Las Cumbres Observatory spectrographs acquire target robotically

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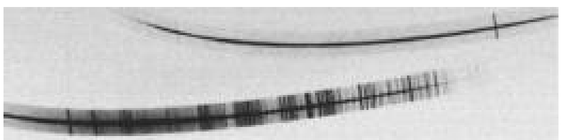


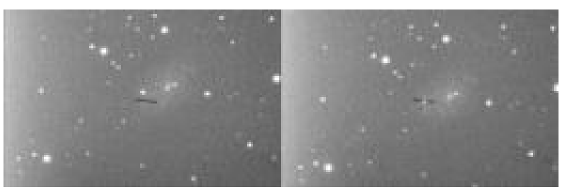
This image shows two spectra of SN2012cg. The upper spectrum covers 320 to 570nm, the lower from 540 to 1000nm. Credit: David Sand, LCOGT

Two identical FLOYDS spectrographs, installed in recent weeks at telescopes 6,000 miles apart, robotically acquired a supernovae target this week. Due to the level of precision required and the difficulty involved, few if any, other ground-based spectrographs have ever achieved this milestone.

"This is unprecedented," staff astronomer David Sand explained. "In a matter of just a few weeks, Las Cumbres Observatory was able to install the spectrographs, achieve first light, and begin robotic operations. It's unheard of." Sand is already gathering data from the spectrographs to support his research.

The FLOYDS spectrographs —- unique for their combination of design, capabilities, and level of automation —- were named after the band Pink Floyd, specifically for their album artwork on The Dark Side of the Moon, which shows a prism dispersing white light into the colors of the rainbow. Instead of sunlight, FLOYDS makes rainbows out of distant supernova explosions and gamma ray bursts to probe their chemical compositions and inner workings.

FLOYDS, installed on Faulkes Telescope North (FTN) at Haleakala Observatory and on Faulkes Telescope South (FTS) at Siding Spring Observatory, are some of the first spectrographs designed to acquire astronomical targets, observe them, and process the data without the aid of on-site astronomers. Observations that are currently rare, like studies of supernovae and gamma-ray bursts hours after their explosion, are expected to be made routine, since the telescopes can get on-target much more rapidly than they could if they were operated by people.



Pointing FLOYDS requires aiming at an offset from the target (left), verifying the location using nearby stars, then centering the telescope on the target, all automatically. Credit: David Sand, LCOGT

Robot Spectrographs

While robotic imaging telescopes are becoming increasingly common in astronomy, robotic spectrographs are rarely built for ground-based observatories. This is because the opening to a spectrograph is a narrow slit, and getting starlight to fall through the slit requires pointing the telescope to better than two-tenths of an arcsecond. This is a daunting proposition —- an arcsecond is equivalent to the width of a human hair as seen from 10 yards away.

Another unique feature of the spectrographs is their ability to observe the entire visible spectrum in a single exposure. "The FLOYDS spectrographs are sensitive to light over the entire range of visible colors," explained LCOGT Science Director, Tim Brown, "including some that cannot be seen by the human eye."

Most spectrographs require two exposures to see over such a wide range, but FLOYDS uses a clever trick to double the range it captures. Light entering the spectrograph strikes a diffraction grating, which splits the light out into a spectrum. But each diffraction angle is shared by two radiant frequencies. Most spectrographs, to achieve an unmuddied spectrum, filter out the higher or lower spectrum, leaving just half the range. FLOYDS adds a prism instead, simply offseting the location of the higher frequency spectrum to a different location on the digital camera, and capturing a much wider range of colors.

Las Cumbres Observatory Global Telescope (LCOGT) has owned and operated FTN and FTS since 2005. To date, observing on these telescopes has been limited to imaging without spectroscopic capabilities. A team from LCOGT including lead mechanical engineer Matt Dubberley, astronomer David Sand, telescope technicians Mark Elphick and Mark Willis completed the installation of the spectrographs during June and July.

Finding New Things

Sand, who worked closely on the development and testing of the spectrographs, and who managed the installations, said "FLOYDS is the next step in understanding the physics behind time varying astrophysical events. We will be able to identify supernovae earlier than ever before, perhaps gaining insight into their explosion mechanisms. FLOYDS also allows us to monitor objects for months on end, something that is very difficult to arrange with non-robotic telescopes. Coupling robotic spectrographs into our telescope network gives astronomers a huge edge."

When supernovae and gamma-ray bursts occur, astronomers may have only minutes or hours to capture the fast-evolving details, such as observing the actual supernova shock breaking out of a red giant star. Such events have been seen only a handful of times, but these observations are critical in linking the explosions to the progenitor star, which cannot otherwise be seen. Previously, shock breakouts were only seen when the astronomers got lucky. The right observer had to be at the right telescope, at the right time, when a supernova close enough was discovered early.

But robotic spectrographs like FLOYDS can be programmed to automatically observe targets from a sky survey, and interrupt other telescope observations to get them. And by having two spectrographs on opposite sides of the globe, chances are improved that one of them will be in the dark and ready to observe in the hours immediately following a supernova explosion.

"Any time you get a new capability in astronomy, you find new things," says Andy Howell, leader of the supernova group at Las Cumbres Observatory. "This is my dream spectrograph. There's a whole universe of stuff out there we've barely glimpsed because of technological limitations. Not any more!"

Provided by Las Cumbres Observatory Global Telescope