# Controlling a giant telescope

**COMPANY:**
Observatory Sciences Ltd.

**INNOVATION:**
Software to control the world's largest solar telescope. This is the biggest telescope of its kind with unusual and complex optics. Similar telescopes have cost about $40 million, whereas this one is about $300 million

**MARKET:**
Observatory Sciences Ltd is in two main areas of control systems software, astronomy and high energy physics. As well as telescopes, the team has worked on the Diamond Synchrotron in Oxfordshire and the Australian Synchrotron

**INSPIRATION:**
"We wanted to do this kind of work commercially. Before that, it had always been done by academics or in government research institutes"

**TURNOVER:**
About £400,000, which is based on consultancy income

**Over the next two to three years, Observatory Sciences Ltd. a scientific software consultancy with four staff in Cambridge and two at the Sussex Innovation Centre, will produce software to control the world's largest solar telescope.**

The company has been awarded a contract from the United States Association of Universities for Research in Astronomy. The Advanced Technology Solar Telescope (ATST) will have a four metre diameter primary mirror and be sited at an altitude of 10,000 feet on the summit of Haleakala ("House of the Sun") on the Hawaiian island of Maui.

The total construction budget for the project is $298 million.

Observatory Sciences' contract covers the production of the ATST telescope control system software. At the heart of this is multi-axis motion control of the servo drives in the telescope mount, which requires monitoring changes in atmospheric temperature, pressure and humidity, to set the altitude and azimuth of the telescope to observe the Sun accurately. Many telescope subsystems are coordinated by the software, such as the dome, cooling systems, primary and secondary mirror positioning and wave front sensor systems.

Philip Taylor, a director at Observatory Sciences, said: "With such a large mirror pointing directly at the Sun, cooling of the equipment is a huge issue for this project and dedicated thermal management is provided for each of the telescope subsystems."

Observatory Sciences was set up in 1998 after the Royal Greenwich Observatory, which moved from East Sussex to Cambridge in 1990, had closed. "I used to work for the Royal Greenwich Observatory, and when it went, a few of us decided to set up a commercial business." Observatory Sciences' team of software specialists have a background in astronomy and computer science. "Rather than having a product we can sell repeatedly with a licence, everything we do is a one off," said Mr Taylor. "With this kind of cutting edge project, governments in particular cannot find anything off the shelf that they want. So everything has to be very much bespoke."

*How did such a small business win a contract for such a huge project?*

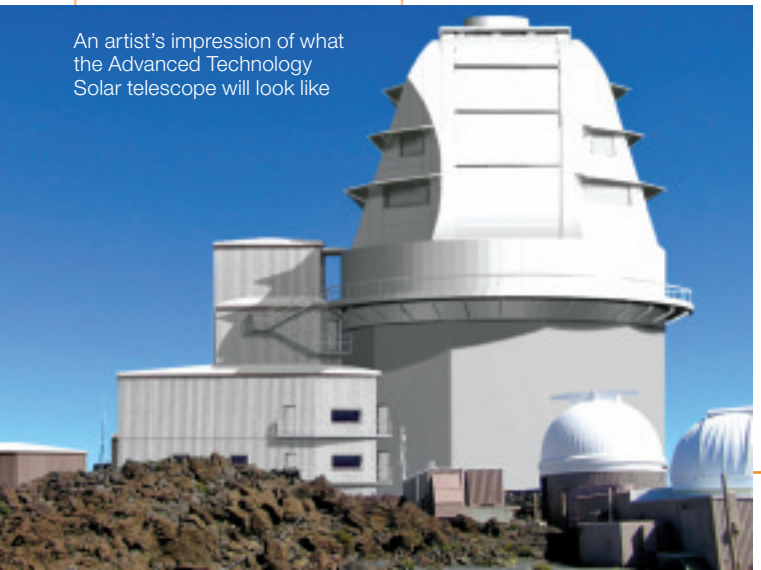
But how did such a small business win a contract from such a huge project? "We have been involved in the Gemini project which was about the same size and built two telescopes, one in Chile and another in Hawaii. We have personal contacts with people in this area, and we are effectively the only commercial company in the world which can do this." Theirs is a niche business with no competitors – but Mr Taylor said there is always the possibility that governments won't contract out but do the work in house themselves.

The ATST project is a collaboration of nearly all of the American institutions involved with solar physics and is run by the United States National Solar Observatory (NSO) based in Tucson, Arizona. When completed, in 2017, it will be the largest telescope in the world dedicated to observing the Sun, with unprecedented abilities to view solar detail and allow scientists to learn even more about the Sun and solar-terrestrial interactions.

"Although the primary aims of the project are scientific," said Mr Taylor, "studies such as mapping magnetic fields around the Sun relate to sun spots and the solar cycle. This knowledge will help predict variability, advance understanding of climate change as well as solar flares which can affect both aircraft and space satellites."

ATST's four metre primary mirror – which is cut from a much larger eight metre piece - will feed an advanced array of instruments designed to study the Sun at wavelengths from near ultraviolet into the far infra-red. High order adaptive optics techniques, developed by the NSO, will correct blurring of solar images caused by Earth's atmosphere. This will allow scientists to observe features in the solar atmosphere with unprecedented sharpness, down to structures only a few tens of kilometres in size. Its unusual design is optimised to allow precise measurements of solar magnetic fields, particularly under circumstances where they have been previously invisible, allowing us to understand and predict solar variability.

Observatory Sciences has been involved in the development of software for the ATST since 2004. The telescope control system will be responsible for the control of the telescope's positioning and image quality. It will operate a number of associated telescope subsystems and will use the ATST common services software that provides a framework for the development and deployment of ATST software throughout the observatory.



An artist's impression of what the Advanced Technology Solar telescope will look like