PROCEEDINGS OF SCIENCE

OAGH NIR photometric and spectral monitoring program of AGNs

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We present and discuss briefly, some aspects of a long term observing program of spectral and NIR photometric studies of AGN's, carried out by our team at the Guillermo Haro Astrophysical Observatory which is located in Cananea, Sonora in northern México. Our spectroscopic monitoring program iniciated about 15 years ago, while the NIR photometric program started in 2008, before the Fermi LAT experiment was providing Gamma-ray data. So far, we have detected spectral changes associated with enhanced fluxes in some AGN's, as well as atypical flaring, this when there are flux increases at lower energies in the electromagnetic spectrum, but there is not a flux enhancement at Gamma-ray frequencies.

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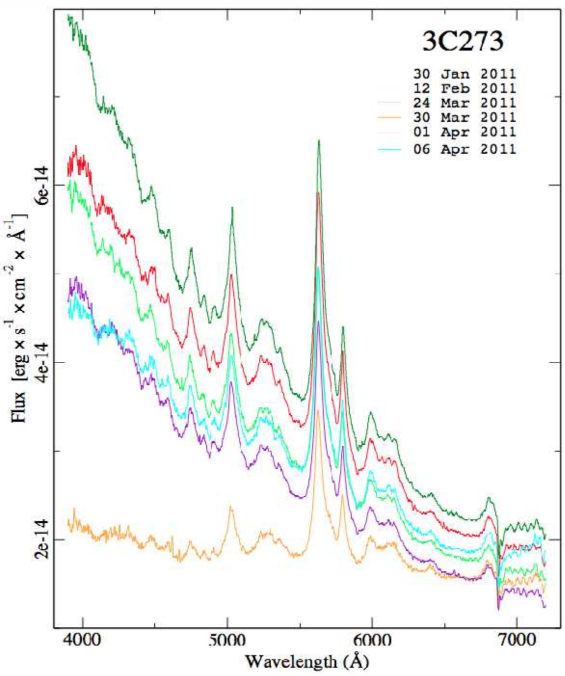

Figure 1: Time changes in the spectrum of 3C 273 for the year 2011. There, absolute fluxes are plotted for different epochs.

1. The observational program.

In an attempt to understand the temporal behavior of the emission from AGNs, we are carrying out both, a visible spectral and a NIR photometric monitoring programs of a selected sample of objects at the Observatorio Astrofísico Guillermo Haro (OAGH) in Cananea, México.

Worth mentioning is the importance of well observed multiwavelength data sets in order to study and correlate the light curves for different frequencies. Flux changes from Radio frequencies to Gamma ray emission vary, showing different time delays in some cases. The detection of these delays are fundamental for the proper understanding and association of the various emitting regions (NLR, BLR, accretion disks and radio jets) in the central parts of the AGNs.

As a result of our monitoring programs, we have detected important spectral changes in visible light for well observed objects such as 3C 273. In Figure 1, we show a sequence of spectra of this object for the year 2011. There, we can see important temporal changes both, in the continuum and the line emission. We have data of similar quality for a number of sources.

Since 2008, we started a NIR photometric monitoring program of AGNs objects that were expected to be detected by the Fermi LAT experiment. Our sample includes about 150 objects. Our NIR observations are carried out with the 2.1 m telescope of the OAGH and CANICA a NIR camera. The detector is a HAWAII array that provides an effective FOV of 4’ by 4’ with a plate scale of 0.32" per pixel.The monitoring program had the aim of having a photometric data point in the J, H and K_s photometric bands, at least once every 15 days, for the objects included in the sample. This goal was not always reach, mainly due to weather conditions and instrument

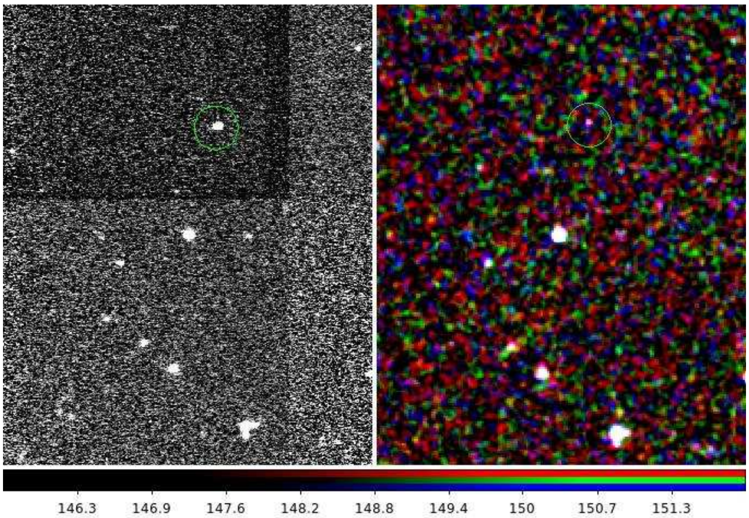

Figure 2: Left **PKS 1441+25** recent H band flare (MJD=2457142.81), right: a composite 2MASS JHK image. Circles mark the flaring object.

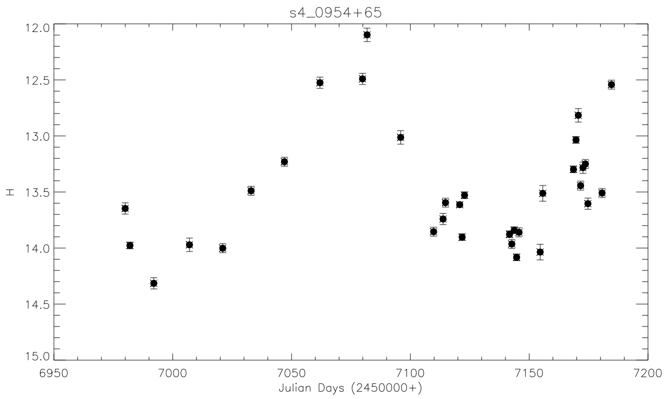

Figure 3: H band light curve of recent NIR flares of **FSQR S40954+658**.

availability. However, an average of 2500 observations with a formal error of 5%, in at least one NIR band (H) per year, has been achieved. In many cases we have detected NIR flares in objects contained in our sample, and so far have produced about 200 Astronomer's Telegrams. As an example, the image of a recent flare in PKS 1441+25 is shown in Figure 2.

2. The Giant NIR Flares of the Blazar FSRQ S4 0954+658.

Recently, since MJD 2456900, the FSQR S40954+658 has been very active showing fast and repeated flaring activity detected at NIR wavelengths. We have not done yet a detailed comparison of the NIR light curve with other wavelengths behavior. Nevertheless, we present a light curve in Figure 3. There, we can notice three flares with an amplitude of about 2 magnitudes between MJD 2457081 and MJD 2457184.

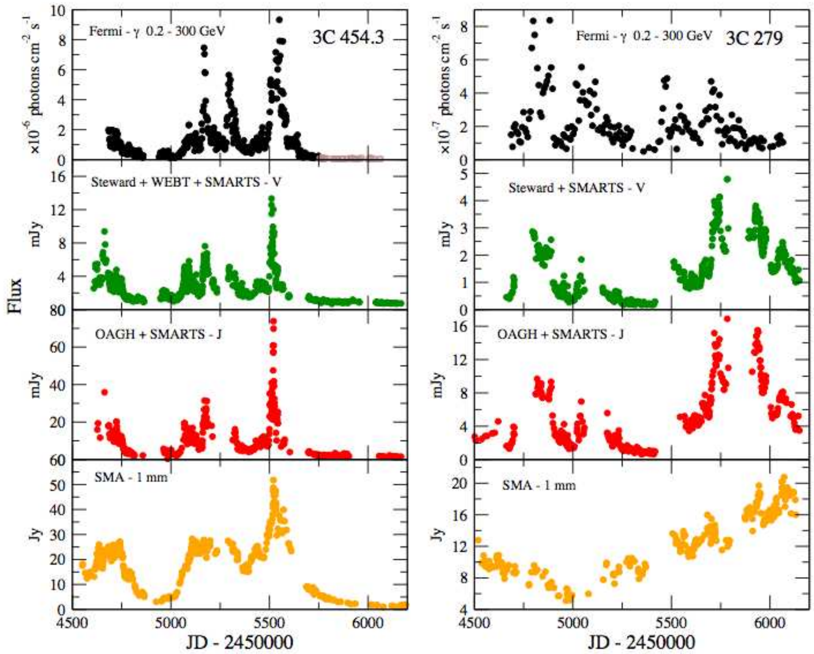

Figure 4: Typical flares in 3C 454.3 and 3C 279, activity is present in the entire electromagnetic spectrum.

3. Well Sampled light curves.

For a proper analysis and correlation studies of light curves in different wavelengths is very important to have well sample data. We have analyzed a few objects for which this condition is met. Noticeable 3C 454.3 and 3C 279, whose multiwavelength light curves are presented in Figure 4. There we show typical flares for these objects, they have been discussed in some detail by [1] and [2]. For 3C 279 we have detected flares that are present in the entire electromagnetic spectrum, we have called those typical flares. Yet, there are flares seen in certain wavelengths and not in the Gamma-ray regime. In some cases we have detected varing time delays in light of different wavelengths. Examples of these different behaviors are shown in Figure 4 and Figure 5. In our analysis and plots presented here, the 100 Gev Gamma-ray data comes from our analysis of the Fermi LAT database, polarization measures from 5000 to 7000 Å come from Steward Observatory database. The rest wavelength fluxes at 3000 Å come from Steward Observatory and OAGH databases, the V band data are from the Steward SMARTS program, the J Band data comes from OAGH plus SMARTS program and finally 1mm data comes from SMA.

4. Long term light curves

For some bright objects, we have observed them as often as possible. Hence, we have information about the long term behavior of these objects. Our NIR light curves for **MRK421** are shown in Figure 6. There, we can notice recurrent flaring activity jointly with an increase of the mean

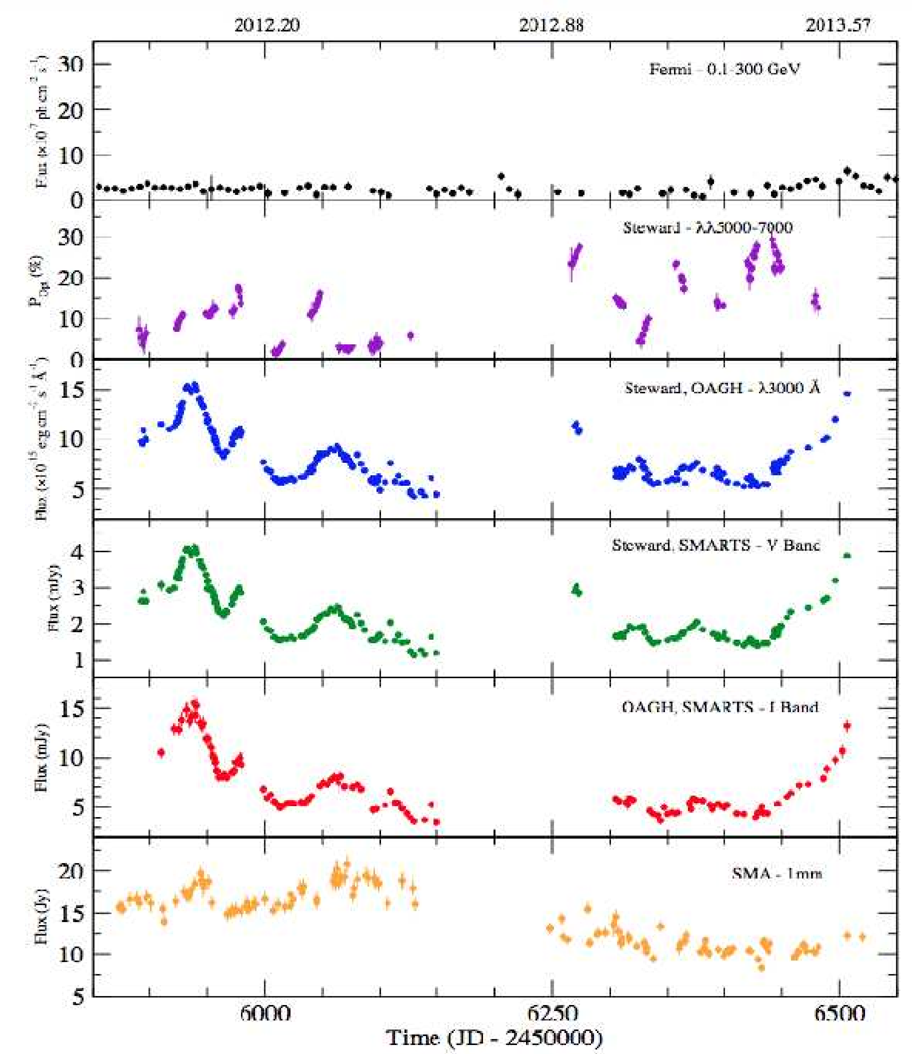

Figure 5: An atypical flare in **3C 279**, note that there is not flaring activity in Gamma-rays.

flux with time. The latter, is indicative of an increase of the accretion rate of the central source on longer time scales.

References

[1] J. León-Tavares, et al. *Flare-like Variability of the MgII λ 2800 Emission Line in the Γ-ray Blazar 3C 454.3.* ApJ Letters **763**,(2013) L36-L41.

[2] V. Patiño-Alvarez et al. *Multiwavelength variability analysis of the FSRQ 3C 279.* in proceedings of IAU Symposium No. **313**, *Extragalactic Jets from every angle.* (2015) 89-90.

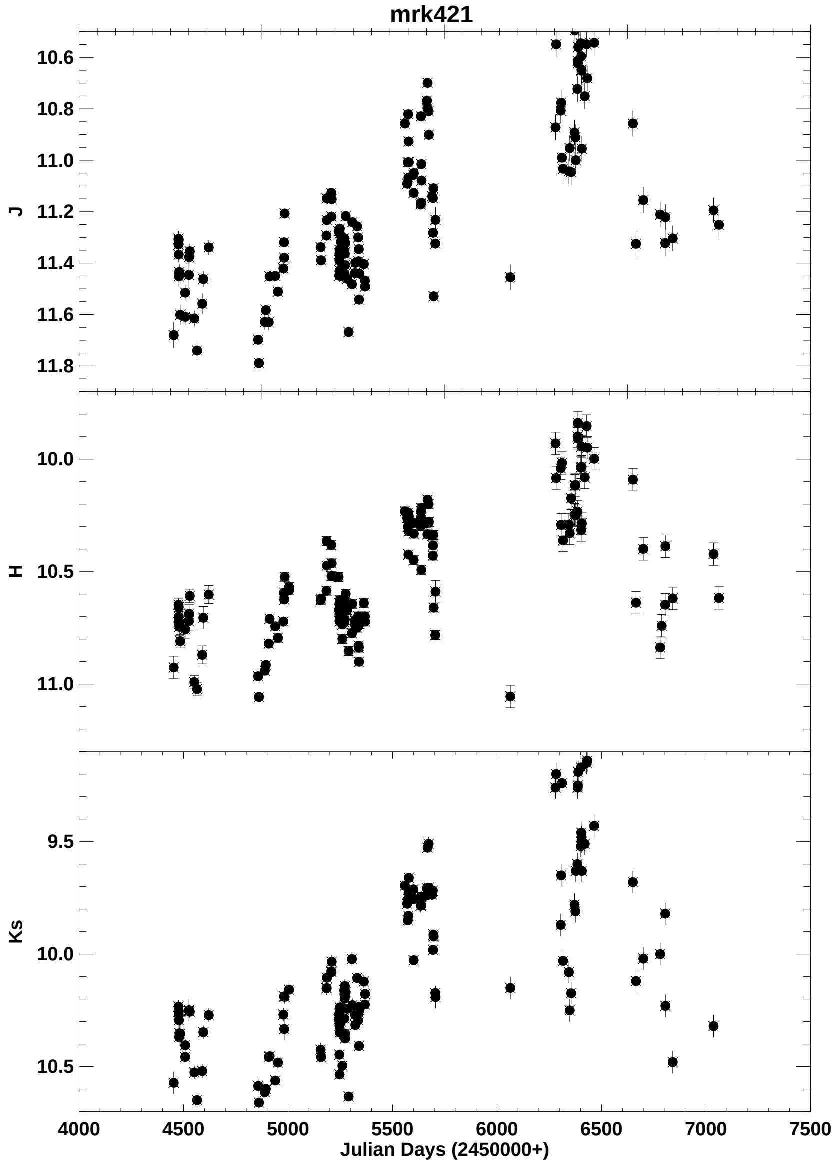

Figure 6: J,H,K$_s$ long term light curves for **MRK421**.