

CTA-Pol — polarimetry for CTA-Oz

Nick Tothill for CTA-Pol

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Update since April...

- Funding is *almost* ready to start.
- Discussions with ANU/MSSSO have progressed.
- We're expecting focal ratio $f/8$

Polarimetry for CTA – Why?

Because... Blazars!

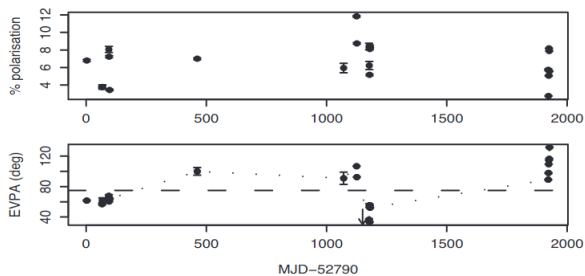
Blazars constitute most of the (known) extragalactic TeV population

- Bright across entire spectrum
- Highly variable
- lots of non-thermal (i.e. synchrotron) emission

From a recent CTA job ad:

“time-dependent modeling of blazar jets in order to study the time delays between photons of different energies (spectral lags) that can arise in emission and acceleration mechanisms. These models are essential for the future interpretation of propagation effects such as those due to a possible violation of Lorentz invariance.”

Polarimetry of Blazars

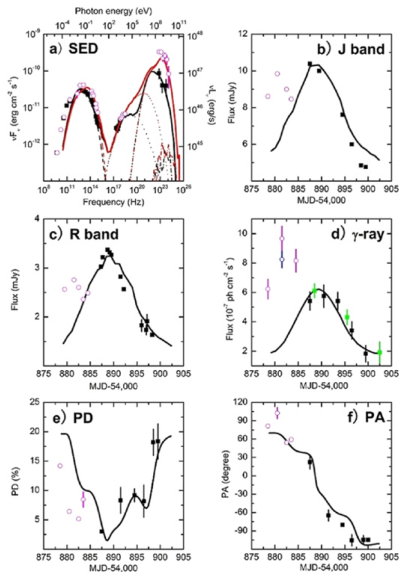


(Barres de Almeida et al 2009, ICRC)

Synchrotron emission is strongly polarised, so optical polarisation sees the non-thermal emission well.

Blazars are highly polarised in optical emission.
(10% is highly polarised.)

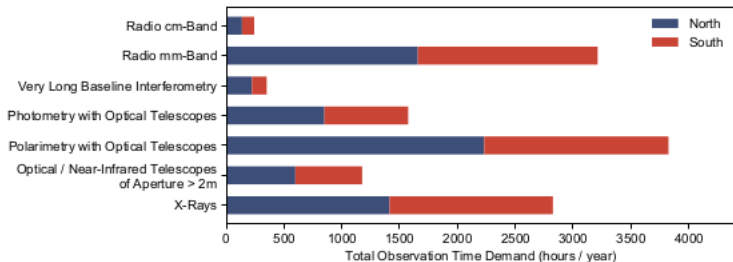
Blazar flaring



- Blazars flare up unpredictably
- Blazar flares include changes in optical polarisation and large polarisation angle swings.
- (see left, from Zhang et al 2015)

Polarimetry in the CTA Science Programme

- The CTA AGN KSP will monitor some blazars, but not all.
- CTA will also expand the TeV blazar population
- Optical polarimetry is important to complement TeV detections of flaring
- Optical polarimetry can spot a flare occurring and generate an alert to CTA
- Programme of blazar monitoring for as many sources as possible with polarimetry (and maybe other stuff).
- N hemisphere is full of small telescopes available for monitoring, eg RoboPol in Crete; Liverpool Telescope in Canaries...
- Plan to site a 1m-class optical telescope with polarimetry on CTA-South site.
- More will be needed, and greater time coverage helps.



3800 h/year = 1.3 FTE

CTA-Oz Needs Polarimetry!

- Australia has comparatively few technological strengths in CTA areas
- Southern Hemisphere MWL is an area of real strength
- Polarimetry is a niche capability, but a strong one

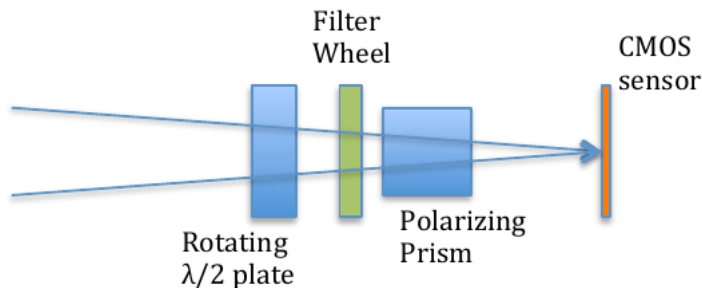
And the ARC seem to agree...

- Construction and commissioning of a prototype polarimeter is part of our new 4-year LIEF
- Polarimetry led by WSU, with testing available at Penrith Observatory

CTA-Pol: Polarimetry for CTA

Construct a polarimeter in the line of HIPPI — mini-HIPPI — HIPPI-2 — PICSARR (Jeremy Bailey and Daniel Cotton)

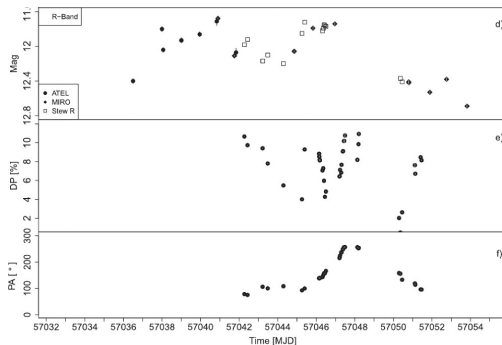
These polarimeters are fast-rotating, high-precision polarimeters for bright stellar targets.



Use high-speed detectors (PMTs, modern sCMOS)

CTA-Pol: What we need

Figure 13. From top to bottom: ultraviolet/optical magnitudes, degree of polarization and EVPA of S5 0716+71 in 2015 ...



Mon Not R Astron Soc, Volume 467, Issue 4, June 2017, Pages 3876–3886, <https://doi.org/10.1093/mnras/stx359>

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Project outline

CTA-Pol:

- Needs to work with fainter sources
- Does not need the same level of precision
 - 1 Blazars are *way* more polarised than stars
 - 2 The polarisation shifts we're looking for are large
- needs to be able to work on a variety of telescopes
 - 1 we don't have a dedicated telescope
 - 2 but there are underused telescopes lying around Oz
 - 3 (and maybe other locations)

Polarimetry for CTA – Where?

- WSU 0.6m
 - ① great for testing, commissioning
 - ② can't go very faint; lousy weather
 - ③ $f/8$
- ANU 2.3m
 - ① currently doesn't work (for us) – this may be fixed
 - ② automation LIEF under review; big mirror
 - ③ $f/8$ Cassegrain under consideration
 - ④ hard to get enough time
- AAT 3.6m
 - ① known to work for polarimetry; $f/8$ -ish
 - ② overkill; resource-intensive; hard to get enough time
- other
 - ① UTas 1m; early discussions positive; $f/8$ -ish
 - ② WA, Qld
 - ③ Other SSO
 - ④ NZ

The Elephant in the Room

Automation is key to a useful programme.
Lots of glass is available and (maybe) usable.
Much of it is uncontrolled.
Sidenote:
PROMPT at SSO

Polarimetry for CTA – Who?

CTA-Oz has been funded to construct and commission CTA-Pol through the new LIEF grant.

Team:

- Jeremy Bailey – UNSW, WSU adjunct; fount of knowledge
- Daniel Cotton – ex-ANU, MIRA, WSU adjunct; consultant
- Ain De Horta – WSU; design, construction, commissioning, science
- Darren Maybour – WSU; design, construction, commissioning
- Miroslav Filipovic – WSU; science
- Gavin Rowell – Adelaide; Lead CI, science
- NFHT – WSU; Local CI, science, chief cook and bottle-washer
- ++...?