RECURRENT OUTBURSTS IN THE BROAD LINE REGION OF NGC 1566

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ABSTRACT. From a set of spectrophotometric data covering 15 years, we observe a recurrent activity in the BLR of NGC 1566. Each period of activity lasts for 1300 days. It consists of successive bursts characterized by a rise-time less than 20 days and an exponential decay on a time scale of around 400 days. The total energy involved in one 1300 day period of activity is 10^{51} ergs. These variations can be understood in the framework of accretion disc models for AGN, as resulting from a limit cycle which operates in the inner regions of the disc.

The aim of the present study is to investigate further the frequency of the rapid and intense outbursts occuring in the BLR of the galaxy NGC 1566 (Alloin et al., 1985a).

We have collected spectrophotometric data on this active galactic nucleus covering the period 1970-1985 (Alloin et al., 1985b). We discuss with care the uncertainties introduced on the emission line measurements by the use of different instrumentations and slit sizes in particular. The intensities of both the Hα and Hβ lines arising from the broad line region are found to vary substantially with time. Interestingly we do not detect any conspicuous Balmer profile changes. This can be understood readily in the frame of ionization bounded clouds distributed in a stable geometric configuration throughout this region. Owing to the small size of the broad line region, less than 20 light-days, the temporal behaviour of the Balmer lines reflects without significant smearing genuine variations of the ionizing source itself. Over this 15 year time-base we observe four successive periods of activity having approximately the same duration of 1300 days (Figure 1). The time spent by the nucleus in a low state is between a few months and a year. In contrast, the highest states do not last for more than a few weeks. The most recent period of activity (1981 January to 1985 August) shows a series of rapid bursts. A burst has a typical rise time of 20 days but a longer exponential decay of around 400 days. The continuum both increases and steepens together with the Balmer line enhancement (Figure 2). Assuming the ionizing flux increase

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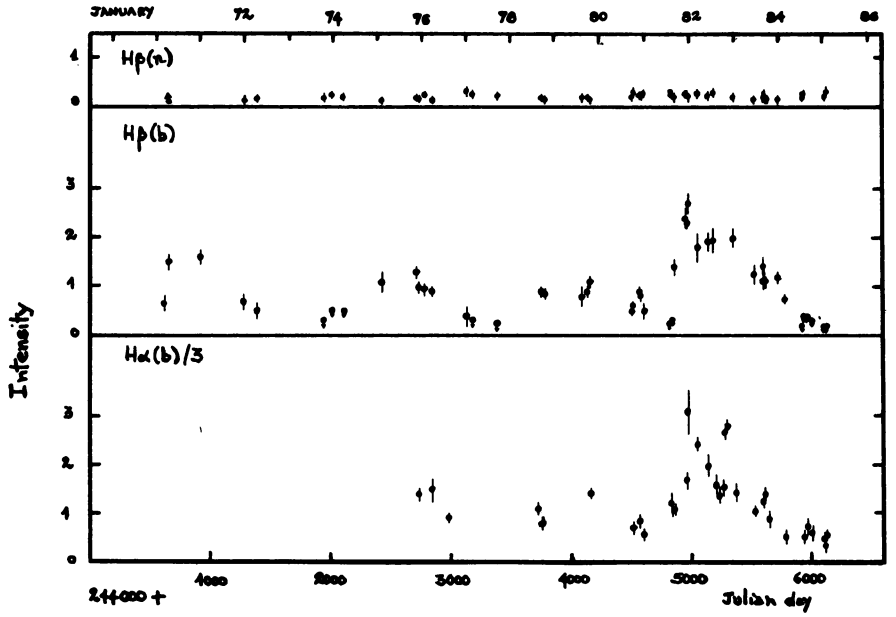

Figure 1. The temporal behaviour of the line emission from the BLR. The intensities of Hβ(b) and Hα(b)/3 are displayed in the medium and low parts of the diagram, respectively. For comparison, we present the intensity of the narrow line, Hβ(n) in the upper part. The intensities are in unit 10^{-13} ergs cm^{-2} s^{-1}.

is linked to the non-stellar continuum, the amount of energy released during one period of activity is of 10^{51} ergs. The energies related to the three successive bursts occuring in the most recent active period appear to follow an exponential decrease.

Theoretical arguments are presented (Abramowicz et al., 1985) in favour of the hypothesis that this variability can be explained by a limit cycle which works due to thermal and viscous instabilities present in the innermost regions of an accretion disc orbiting a black hole in the active nucleus of NGC 1566.

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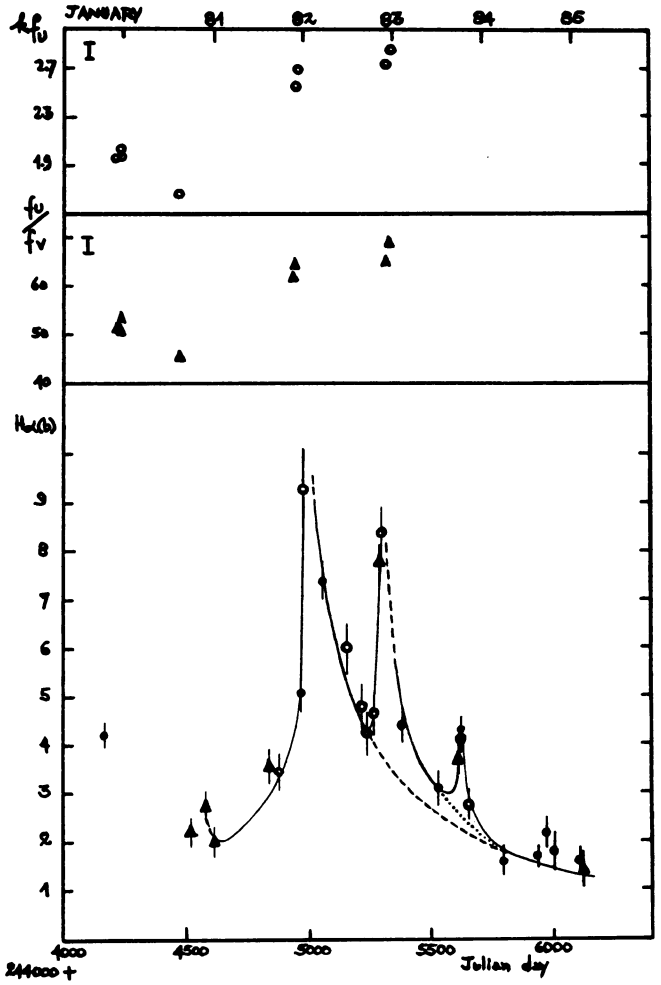

Figure 2 . Enlargement of the most recent period of activity in the Hα(b) line emission. Black dots correspond to low resolution data : Empty circles to high resolution data : Empty triangles to a weighted mean of low and high resolution data for the same epoch. The unit is 10^{-13} ergs cm^{-2} s^{-1}. A sketch of the burst activity has been drawn on top of the data points. In the upper part, we have plotted the ultraviolet flux as well as the ultraviolet to visible light ratio from photometric data by de Ruiter and Lub (1985) in an 11.6" entrance diaphragm. The two main bursts in Hα are correlated with both an enhancement and a steepening of the continuum in the ultraviolet by around 40%.

References

Alloin, D., Pelat, D., Phillips, M., Whittle, M., 1985a Astrophys. J. 288, 205.

Alloin, D., Pelat, D., Phillips, M., Fosbury, R., Freeman, K., 1985b Astrophys. J. submitted.

Abramowicz, M., Alloin, D., Lasota, J.P., Pelat, D., 1985, Nature submitted.

De Ruiter, H., Lub, J., 1985, Astron. Astrophys, in press.

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