LIVERPOOL TELESCOPE 2 and LOFT

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The Liverpool Telescope

The Liverpool Telescope (LT) is a robotic, 2m alt-az telescope sited at the Observatorio del Roque de los Muchachos on the Canary Island of La Palma. It is owned and operated by Liverpool John Moores University, with financial support from STFC. The LT is the largest robotic telescope in the world, and operates fully autonomously without night-time supervision. The robotic software decides what and how to observe, and has responsibility for the safe operation of the telescope throughout the night.

The LT benefits from a diverse instrument suite, which provides capabilities such as optical/infrared imaging, high cadence ('lucky') imaging, intermediate resolution IFU spectroscopy, and fast readout tri-band polarimetry. Instrument changes take minutes and so can occur at any point throughout a night.

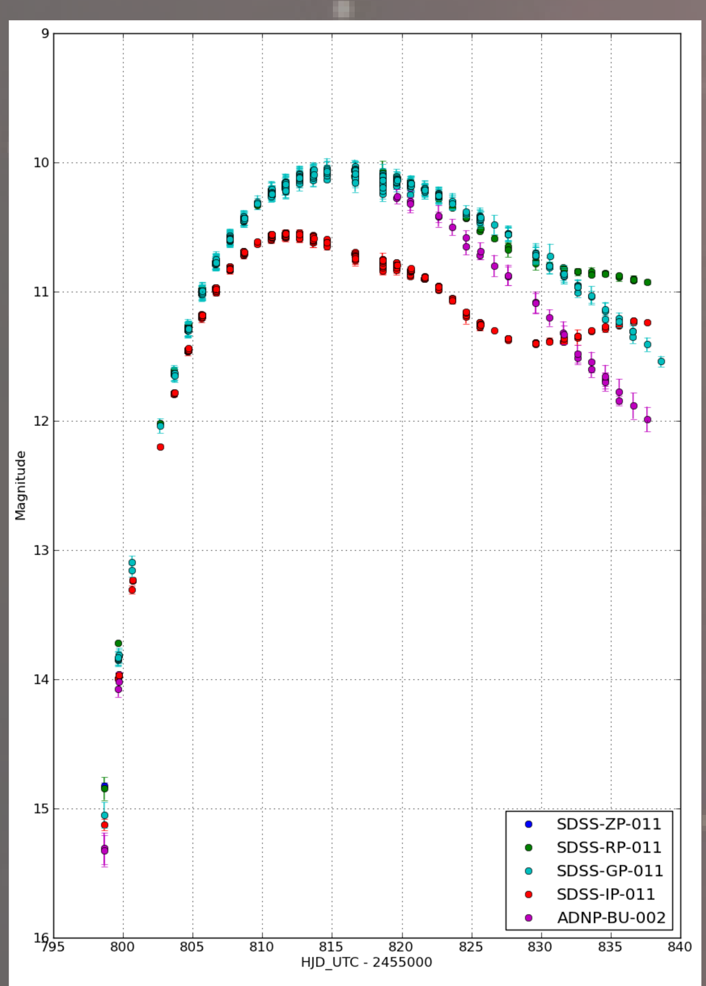
The flexibility of LT observing modes makes it particularly suitable for time domain astronomy. In particular, robotic observing allows for rapid follow-up, and so the LT has proved to be an excellent tool for the study of astrophysical transients such as Gamma-ray bursts (e.g. Mundell et al., 2007, Science; Steele et al., 2009, Nature) and Supernovae (Nugent et al., 2011, Nature).

Liverpool Telescope 2

The LT is expected to stay competitive until at least 2020. In September 2012 LJMU committed £200,000 to fund a feasibility study for a successor facility to come into operation at around that time. It is expected that 'Liverpool Telescope 2' will also be focused on exploiting the time domain, since this has been such a successful area for the LT. Additionally the next couple of decades promises to be an exciting time for time domain astronomy: ground based synoptic surveys such as PTF, Pan-STARRS and LSST will report large numbers of optical transients, and facilities such as SKA, Gaia, LOFT, SVOM and CTA will find exotic transients and time variable objects across the electromagnetic spectrum.

Ground-based optical follow-up will be vital for the exploitation of the objects discovered by these facilities. In particular there will be a pressing need for intermediate resolution spectroscopic follow-up – even today only a small fraction of transients are classified. A modern spectrograph on a dedicated 4m class optical telescope, combined with the speed and flexibility of robotic operations, will be a powerful tool for transient follow-up, building on the work of surveys such as PESSTO. We anticipate LT2 will not be limited to spectroscopy: the instrumental diversity of the LT is one of its core strengths, and this is something we would like to continue.

We are currently in the process of choosing our preferred site for LT2. One interesting possibility is co-locating it with the LT on La Palma. The two telescopes could then provide a combined capability, offering the potential for simultaneous photometry and spectroscopy or using a wide field instrument on LT to quickly improve the localisation of transient detections before spectroscopic follow-up with LT2.



Light curve of SN2011fe, discovered very soon after the explosion by PTF. The rapid response of LT led to the contribution of some of the first photometric follow-up observations, as well as probably the earliest SN Ia spectrum ever taken. Synpotic surveys will discover many such objects over the coming decades, and LT2 will provide the most rapid follow-up (Image credit Fulton/LCOGT/PTF)

Science with LT2

The LT has been particularly successful at following up extremely rapidly fading transients such as Gamma-ray bursts. This is due to both its robotic nature but also the design of the telescope and the dome, which allows for extremely rapid slewing. This is a capability we hope to enhance with the 4m LT2: our aim is to be on target within tens of seconds of the alert. As well as conventional GRB follow-up, this capability will be crucial for more exotic transients, such as the rapidly fading counterparts of merging NS/NS or NS/BH binaries that will be detected by aLIGO as gravitational wave events.

Supernovae do not require such a rapid response, but synoptic surveys will detect many SNe very soon after the initial explosion (such as SN2012fe, left). Early time spectra and photometry help elucidate the nature of the progenitor, and the flexibility of robotic observations allows for high cadence monitoring of SNe at early times and over the peak.

There is a strong synergy between LT2 and LOFT. The flexibility of robotic observations makes LT2 ideal for simultaneous optical/X-ray studies of phenomena like tidal disruption events. Follow-up of transients detected by the LOFT Wide Field Monitor also forms an important part of the LT2 science case. The wide energy range and field of view of WFM means LOFT will detect large numbers of transients such as Type-I X-ray bursts, GRBs and Soft Gamma Repeater events, all of which would benefit from complementary optical follow-up. A core strength of the LOFT mission is that it has been designed with ground based follow-up in mind, with a real time burst alert system and good (~1') localisation of transients. With this capability LOFT and LT2 could form a powerful and productive partnership, akin to what we see today with Swift and LT.

We would be keen to hear your views on LT2. For more information contact c.m.copperwheat@ljmu.ac.uk, or attend our talk in the 'Future instruments and facilities' session at this year's NAM.

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