

# Optical monitoring of the Blazar Mkn421 during the TeV outburst

A. Sillanpää<sup>1</sup>, L. O. Takalo<sup>1</sup>, and The WEBT Collaboration<sup>2</sup>

<sup>1</sup>Tuorla Observatory, FIN-21500 Piikkiö, Finland

<sup>2</sup><http://astro.fmarion.edu/webt/>

**Abstract.** We have monitored blazar Mkn 421 optically using our WEBT collaboration (Whole Earth Blazar Telescope) during the huge TeV-outburst in 2001, detected and followed by the HEGRA-system on La Palma. In this monitoring we have also used our KVA-telescope on La Palma, located quite close to the HEGRA (and MAGIC in the future). Preliminary optical light curves are presented and we will also discuss briefly the possible time lags and correlations between the TeV and optical fluxes.

---

## 1 Introduction

Currently there exists only a handful of extragalactic objects which have been observed at the TeV-energies. All of these objects belong to blazars; Mkn 421, Mkn 501, 1ES2344+514, 1ES1959+650 and PKS2155-304.

Mkn 421 is one of the best observed of these objects, being the first extragalactic TeV-object. It has shown large variability, in TeV-energies, in time scales ranging from tens of minutes to years (e.g. Gaidos et al. 1996). During its large flare at TeV-energies in May 1996 it showed also simultaneous optical flaring activity (e.g. Tosti, et al. 1998). Based on this discovery we have now been monitoring Mkn 421 optically during its latest TeV-flares in order to study possible correlated activity.

## 2 Observations

After receiving information from the HEGRA in late January 2001 that Mkn 421 was in high flaring state at TeV-energies, we started a new optical monitoring campaign on this object, using the WEBT (Whole Earth Blazar Telescope) collaboration. WEBT (<http://astro.fmarion.edu/webt/>) is a large collaboration among optical institutes involved in blazar monitoring studies. It has been involved and organized several

*Correspondence to:* A. Sillanpää  
([aimosill@astro.utu.fi](mailto:aimosill@astro.utu.fi))

large campaigns on different BL Lac objects (e.g. Villata et al. 1999, 2001). All the Mkn 421 data obtained using CCD-cameras have been reduced in a similar way in order to minimize the effects caused by the huge host galaxy in Mkn 421 (Nilsson et al. 1999).

## 3 KVA-telescope

We have also used our 60cm KVA-telescope on La Palma during this campaign. We are currently in working towards making this telescope automatic and the plan is to have it automated by the time when MAGIC will be operating. This telescope is located very close to HEGRA (and the forthcoming MAGIC telescope), allowing truly simultaneous observations in TeV and optical regimes.

## 4 Results

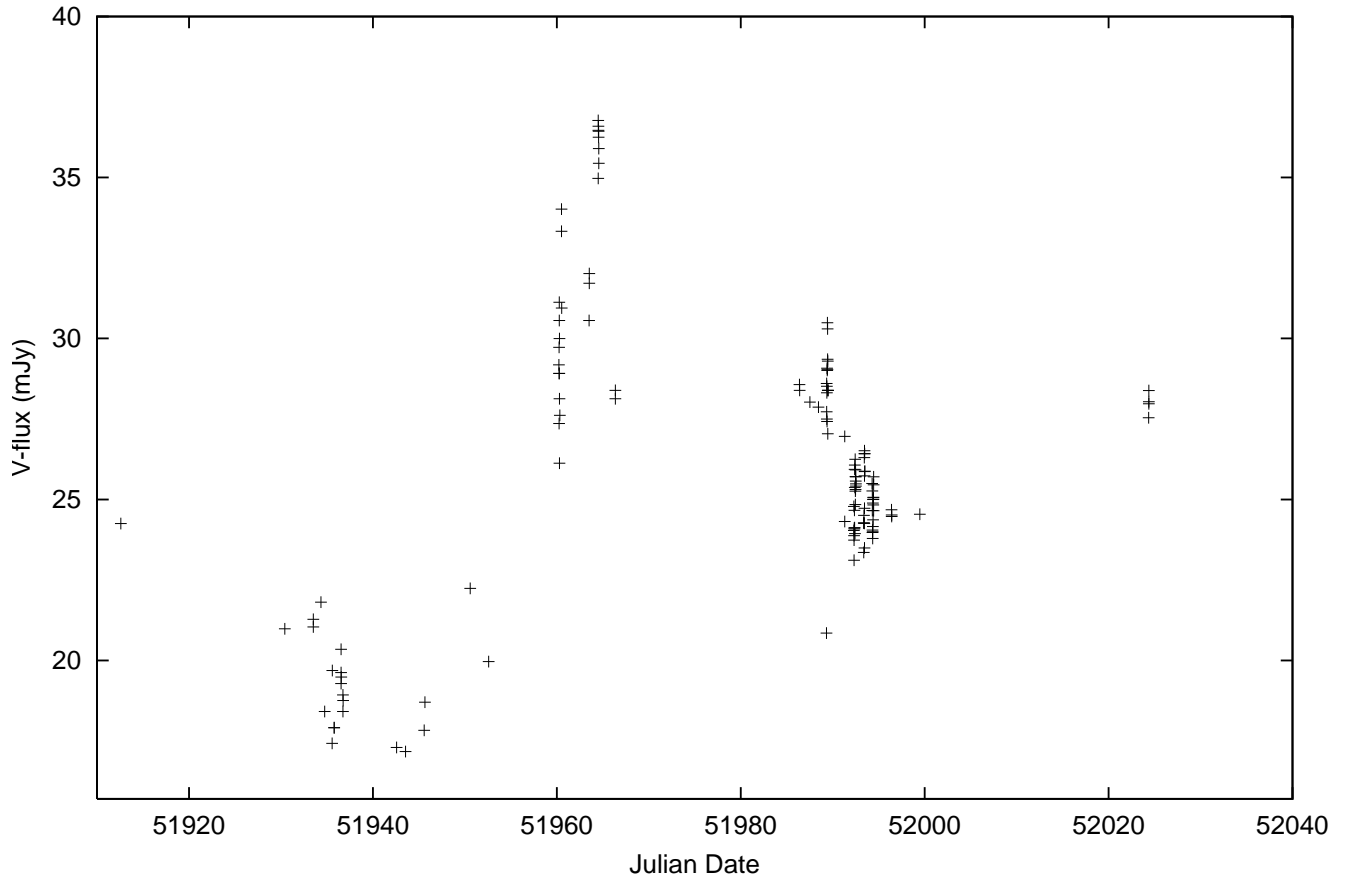
During this WEBT campaign we have observed Mkn 421 in UBVRI bands, with the best covered light curves being in V and R-bands. In Fig. 1. we display our preliminary V-band light curve. As can be seen from the light curve Mkn 421 has been very active also in optical bands during spring 2001. Variability can be seen in time scales from tens of minutes to days and weeks. In Fig 2. we show an example of the nightly variations observed in optical bands. Around the same time HEGRA observed a large TeV flare in this object. Correlation analysis between these data sets is in progress.

## References

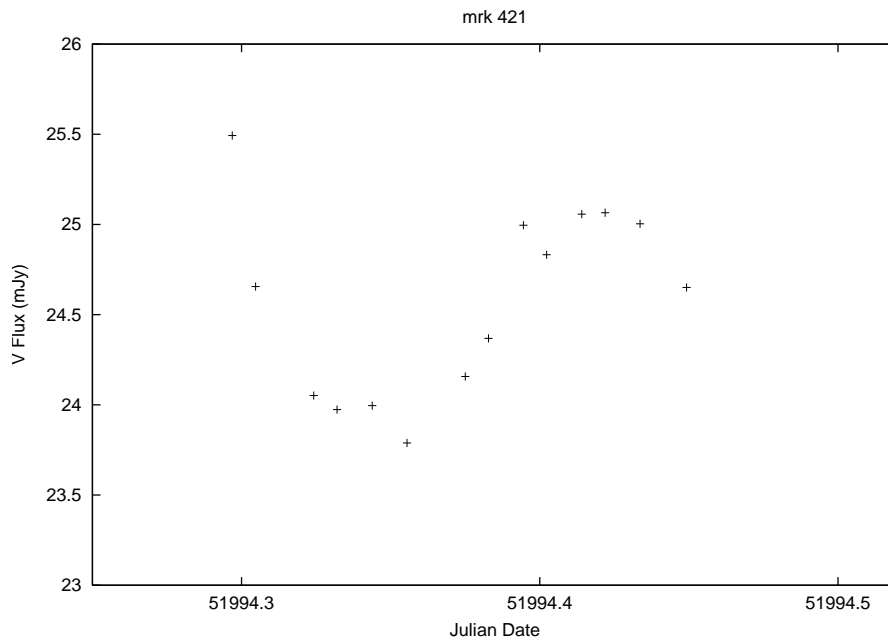
- Gaidos, J.A., et al. *Nature*, 383, 319, 1996.
- Nilsson, K., et al. *PASP*, 111, 1223, 1999.
- Tosti, G., et al. *A&A*, 339, 41, 1998.
- Villata, M., et al. *A&A*, 363, 108, 2000.
- Villata, M., et al. 2001, in preparation.

2700

mrk 421



**Fig. 1.** Optical V-band light curve of Mkn421 obtained during spring 2001, using the WEBT collaboration data.



**Fig. 2.** Nightly variability observed in Mkn 421 on March 25th.