Publ. Astron. Obs. Belgrade No. 61 (1998), 139 – 142 *Poster paper*

LONG-TERM H_β LINE PROFILE VARIATION IN Akn 120

L. Č. POPOVIĆ[1], N. TRAJKOVIĆ[1], A. KUBIČELA[1], V. T. DOROSHENKO[2], S. G. SERGEEV[3], E. BON[1] and I. STANIĆ[4]

[1] *Astronomical Observatory, Volgina 7, 11160 Belgrade 74, Yugoslavia*
[2] *Crimean Astrophysical Observatory, Nauchny, Ukraine*
[3] *Sternberg Astronomical Institute, Moskow, Russia*
[4] *Imtel Computers & Digital Radio, Belgrade, Yugoslavia*

Abstract. Long-term H_β line shape variation in spectra of Akn 120 is discussed. We have analysed the H_β line shape from 96 spectra observed from 1977. till 1990. The H_β line has been fitted with two broad and one narrow gaussians troughout the whole considered period. The broad components of H_β and shelf cause the H_β line shape variation. Two broad gaussians of H_β may suggest existence of two broad line region in Akn120 – central part.The mean redshift of H_β line amounts to 213 kms^{-1}.

1. INTRODUCTION

Optical spectra of Seyfert 1 galaxies (Sy1) usually show significant emission lines and continuum variabilities. Investigations of these variations may bring more information about the structure of Broad Line Regions (BLRs) in them (e.g. Peterson 1993).

One of the Sy1 galaxies which has a large-amplitude variability in continuum and in spectral line shapes is Akn120 (Peterson *et al.* 1985, Peterson and Cota 1987, Winge *et al.* 1996).

Here we present the preliminary results of our analysis of H_β line shape variation in Akn120.

2. THE DATA AND ANALYSIS

We have analysed 96 spectra in the wavelength interval 4500-5300 $\AA$ obtained by K. K. Chuvaev on 2.6 m Shajn telescope at Crimean Astrophysical Observatory (CrAO) during the period 1971-1990 (HJD 2443435 till 2447944).

All spectra were scanned on two-coordinate CrAO microphotometer. The further treatment, including the correction for film and sky background, instrumental spectral sensitivity, as well as wavelength and flux calibration were made using the SPE data reduction package, developed by S.G. Sergeev. The wavelength calibration was based on the night sky lines and narrow emission lines of the galaxy. The redshift of Akn120 was accepted equal to z=0.03428 (Foltz *et al.* 1983).

In order to investigate the long-term variability of H_β line shape and to take into consideration the big gaps in the observations, spectra have been divided into 10 groups (see Table 1).

Table 1. Time-distribution and number of the observed spectra (in Heliocentric Julian Days – HJD.)

group	1	2	3	4	5	6	7	8	9	10
from HJD 2440000 +	3435	3790	4173	4522	4881	5263	5619	5997	6853	7832
till HJD 2440000 +	3574	3934	4289	4672	5054	5412	5734	6088	7124	7944
mean HJD 2440000 +	3474	3879	4229	4577	4958	5331	5695	6058	7014	7888
numbers of spectra	14	14	9	5	15	12	11	6	6	4

The spectra within groups have been averaged. In the mean spectra noises and some short-term variability are to some extent suppressed and possible long-lasted features better expressed. The local continuum in two narrow zones around 4900 and 5260 Å was interpolated with a straight line. The mean spectra have been normalized to this continuum.

The broad H_β line has two peaks shifted blueward and redward from the line center defined by the narrow emission lines. The peaks are more or less clearly resolved. Besides, the H_β is blended with OIII(4959,5007) and some other emission lines (Jackson and Browne 1989, Meyers and Peterson 1985).

3. RESULTS AND DISCUSSION

In order to decrease the number of free parameters, some relations among the fitting gaussians have been established a priori (Popović and Mediavilla 1997). Namely, the three gaussians representing two narrow OIII lines and a narrow H_β component are preconditioned to have the same systemic redshift (z=0.03248, according to Foltz *et al.* 1983), and the intensity ratio of the two OIII lines has been supposed to be 1 : 3.03 . Also, the ratio of the full widths of these two lines and narrow H_β component are fixed in proportion with their wavelengths as

$$\frac{W_{H_\beta}}{4861} = \frac{W_{4959}}{4959} = \frac{W_{5007}}{5007},$$

where W_{H_β} is width of H_β narrow component, W_{4959} and $W_{(5007)}$ are widths of the two OIII(4959,5007) lines.

We obtained the best fit with six gaussians (Figure 1). During the considered period, in all groups, H_β can be resolved into three components. Two of them are broad with the full width from 654 to 1707 kms^{-1} (red peak) and from 3225 to 3328 kms^{-1} (blue peak) and one, narrow, is about 550 kms^{-1} wide.

The slow time-variations of H_β broad gaussian shifts can be noticed in the sense that the red peak progressively decreases its line-of-site velocity, while the blue one exhibits a minimum during the observed period (Figure 2).

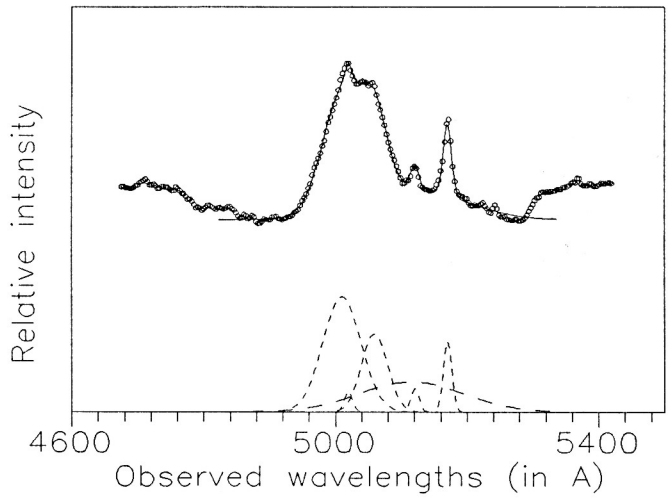

Fig. 1. The data of the seventh group of the mean spectra as an example of decomposition of the Hβ and OIII lines. (o o o) – observed data, (—) - the best fit, (- - -) - gaussians of the resolved spectral lines, (– –) - the broadest gaussian (shelf).

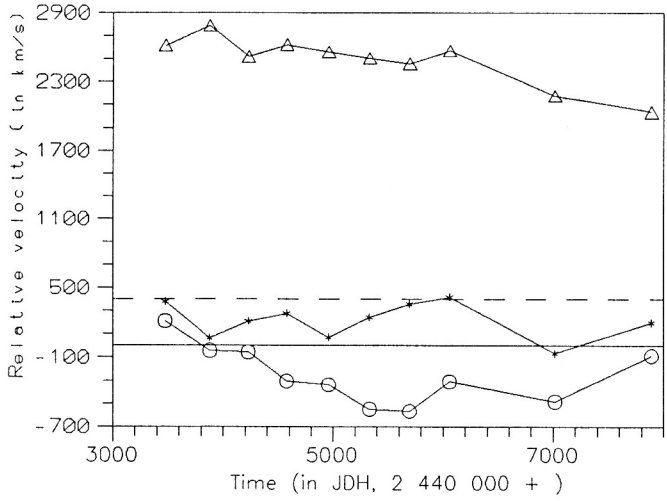

Fig. 2. The line-of-site velocities of the blue and red gaussians (circles and triangles respectively) relative to the narrow Hβ component having the systemic redshift z=0.03248 (the horizontal solid line) are shown as functions of time. The asterisks are the weighted mean of the red and blue broad Hβ wings. The dashed line represents the gravitational redshift estimated by Peterson *et al.* (1985).

The presence and behavior of two broad gaussians in Hβ line may indicate the existence of two broad line regions in Akn120, as it was suggested by Gaskell (1983, 1996) for the 3C390.3 – type of galaxies. However, in all considered groups, the intensity

of the blue H_β gaussian is higher than intensity of the red one. It is an accordance with the curves in Figure 3. Alternatively, these results can be taken as a kind of a "blue boosted, redshifted" spectral line usually connected with a rotating disk (e.g. Stuchlik, 1998).

The overall redshift of H_β line is in a way presented by the weighted mean of the blue and the red wing line-of-sight velocities, asterisks in Figure 2. The areas under the corresponding gaussians were taken as weights. This velocity averaged amounts to 213 kms^{-1}. It is slightly lower than the value of 400 kms^{-1} found by Peterson *et al.* (1985) as the gravitational redshift of Akn120.

The detailed discussion of the obtained results will be presented elsewhere (Popović *et al.* 1998).

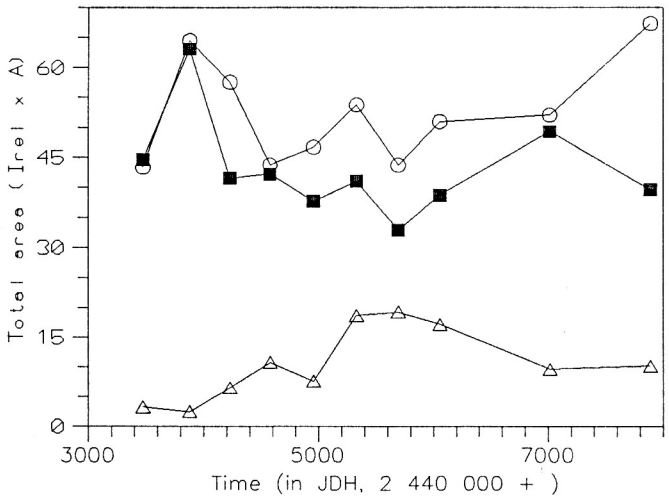

Fig. 3. The areas of the red broad H_β gaussian (triangles), blue broad gaussian (circles), and shelf (filled squares) as functions of time.

References

Foltz, C.B., Wilkes, B.J. and Peterson, B.M.: 1983, *Astrophys. J.* **88**, 1703.
Gaskell, C.M.: 1983, Proc. 24th Liege Intern. Ap. Colloquium, Univ. de Liege, Liege, 473.
Gaskell, C.M.: 1996, *Astrophys. J. Lett.* **464**, 107.
Jackson, N. and Browne, I.W.A.: 1989, *MNRAS* **236**, 97.
Meyers, K.A. and Peterson, B.M.: 1985, *PASP* **97**, 734.
Peterson, B.M.: 1993, *PASP* **105**, 247.
Peterson, B.M. and Cota, S.A.: 1987, *Astrophys. J.* **94**, 7.
Peterson, B. M., Meyers, K.A., Capriotti, E.R, Foltz, C.B., Wilkes, B.J., Miller, H.R.: 1985, *Astrophys. J.* **292**, 164.
Popović, L.Č. and Mediavilla, E.: 1997, *Publ. Astron. Obs. Belgrade* **57**, 95.
Popović, L.Č., Trajković, N., Kubičela, A., Doroshenko, V.T., Sergeev, S.G., Bon, E. and Stanić, I.: 1998, in preparation.
Stuchlik, Z.: 1998, Proc. 20th Stellar Conference, eds. Dushek, J. and Zejda, M., N. Copernicus Obs. and Planetarium, Brno, 147.
Winge, C., Peterson, B.M., Pastoriza, M.G. and Storchi-Bergman, T.: 1996, *Astrophys. J.* **469**, 648.