

## TRIUMF's Whistler workshop strengthens the case for future linear colliders



The attendees of the LCWS2015 linear-colliders workshop, which was hosted by TRIUMF in Whistler, Canada.

In early November 2015, 220 participants from around the world gathered in Whistler, British Columbia, Canada, for the annual International Workshop on Future Linear Colliders (LCWS2015, [lcws15.triumf.ca/](http://lcws15.triumf.ca/)). Hosted by TRIUMF, the workshop provided the opportunity to continue the study of the physics case for a high-energy linear electron-positron collider – taking into account the recent LHC results – and to review the progress in detector and accelerator designs for both the ILC and CLIC projects.

### Continuing developments

LCWS2015 began with a review of recent linear-collider activities and developments. Sachio Komamiya, a chair of the Linear Collider Board, opened the workshop with a summary of the board's activities and plans. Of the efforts identified, the priorities include continuing accelerator-technology developments, reinforcing political activities to facilitate intergovernmental negotiations, and continuing the development of the physics programme, taking into account LHC results. He also presented the comments from Japanese government studies about hosting the ILC in Japan, revealing that an additional period of approximately two years is needed before the government will arrive at a decision, and that international support for the project is

therefore essential.

Linear-collider collaboration chair Lyn Evans summarised the technical progress that has been made over the past few years for both the CLIC and ILC designs, recognising that strong collaborations between many universities and laboratories have helped with the design developments and improvements to the accelerator parameters. Experience with the design and construction of the free-electron lasers, such as XFEL (DESY) and LCLS-II (SLAC), provides important developments related to linear-collider technologies.

KEK director-general Masato Yamauchi summarised the situation in Japan, which is strongly considering hosting the ILC. He underlined the need to share the project costs internationally and to confirm the willingness of each participating country to cover a reasonable fraction of the project expenses.

The review talks also highlighted the status and plans of both the ILC and CLIC projects, recent results from the LHC (including the first 13 TeV analyses) and a review of the field in respect of the areas where linear colliders could make critical contributions, including discoveries in the top-quark sector, precision Higgs studies, searches for dark matter and beyond Standard Model particles and interactions.

During the following three days of the

workshop, more than 250 presentations took place, with ample time allowed for discussions at the parallel sessions of multiple working groups. Accelerator physicists discussed beam dynamics, beam delivery systems, machine-detector interfaces, sources, energy efficiency, nanobeams and conventional facilities. There were sessions on Higgs and electroweak, beyond the Standard Model, and top/QCD/loopverin physics. Detector sessions focused on software development, detector performance, machine detector interface, integration and vertex, tracking, calorimetry and muon systems. The CLIC and ILC projects and the detector collaborations also met during the workshop.

An interesting roundtable discussion entitled "How to formulate the case for the ILC – to physicists, to other scientists, and to the public" provided lively presentations, with many questions from the participants.

### Future visions

The final day of the workshop concentrated on the summary reports from all working groups, followed by a vision talk on future linear colliders by Hitoshi Murayama. Alberto Ruiz Jimeno concluded LCWS2015 with the announcement that the spring 2016 linear-colliders workshop will be hosted in Cantabria, Spain from 30 May to 5 June. Mark your calendars!

## MEETINGS

### SESAME charts shared cultural future for the Middle East

The 2015 SESAME Users' Meeting, the 13th in the series, was likely to be the final one before the commissioning of the pioneering regional light source for the Middle East begins in late 2016. The meeting was opened by SESAME director Khaled Toukan, who pointed out that not only will SESAME be the first light source in the region, but also its first intergovernmental centre of scientific excellence. Toukan went on to describe the progress towards commissioning. The first stage of the injector was commissioned in 2012, with the second stage in 2014. In 2015, the first full cell of the 2.5 GeV SESAME ring was commissioned at CERN, and components are now steadily arriving at the laboratory. Eight of the 16 girders that will support the main ring's magnets are at the laboratory, along with half of the dipoles. Almost half of the quadrupoles and sextupoles have arrived at the port of Aqaba and are awaiting transport to the laboratory. The magnets, along with their supporting girders and power supplies, have been provided through the European Commission-funded CESSAMag project coordinated by CERN.

SESAME's scientific director Giorgio Paolucci painted a vibrant picture of the initial science programme at the laboratory's two day-one beamlines, an X-ray absorption fine-structure/X-ray fluorescence (XAFS/XRF) beamline and an infrared beamline. He also pointed out the good progress towards beamlines three and four: a powder-diffraction beamline and a beamline for protein crystallography, both identified as priorities by the SESAME user community.

The XAFS/XRF beamline is built on a donation from a group at the European Synchrotron Radiation Facility (ESRF), and will provide an important tool for materials science, environmental science, life science, archaeology, art, cultural heritage and a broad range of industrial applications. The beamline components are at SESAME, while delivery of the beamline hutches is expected in March 2016. Discussions are underway with Italy's INFN concerning the development of a high-sensitivity silicon drift detector, and all is expected to be ready for beam by late summer 2016.

SESAME's infrared beamline, developed in co-operation with the French SOLEIL light source, is the first completely new beamline for the laboratory. Using an off-line source, it is already being used for research, and is also expected to be ready in



SESAME beamline scientist Gihan Kamel (left) discusses the laboratory's infrared beamline with prospective users.

the second half of 2016.

Beamline number three, a materials-science beamline based on a wiggler donated by the Swiss Light Source, should be complete by the end of 2017, while a macromolecular crystallography beamline should follow in 2018. This fourth beamline will benefit from a grant of \$2 million from the Jordanian Scientific Research Support Fund.

### Ready to go

Concluding the presentations from SESAME directors was technical director Erhard Huttel, who reported on the status of the machine. The CESSAMag project, he said, is reaching a conclusion, with all of the magnets and power supplies on their way to SESAME. Each magnet has been tested and shown to perform about a factor of 10 above the specification. At the time of the meeting, the power supplies were due to be delivered to the laboratory in December 2015, while the first batch of vacuum-chamber components had passed their factory acceptance tests. Delivery of the vacuum system is scheduled to be complete by April 2016. The RF system, with an amplifier designed at SOLEIL and cavities being provided by the Italian INFN and Elettra synchrotron in Trieste, is due for delivery starting in February 2016. All this leads to installation from January to October 2016, with commissioning scheduled for the end of the year. By the time of the next users' meeting, concluded Huttel, the SESAME main ring should be closed up and ready to go.

The remainder of the plenary talks mixed science perspectives from SESAME staff and users with inspirational talks from representatives of light sources around the world. Jesper Andersen presented Sweden's Max IV lab, while Marco Stampanoni of the Swiss Light Source discussed the

remarkable potential of tomography, including a spectacular demonstration of the reconstruction of old film too fragile to be unrolled. Sarah Elliott of the University of Reading gave a broad overview of archaeological techniques, such as the identification of the earliest instances of animal penning in the Fertile Crescent.

Herman Winick of SLAC, one of the pioneers of SESAME, painted a compelling case for light sources in the developing world. They are capable of world-class research with only moderate outlay, provide training, reverse the brain drain, address regional concerns and promote peaceful collaboration among neighbours. He went on to describe existing facilities in China, Brazil, India, Korea, Taiwan and Thailand that have proven their worth. These are now well established, many are upgrading, and some have stimulated complementary programmes such as the burgeoning nanotechnology research linked to Brazil's light source.

Among the talks from SESAME users was one by Israeli archaeometrist Jan Gunneweg. After years of scientific work on the Dead Sea Scrolls found at Qumran, Gunneweg issued a call to the SESAME user community to develop proposals to explore their common cultural heritage. He proposed a multidisciplinary approach through which SESAME members would team up to explore the cultural heritage of the region, and went on to give a long list of potential topics, ranging from unravelling the remaining mysteries of the pyramids, to studying the Amarna tablets, the plethora of ancient manuscripts from across the region, or even taking a scientific approach to the story of Noah's ark. Gunneweg's proposal distils the essence of SESAME into a single thought: it is as much about finding a shared cultural future, as it is about investigating.