kinney, A. L. (1995), *Ap.J.*, **450**, 501
Laor, A., Netzer, H., and Piran (1990), *M.N.R.A.S.*, **240**, 560