RAPID LINE VARIATIONS IN HIGH LUMINOSITY AGN AND ANISOTROPIC EMISSION OF THE OPTICAL/UV CONTINUUM

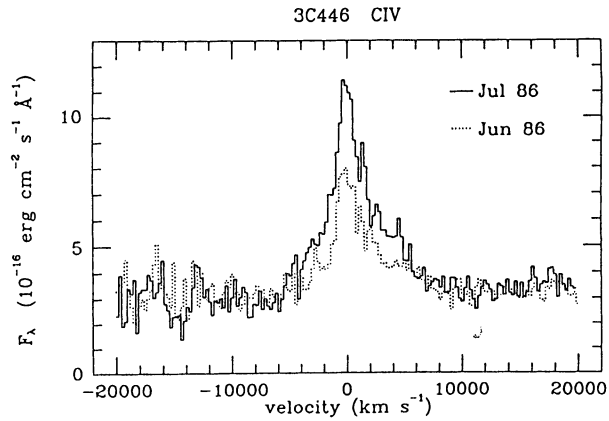
M V Penston
Royal Greenwich Observatory,
HAILSHAM, E Sussex
BN27 1RP, UK

E Pérez
Instituto de Astrofísica de Canarias
La Laguna, Tenerife
Spain

M Moles
Instituto de Astrofísica de Andalucia
Granada
Spain

ABSTRACT The emission lines of OVV quasars can vary significantly within a month, more rapidly than expected from photoionization models. This can be explained by anistropic continuum emission and joins several other lines of evidence suggesting anisotropic emission of the optical /uv continuum in AGN.

Figure 1 shows the best case of month-to-month line variation we have observed during our 1984-6 programme on the 2.5m Isaac Newton Telescope at the Observatorio del Roque de los Muchachos on La Palma in the Canary Islands using the RGO spectrograph and IPCS at 2Å/pixel resolution. In this figure the continua have been shifted relatively to match and thus show the line variations.



As is well known however the vital point in establishing such variations is to ensure that the flux calibration has been properly performed. As precautions, we have used a wide 5" slit to calibrate the fluxes, worked at the parallactic angle, observed up to 5 spectrophotometric standards per night and used only photometric nights. As spot-checks we have used (on other objects observed in the same way) the narrow line [OIII] fluxes, compared with simultaneous broad-band and spectrophotometric data and found constant sources. These checks suggest that our errors are ≲ 15%. We find variable equivalent widths, as well as variable line and continuum fluxes.

Table 1 summarizes our results comparing sizes of the BLR estimated from line variability using Terrell's (1964) formula with those from photoionization models assuming log $\underline{U}$ = -2.5 (-2.3 for 3C446). The discrepancy is greater than x10 for four objects.

D. E. Osterbrock and J. S. Miller (eds.), Active Galactic Nuclei, 85–87.

DISCREPANCIES
in size estimates of the BLR

Object	Line	Variations "Terrell" formula			Photoionization Model		Discrepancy
		Δt days	$\Delta L/L$ %	diam lt.day	Q 10^{55} s^{-1}	diam lt.day	log
3C446	CIV	54	57	50	49	2000	1.6
		(3)	10	16			
	CIII]	54	75	38			1.7
		(3)	39	4			
2134+004	Lα	54	40	59	52	2600	1.6
	CIV	54	36	65			1.6
	CIII]	54	59	40			1.8
2344+09	MgII	310	11	2300	11	1200	
3C232	MgII	450	25	1500	5	770	
3C454.3	MgII	55	25	150	26	1800	1.1
3C345	MgII	55	27	160	9	1100	0.8

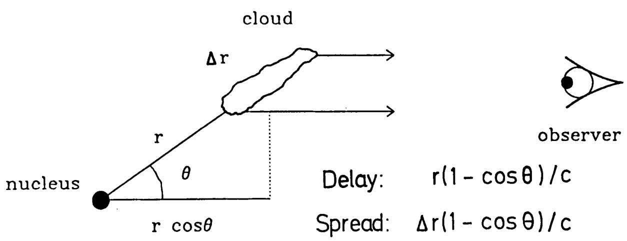


Figure 2 illustrates our proposed resolution of the discrepancy by geometrical means.

If the optical/uv continuum is anisotropic and pointed in our direction, then the illuminated part of the BLR also points at us and the "size" is deduced too small by a factor (1-cos Θ). A selection effect ensures that the brightest OVV objects should fill our sample with such cases.

Table 2 summarises other evidence that the optical /uv continuum is anisotropic.

EVIDENCE FOR ANISOTROPY
of the optical/ultraviolet
continuum

1. Beaming Models	Orr & Browne 1982 Wills & Browne 1986 Browne & Murphy 1987
2. Accretion Disks	Malkan & Sargent 1982 Netzer 1987 Perez *et al.* 1988a
3. Hidden Seyfert 1 nucleus	Antonucci & Miller 1985
4. Illumination of the ENLR	Unger *et al.* 1987
5. "Too rapid" line variations	Stephens & Miller 1984 Bregman *et al.* 1986 Zheng 1987 Gondhalekar *et al.* 1987 Perez *et al.* 1988b

A full account of this work has been submitted to the Monthly Notices of the Royal Astronomical Society (a journal which is required reading for any who want to keep up to date in AGN research!)

https://doi.org/10.1017/S0074180900140422 Published online by Cambridge University Press

References

Antonucci & Miller, 1985. Ap.J., 297, 621.

Bregman et al., 1986. Ap.J., 301, 698.

Browne & Murphy, 1986. M.N., 226, 601.

Gondhalekar et al., 1987. RAL Workshop on AGN.

Malkan & Sargent, 1982. Ap.J., 254, 22.

Netzer, 1987. M.N., 225, 55.

Orr & Browne, 1982. M.N., 200, 1067.

Pérez et al., 1988a. M.N., 230, 353.

Pérez et al., 1988b. This work.

Stephens & Miller, 1984. Bull. Ann. astr. Soc., 16, 1007.

Terrell, 1966. Ap.J., 147, 827.

Unger et al., 1987. M.N., 228, 671.

Wills & Browne, 1986. Ap.J., 302, 56.

Zheng et al., 1987. Ap.J., 322, 164.

https://doi.org/10.1017/S0074180900140422 Published online by Cambridge University Press