Near Infrared polarization of blazars

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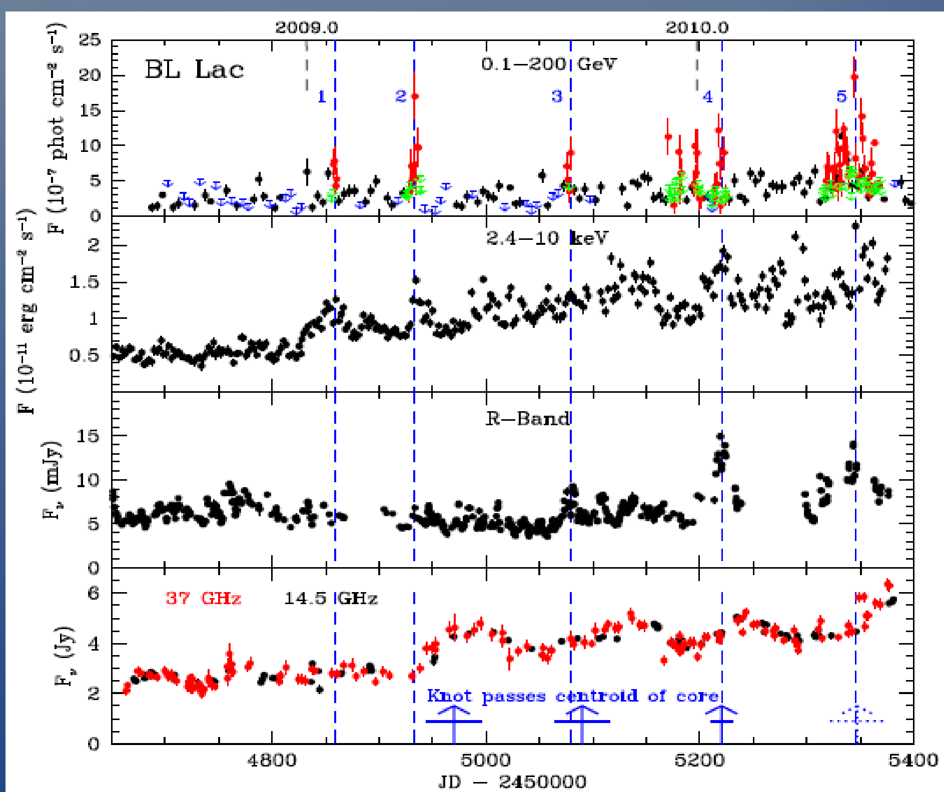
Putting in context

Blazars emit profusely from radio to gamma rays:

Emission is variable and highly polarized.

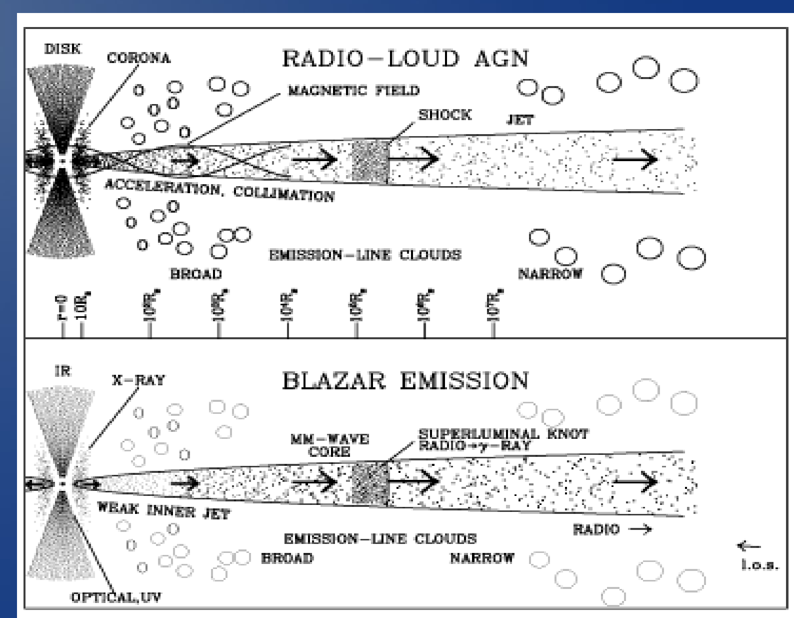
Correlations between high and low energy ⇒ common origin, identified with a relativistic jet pointing very close to our l.o.s.

Very luminous at gamma-ray ⇒ Now “golden age” for blazar studies thanks to new facilities like Fermi, MAGICs, etc...



Adapted from Marscher et al 2011

Dense multiwavelength monitoring is essential to understand physics of jets



Adapted from Marscher 2006

Our goals

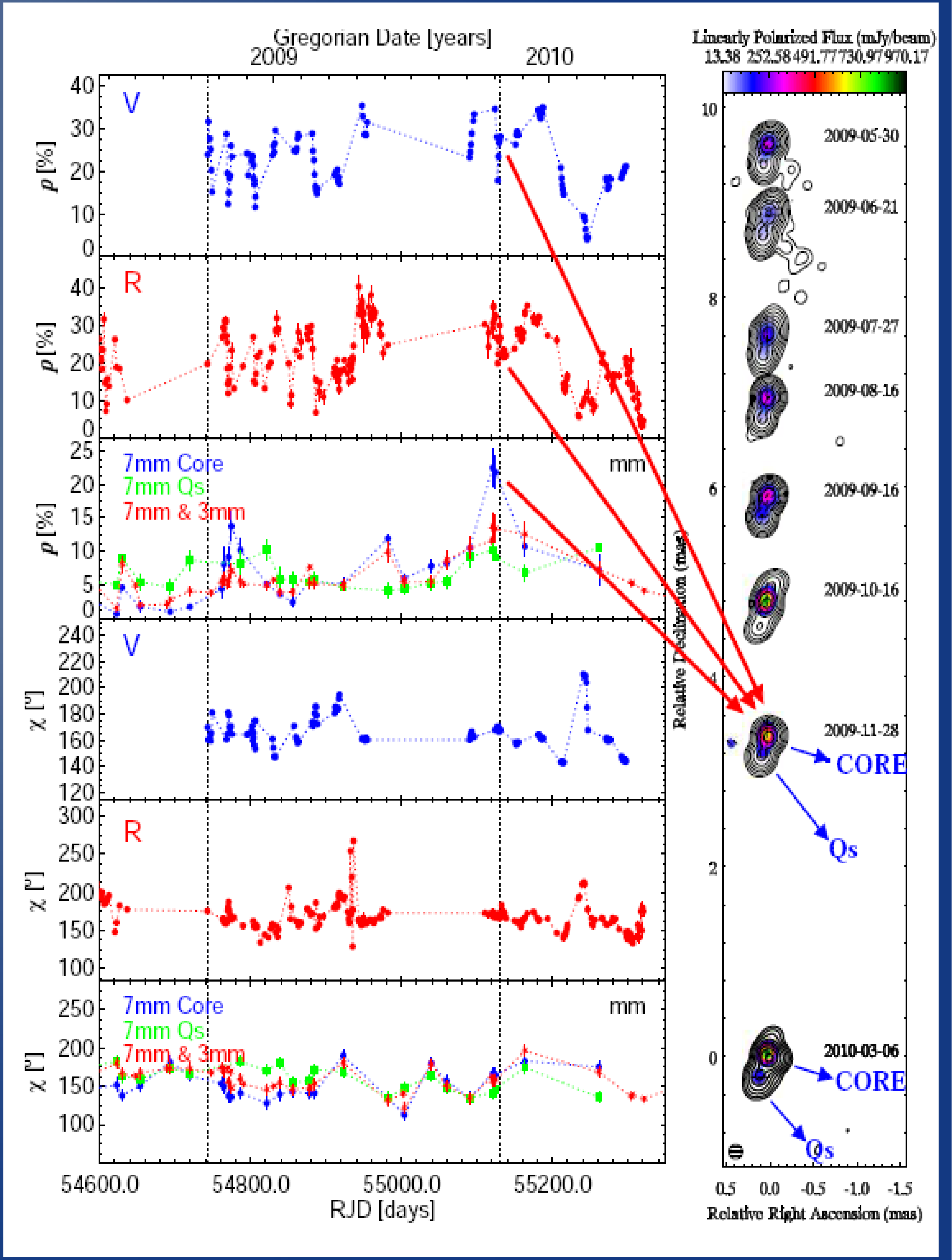
VLBA (spatial resol. 0.1 m.a.s.) frequent observations permits to monitorize the birth+evolution of structures (shock fronts?) propagating through the jet

Optical Polarization permits to "locate" optical flares assuming EVPA is the same as in radio

Measuring near-infrared polarization is a natural bridge

- Permits to establish if synchrotron radiation is stratified with wavelength

Not very common



Our Near-IR polarimetric observations

- Sample contain the brightest mm and gamma ray blazars with V<18, which are monitorized by the Astronomy group of Boston University (Marscher et al).
- Observations performed using LIRIS@WHT (filters J and Ks)
- Data collected in two campaigns :
  - 2011 March 17th & 22nd
  - 2011 September 8th+9th and 13th+14th
  - 28 targets observed, at least twice.

Aim to obtain simultaneous observations at radio and optical, but difficulties due to bad weather conditions and non-flexible schedules at different observatories.

Preliminary Results

Similar studies by Ikejiri et al (2011) [polarization at V]

88% appears bluer-when-brighter

30% show correlations of flux and polarization degree

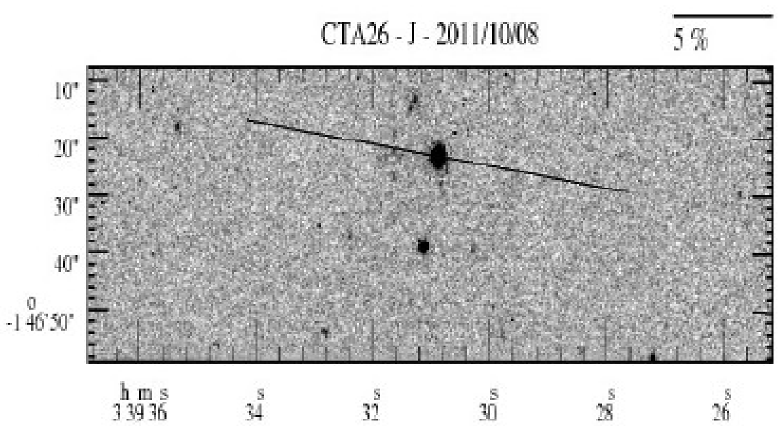
Rotations of pol. observed only in 3 objects.

Polarization degree ranges between few percent (0836+710: 2-4%) to 20% max (CTA26, 0420-014)

Different types of behaviour:

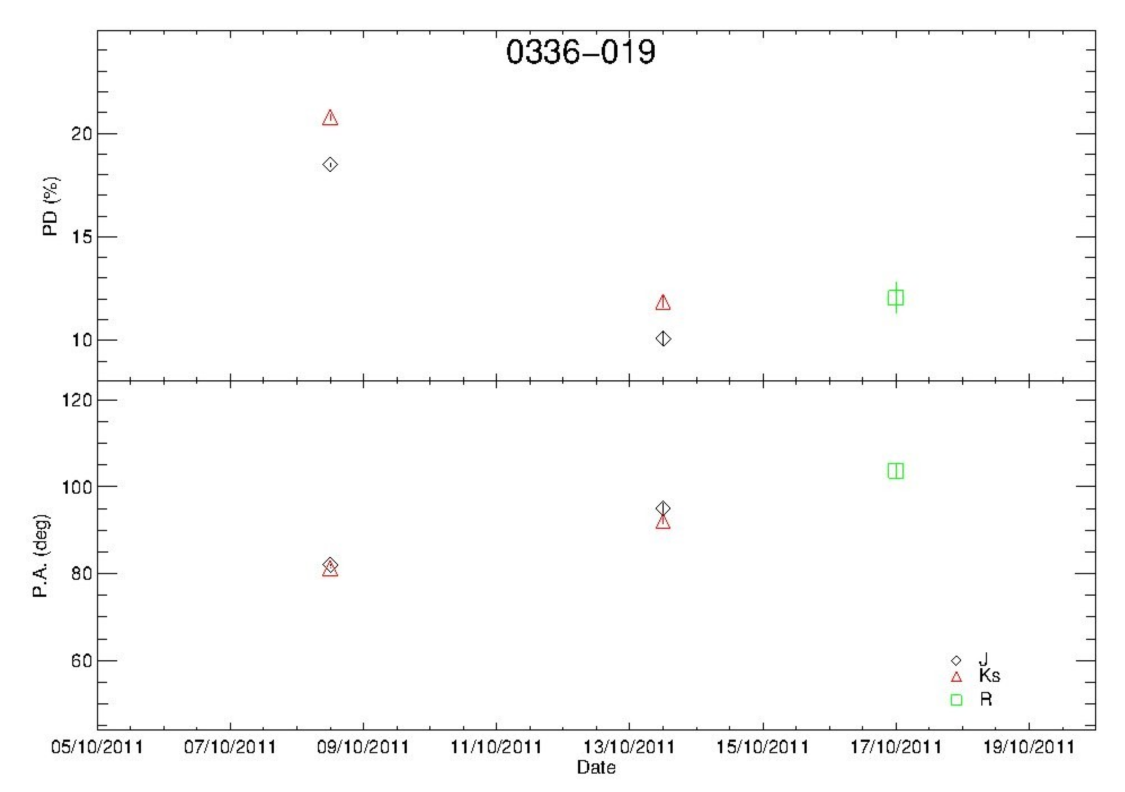
- p varies 20% -> 10% in few days

- variations of p, but ~constant P.A.

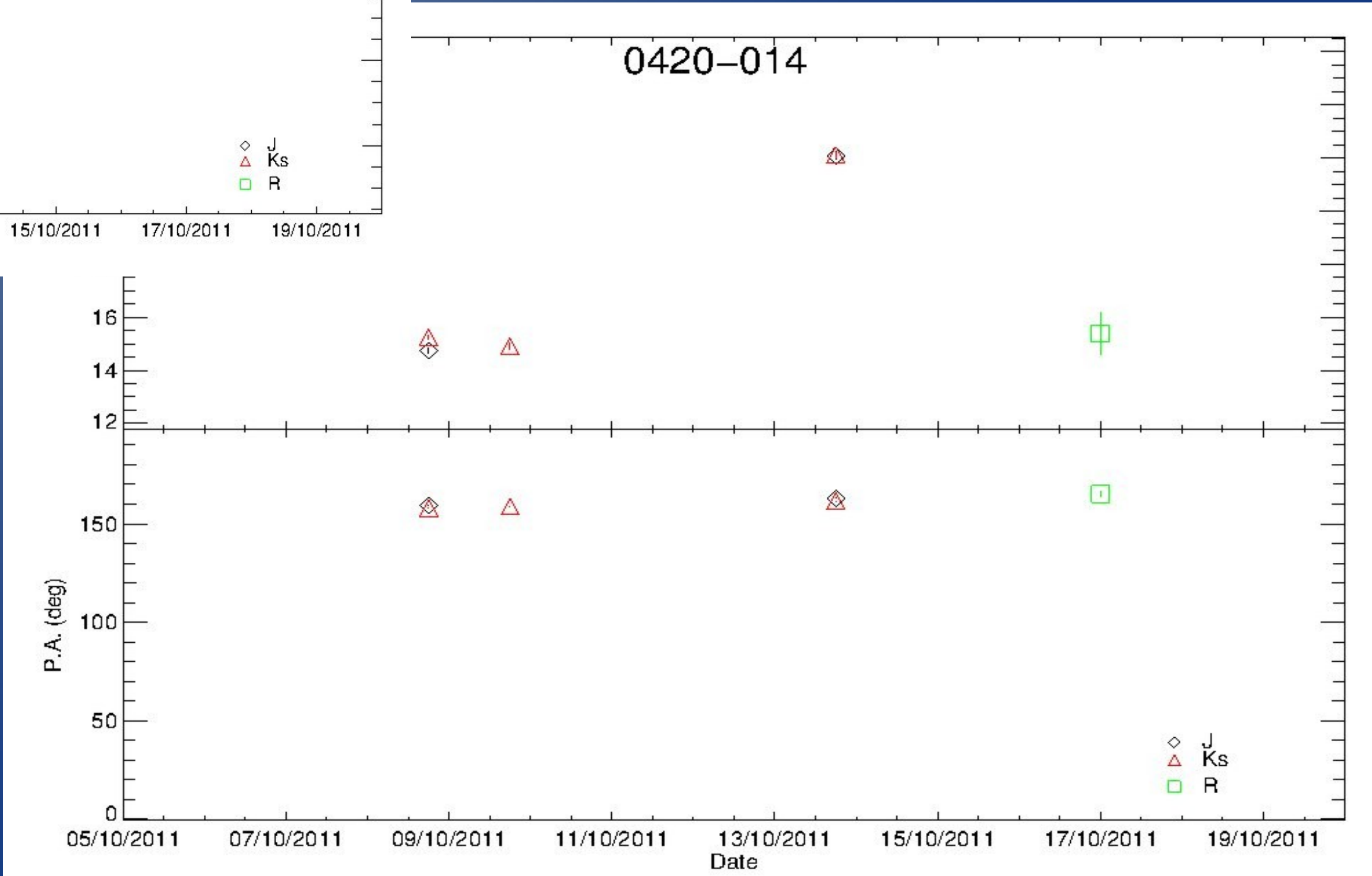


J band image of CTA26 obtained using LIRIS. Polarization vector is overlayed.

Some examples

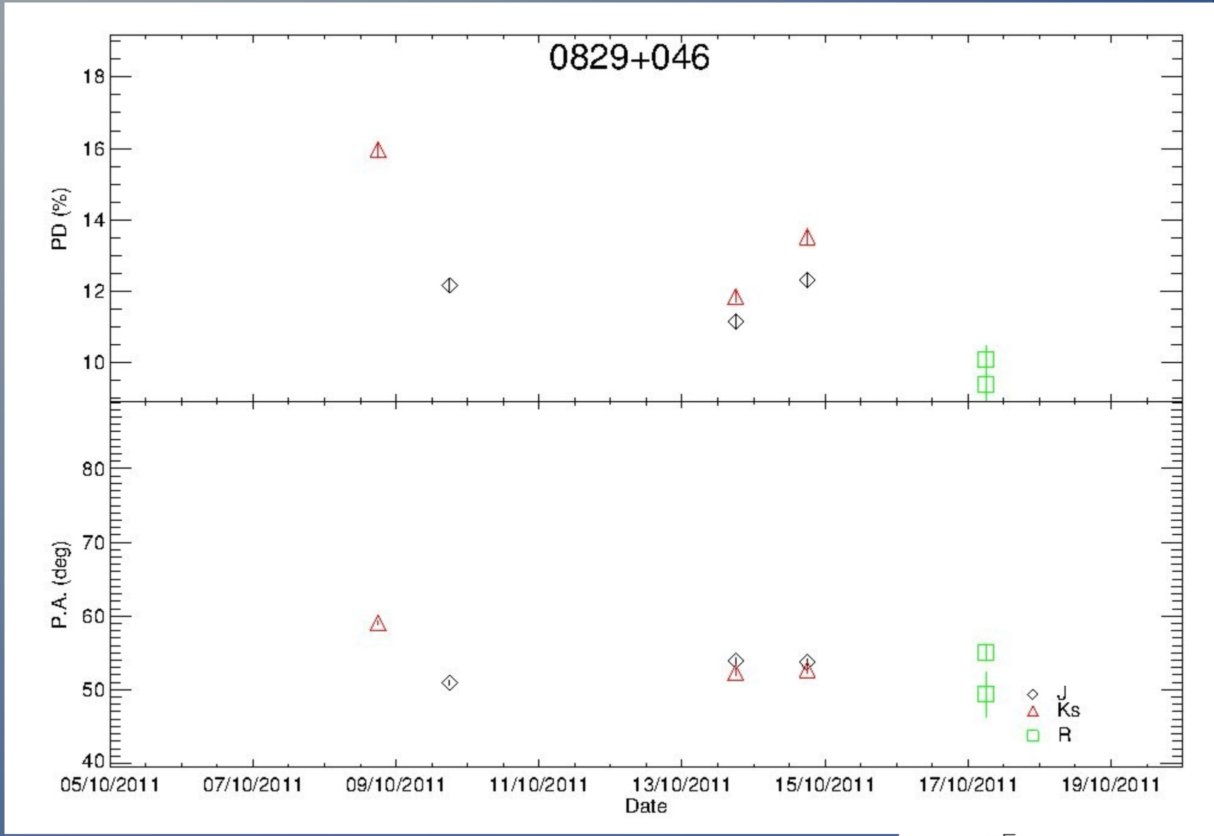


Large variation of PD plus PA rotation



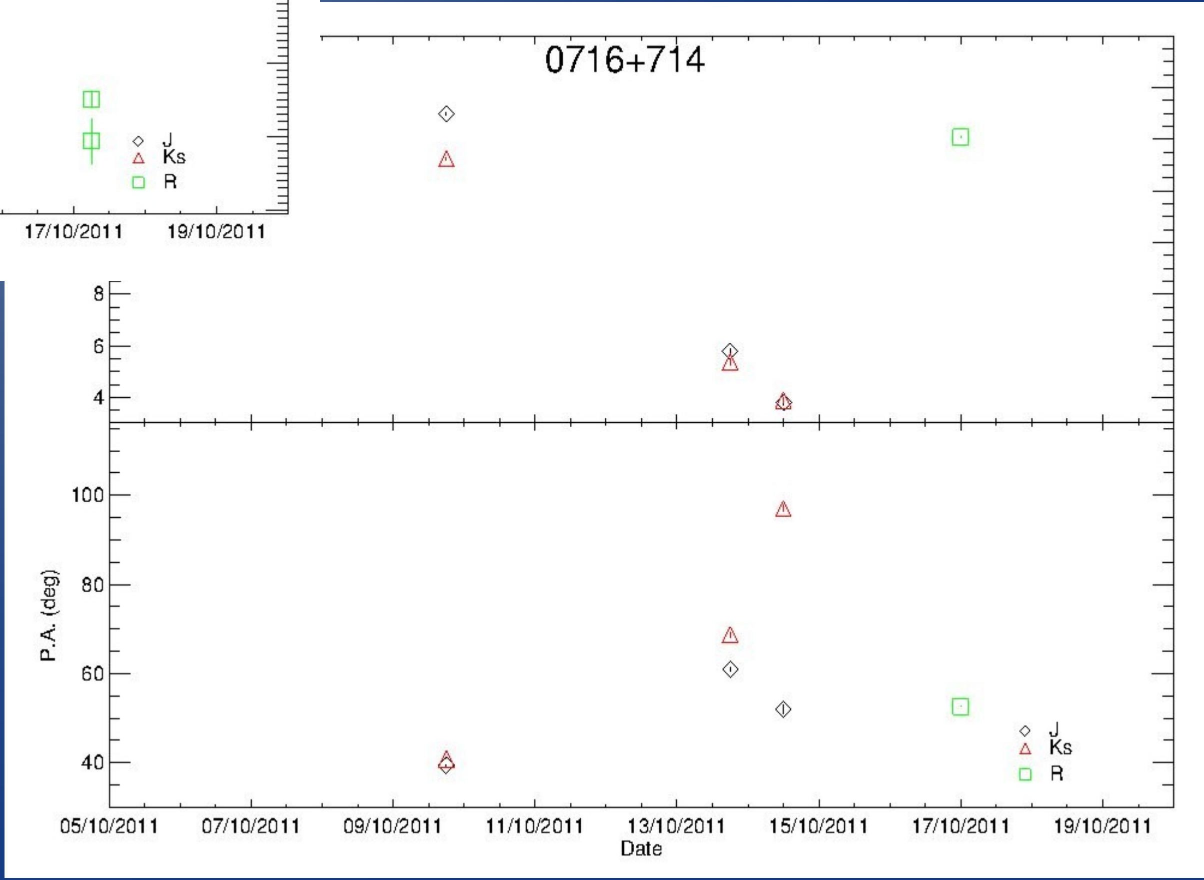
Flare of PD, J and Ks same values, PA constant

More examples



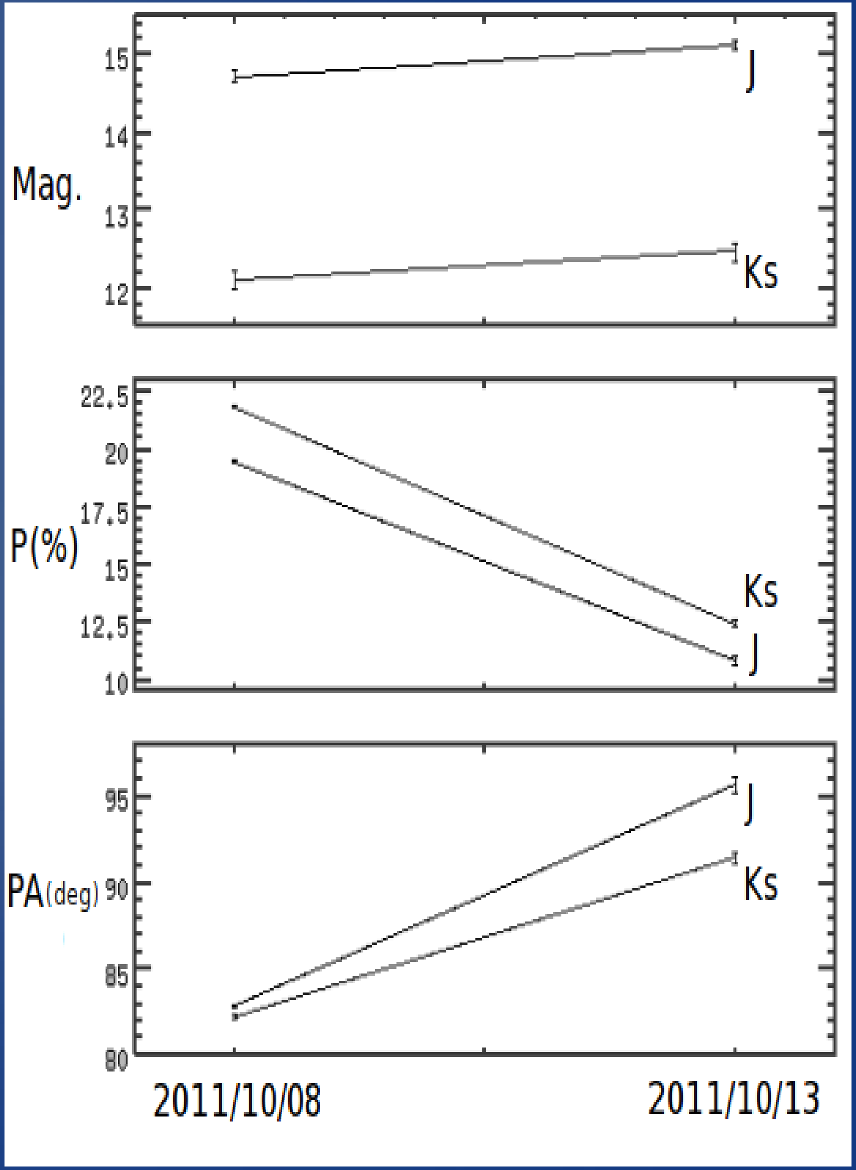
PD varies at Ks but not at J.
PA nearly constant

PA varies differently at J than Ks



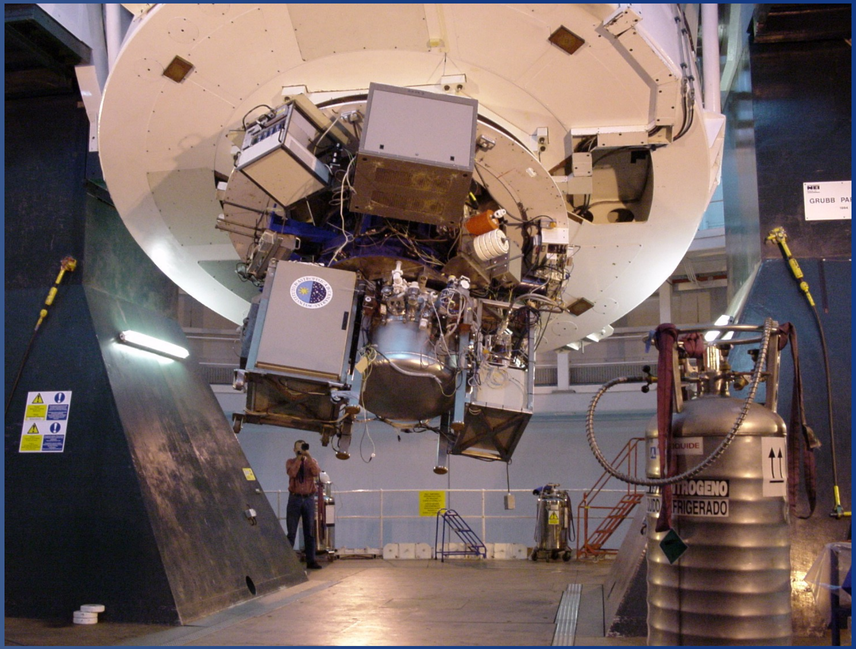
Work to be done

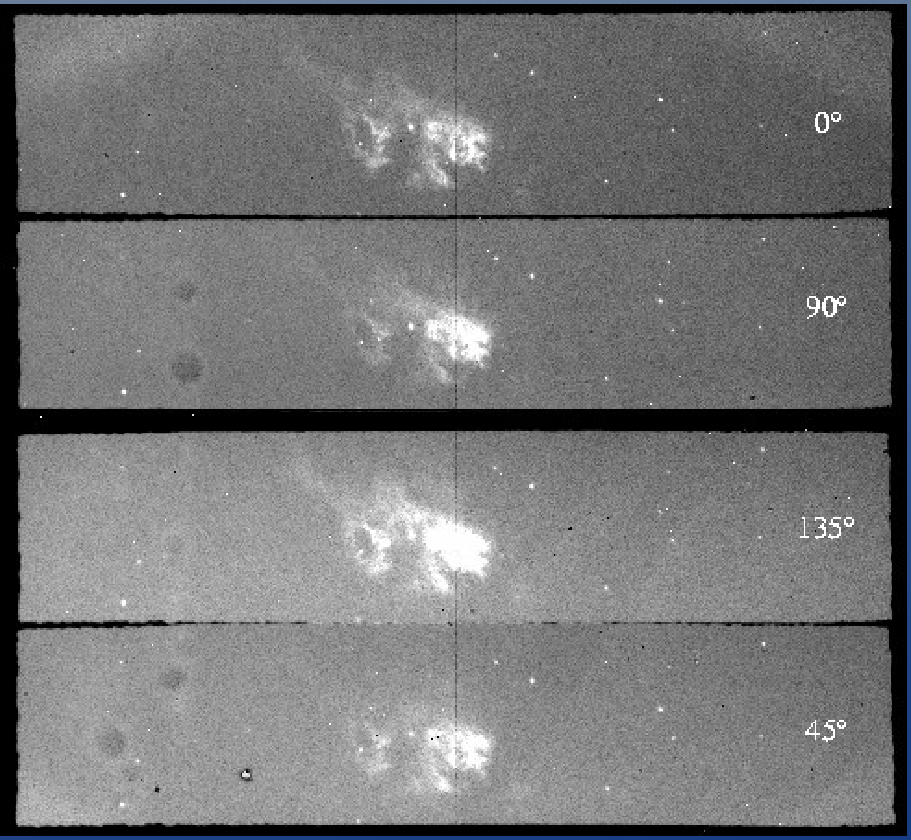
- Comparison with optical polarization (CAHA/MAPCAT+Arizona/Paul Smith)
- Photometric calibration
- Correlation with high-energy light curves (FERMI daily observations publicy available)
- Correlation with optical+near-infrared light curves (Long-term monitoring being conducted at Teide Observatory)

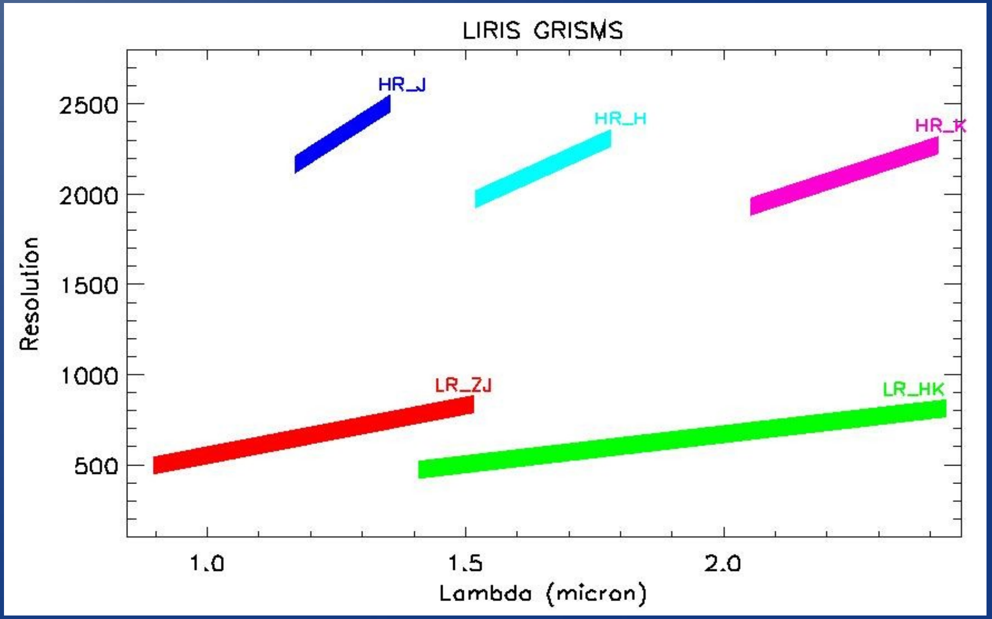


Polarimetry with LIRIS

- LIRIS is a public instrument attached at 4.2m WHT Cassegrain-focus (~0.5% instrumental polarization)
- Based on WeDoWo (Wedge Double Wollaston)
- Two modes offered: imaging (broad+narrow filters) + spectropolarimetry



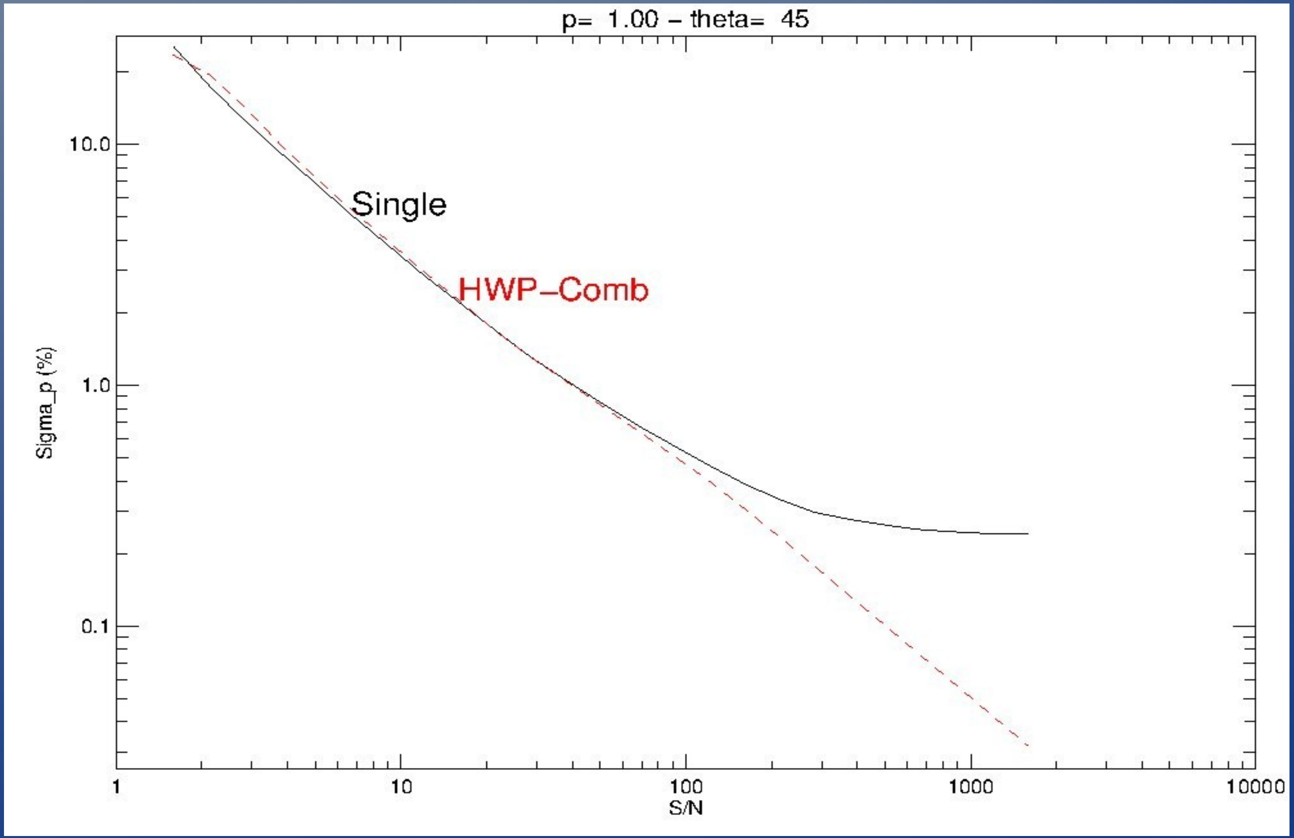




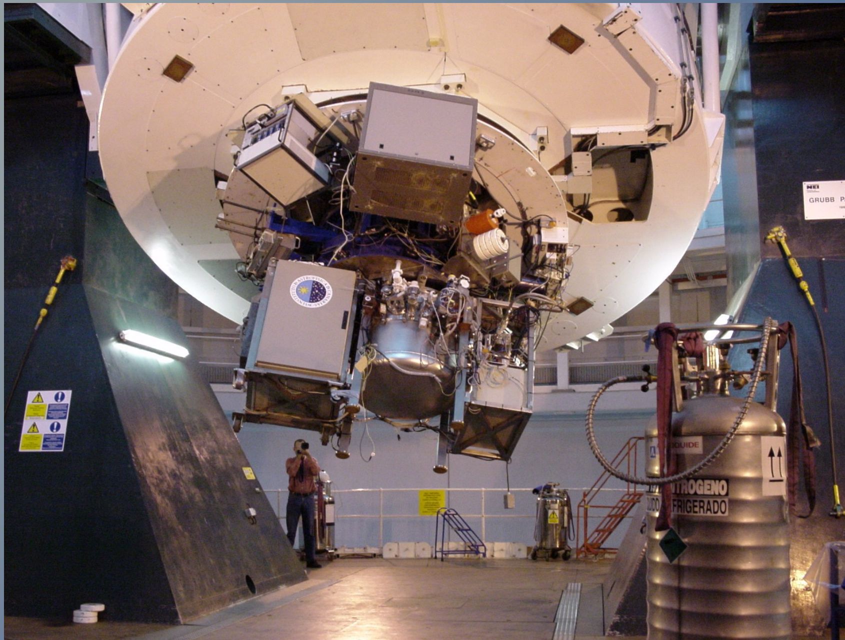
Upgrade Polarimetry@LIRIS

Two techniques to improve accuracy:

- Rotate whole instrument
- NEW!! Use of half-wave plates [Currently waiting to collect commissioning data, up to now frustrated by bad weather conditions].



Accuracy improves thanks to combination of two Half-wave plates measurements



Polarimetry with LIRIS

Based on Wedge-Double-Wollaston (Oliva 1997). Only few instruments (ALFOSC@NOT, NICS@TNG, LIRIS@WHT) used this type of devices.

590 E. Oliva: Wedged double Wollaston, a device for single shot polarimetric measurements

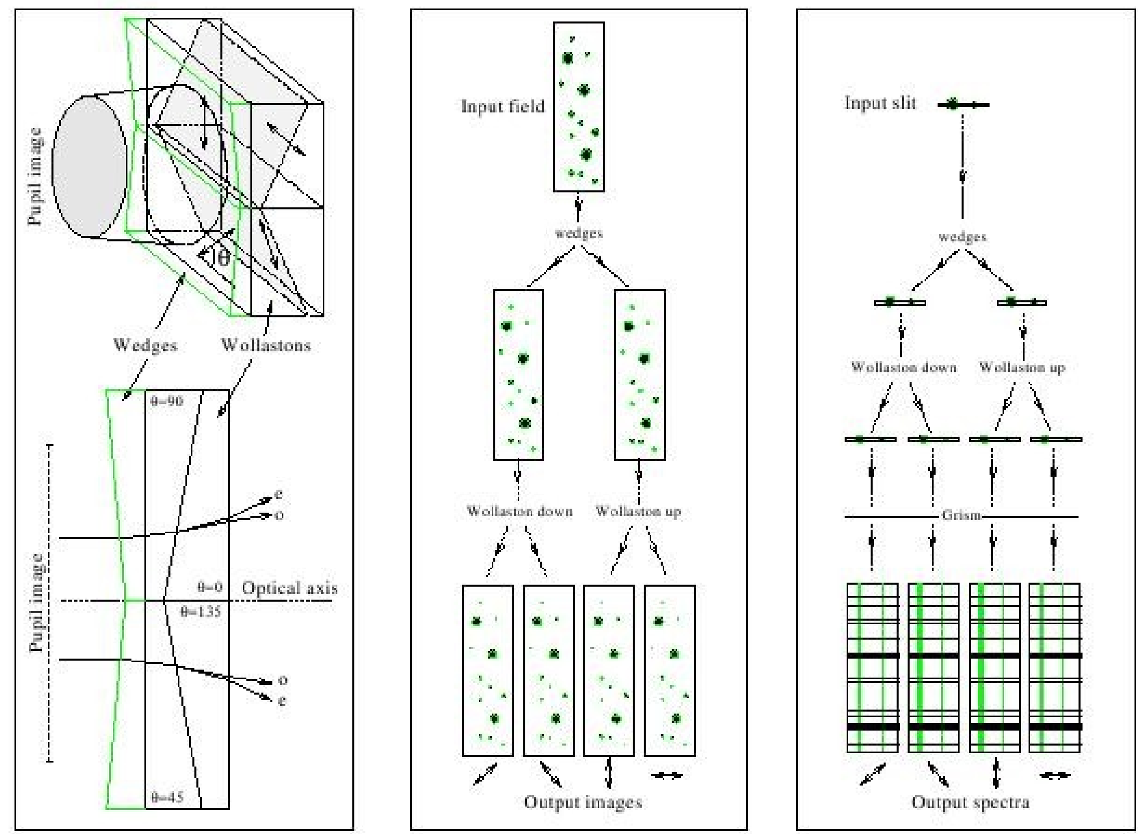


Fig. 1. Left: schematic representation of a WeDoWo device and ray–tracing. To prevent vignetting at the prisms interface the wedge angle is chosen to ensure that all rays (including those from the field edges) always travel above/below the optical axis. Center: illustration of how this device creates four polarized images (at 0, 90, 45 and 135 degrees) of a stellar field. Right: illustration of how the WeDoWo creates four long slit polarized spectra (at 0, 90, 45 and 135 degrees) of two stars

Pros:
simultaneous measurement of four polarization stages

Contras:
input beam is split into four ⇒ luminosity decrease

LIRIS Instrumental polarization: <0.6%