OBSERVATORY SCIENCES LTD

DISCOVERY

BIG SCIENCE SOLUTIONS AUTUMN 2005

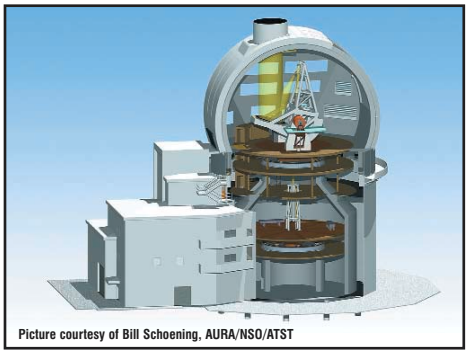
Bend it, shape it The shape of the primary mirror of the world's largest infrared astronomical telescope, currently being built by the UK in Chile's Atacama Desert, is to be controlled by bespoke software developed by Observatory Sciences of Cambridge **Page 3**

Diamonds are forever Diamond Light Source, currently under construction in Oxfordshire and scheduled to welcome its first scientific users during 2007, will have two software systems from Observatory Sciences controlling critical functions. **Page 4**

US SOLAR OBSERVATORY PICKS TELESCOPE CONTROL SUPPLIER

The first overseas supplies contract awarded by the Advanced Technology Solar Telescope has gone to Observatory Sciences and its partner Rutherford-Appleton Laboratory, for the design of a new telescope control system.

Picture courtesy of KC Environmental, Inc.



Picture courtesy of Bill Schoening, AURA/NSO/ATST

The United States National Solar Observatory is managed by the Association of Universities for Research in Astronomy, Inc. (AURA) under a cooperative agreement with the National Science Foundation (NSF).

The Advanced Technology Solar Telescope (ATST) project is a collaboration of nearly all of the American institutions involved with solar physics, run by the United States National Solar Observatory. Their combined mission is to build and operate the largest solar telescope in the world, with each institution also having its own specific ambitions and projects. The telescope will have a 4 metre diameter primary mirror and will be sited on the summit of Haleakalâ ('House of the Sun') on the Hawaiian island of Maui.

The scope of Observatory Sciences' initial work covers both the control of the main telescope and the acquisition of astronomical targets, plus the coordination of the telescope's subsystems. "It is a great compliment to be chosen to work on this major US scientific project," says Dr. Chris Mayer, who is leading the development work at Observatory Sciences' Cambridge headquarters. "Along with

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NEW AUSTRALIAN SYNCHROTRON IS EPIC

Scientists at the A$200m Australian Synchrotron Project, currently completing construction, have selected the EPICS (Experimental Physics and Industrial Control System) toolkit as the software environment for their system controls. UK specialist Observatory Sciences has delivered the initial training on the EPICS software environment.

The synchrotron, Australia's most exciting and significant science infrastructure investment for decades, opens up a broad range of research projects to Australia in both industrial and scientific fields, from micro-manufacturing to medical advances and puts the Southern Hemisphere at the leading edge of research in materials and chemical sciences, life sciences, molecular physics and environmental science.

Proven solution

The EPICS toolkit has been used on many high energy physics facilities as well as on large astronomical telescopes around the world. Observatory Sciences is one of the leading exponents at delivering EPICS training, particularly to major new scientific projects.

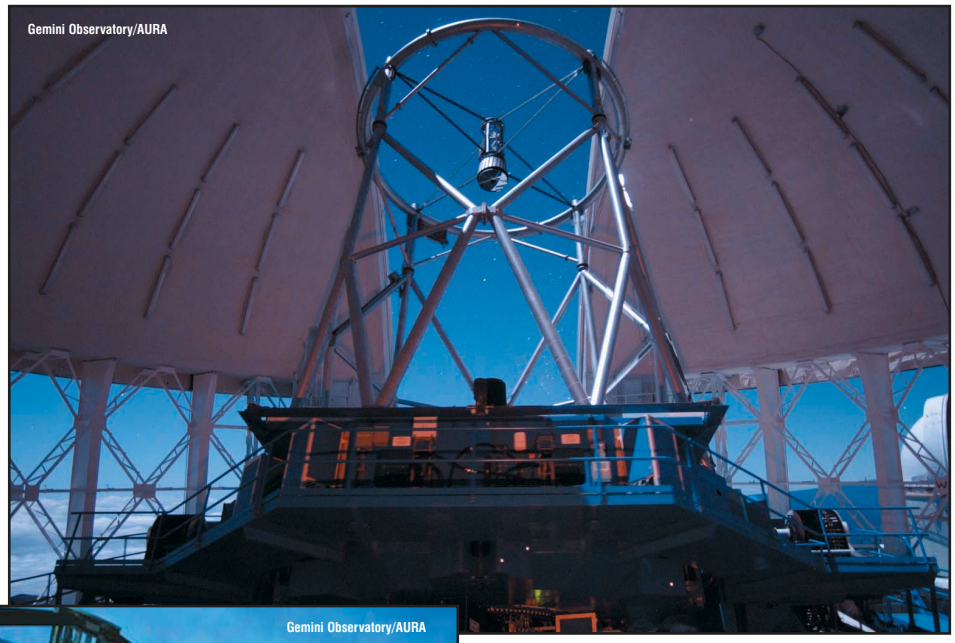
EPICS software now provides the core control for most synchrotron facilities, so provides a low-risk, high functionality investment for the Australian Synchrotron Project. Richard Farnsworth, Lead Control Engineer at the Project, says: "We needed a deep knowledge of EPICS in order to deploy it in the facility we are building. One of the real benefits of the training course has been to give us sufficient confidence and experience in the EPICS product to enable us to make full use of its many features."

The training was carried out by Philip Taylor and Andy Foster, who flew out from the UK and spent time not only bringing the controls team up to speed but also helping set up the EPICS software environment.

Taylor explains: "We have major commitments in Europe, North and South America and Australia and pride ourselves on delivering support all over the world."

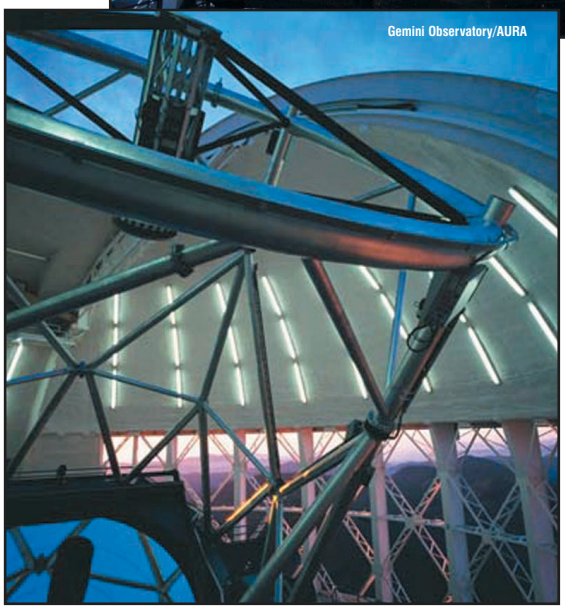
TEN YEARS WITH GEMINI KEEPS ANDY PUSHING THE ENVELOPE

Long-time Observatory Sciences consultant Andy Foster has had a remarkable career at the cutting edge of astronomy and its supporting sciences. Here he gives a personal perspective on the Gemini project.


Gemini Observatory/AURA

Everybody has a few career highlights – a favourite project, a promotion, a successful overseas trip. Andy Foster counts himself lucky because his career high has been a long running succession of projects for the Gemini Observatory.

"I was involved in the early days of Gemini in the mid-1990s and worked for them while Gemini North was being commissioned in the late 1990s. I've moved on through a succession of new projects, upgrades and redevelopments. Gemini is making significant contributions to our understanding of the universe, and I am proud to think that I'm part of the team which made this possible."


Gemini Observatory/AURA

Gemini is an international project centred around twin 8.1m reflecting telescopes, one in Hawaii the other in Chile, which together provide complete sky coverage. "We have worked with Gemini colleagues from many countries, based on different continents. Despite the distances involved, much of the work has been done at our UK base, using computer simulation of the telescopes' facilities where necessary."

As part of its responsibilities, Observatory Sciences developed the software to control the two telescopes. This involved the integration and testing of several subsystems to meet the design requirements set out years before.

"One of the most interesting jobs was developing the software to acquire targets for the telescope. The user can click on a sky image and then point the Gemini telescope simply by dragging the cursor to the required position. We also improved the telescope's image quality by providing an open-loop model of the primary mirror surface at different elevations."

Currently, Observatory Sciences consultants are now working on an exciting capability for Gemini. The Multi-Conjugate Adaptive Optics (MCAO) system is a project using leading-edge technology, which aims to overcome the effects of atmospheric turbulence on telescope observing over a wide field of view. Up to five powerful laser beams will be launched from the Gemini telescope in Chile to allow atmospheric disturbances to be modelled accurately. Observatory Sciences has provided software for the laser beam launch system, control of many of the new system's optical components as well as beam diagnostic systems to provide real time monitoring of its performance.

"The MCAO system aims to provide image quality equal to that of the Hubble Space Telescope but over a wider field of view and at a fraction of the cost."

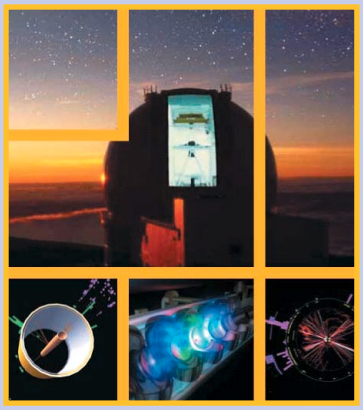
TAKE NEW VIRTUAL TOUR

A new website has been launched by Observatory Sciences to explain its products, services, expertise and experience to both professional and lay visitors (www.observatorysciences.co.uk).

"Our work is often at the cutting edge of science and technology, so there is a constant need to update our website," explains Philip Taylor, an Observatory Sciences consultant. "We got to a point with our previous website where the updates were crowding out its original structure, so we decided it was time to start afresh."

Rather than rushing headlong into the project, Taylor first did some research into the usage patterns of visitors.

"The primary role of the site is of course to promote our capabilities to the scientific world, but it was apparent that people other than potential clients were also making use of the site. For example, EPICS software users from all over the world have downloaded free software



Observatory Sciences is a registered ISO 9001:2000 company that provides full project management and support services for public and private sector clients. This can reduce the learning curve at project implementation and achieve crucial savings in time and manpower.

- **Design and development of instrument and equipment control software**
- **Data assessment and analysis systems**
- **Training and skills transfer**
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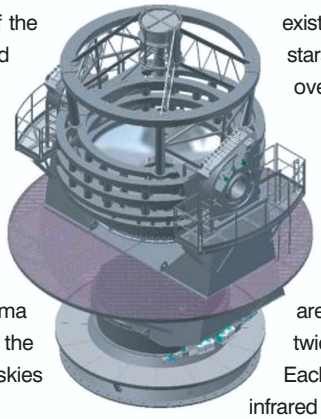
CONTROLLING VISTA'S TARGETING AND MAPPING

Deep images of large areas of sky will be produced more rapidly than ever with the VISTA telescope. Key to its success will be control software that corrects the mirror's shape 50 times a second.

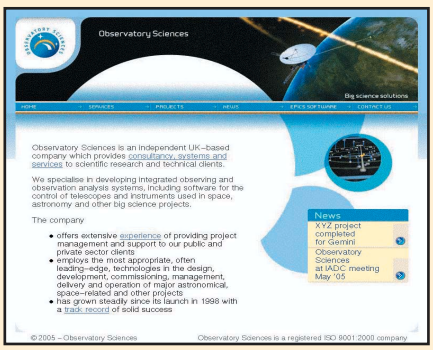


The shape of the primary mirror of the world's largest infrared astronomical telescope, currently being built by the UK in Chile's Atacama Desert, is to be controlled by bespoke software developed by Observatory Sciences of Cambridge. The telescope will be located at the European Southern Observatory's (ESO) Cerro Paranal site in the Atacama Desert, Chile. This site offers some of the darkest, clearest, driest and most stable skies on Earth.

VISTA, the Visible And Infrared Survey Telescope for Astronomy will, when completed next year, produce infrared surveys of large regions of the southern sky to levels 10-100 times fainter than existing surveys. It will map the faint stars and galaxies in the Universe over a much larger volume of space and much more quickly than has previously been possible. VISTA's novel optical design optimises the telescope and camera as a single instrument to cover an area of sky equivalent to about twice the size of the full Moon. Each exposure of the 64 megapixel infrared camera allows it to obtain deep images of large areas of sky in a short time. The telescope is currently under test at the factory in Texas, where Observatory Sciences consultant Andy Foster will be commissioning the mirror control software.


Credit: UK ATC/Royal Observatory Edinburgh

Observatory Sciences designed and implemented the system, using ESO's VLT Common Software, to adjust the position and shape of VISTA telescope's 4.1 metre diameter primary mirror. The mirror control system consists of a set of 84 supports which apply varying forces during changing conditions. These include different telescope positions and wind gusts as well as gravity. As the telescope changes position, so the loads on the primary mirror alter. The software will calculate the forces to be applied by the active supports at a rate of up to 50 times a second, to compensate for the ongoing changes and ensure that the mirror maintains optimal shape for best possible image quality at all times.



from our website. So not only have we updated its content but we have also adopted a modular structure for easy navigation."

US SOLAR OBSERVATORY...

Continued from page 1

Observatory Sciences, Patrick Wallace and David Terrett of the Rutherford-Appleton Laboratory near Oxford, have joined the design contract to provide their telescope pointing kernel and associated algorithmic experience to the project."

The design of the telescope control system will produce a highly accurate solar pointing model, algorithms for telescope positioning, tracking and guiding, and interfaces to the telescope subsystems. Observatory Sciences will be working on the control system for the next two years, allowing the ATST project to produce a final systems design in time for the start of the construction phase.

The ATST project is using Common Services software to provide the infrastructure for the control system.

Managers at ATST welcomed Observatory Sciences into their team, noting that they are well known in the nighttime astronomy and particle physics worlds for their real-time control expertise.

DIAMOND LIGHT SOURCE GETS READY TO ADVANCE SCIENCE

The largest scientific facility to be built in the UK for thirty years will have two software systems from Observatory Sciences controlling critical functions.


Picture courtesy of Diamond Light Source Ltd

Diamond Light Source, under construction in Oxfordshire and scheduled to welcome its first scientific users during 2007, is a synchrotron the size of five football pitches. It will generate powerful beams of synchrotron light for use in a wide variety of experiments in the life, physical and environmental sciences.

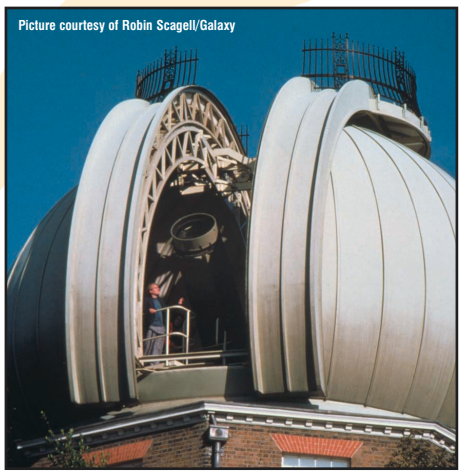
In order to maintain the synchrotron's beam position and to compensate for any unexpected movements, a dynamic support system is required for the girders supporting the main storage-ring structure of the synchrotron. Observatory Sciences has been contracted to produce the control software for this, using the EPICS software environment, working closely with control systems supplier Micromech Systems.

Developing the software for the prototype insertion device control system has also been entrusted to Observatory Sciences, again with Micromech. The insertion device, known as a helical undulator, is the key device for the generation of synchrotron light and consists of four magnet arrays positioned outside the vacuum chamber housing the electron beam. Each array can be positioned relative to the beam by an associated motor, and two further motors are used to set the phase between the arrays.

"Diamond's potential is enormous: it will produce a tremendous body of work very quickly," says Philip Taylor. "It is on track to produce its first results in 2007. Scientists will benefit from using its macromolecular crystallography, nanoscience and microfocus spectroscopy facilities."

SCIENTISTS GO IT ALONE AND FLOURISH

Creating one's own opportunities has become a hallmark for Philip Taylor of Observatory Sciences who, along with four others, founded the company in 1998. "We were scientists and engineers at the Royal Greenwich Observatory in Cambridge until it was closed down," he recalls. "Faced with redundancy, the choice was either moving into entirely new fields or trying to find work overseas.


Picture courtesy of Robin Scagell/Galaxy

"For various reasons these options did not appeal, and we thought 'Here's a chance to become our own bosses. We have saleable skills and a lot of experience that many organisations would like to be able to tap into.' We also realised that few existing companies could offer this.

"The benefits of contracting out work rather than doing it in-house are now fully appreciated by scientific institutes and external service provision is often the preferred option."

Observatory Sciences core product is software services for astronomical telescopes and instruments of all sizes, but it also transfers these skills to high energy physics research facilities and other scientific control systems. It designs, builds, commissions and maintains control system software, creates bespoke data acquisition and analysis systems, as well as providing project management and training. The client base encompasses government research and scientific bodies as well as private sector companies.

"If there is a common thread running through all our work, it is the integration of leading edge computer technology into high function systems for big science and technology projects," says Taylor.

Much of its work remains in the world of astronomy, with Observatory Sciences consultants regularly being dispatched to telescopes in Hawaii, Chile and the Canary Islands. This expertise transfers to synchrotrons and other particle physics work and increasingly is spreading into more commercial fields too.

A favourite job brought Taylor back to the company's historical roots at the Old Royal Observatory, Greenwich, where the 110 year old Great Equatorial Refractor (pictured left) was to be modernised so that it could continue its public viewing sessions. "Most of the visitors come in the daytime, so we created a computer system that would enable finding astronomical objects that are visible in daylight."

"While at heart I will always be an astronomer," sums up Taylor, "it is very exciting to see our company spreading our skills into wider areas, gaining expertise as we do so and helping transfer new technologies to new users."