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Precision optics

A New Zealand company that specialises in high-tech optics is taking on the world.

From an unassuming industrial park on the outskirts of a Wellington suburb, a New Zealand company is delivering world-leading solutions for some of the planet’s most important astronomy projects, including several in Australia.

Earlier this year KiwiStar Optics produced one of the world’s largest astronomical lenses — at 1.1 metre in diameter — for the William Herschel Telescope project in Spain’s Canary Islands. Its most recent project has been building and installing a spectrograph as part of the MINERVA-Australis telescope array at Queensland’s Mount Kent Observatory.

Despite a history dating back decades, and an industry reputation for producing state-of-the-art equipment needed to produce some of the world’s best lenses, KiwiStar Optics manager Sandra Ramsay admits the company has a low profile outside astronomy circles.

“We design, manufacture and install everything from one-off components to complete optical systems. Our work includes building large precision lenses for some of the world’s best telescopes, astronomical spectrographs, and optical components and instruments,” she said.

Ramsay says the business is primarily based around two products: large, customised and highly-specialised telescope lenses up to more than 1 metre in diameter, and astronomical spectrographs.

From humble beginnings KiwiStar Optics is a business unit of Callaghan Innovation, New Zealand’s Innovation Agency, and is based at the Gracefield Innovation Quarter, home to a cluster of high-tech businesses and Callaghan Innovation’s Research...
“We’re one of only a handful of companies in the world making 500 mm to 1 metre lenses,” said Cochrane.

KiwiStar Optics has a core team of 14 staff but we also tap into numerous skill sets and expertise from across Callaghan Innovation’s much larger pool of scientists, engineers and technicians who work with us. We also have a strong supply chain of New Zealand businesses who complement our skills and expertise.”

Dave Cochrane, KiwiStar Optics’ team leader of optical manufacturing, says that while the company’s genesis was the formation of a government optics workshop after World War II, the KiwiStar Optics name — and its current business focus — date back to 2004 when a strategic decision was made to focus on large optics.

“With global spending on large telescopes growing, and increasing competition around the manufacture of smaller lenses — up to 300 mm diameter — we decided to focus on making large optics for astronomy, essentially starting at 400 mm diameter. We’re one of only a handful of companies in the world making 500 mm to 1 metre lenses,” said Cochrane.

One of the world’s largest lenses
An example of the world-leading work being done by KiwiStar Optics is its contribution to the William Herschel Telescope (WHT), Europe’s second-largest telescope, based on the island of La Palma in the Canary Islands, Spain.

As reported in the June 2018 issue of Australian Sky & Telescope, KiwiStar Optics manufactured six lenses for the telescope’s Prime Focus Corrector, with the largest being 1.1 metre in diameter. The lenses will form a crucial part of a new multi-object spectroscopy facility being constructed for the telescope, called WEAVE (WHT Enhanced Area Velocity Explorer).

WEAVE will enable simultaneous observations of up to a thousand targets over a 2-degree field of view, and is designed to complement information produced by other European astronomical projects. It will operate for a minimum of five years and conduct large-scale surveys of over 10 million objects, including stars in the Milky Way.

Spectrograph for Mt Kent
KiwiStar Optics’ most recent major contract, and the latest in a growing number of Australian projects, is the delivery of one of its ‘KiwiSpec’ spectrographs for the University of Southern Queensland’s Mt Kent Observatory.

Scheduled for completion mid-2018, the KiwiSpec R4-100 spectrograph is part of Mt Kent’s expansion to include the MINERVA-Australis telescope array.

The multi-telescope MINERVA-Australis project complements the four-telescope MINERVA (MiNiature Exoplanet Radial Velocity Array) array in Arizona, USA, with both facilities dedicated to the observation of exoplanets found by NASA’s Transiting Exoplanet Survey Satellite (TESS) space mission.

The spectrograph is compact, bench-mounted, in vacuum, optical fibre-fed and enables six optical fibres to be sampled at a time. It will enable precise radial velocity measurements (whether an object is moving towards or away from Earth) of less than 1 metre per second, as well as transit studies (where one celestial object briefly eclipses another).

Close Australian connections
Ramsay says KiwiStar Optics is active in Australia through its relationship with Electro Optic Systems (EOS), a Canberra-based company with a significant space systems division.

“We’ve sub-contracted to EOS for several large pieces of work for Australian observatories and we’ve also partnered with them to deliver some large international projects. It’s a very constructive and mutually beneficial relationship, and one we are keen to continue and grow,” she said.
The relationship began when KiwiStar Optics sub-contracted EOS to build the Prime Focus Corrector (PFC) for FMOS, a fibre-fed, wide-field spectroscopy system for the Subaru Telescope in Hawaii, which enables near-infrared spectroscopy of more than 100 objects at a time. This was installed in 2007.

KiwiStar Optics later partnered with EOS to build the PFC for the SkyMapper telescope at Siding Spring Observatory, Coonabarabran, which is undertaking the five-year Southern Sky Survey.

Other Australian projects KiwiStar Optics has been involved with include building a prototype image slicer for Australia National University’s Wide-Field Spectrograph (WiFeS), installed on the 2.3-metre telescope at Siding Spring Observatory.

The company has worked on projects for Australia’s largest optical telescope, the 3.9-metre Australian Astronomical Telescope, also at Siding Spring. This has included producing precision optical components and, most recently, carrying out the optical fabrication, mechanical design and manufacture, assembly and testing of the collimator optics and four large aperture cameras for the HERMES spectrograph.

KiwiStar Optics also manufactured a set of three-element corrector optics for the Harlinger telescope at Tasmania’s Greenhill Observatory.

Future looks bright
Ramsay says work is not letting up and KiwiStar Optics has a substantial list of large contracts on its order book. Projects in the pipeline include the manufacture of more large lenses, building three high-resolution cameras for the VISTA telescope in Chile, and constructing more spectrographs.

With international demand for its expertise continuing to grow, the future looks bright for this New Zealand company with its sights set on helping those with their eyes set on the stars.

Simon Hendery, a New Zealand-based technology and innovation writer.