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

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

- ~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

2-band MOPTOP design

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

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- 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

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