Slide design and formatting: Ciara Naughton

Time Domain Astronomy with the New Robotic Telescope

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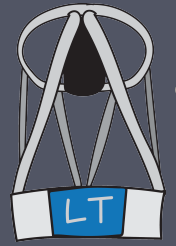
Liverpool John Moores University

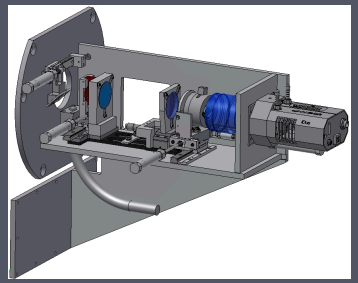
The Liverpool Telescope

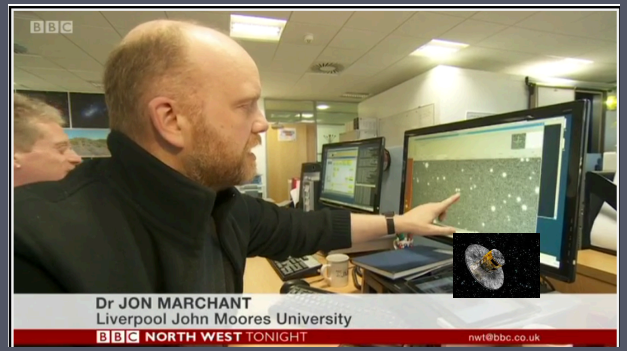


D. Coogan

- 2-metre diameter mirror, Ritchey-Chrétien design
- Robotic observations began in 2004.
- Designed for *rapid* follow-up of transient sources such as novae, supernovae and GRBs.
- World's largest *fully autonomous*, robotic telescope. *Not* 'remote control'.
- Intelligent dispatch scheduler identifies next observation.
- Gaia position monitoring since 2014
- International facility, owned and operated (and was built) by Liverpool JM University, with support from STFC (UK research council).
- Simple, low-cost instrumentation built in Liverpool and housed simultaneously on the telescope.

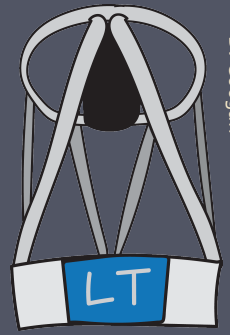
Full video by Daniel López, IAC.





LT spectroscopic classification of Gaia19bok, Atel, May 2019
Kostrzewa-Rutkowska, Z.; Jonker, P. G.; Cannizzaro, G.

Continuing the legacy



D. Coogan

- Celebrating 15 years of Liverpool Telescope robotic operations (22nd April 2004)
- Looking toward the future of time domain astronomy with rapid follow-up
- Continuing the LT's model of simplicity, rapidity and user-driven-instrumentation

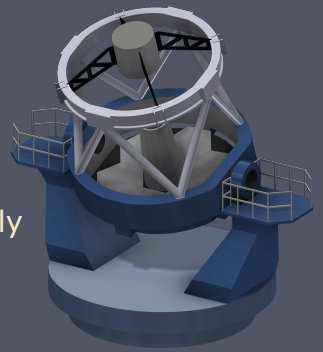
Marco Lam

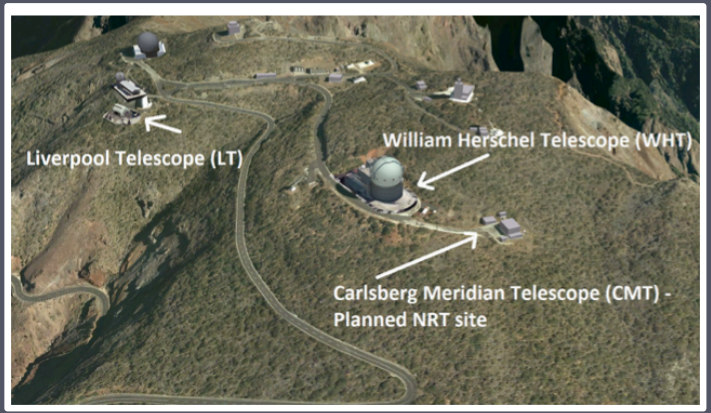
Video: Daniel López IAC

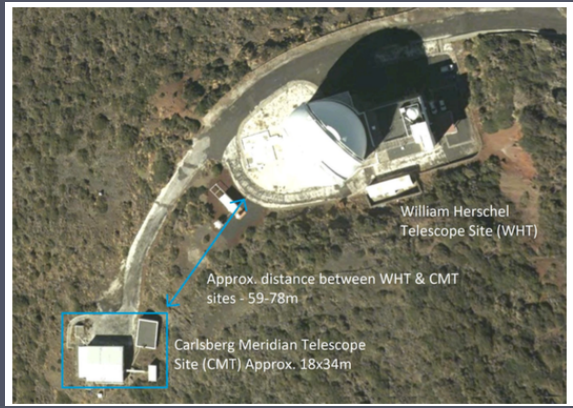
Entropy - Operation Lightfoot
Composed by Luke Moore

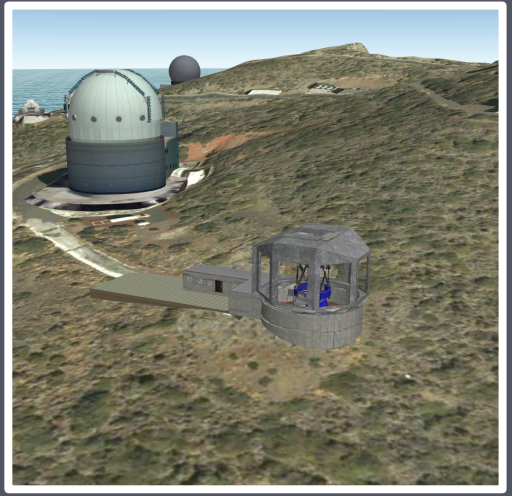
New Robotic Telescope

- 4-metre-class optical Ritchey-Chrétien telescope (f/7.5 @cass)
- Located on **La Palma**, Canary Islands at Roque de los Muchachos
- **Fast slewing** in both Az and Alt (15 deg/s in Az) to meet time-on-target requirements
- **Autonomous, robotic operation** with intelligent scheduler for carrying out observations efficiently
- **Unstaffed facility** with remote monitoring capabilities from Liverpool, UK.
- Occasional routine maintenance and support will be carried out by staff on the island
- Collaboration between UK and Spain, with Thailand and China.





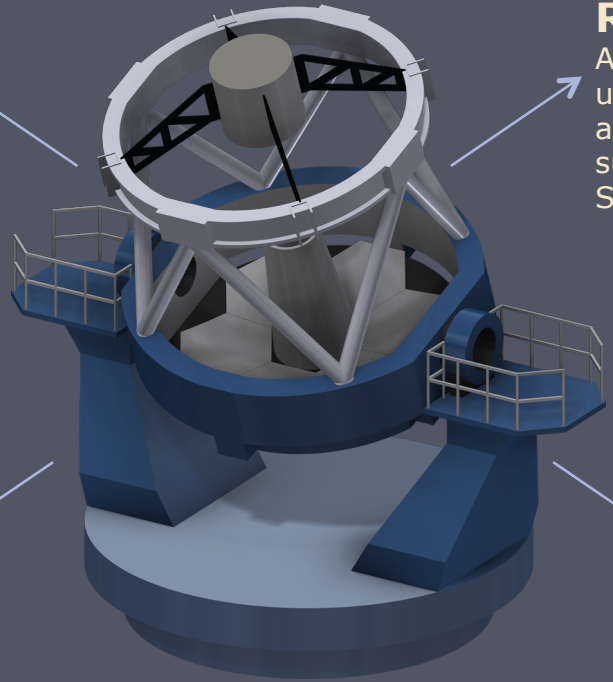




New Robotic Telescope

Flexible
time domain astronomy – featuring a range of smaller scale instruments for specific science cases

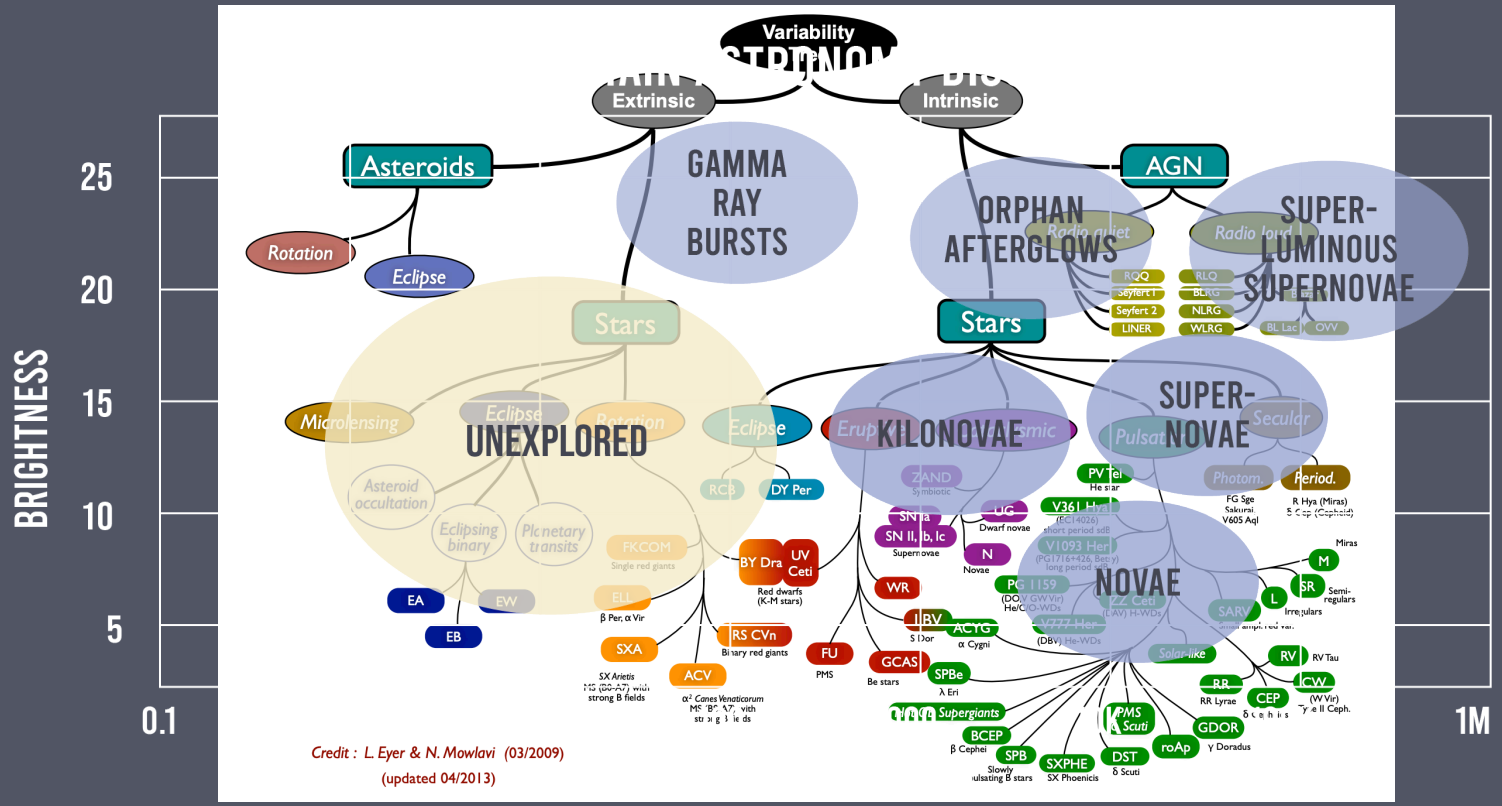
Robotic
Allows scheduled observations at an unstaffed facility which can respond automatically to triggers from survey facilities such as LSST, SVOM, SKA, CTA.



Fast
Follow-up of transient phenomena –on target and taking data within 30 seconds

Sensitive
The first 4-metre class optical robotic telescope. Four-times more sensitive than LT.

Science Case



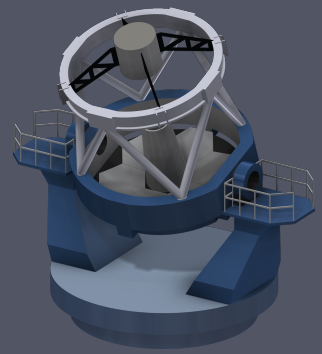


Image taken from TMT Science Case 2015

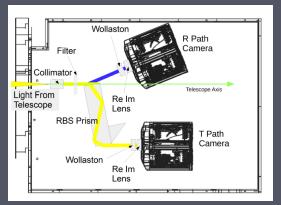
Content from Éamonn Harvey and Eoin O'Connor

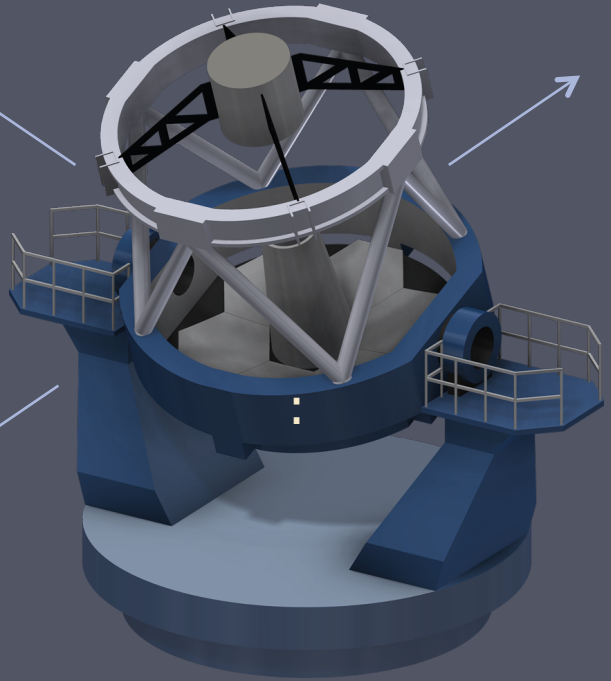
Instrumentation

Polarimetry
-high time-resolution polarimeter (MOPTOP or GASP)

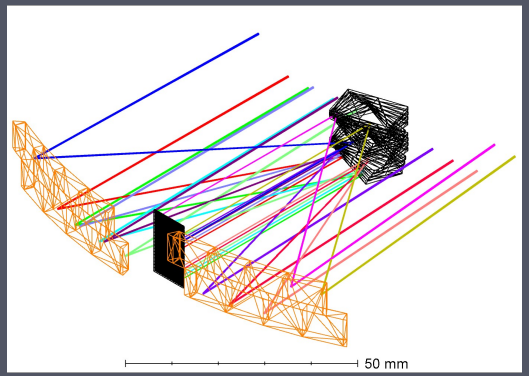
MOPTOP

GASP

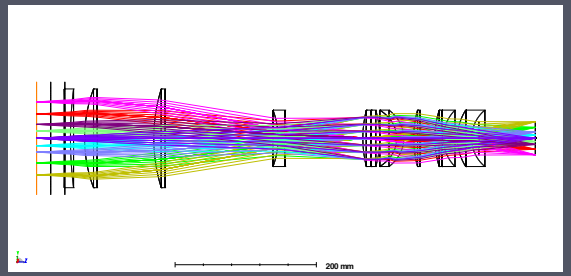




Spectroscopy
-2 Arm IFU spectrograph (CLISTE)



Photometry
-fast readout photometer & wide field imager (GLIC)

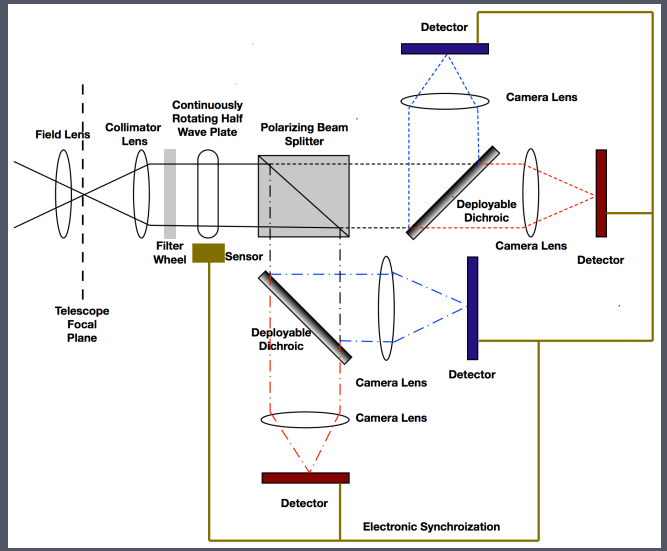


Stable and diverse instrument suite

Polarimetry

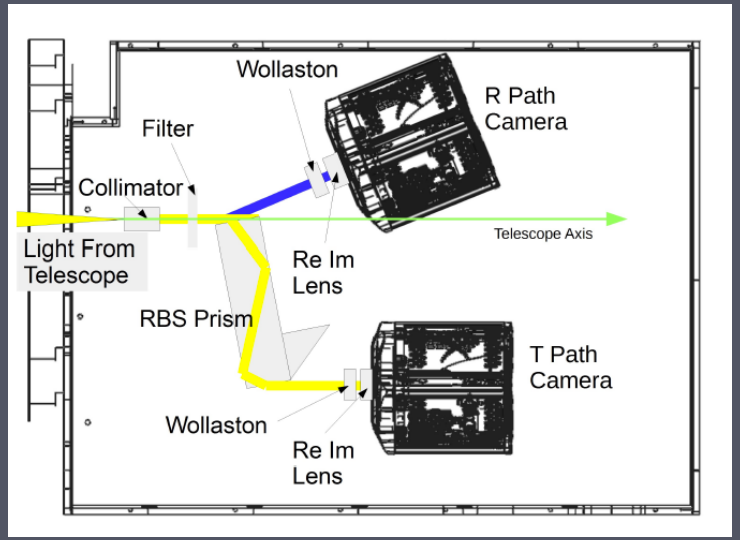
MOPTOP Shrestha et al. 2020, in prep

- Multicolour OPTimised Optical Polarimeter (MOPTOP)
- Half-wave plate and beam splitter design
- Current single band prototype tested on LT
- On-sky and available Spring 2020



GASP

- Galway Astronomical Stokes Polarimeter (GASP).
- High-speed, full Stokes imaging polarimeter
- Measures the complete Stokes vector from one exposure
- No moving parts or modulated components

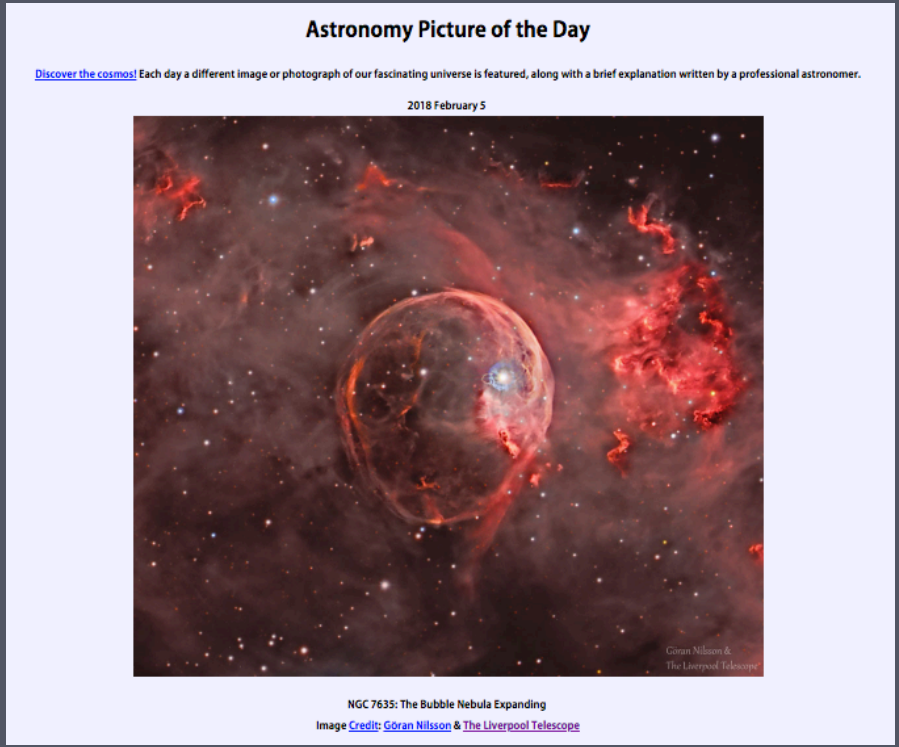


Eoin O'Connor

Expanding the NSO

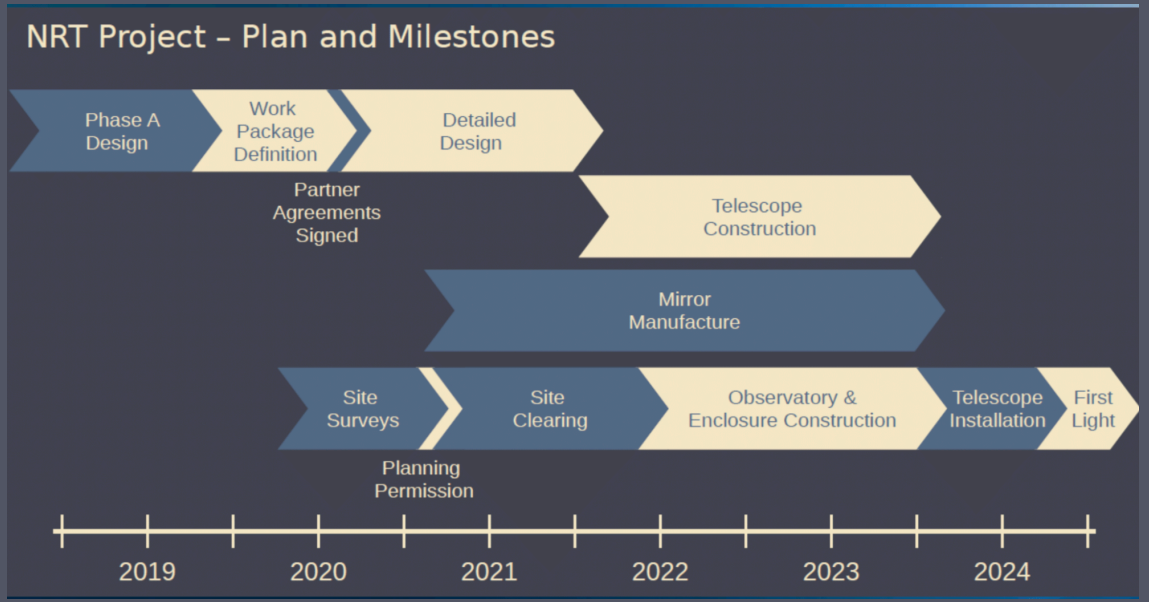
- National Schools' Observatory
- "Free educational access to a professional, robotic telescope."
- 10% of LT time dedicated for use by (~3000) schools in UK and Ireland (~160,000 observations since 2004)
- Simple user interface to allow children to request data from telescope.
- Organise outreach events and lectures.
- Activities and projects aligned with curriculum available on website.
- More telescope time through NRT/LT -> reach more schools in UK, Ireland and internationally.

www.schoolsobservatory.org



Project Status

- Phase A design board review complete; NRT team working on comments (many thanks to Vik Dhillon and others).
- Strong partnership with IAC and University of Oviedo, with potential in-kind contributions from different countries.
- Application to CCI provisionally approved, site surveys to follow.
- Provisional investigation suggests no negative impact on WHT
- Meetings with a variety of mirror, dome and telescope companies to discuss design: potential for DCT-like structure.
- Continue to encourage collaborations with different universities and countries for instrumentation or other in-kind contributions.

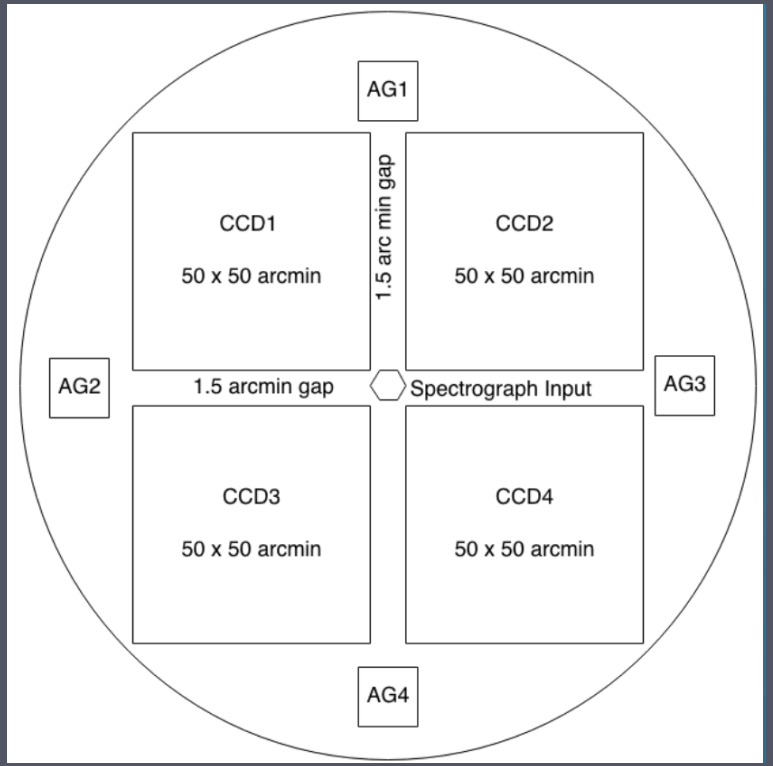


Phase A outcome

- Convened in May 2019.
- Led by Prof. Vik Dhillon, Sheffield University, with other experts in telescopes, optics, instrumentation and software.
- “Extremely exciting, innovative project with the potential to do world-leading science.”
- Monolithic mirror considered lower risk than segments
- Favour fast-slewing dome over clamshell enclosure
- Prioritise U-band capabilities (+ spectrograph if possible) over K-band.
- Allow for possibility of Nasmyth use in future

Future of the LT

- LT to stay in operation as part of a combined facility with NRT
- More time available for National Schools' Observatory
- Plan to replace current instrumentation suite with single, prime focus, 2x2 degree field imager (for GW counterpart searches)
- Straight-through port for spectrograph
- Additional budget required



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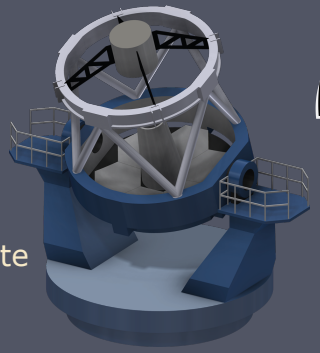
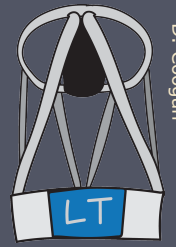
Summary





D. Coogan

- LT ideal facility for transient follow-up; rapid response, flexible instrumentation suite
- NRT project office work ongoing (mechanical, optical, software)
- Future instrumentation capabilities for joint facility established
- Keen to attract new partners/collaborators and promote science collaborations
- Site analysis confirms no impact on WHT