# MOPTOP:
# The New Polarimeter for the LT.


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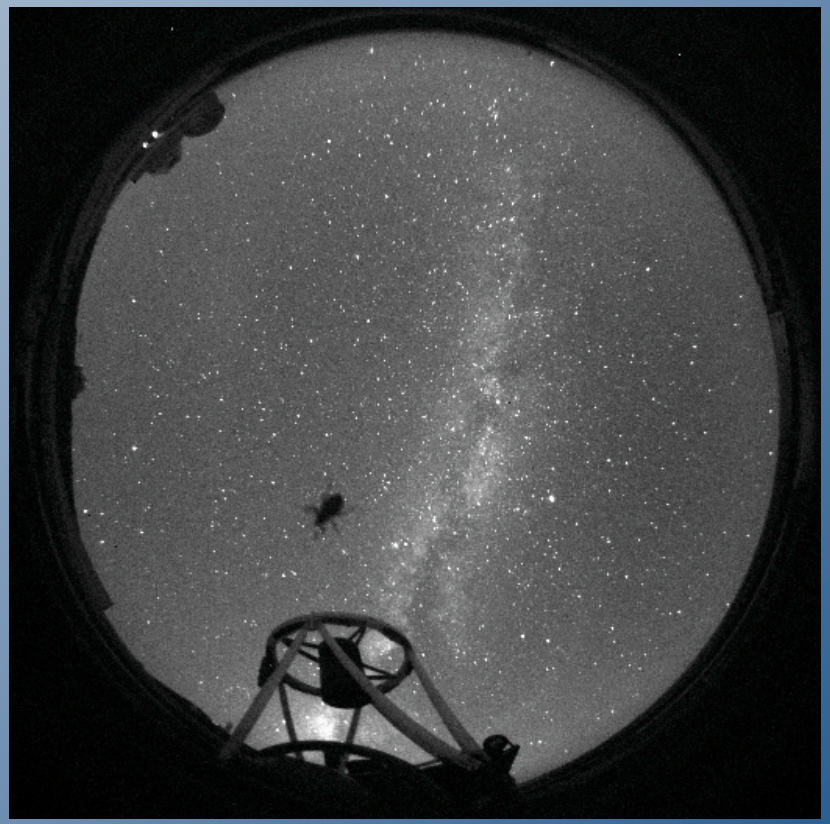
# The Liverpool Telescope

## telescope.livjm.ac.uk

- First light in July 2003, robotic observations began in 2004.
- Designed for *rapid* follow-up of transient sources such as novae, supernovae and GRBs.
- 2 metre diameter primary mirror, 0.62 metre diameter secondary mirror.
- Ritchey-Chretien Cassegrain optics.
- World's largest *fully autonomous*, robotic telescope. *Not* 'remote control'.
- Intelligent dispatch scheduler identifies next observation.
- Clamshell design enclosure; two shutters, three separate portals (3 mins to open).
- Owned and operated (and was built) by Liverpool JM University, with support from STFC (research council) .

# Instrumentation

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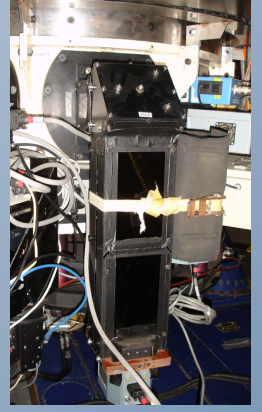
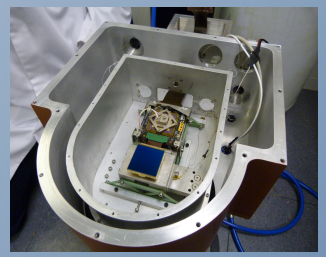
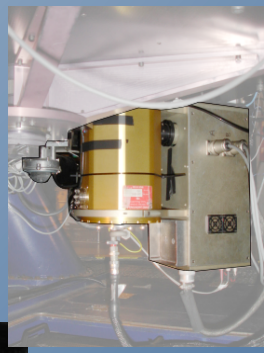
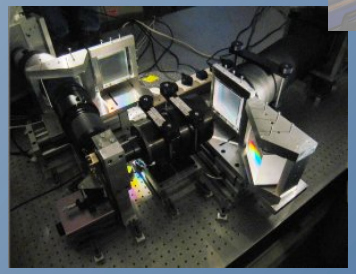
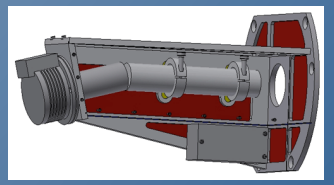


- RISE – 9 arcmin diam. rapid-readout (0.8 sec) optical imager
  Large (1.0" binned) pixels but PSF still fully sampled
  Fixed (V+R) filter
- IO:O – 10x10 arcmin optical imager (many filters)
- IO:I – 6x6 arcmin near-IR imager (H-band)
- FRODOspec – fibre-fed integral field spectrometer
  R~2500/5500, red+blue simultaneously
- SPRAT – long-slit spectrometer
  R~ 350, 400-800 nm wavelength coverage
- LOTUS – long-slit UV spectrometer
  R~300, 320 – 630 nm wavelength coverage
- RINGO3 – tri-color optical polarimeter
- Sky-cameras – three wide-field imagers (all-sky, 9°, 1°)
  Photometry down to 6th, 13th, 18th mag



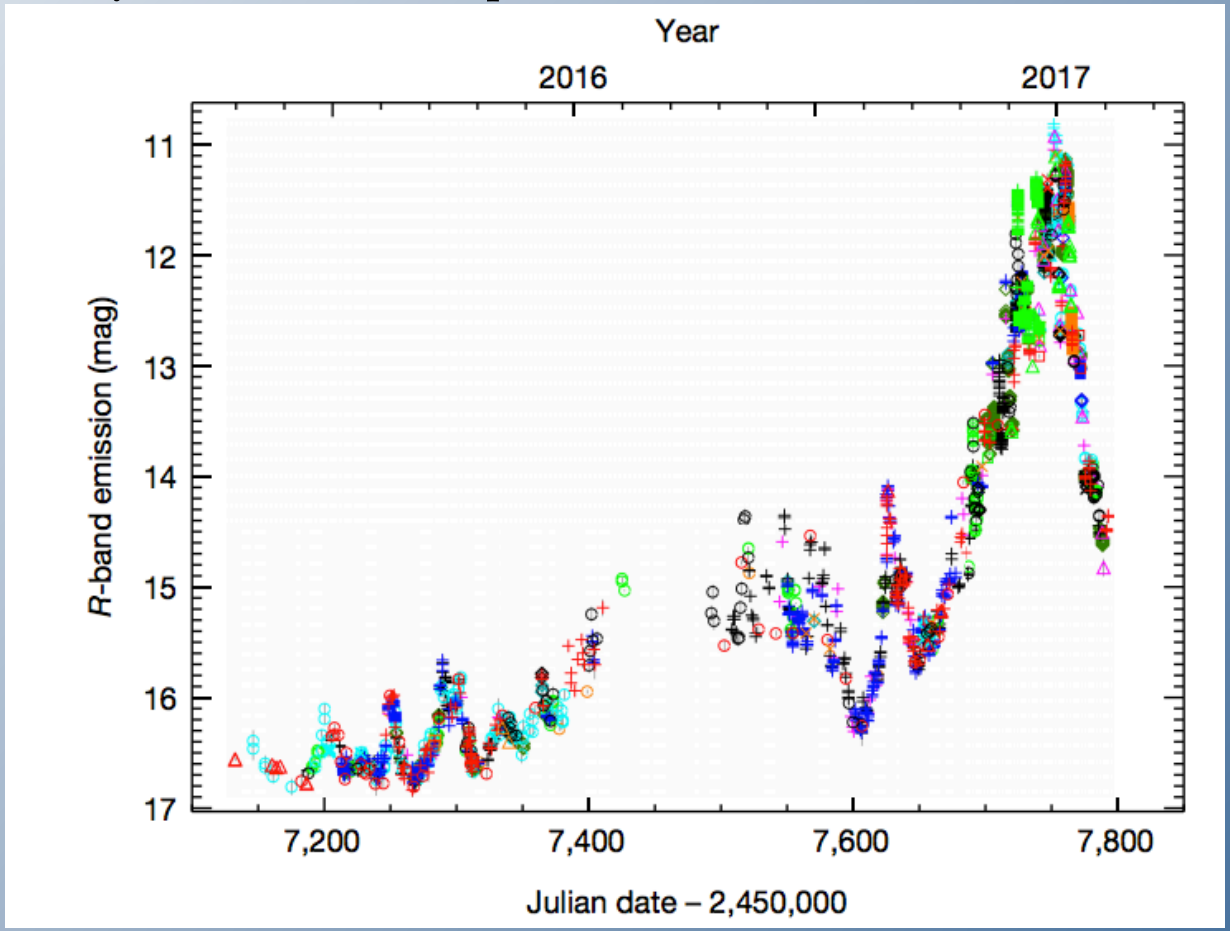






# Polarimetry with Ringo3

- Polarisation used to probe dusty environments and explore magnetic field order/ strength/geometry.
- Main science: GRB follow-up and Blazar monitoring
- e.g. Photometry of CTA 102 as part of the WEBT collaboration.



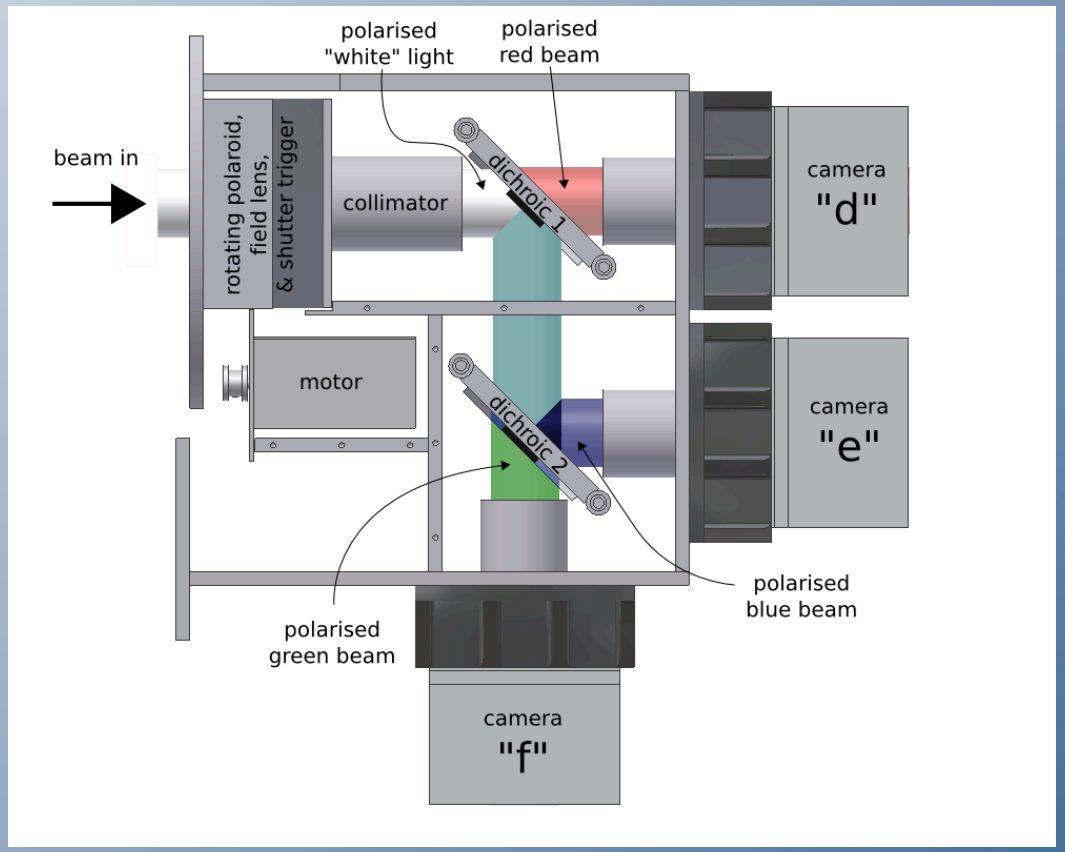

Raiteri et al. 2017 (Nature)

# Tabby's star follow-up

- KIC 8462852 'Tabby's Star' polarimetric follow-up (Steele et al. 2018, MNRAS, 473, 1, 26).
- ~1% photometric dips reported by other observers.
- No evidence of excess polarisation; shows normal polarisation properties consistent with the expected interstellar polarisation for a source at its distance and location.
- Limit on polarisation change of <0.1-0.2% between its dipping and non-dipping states.
- Monitoring continues; should a future ~20% dip be observed, induced polarisation caused by occulting material could be constrained.
- More sensitive measurements will be possible with MOPTOP.

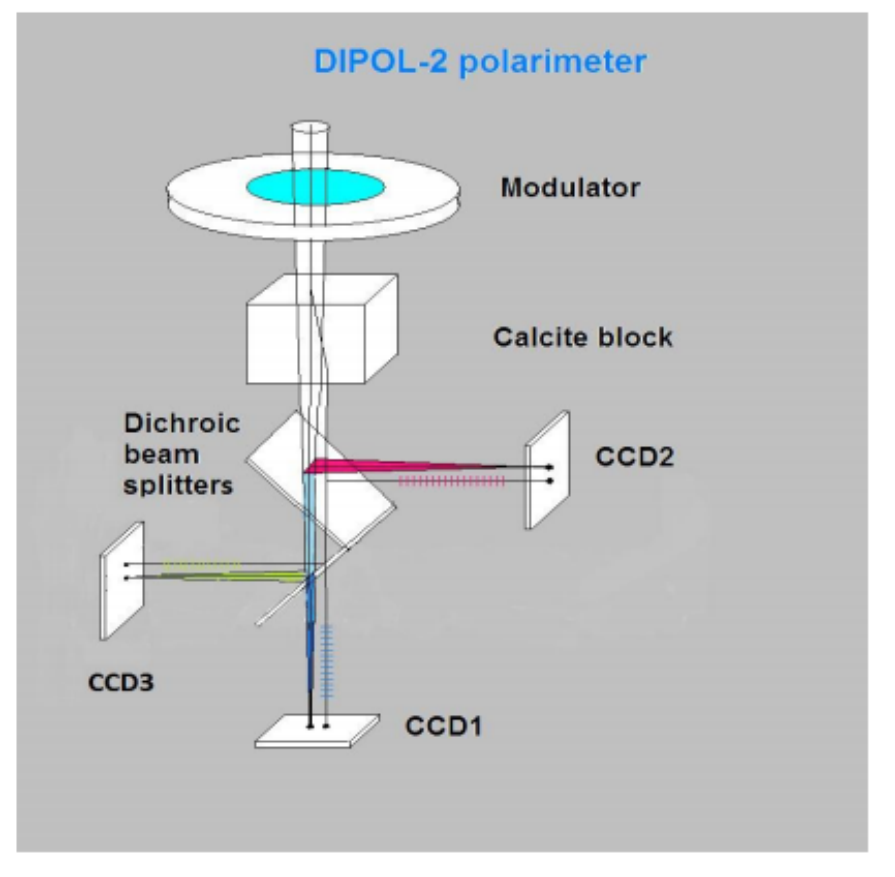
# Ringo3 on the LT

- Rotating Polaroid (~0.4 Hz)
- Three EMCCD cameras:
  Red: 760-1000 nm
  Green: 650-750 nm
  Blue: 350-640 nm
- Designed for GRB science; equal flux in 3 bands.
- Required depolarising Lyot prism to account for instrumental polarisation caused by nonsymmetrical obstructions and specular reflections in light path.



# Wave-plate and beamsplitter polarimeter

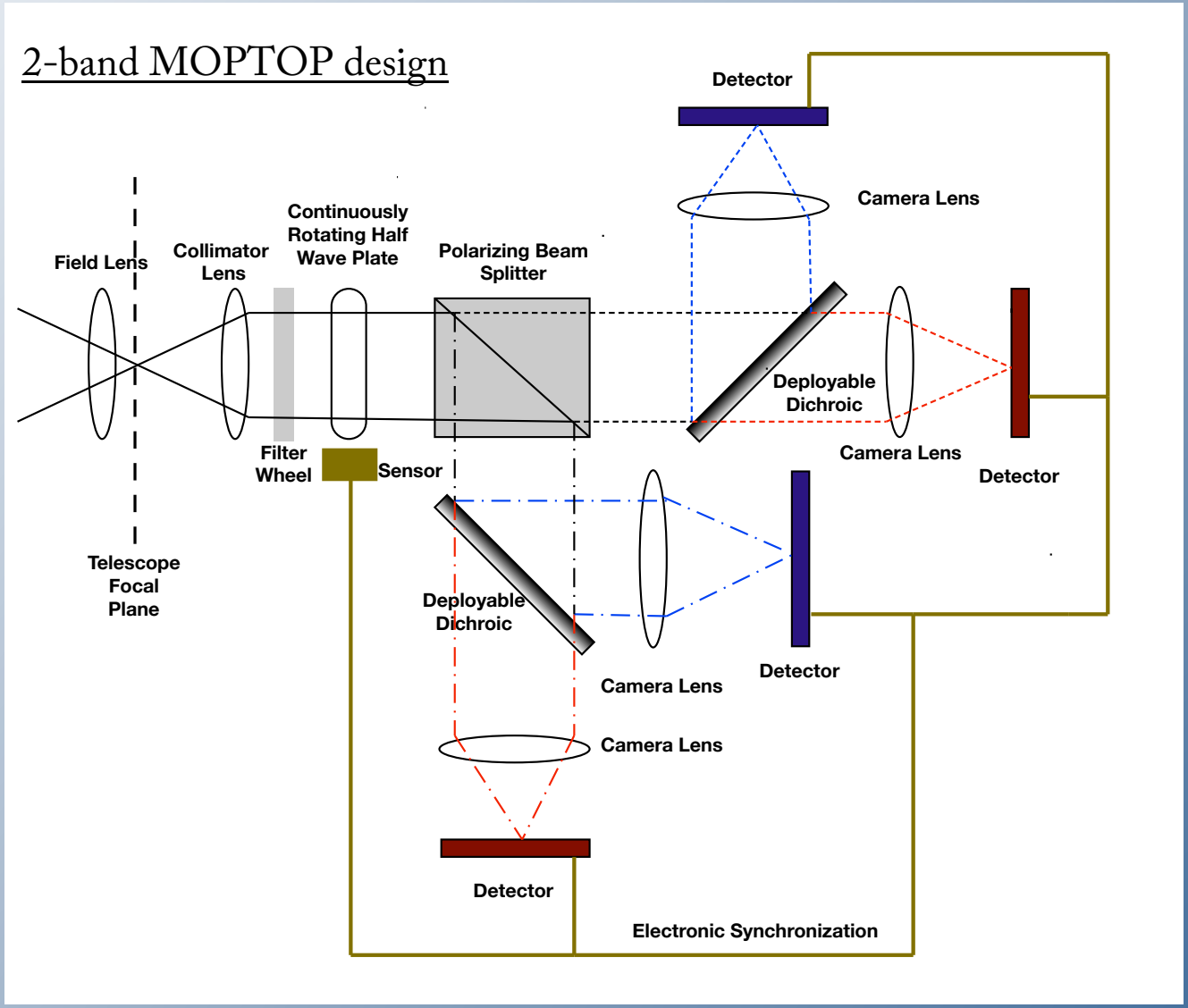
- Rotating wave-plate modulates light
- Calcite block separates parallel and perpendicular plane of polarisation
- Dichroics split light to three standard bands
- Two beams imaged on same cooled CCD
- Double sky noise and potential source identification issues.




V. Piirola et al. 2016, SPIE, Vol. 9147

# MOPTOP

## Multicolour OPTimised Optical Polarimeter




Jermak et al. 2016, SPIE, 9908, 4IJ

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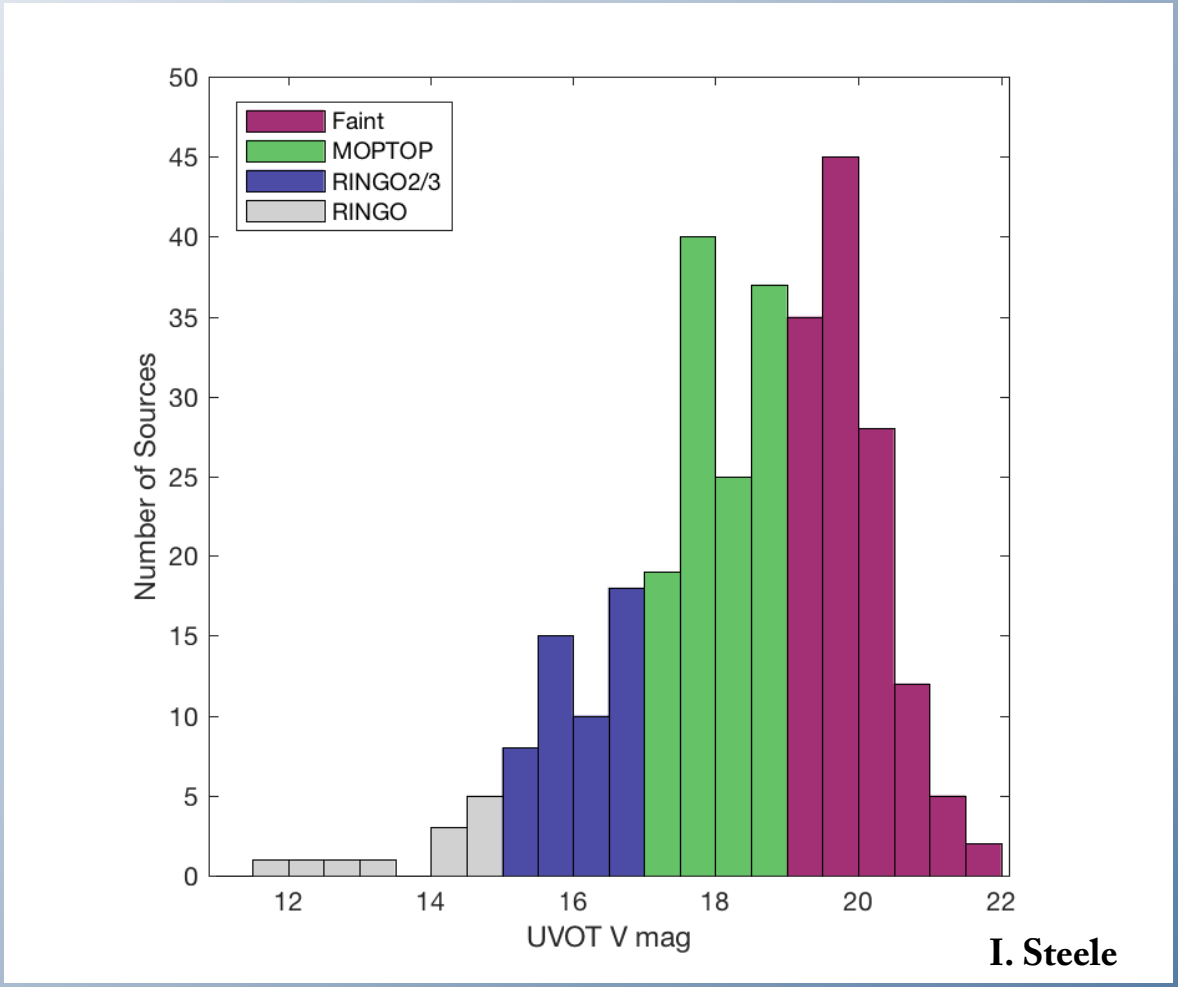
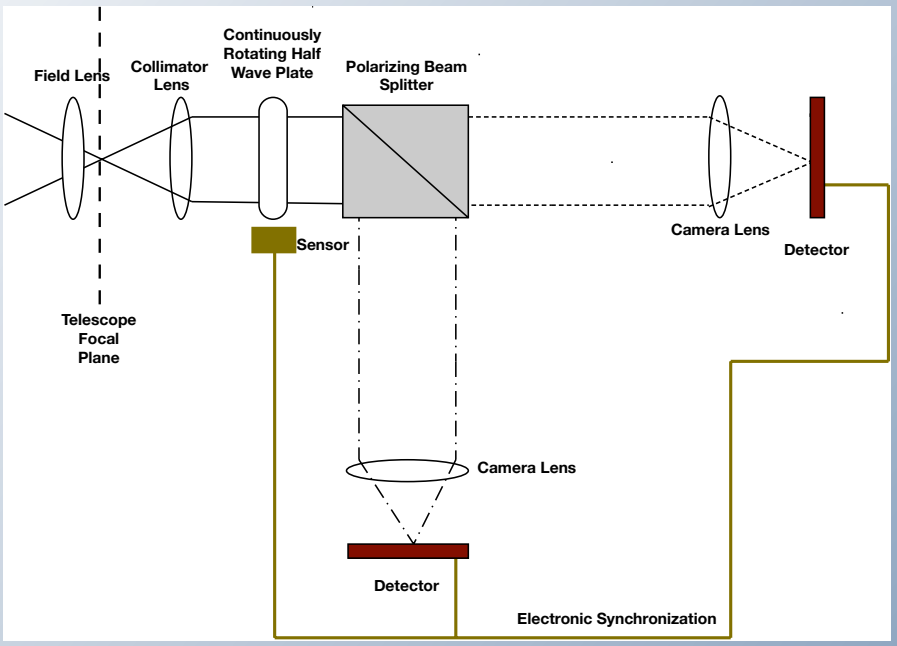



- Afterglow magnitudes for all optically detected SWIFT GRBs (up to May 2016)
- MOPTOP's predicted sensitivity (grey+blue+green) can measure the majority of bursts.

# MOPTOP

## Multicolour OPTimised Optical Polarimeter

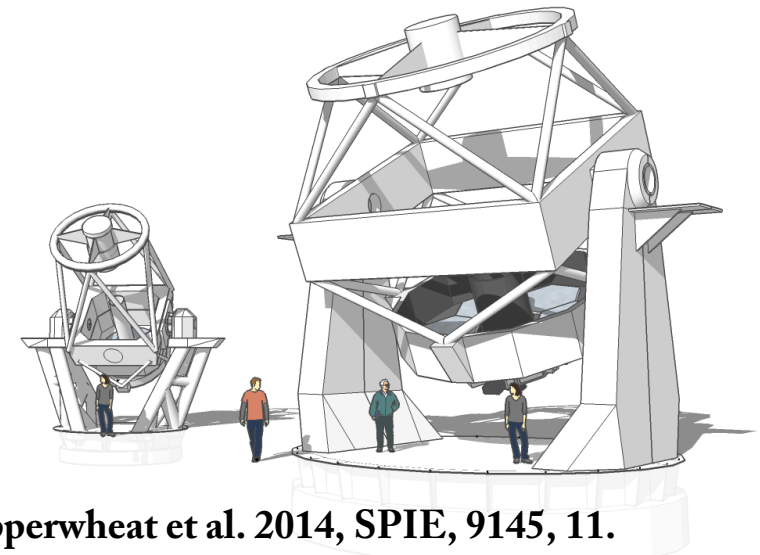



- Current [M]optical bench set-up for single band prototype.
- sCMOS cameras being tested for response to polarised light.
- On-sky testing to commence ~April 2018.
- Full instrument funded by PPRP STFC.
- Science PDRA position starting next year for calibration, data reduction and exploitation of MOPTOP.

# The Liverpool Telescope 2

**telescope.livjm.ac.uk**

- 4 metre fully robotic and autonomous
- Successor to the LT, to be co-located on La Palma (at CMT site)
- Chinese, Spanish, Thai and UK collaboration.
- First light ~2022
- Designed for rapid follow-up of transient sources and gravitational wave electromagnetic counterparts.
- Design office being formed.



**Copperwheat et al. 2014, SPIE, 9145, 11.**

EARLY BIRD REGISTRATION DEADLINE
22nd DECEMBER

# Liverpool 2018

## European Week of Astronomy and Space Science

## Royal Astronomical Society National Astronomy Meeting

ACC Liverpool UK
3–6 April 2018

eas.unige.ch/EWASS2018/
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