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Double Peak profile in the Seyfert 1.5 Galaxy Mkn 926.

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Abstract. From a sample of 15 objects that have been studied for line variability in the region between Hβ to Hα, we present preliminary results and a new spectrum from San Pedro Mártir Observatory (OAN) for the Seyfert 1.5 galaxy Markarian 926. This object presents profile variations in its broad Hβ component, showing a clear transient double peak.

We briefly discuss also the origin of such variations in the context of accretion disks models published in the literature.

1. Introduction

Variability studies have been essential in understanding the physics of central regions of AGN. They provide important information on the nature and location of line components as well as continuum, and on their interdependencies. The motivations for monitoring emission line variations in AGN are to clarify the kinematics of the emission line regions and to determine the mass of the central source (Peterson , 1988; Ulrich et al , 1997).

There is an increasing interest in radial flow models for explaining line profiles. This is due in part to the growing acceptance that both low and high ionization emission lines (LIL and HIL, respectively) show frequent line shifts.

HIL blueshifts in radio quiet (RQ) sources (Marziani et al , 1996) argue for a radial outflow whose far side component might be obscured by an accretion disk (Livio & Xu , 1997). This disk also might produce a wind that would be related with the outflowing component (Williams et al , 1999). The outflow model competes with accretion disks and binary black hole models in explaining double-peaked profiles (Sulentic et al , 2000a).

In this context, we present one object from our sample, in which we found a transient double peak. Here, we will expose a brief discussion about the variation observed. In a future work we will present a subsequent analysis and modeling.

2. Observations

The sample selected has a redshift range of $0.03 \lesssim z \lesssim 0.2$, as it is shown in Table 1. The full sample spectra was obtained from original observations performed at several observatories (SPM, ESO, KPNO and CA). Additional spectra from literature for some objects were kindly provided by the authors.

In the case of Mkn 926, the most recent observation was obtained on October 4, 1997, at the 2.1m telescope at the Observatorio Astronómico Nacional (San Pedro Mártir) using a Boller & Chivens spectrograph with a projected resolution of 4 Å. Figure 1 shows the full region spectrum.

Initially, the choice of Hβ was made mainly because it is the least contaminated by nearby lines. But also Hα might show interesting results in some objects of our sample (it is planned for Mkn 926 searching a similar signature of double-peaked broad component and comparing its behavior with the observed from Arp 102B by Chen et al (1989)).

3. Spectrum of Mkn 926

We consider the optical range of the spectrum of Mkn 926 (see Figure 1). Both Hβ and H$_\alpha$ present narrow and broad components, but Hα is more contaminated by other lines (basically [N II]). In this object, contamination due to optical Fe II is not as important as in other objects, but we also consider it in our analysis.

4. Line Spectra History

For Mkn 926, the spectra were taken in 1978 (Durret & Bergeron , 1988), 1989, 1993 and 1997. In Figure 2 we show these chronological spectra, centered in Hβ line. The lower right panel shows the most recent spectrum. As opposed to the other panels, this one shows a transient double peak. Not only does the difference between narrow and broad components becomes more conspicous, but the appearance of a symmetrically shaped double peak is to be noted.

Figure 3 presents the 1997 spectrum with continuum and Fe II emission lines subtracted. As population B Radio

Table 1. The sample.

OBJECT	TYPE[a]	RA (2000.0)[b]	DEC. (2000.0)[b]	Z[c]	MAG[b]
III ZW 2	RL	00h 10m 31.0058s	10° 58' 29.504"	0.089	15.40
PG 0026+129	RQ	00h 29m 13.725s	13° 16' 04.35"	0.142	15.41
I ZW 1	RQ	00h 53m 34.94s	12° 41' 36.2"	0.061	14.36
PG 0052+251	RQ	00h 54m 52.16s	25° 25' 38.9"	0.155	15.42
MKN 1014	RQ	01h 59m 50.211s	00° 23' 40.62"	0.164	15.69
NAB 0205+02	RQ	02h 07m 49.86s	02° 42' 55.9"	0.1553	15.39
PG 1211+143	RQ	12h 14m 17.6s	14° 03' 12.5"	0.085	14.63
3C 273	RL	12h 29m 06.6997s	02° 03' 08.598"	0.158	12.86
PG 1411+442	RQ	14h 13m 48.39s	44° 00' 13.6"	0.089	14.99
MKN 509	RQ	20h 44m 09.738s	-10° 43' 24.54"	0.0344	13.00
II ZW 136	RQ	21h 32m 27.813s	10° 08' 19.46"	0.061	14.60
PKS 2135-14	RL	21h 37m 45.242s	-14° 32' 55.38"	0.2003	15.91
MKN 304	RQ	22h 17m 12.261s	14° 14' 21.06"	0.067	15.08
MKN 926	RQ	23h 04m 43.455s	-08° 41' 08.49"	0.04732	15.00
PKS 2349-01	RL	23h 51m 56.141s	-01° 09' 12.74"	0.174	15.33

[a] The Radio Loudness was obtained based on Boroson & Green (1992); Kellermann et al (1994); Elvis et al (1994); Corbin & Boroson (1996); Véron-Cetty & Véron (1998); and Xu et al (1999).
[b] Taken from NED database.
[c] Taken from Boroson & Green (1992) and NED database.

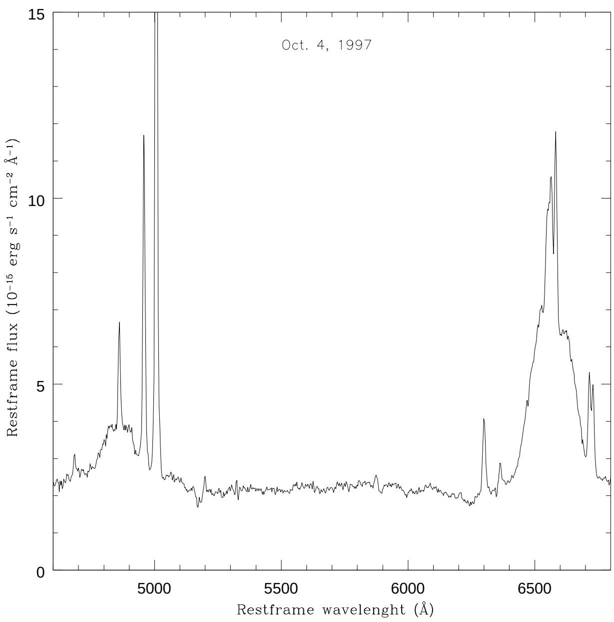

Fig. 1. Optical spectrum of Mkn 926 taken on October 1997 at SPM Observatory. X axis corresponds to the restframe flux (erg s^{-1} cm^{-2} Å), wavelenght (Å) is at Y axis.

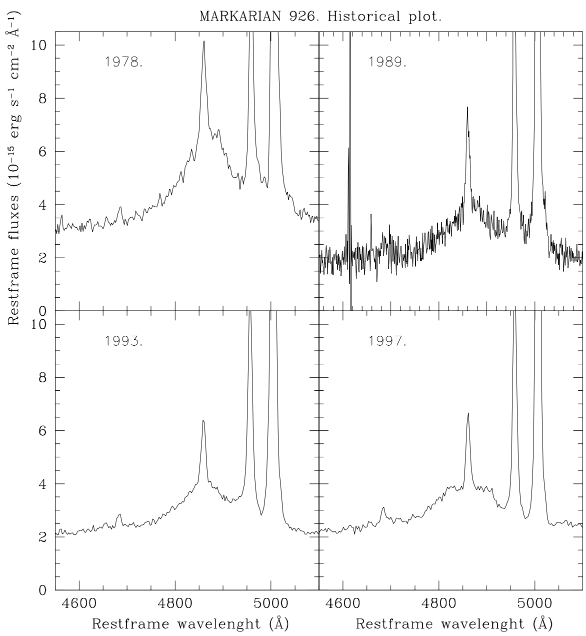

Fig. 2. Mkn 926 Hβ spectra taken between 1978 and 1997, and flux calibrated with [O III]. Restframe wavelenght is shown in Å and fluxes are indicated in 10^{-15} erg s^{-1} cm^{-2} Å^{-1}.

Quiet source (see Sulentic et al , 2000b), this object has weak Fe II emission lines, and we scaled the Fe II template from Boroson & Green (1992) to isolate the Hβ line.

The symmetrical double peak feature remains practically unaffected after Fe II subtraction.

5. Broad components Double Peaks

All of the well known double-peaked sources are either RL or RQ population B (see Sulentic et al , 2000a,b). Many of these sources show large amplitude variability that includes transient single or double-peaked BLR structure.

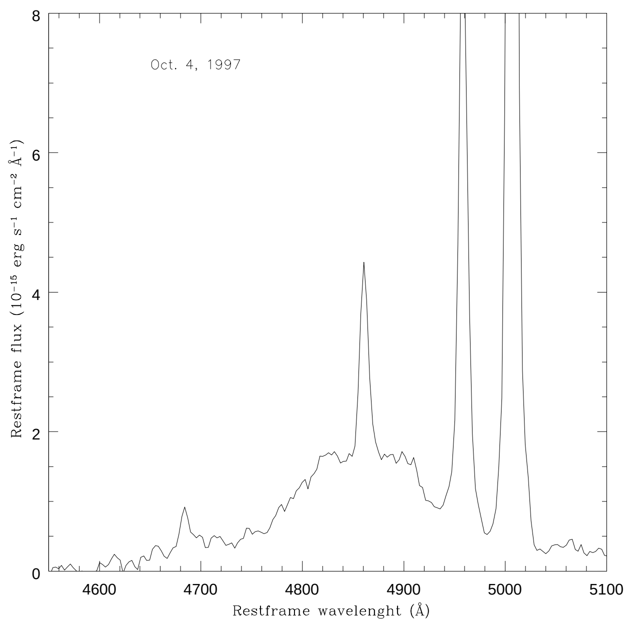

Fig. 3. Hβ profile with double peak. Fe II and continuum was substracted. X and Y axis are resframe wavelenght (Å) and flux (erg s^{-1} cm^{-2} Å) respectively.

Very broad and double-peaked line profiles are primarily RL sources (Eracleous & Halpern , 1994); however, at least 2 recent RQ examples of transient double-peaked Balmer lines without any previous broad component are known (NGC 1097: Storchi-Bergmann et al (1995); M81: Bower et al (1996)). Also in the RL object Pictor A the double-peaked LIL structure appeared when previously this object showed only single peaked profile (Halpern & Eracleous , 1994; Sulentic et al , 1995).

Uniform axisymmetric disk models produce double-peaked line profiles with the blue peak stronger than the red because of Doppler boosting, a feature that is not always observed. Eccentric and warped disks have been invoked to explain red/blue peak ratio variations as well as line shifts (Pringle , 1997; Eracleous , 1998). The variable double-peaked line profiles in population B source NGC 1097 have been successfully modeled as arising from an elliptical accreting ring rather than a disk (Storchi-Bergmann et al , 1997; Eracleous et al , 1995).

Polarization studies of RL sources (e.g. Corbett et al (1998)) suggest that a biconical BLR within an obscuring torus scenario can account for both the shapes and widths of the scattered line profiles. The biconical outflow model has successfully reproduced LIL profiles in several RL and RQ pop B "double peakers" (Ark 120: Zheng et al (1990); OQ 208: Marziani et al (1993); Pictor A: Sulentic et al (1995)).

Binary black hole scenarios represent a third model to explain double peakes or other complex velocity-shifted line profiles. In this scenario the broad line profiles arise from two physically distinct BLRs.

6. Discussion and preliminary results

Our goal for this object will be to analyze the double peak in Hβ comparing several models and fitting the one that would be applicable. Hα also could be analyzed in this way, taking particular care in its contamination by other lines.

The symmetrical shape of broad Hβ does not seem to prevail in the Hα broad component, where it seems that the blueward peak is bigger than the red one, as the Accretion Disk (AD) models predict. This difference poses a particular difficulty for model fitting. Even so, this will also be revised and considered. On the other hand, AD provides a natural way to obscure the far-side HIL (Livio & Xu , 1997) in models that explain the blueshift as an outflow (Murray & Chiang , 1997).

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