TANGO partners Working with the Danish equipment supplier Danfysik, Observatory Sciences has completed a TANGO software control system for an in-vacuum undulator, in association with Heason Technology who provided the control hardware. **Page 4**

Software quality assurance vital to large projects As telescopes grow larger, so the issue of software quality testing and assurance has come to the fore. The sums of money involved in these facilities mean that systems simply have to work as expected. **Page 3**

DIAMOND LINK RENEWED

Observatory Sciences has won a further three-year framework contract to supply controls software effort to Diamond Light Source, the UK's national synchrotron science facility.

Diamond Light Source became operational in 2007 and is recognised as one of Europe's foremost research facilities. OSL's involvement goes back more than 10 years to the earlier days of planning and building, with staff member Andy Foster now based locally in Oxfordshire. Initially OSL was involved with girder control and insertion device control, as well as the software release system and commissioning some of the first beamlines to come on-stream.

The beamlines at Diamond Light Source have been used for projects that include research into drugs to prevent cancer cells from spreading, studying comets to understand the early solar system, examining ways to improve digital storage through improved magnetic materials, and using powerful X-rays to

OSL has supplied EPICS training and written beamline control software. Image courtesy of Diamond Light Source

investigate fragile ancient parchments. Over the years, Observatory Sciences consultants have been involved with many different projects at Diamond Light Source, including developing and commissioning insertion devices and contributions to Percival, an international collaboration to develop a MAPS-based (monolithic active pixel sensor) soft X-ray imager.

As well as providing a series of on-site training courses for the EPICS software toolkit, they have been responsible for production of software systems and writing and commissioning software used to control beamline equipment. Recently Andy Foster has been involved in work on the new beamline B24

(Cryo-TXM), which achieved first light in November 2014. This is the full-field transmission microscope at Diamond Light Source designed specifically to meet the rising demand for tomographic (by sections) imaging of biological specimens under near physiological conditions. The technique bridges the resolution gap that exists between electron microscopy and conventional light microscopy.

Other recent Diamond beamline work for Andy has included software for a new end station on the microfocus MX beamline I24 and

FIRST LIGHT AT SPANISH TELESCOPE

Observatory Sciences consultants were working in Spain in September 2014 for the commissioning of a Spanish 2.5 metre telescope control system. We are pleased to report that the control system worked first time, enabling rigorous testing of the pointing performance.

The Javalambre Survey Telescope (JST/T250) was built by AMOS in Belgium for the OAJ (Observatorio Astrofisico de Javalambre) based in Teruel, Spain. Together with its smaller sister T80 telescope, the T250 will provide
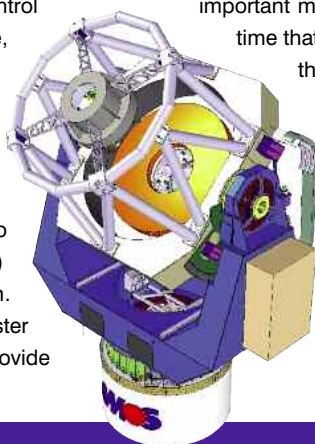
Spain with state of the art facilities for wide field astrophysical surveys.

On 25 September, at 22:57 local time, the T250 achieved engineering first light. This important milestone in the project was the first time that photons, in this case coming from the star Polaris, went through the complete optical system of the telescope.

The telescope control system (TCS) developed by Observatory Sciences co-ordinates several sub-systems, including the secondary mirror hexapod motion control, the telescope dome, the guiding system and a

wavefront sensor system used to monitor and improve the image quality. The TCS was designed to fulfil all the requirements of the Control Integrated Architecture model used by the overall Observatory Control System at OAJ.

The guiding system incorporates four charge coupled devices (CCDs) at the corners of the telescope field of view which will be used to monitor the position of guide stars. The guiding and active optics systems for the T250 telescope have yet to be commissioned.

Observatory Sciences developed the telescope control system using the TCSpk software package provided by Tpoint Software (Pat Wallace). The interactive software tool

EPICS TO LABVIEW INTERFACE OFFERS SEAMLESS LASER INTEGRATION

A comprehensive package from Observatory Sciences enables a LabVIEW system to act as an EPICS data server, giving seamless integration on a new beamline.

Observatory Sciences is working with the Extreme Light Infrastructure (ELI) project enabling EPICS integration with LabVIEW for the world's most powerful laser to be installed in a beamline at ELI's Research Institute in Prague.

With centres in Hungary, Romania and the Czech Republic, the European Union funded ELI project has set out to build the world's most intense laser beamline systems at three facilities – one in each country – offering interdisciplinary research opportunities with light lasers and secondary radiation. Research projects will cover the interaction of light with matter at intensities ten times higher than currently achievable values.

The new ELI laser L4 will provide laser pulses of a 150 femtoseconds duration and will be capable of producing peak power in excess of 10 petawatts, making it the most powerful laser of its class in the world. A $40 million contract to

A project as large and diverse as ELI needs to integrate many different subsystem control systems, being built around the world. This can mean interfacing many disparate packages

design, construct, and deliver the laser system to the facility was awarded to a consortium led by National Energetics of Austin, Texas in partnership with Ekspla in Lithuania. To address these requirements, ELI Beamlines in Prague contacted Observatory Sciences, which has extensive expertise in both EPICS and LabVIEW. The company has implemented numerous EPICS, TANGO and LabVIEW control systems.

Extensive experience

Observatory Sciences consultant Philip Taylor comments: "A project as large and diverse as ELI needs to integrate many different subsystem control systems being built around the world. With our background, we are well-placed to integrate systems using the main software frameworks used at ELI: EPICS, LabVIEW and TANGO.

"The package we have produced for ELI Beamlines Prague is called LabIOC and provides a comprehensive and portable solution
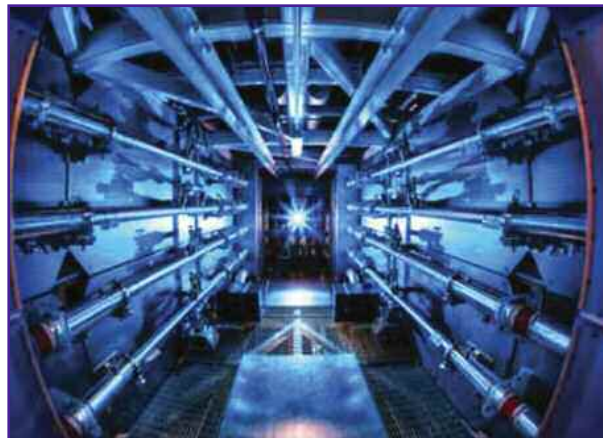
to enable connectivity between LabVIEW and EPICS systems. It enables any LabVIEW system to act as an EPICS data server, providing a wide range of EPICS record fields. The software is a native LabVIEW application which runs on all LabVIEW platforms, including LabVIEW Real-Time. It is compatible with both the Windows and Linux operating systems."

With the EPICS to LabVIEW interface development for the laser, Observatory Sciences is anticipating that this will be the first of other projects with ELI. "With EU funding to the tune of hundreds of millions of Euros, three facilities being constructed and a fourth under discussion, there will be plenty of projects to address," comments Philip.

"With our expertise in beamline systems, drawn from projects at the likes of Diamond Light Source, the Australian Synchrotron and others, we could have a big role to play."
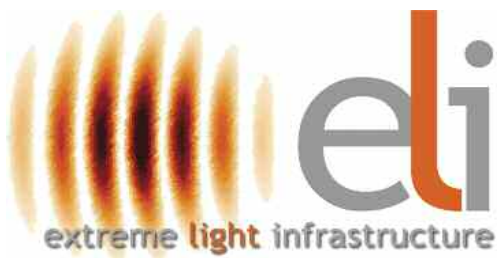
RIGOROUS TESTS ON POINTING PERFORMANCE

TPOINT was used during commissioning, an analysis tool that takes telescope pointing observations and determines a mathematical model to describe the various systematic errors in the telescope and mount. With the TPOINT model embedded in the actual control system code, target acquisition is swift and assured, and long-term tracking accuracy enhanced.
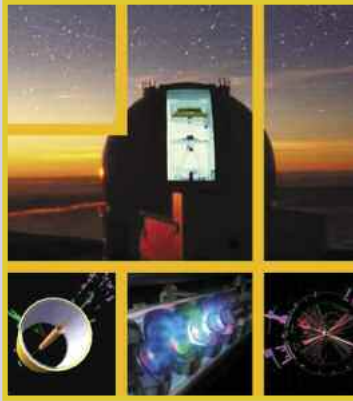
The improvements come about not only through the continuous correction of mechanical errors such as misalignments and flexures, but also as a result of accurate mount alignment. The TPOINT analysis tool has been

widely adopted by both professional and amateur astronomers on telescopes of many different designs, including equatorial and altazimuth mounts and optical, IR and radio telescopes.

Observatory Sciences consultant Philip Taylor comments: "TTCSpk and TPOINT use the same accurate and sophisticated algorithms for controlling the telescope and for analysing pointing and tracking data. It is no surprise that it has become a standard worldwide for telescope control systems. Observatory Sciences has extensive expertise with this software, following a licencing

T250 image courtesy of CEFCA

agreement signed with Tpoint Software in 2008, so we were confident during T250 commissioning that our software would work as expected."

QUALITY ASSURANCE KEY ON SOFTWARE PROJECTS

With software quality assurance vital on large scientific projects, Observatory Sciences is set to apply its software testing expertise.

O bservatory Sciences 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
- Technical reviews and studies of software solutions
- Training and skills transfer
- Systems maintenance and upgrade management
- Procurement and integration
- Facilities management and operation
- Software commissioning and support
- Project reviews

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A s telescopes grow ever larger, with control systems orders of magnitude more complex and sophisticated, so the issue of software quality testing and assurance (QA) has come to fore. The sums of money involved in constructing these facilities mean that systems simply have to work as expected.

Very large scientific projects are starting to take the issue of software verification and testing more seriously, looking to implement much more comprehensive testing during the development and construction phases rather than relying on software fixes on the fly as bugs are discovered during commissioning.

Telescope controls are built up from many different subsystems, often developed by separate companies. It is vital that all of these subsystems should integrate and operate as a whole that is a seamless sum of its parts. The underlying software infrastructure also evolves as the project develops over extended timescales which may be more than a decade with some large projects. Such changes must be proven not to disrupt existing control systems.

Observatory Sciences is already providing software quality assurance services under a four year contract with the National Solar Observatory in Tucson, Arizona who are building the 4-metre Daniel K. Inouye Solar Telescope (DKIST) in Maui, Hawaii. The contract is to define software testing practices and procedures that both in-house and

Observatory Sciences is providing software quality assurance services under a four year contract for DKIST in Hawaii

external software suppliers will use. It includes design and implementation of a test infrastructure for DKIST software, writing unit and system tests to verify the common software components of DKIST and executing system tests and bug reporting of DKIST software as part of the release cycle.

Work on software quality assurance services is being planned by other large scientific projects and with its background in the development of a wide range of control systems on some of the world's highest profile scientific projects, Observatory Sciences is well placed to help.

ICALEPCS GOES DOWN UNDER

This year's International Conference on Accelerator and Large Experimental Physics Control Systems (ICALEPCS) will be held in Melbourne, Australia, 17-23 October, and OSL will once again be attending. Observatory Sciences consultant Alan Greer says: "The conference provides an opportunity for people from different sites across the world to come together and share ideas, and discuss their work and progress. For Observatory Sciences, it is also a great place for us to showcase the work we are doing on different projects to a worldwide audience."

DIAMOND LINK RENEWED

a new diffractometer on the small molecule single crystal diffraction beamline I19. OSL consultant Alan Greer is now part of the team at Diamond Light Source working on the new Mapping project. Having the sample scanned by the X-ray beam is a standard operation on many beamlines and this has usually been implemented as a series of steps. The Mapping project is designed to provide an integrated solution using continuous scans which should provide major improvements in experimental efficiency.

OSL consultant Alastair Borrowman has also been working at Diamond Light Source,

systematically upgrading the software used with both new and existing insertion devices.

The work covered by the framework agreement is not fixed, as Andy explains: "The agreement provides an umbrella under which we supply effort at agreed prices. We tend to consider future work on a project-by-project basis with longer or shorter work packages being agreed within the framework. Work can be performed both on-site at Diamond Light Source or at our offices. Previously we have been involved with some of Diamond Light Source's important research and are very excited about the discussions of forthcoming projects."

TANGO PARTNERS

Observatory Sciences has completed its first major project based on TANGO software.

Working with the Danish equipment supplier Danfysik, Observatory Sciences has completed a TANGO software control system for an in-vacuum undulator. Observatory Sciences worked on the control system for the undulator, with Heason Technology providing the control hardware.

TANGO is becoming increasingly popular in big science projects and helps provide large scale distributed control systems for synchrotrons and laser systems. Such distributed control systems may comprise hundreds of computers, networked to control equipment and analyse results from experiments.

"The TANGO control software toolkit is being sustained by an open source community and is constantly improving," explains Philip Taylor of Observatory Sciences. "It is easy to develop new functions and features to suit specific needs, and these contributions will be in the public domain so that others can use them too."

The TANGO toolkit design is based on the concept of distributed devices or objects and provides native support for multiple programming languages. The toolkit implements a full set of tools for developing and using control systems.

The TANGO project is planned to serve the needs of the research and technological communities for at least the next 20 years and has ambitions to become a de facto standard for industrial and scientific distributed control systems. "It is significant that the Square Kilometer Array (SKA) international radio astronomy project, at a recent meeting in Italy, adopted TANGO as its preferred software environment," says Philip. "This means TANGO will be used for software development in the 11 SKA member countries and eventually will become operational at both of the SKA project sites, in South Africa and Western Australia."

The scale of the Square Kilometer Array radio telescope represents a huge leap forward in both engineering and research and development, and the project has recently taken an important step by selecting Jodrell Bank in the UK as the SKA's permanent international headquarters.

Observatory Sciences has always supported the development of TANGO. "It has grown from a modest start to become potentially one of the most exciting opportunities in control systems development," says Philip. "And because it is open source we are able to contribute to its development." ✦

VIDEOS SHOW CAPABILITIES AND PROJECT SUCCESSES

Observatory Sciences has produced seven videos highlighting its capabilities and successes in the fields of telescope control and big science. The videos provide an overview of Observatory Sciences' core areas of expertise, and look at the company's involvement in projects such as the ATST, the Australian Synchrotron, Brookhaven National Laboratory, the Discovery Channel Telescope, the E-ELT, the LSST and VISTA.

In particular, two of the videos focus on Observatory Sciences' involvement in facilities such as the Thirty Meter Telescope, Gemini and Diamond Light Source.

The videos also include an interview with Maggie Aderin-Pocock, perhaps best known today as the co-presenter of BBC TV's 'The Sky at Night' in the UK, but who previously worked as the project manager on the bHROS instrument for Gemini whilst at University College London. In the video, she describes some of the intricacies of the project and her positive experience working with Observatory Sciences.

The videos can be found on the Observatory Sciences YouTube channel at https://www.youtube.com/user/Observatory Sciences. ✦

BIG SCIENCE APPLIED TO MEDICINE

Observatory Sciences' latest project with Danfysik of Denmark is to supply control software for two beamlines on a new medical cyclotron being operated at VECC Calcutta in India. Run by the Indian government's Department of Atomic Energy, the Variable Energy Cyclotron Centre (VECC) is dedicated to frontier research and development. In particular, a new 30 MeV 500μA proton cyclotron facility is being set up at VECC. This high current cyclotron will be used to produce PET (Positron Emission Tomography) and SPECT (Single Photon Emission Computed Tomography) isotopes for medical diagnostics purposes. At the same time, there will be provision for front-line research experiments in the fields of material sciences, radiochemistry and liquid metal target development.

The new cyclotron beamlines are being installed on behalf of two Indian scientific institutions: BARC (Bhabha Atomic Research Centre) and IGCAR (Indira Gandhi Center for Atomic Research), and represent a first for Observatory Sciences in the medical arena.

Observatory Sciences consultant Philip Taylor comments: "This is our first project at a medical cyclotron facility, but we will be able to use a combination of software tools (EPICS and LabVIEW) that have previously shown their excellence on both synchrotron and astronomical projects." ✦