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Flare in the Hydrogen Line Region of the NGC 3227 Nucleus on January 12-15, 1997

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Introduction. The nucleus of NGC 3227 was classified as a Sy2 type before 1974, and a Sy1 type after 1974. The Seyfert type of the nucleus changed corresponding to its brightness: U brightness of the nucleus increased in 1974: $\Delta U \sim 1^m$. Maximum brightness of the nucleus was observed in 1975 – 1977.

Observations. 57 spectrograms in the spectral region 3700–7300ÅÅ were obtained with the 6-m telescope on January 12–15, 1977 during maximum of the nucleus brightness. Spectral resolution was $\sim$ 8Å. Seeing was (1–3)″.

Equivalent widths (W_λ) and profiles of the emission lines H_δ, H_γ, H_β, [OIII]$\lambda\lambda$4959,5007ÅÅ, H_α+[NII], and [SII]$\lambda\lambda$6717,6731ÅÅ were averaged by series. Duration of the series of observation was $\sim$25 min.

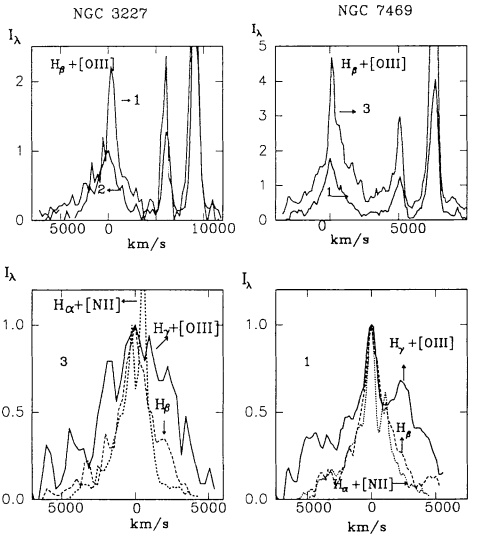

Figure 1. Night-to-night variations in line profiles (see text).

Equivalent widths of lines showed asynchronous variations. This fact leads us to suspect, that there were night–to–night variations of intensities of emission lines with upper limit $\sim$ 1.5 times.

Profiles of Balmer lines H_γ, H_β and H_α in the spectrum of the NGC 3227 nucleus showed remarkable similarity in characteristics of night–to–night varia-

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tions with the same lines in the spectrum of the NGC 7469 nucleus (Pronik et al., 1997).

Comparison of results can be seen in the Figure, where figures on plots signify the ordinal numbers of nights from the beginning of the event. Profiles on the top panel, where I_λ are given in continuum units show that:

1. Central narrow peaks of the H_β line are double in both cases.

2. The ratio I_b/I_r of the narrow H_β line smoothly decreases from $I_b/I_r \geq 1$ to $I_b/I_r \leq 1$ when W_β is increased (i.e. continuum of the nucleus is decreased).

On bottom panel I_λ of profiles are given in units of peak brightness of Balmer lines. These profiles show that:

3. Strong brightening of H_γ broad wings were observed with lag 1-2 days from the beginning of the brightening of the blue narrow H_β component.

Discussion. We suppose that night–to–night variability of profiles of Balmer lines in spectra of NGC 3227 and NGC 7469 nuclei are connected with short time flares in emission line regions of these nuclei. Two variable components of a narrow H_β line can reflect the existence of two variable streams in both nuclei. In that case, radial velocities of the streams emitting H_β light are about –250 km/s and –550 km/s compare to the recession velocities for the galaxies NGC 7469 and NGC 3227 correspondingly.

The observational indication of the beginning of a short–time flare appears to be a relative brightening of the blue narrow peak of the H_β line and an increasing of continuum flux of the nucleus. Variations in streams approaching observers can be interpreted as an ejection from the nucleus with radial velocities of about 200–500 km/s. This ejection influences the gaseous regions emitting broad Balmer lines: brightening of narrow blue H_β component was accompanied by an increase with 1 day lag of the intensity of the broad H_γ wings with the radial velocities equal to $\pm$ 6500 km/s. Such high intensity of broad wings was not observed in the H_β and the H_α profiles. One can argue that the emission of broad H_γ wings has an inverse Balmer decrement. Comparison with theoretical models permits us to suppose that this gas could be opaque, hot and inhomogeneous in physical conditions of plasma (T_e = 25 000 K, $n_e = 10^{12} - 10^{14}$ cm^{-3}), and it is ionized and excited mainly by a collisional process.

Almost simultaneous variability of the broad H_γ line and the narrow component of the H_β line during the flare shows that regions emitting broad lines and narrow lines are overlapped. These regions are not more than several light days ($\sim 4.5 \cdot 10^{15}$ cm) in dimension. One can speculate that regions of flares are excited by shocks acting inside jets.

The flare in NGC 7469 was observed during the minimum brightness of its nucleus (Pronik et al., 1997). The flare in NGC 3227 was observed during the maximum brightness of its nucleus. Therefore short time flares did not connect with the general brightness of nuclei of galaxies. One can suspect that there are two independent sources of nuclear activity. One of them is connected with the general brightness of the nucleus, and another one is not.

References

Pronik, I., Metik, L., & Merkulova, N. 1997, A&A, 318, 721