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# SEARCH FOR OPTICAL VARIABILITY IN TWO SEYFERT GALAXIES

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**Abstract.**. We started a program for optical $VR_cI_c$ monitoring of variable Seyfert galaxies. First results for two Seyfert 1 type objects - Mkn 335 and Mkn 315 - are presented here. We detected significant variability in one of the objects - Mkn 335. Connections between variations in different spectral bands are found and some conclusions about the nature of the Seyferts' optical variability are given.

## 1. OBSERVATIONS

All observations are performed with the 0.6 m reflector of the Observatory of Belogradchik, Bulgaria, equipped with SBIG ST-8 CCD and Johnson-Cousins set of filters (Bachev et al. 1999). Aperture photometry with a diaphragm of 16 arcsec is performed using a code developed at the Observatory (Bachev et al. 1999). As comparison stars we used relatively bright, non-variable stars, close to the monitored objects. The $VR_cI_c$ magnitudes of these stars were calibrated via observations of standards (Bachev et al. 2000). The monitoring has covered a period of about 3 years (1997 - 2000) and the objects have been observed in about 15 turns each.

## 2. LIGHT CURVES AND ANALYSIS

The V-band light curves of the monitored AGN are given in Fig.1a and 1b. Although both objects are reported to be variable, Mkn 315 did not show any significant variability exceeding the measurement errors (about $0.02\text{-}0.03^m$) during the period of observation. Its brightness remained almost constant (V=14.7). The second object - Mkn 335, however, showed variations of about $0.3\text{-}0.4^m$ in V-band. No intra-night variability was detected in both objects.

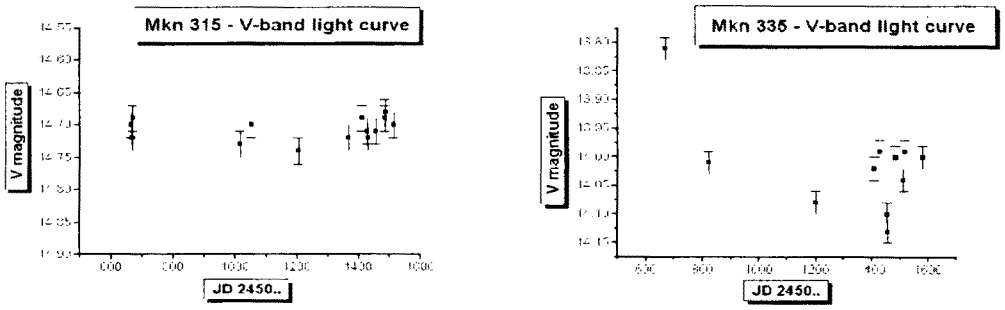


Fig. 1. Optical (V-band) behaviour of Mkn 315 and 335.

During the greater part of the monitoring, Mkn 335 showed V-band magnitude of about 14.0 (Fig. 1b). There are also dips seen in the light curve, sometimes rather sharp (lasting just a few days) as well as some signatures for flaring events. Unfortunately, the scarce sampling does

not allow making any detailed analysis of the light curve. However, combining colour and intensity changes of this object some conclusions about the reasons of its variability could be drawn. In Fig. 2 we present the relation between V-I colour of Mkn 335 and its V magnitude. This colour - brightness diagram implies that the main reason for the variability is probably that one, causing decreases in brightness and leading to gradual colour changes (reddening). On the other hand, R-I colour did not change significantly with brightness.

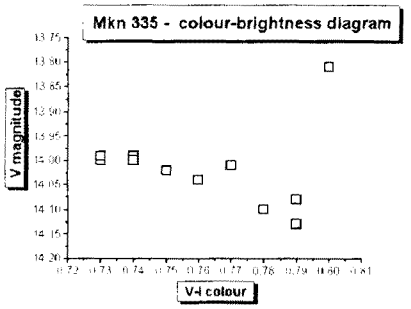


Fig. 2. Mkn 335 - "V - (V-I)" diagram.

These observations give preference to global processes like optical reprocessing of variable X-ray emission (Ulrich et al. 1997), accretion disk instabilities (Kawaguchi et al. 1998), microlensing, shadowing by outer matter (Cherni et al. 1999), changes in accretion rate, etc. However, most of these processes are inconsistent with the sharp dips observed. The flaring event, however, has probably different nature since it deviates significantly from brightness-colour dependence (Fig. 2). It could be attributed to local events like stellar explosions (Kawaguchi et al. 1998) or explosive processes in an accretion disk.

## 3. DISCUSSION AND CONCLUSIONS

It is important to study optical continuum variability in radio-quiet AGN since the reasons for their variability are usually connected with the instabilities in the accretion flow feeding the central massive black hole, rather than with the instabilities in relativistic jets, as in blazars case. Hence, any knowledge about that variability could shed some light onto the accretion process and the nature of the central engine. Two basic conclusions could be drawn from our study: i) Variability is not attributed to all Seyferts or at least the periods of continuum changes are often followed by a quiescent periods. The processes responsible for these variations, therefore, should not be based on the general principles of accretion or on the common properties of AGN. ii) The strict relations between the colours and brightness imply a single reason inducing variability of the continuum. Otherwise, in the case of many superimposed independent events, each characterised by different physical properties, evolving on different time scales, such tight relations could not be observed. In the case of Mkn 335, a significant role in the optical variability probably can play reprocessing, shadowing by outer clouds and explosive stellar or accretion disk processes.

## References

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