Near infrared polarimetry of a sample of blazars

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Abstract

Polarization variability is one of the most ubiquitous characteristic of **blazars**.

Near infrared (NIR) polarization measurements of blazars are not common, contrary to the optical ones. Nonetheless, the NIR regime can be essential to understand correlated or non-correlated behaviour between the optical and radio energy ranges. In this work, we report on NIR polarimetry measurements of a sample of 28 blazars, gathered with LIRIS at WHT/La Palma in several campaigns during 2011. The majority of the blazars were observed more than one epoch using two filters (J and Ks). Here we present preliminary results for the few targets.

Motivation

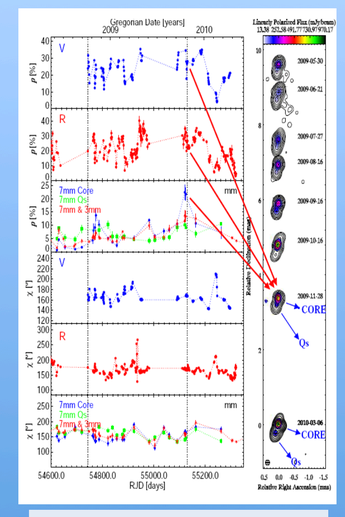
Blazars appear as the most luminous objects in the gamma ray sky. Nowadays, blazar studies are living in a "golden age" thank to facilities like Fermi satellite, MAGIC telescopes, etc…

Blazars emit profusely from radio to gamma rays and, their emission is variable and highly polarized at almost any energy range. It is usually attributed to a common mechanism, which is identified with a relativistic jet pointing very close to our line of sight. The frequently observed gamma-ray flares are sometimes associated with optical polarization variations (pol. degree angle rotations) and other time are not, which indicates that the paradigm of the innermost regions of the blazar jets should be based on multiple scenarios. In order to select the most successful models for jet acceleration and collimation, the analysis of multi-wavelengths is necessary (*Agudo et al, 2010: Jorstad et al, 2010: Marscher et al, 2008, 2010*).

Our goal

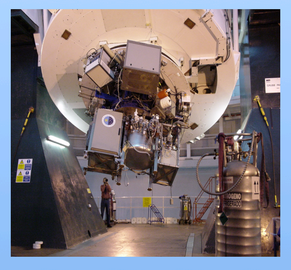
The superb spatial resolution of VLBA (0.1 m.a.s.) and the frequent observations permit to monitorize the birth and evolution of structures propagating through the jet. The information gathered from these observations include detailed polarization maps. Despite its poorer spatial resolution, polarimetric observations at optical wavelengths would permit to "locate" optical flares assuming continuity of the electric vector polarization angle (EVPA). **On the other hand, measuring near-infrared would permit to establish a natural bridge between optical and radio emission.** Here we present preliminary results of a study in which near infrared polarization (LIRIS@WHT) was measured with time gaps of few days.

Near infrared polarimetry is not a common facility at public observatories, and simultaneous/frequent observations are difficult to obtain for fixed scheduling observatories.



Adapted from Agudo et al (2010)

Instrumental setup



LIRIS is a public instrument attached at the Cassegrain focus of the 4.2m William Herschel Telescope (La Palma).

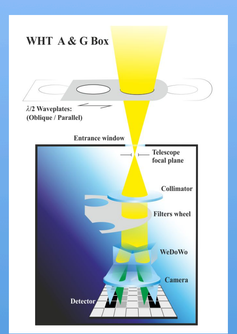
LIRIS is a near infrared multipurpose instrument with imaging and spectroscopy capabilities.

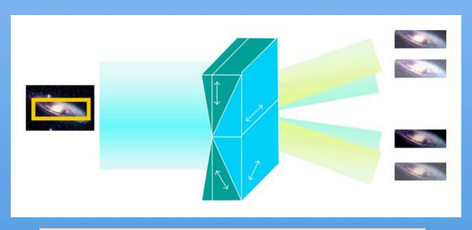
Polarimetric analyzers are based on WeDoWo (Wedge Double Wollaston) devices [Oliva, 1997].

Currently, two modes are offered:

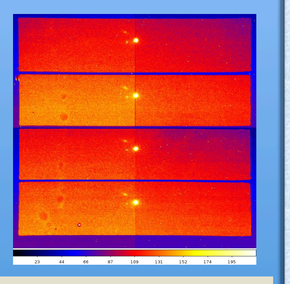
- Imaging polarimetry - FOV 4'x1', with common near IR filters.
- Spectropolarimetry – slit 0.75"x1', R=1000, 3000 from 0.9 to 2.3 μm

Two half-wave plates can be used as modulators.Measured instrumental polarization is around 0.5%





Adapted from Vitali et al. (2010)



LIRIS Frame in pol. mode

The Observations

The sample was selected to contain the brightest millimeter and gamma-ray blazars with typical optical magnitude below 18. Objects in this sample are being monitorized in radio by the Astronomy group of the Boston University and in optical polarimetry at Calar Alto. [http://www.bu.edu/blazars/research.html] (http://www.iaa.es/~iagudo/research/MAPCAT/) .

Our observations were performed using LIRIS@WHT in the J and Ks bands. Data were collected in two campaigns during 2011 :

March 17th & 22nd

September 8th+9th and 13th+14th

OBJECT	DATE											
	2011-03-17		2011-03-22		2011-10-08		2011-10-09		2011-10-13		2011-10-14	
	J	Ks	J	Ks	J	Ks	J	Ks	J	Ks	J	Ks
3C 273	■	■	■	■								
3C 279	■	■	■	■								
4C 38.41	■	■	■	■			■	■	■	■		
OJ 287	■	■	■	■	■	■			■	■	■	■
B2 1308+326	■	■	■	■								
AO 0235+164					■	■	■	■			■	■
3C 345					■	■			■		■	■
3C 454					■	■	■	■			■	■
ON 231	■	■	■	■								
PG 1222+216	■	■	■	■								
PKS 1510-08	■	■	■	■								
S4 0954+65	■	■	■	■								
KS 0420-014					■	■	■	■	■	■		
3C 66A					■	■	■	■	■	■	■	■
CTA 26					■	■			■	■		
CTA 102					■	■	■	■			■	■
NRAO 150					■	■	■	■				
OJ 49						■	■		■	■	■	■
BL Lac					■	■	■	■	■	■	■	■
KS 0528+134								■			■	■
OT+081							■	■				

Data Reduction

Data were reduced using a dedicated package developed within IRAF (lirisdr). Each frame is trimmed into four strips. Each strip is processed following standard near infrared data reduction steps: flat-fielding, sky subtraction, geometric distortion and shift-and-add combination.

Preliminary results

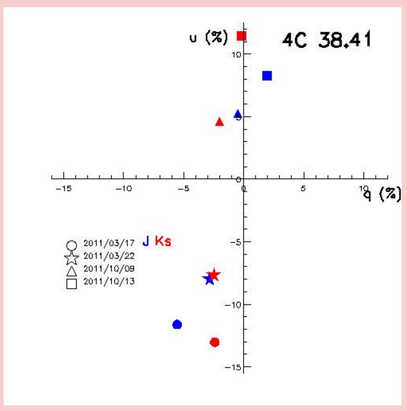
Observed Polarization degree ranges between:

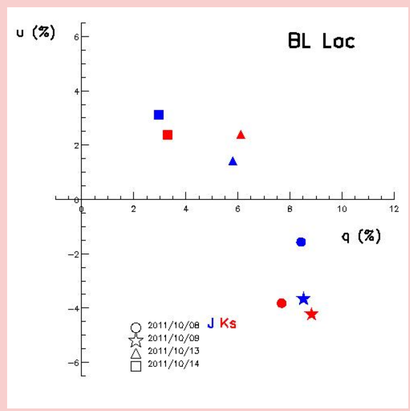
- few percent [3c273: <1%; 02355+164: 2-4%; 3c111: 1-4%; 0836+710: 2-4%,]
- max. is up to 20% [CTA26: , 0420-014: 15-20%, OJ 287: 20%]

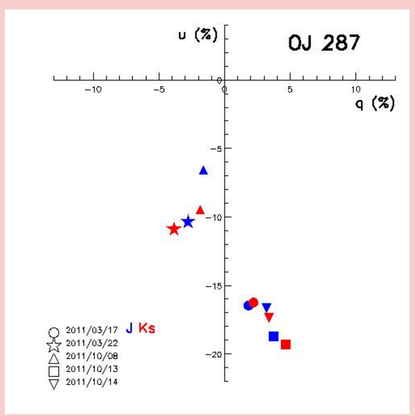
Different types of behaviour are observed:

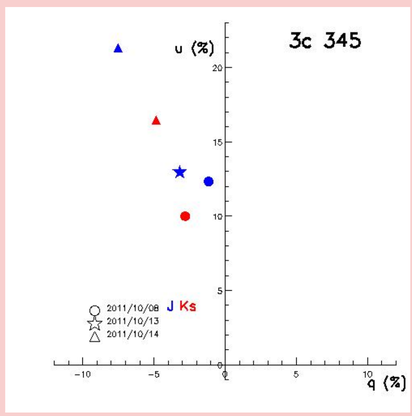
Polarization degree (*p*) varies from 10% to 20% in few days [3c345, CTA 26]

In most cases, variations of *p* are not associated with variations of EVPA, but some exceptions [e.g. 4C 38.41].









Future work

Search correlations between polarimetry variations and colour/photometry variations. Need to combine NIR polarimetry with optical polarimetry available from MAPCAT and also from theground optical observational support of Fermi [http://james.as.arizona.edu/~psmith/Fermi/]

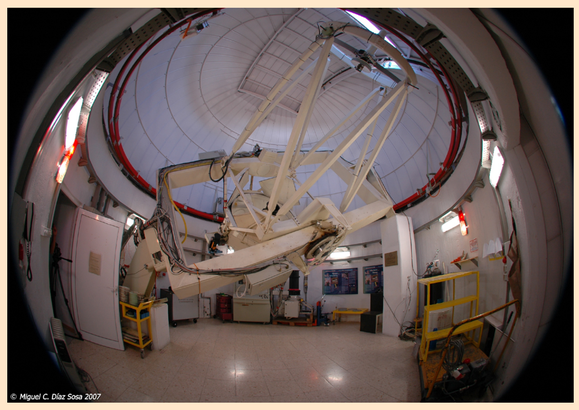
On-going blazar monitoring programs at IAC-Canary Islands telescopes

Photometric monitoring at the near infrared (J, H and Ks) using the TCS and at the optical (R band) using the IAC-80 and Stella-I telescopes at the Observatorio de Izaña (Tenerife).

Data are taken roughly every 3-4 weeks, starting from 2011. Data for potential collaborations are made available upon request (jap@iac.es).

Participation in the GASP project of the WEBT consortium (Whole Earth Blazar telescope: Raiteri et al (2011) A&A 545, 48 and few othe publications are in preparation.

Telescope IAC-80, equipped with an optical camera



1.5m Carlos Sánchez Telescope, equipped with an infrared camera

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