

# Berkeley welcomes real-time enthusiasts

Specialists in real-time techniques from a variety of fields had the opportunity to share experiences at a conference in June.

The IEEE-NPSS Real-Time Conference is devoted to the latest developments in real-time techniques in particle physics, nuclear and astrophysics, plasma physics and nuclear fusion, medical physics, space science, accelerators and general nuclear power and radiation instrumentation. Taking place every second year, it is sponsored by the Computer Application in Nuclear and Plasma Sciences technical committee of the IEEE Nuclear and Plasma Sciences Society (NPSS). This year, the 18th conference in the series, RT2012, was organized by the Lawrence Berkeley National Laboratory (LBNL) under the chair of Sergio Zimmermann and took place on 11–15 June at the Shattuck Plaza Hotel in downtown Berkeley, California.

The conference returned to the US after being held in Lisbon for RT2010 and in Beijing in 2009, when the first Asian conference of this series was held at the Institute for High-Energy Physics. RT2012 attracted 207 registrants, with a large proportion of young researchers and engineers. Following the meetings in Beijing and Lisbon, there is now a significant attendance from Asia, as well as from the fusion and medical communities, making the conference an excellent place to meet real-time specialists with diverse interests from around the world.

## Presentations and posters

As in the past, the 2012 conference consisted of plenary oral sessions. This format encourages participants to look at real-time developments in different sectors other than their own and greatly fosters the necessary interdisciplinary exchange of ideas in the various fields. Following a long tradition, each poster session is associated with a “mini-oral” presentation session. Presenters can opt for a two-minute talk, which helps them to emphasize the highlights of their posters. It is also an excellent educational opportunity for young participants to present and promote their work. With a mini-oral presentation still fresh in mind, delegates can then seek out the appropriate author during the following poster session, an approach that stimulates lively and intensive discussions.

The conference began as usual with an opening session with five invited speakers who surveyed hot topics from physics or



Berkeley's Shattuck Plaza Hotel was the setting for RT2012. (Image credit: Stefan Ritt.)

innovative technical developments. First, David Schlegel of LBNL gave an introduction to the physics of learning about dark energy from the largest galaxy maps. Christopher Marshall of Lawrence Livermore National Laboratory introduced the National Ignition Facility and its integrated computer system. CERN's Niko Neufeld gave an overview talk on the trigger and data acquisition (DAQ) at the LHC, which provided an introduction to the large number of detailed presentations that followed during the week. Henry Frisch of the University of Chicago presented news from the Large Area Photodetectors project, which aims for submillimetre and subnanosecond resolution in space and time, respectively.

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Last, Fermilab's Ted Liu spoke about triggering in high-energy physics, with selected topics for young experimentalists.

The technical programme, organized by Réjean Fontaine of the University of Sherbrook, Canada, brought together various areas of real-time computing applications and DAQ covering a range of topics in various fields. About half of the topics ▾

## RT2012

came from high-energy physics, the rest mainly from astrophysics and nuclear fusion, medical applications and accelerators.

Some important sessions, such as that on Data Acquisition and Intelligent Signal Processing, started with an invited introductory or review talk. Ealgoo Kim of Stanford University reviewed the trend of data-path structures for DAQ in positron-emission tomography systems, showing how the electronics and DAQ are similar to those for detectors in high-energy physics. Bruno Gonçalves of the Instituto Superior Técnico Lisbon spoke about trends in controls and DAQ in fusion devices, such as ITER, particularly towards reaching the necessary high availability. Riccardo Paoletti of the University of Siena and INFN Pisa presented the status and perspectives on fast waveform digitizers, with many examples being given in following presentations.

### Rapid evolution

This year the conference saw the rapid and systematic evolution of intelligent signal processing as it moves further towards front-end signal processing at the start of the DAQ chain. This incorporates ultrafast analogue and timing converters that use the waveform analysis concept together with powerful digital signal-processing architectures, which are necessary to compress and extract data in real time in a quasi “deadtime-less” process. Read-out systems are now made of programmable devices that include hardware and software techniques and tools for programming the reconfigurable hardware, such as field-programmable gate arrays, graphic processing units (GPUs) and digital signal processors.

Participants saw the evolution of many new projects that include architectures dealing with fully real-time signal processing, digital data extraction, compression and storage at the front-end, such as the PANDA antiproton-annihilation experiment for the Facility for Antiproton and Ion Research being built at Darmstadt. For the read-out and data-collection systems, the conceptual model is based on fast data transfer, now with multigigabit parallel links from the front-end data buffers up to terabit networks with their associated hardware (routers, switches, etc.). Low-level trigger systems are becoming fully programmable and in some experiments, such as LHCb at CERN, challenging upgrades of the level-0 selection scheme are planned, with trigger processing taking place in real time at large computer farms. There is an ongoing integration of processing farms for high-level triggers and filter farms for online selection of interesting events at the LHC. Experiences with real data were reported at the conference, providing feedback on the improvement of the event selection process.

A survey of control, monitoring and test systems for small and large instruments, as well as new machines – such as the X-ray Free-Electron Laser at DESY – was presented, showing the increasing similarities and possibilities for integration with standard DAQ systems of these instruments. A new track at the conference this year dealt with upgrades of existing systems, mainly related to LHC experiments at CERN and to Belle2 at KEK and the SuperB project.

The conference saw an increasing number of applications and projects using new standards, emerging technologies such as Advance Telecommunications Computing Architecture (ATCA), as well as feedback on the experience and lessons learnt from suc-

cesses and failures. This last topic, in particular, was new at this conference. Rather than showing only great achievements in glossy presentations, it can also be helpful to learn from other people’s difficulties, problems and even mistakes.

A highlight of the Real-Time conference is the presentation of the CANPS prize, which is given to individuals who have made outstanding contributions in the application of computers in nuclear and plasma sciences. This year the award went to Christopher Parkman, now retired from CERN, for the “outstanding development and user support of modular electronics for the instrumentation in physics applications” (*CERN Courier* September 2012 p64). Special efforts were also made to stimulate student contributions and awards were given for the three best student papers, selected by a committee chaired by Michael Levine of Brookhaven National Laboratory.

Last, an industrial exhibit by a few relevant companies ran through the week (CAEN, National Instruments, Schroff, Struck, Wiener and ZNYX). There was also the traditional two-day workshop on ATCA and MicroTCA, which is the latest DAQ standard, following CAMAC, Fastbus and VME, from the telecommunications industry. This workshop with tutorials, organized by Ray Larsen and Zheqiao Geng of SLAC and Sergio Zimmermann of LBNL, took place during the weekend before the conference. Two short courses were also held that same weekend, one by Mariano Ruiz of the Technical University of Madrid on DAQ systems and one by Hemant Shukla of LBNL on data analysis with fast graphic cards (GPUs).

The 19th Real-Time Conference will take place in May 2014 in the deer park inside the city of Nara, Japan. It will be organized jointly by KEK, the University of Osaka and RIKEN under the chair of Masaharu Nomachi. A one-week Asian Summer school on advanced techniques on electronics, trigger, DAQ and read-out systems will also be organized jointly with the conference.

● For details about the Real-Time Conference, see <http://rt2012.lbl.gov>. A special edition of *IEEE Transactions on Nuclear Sciences* will include all eligible contributions from the RT2012 conference, with Sascha Schmeling of CERN as senior editor.

### Résumé

*Berkeley accueille des enthousiastes du temps réel*

*Des spécialistes des techniques de temps réels issus de différentes disciplines ont eu l'occasion de mettre en commun leurs expériences à la 18<sup>e</sup> Conférence sur le temps réel IEEE-NPSS, organisée en juin par le Laboratoire national Lawrence de Berkeley. Cette conférence biennale est consacrée aux dernières avancées des techniques de temps réel en physique des particules, en physique nucléaire et en astrophysique, en physique des plasmas et de la fusion nucléaire, en physique médicale, en sciences de l'espace et enfin dans les technologies de l'énergie nucléaire et de l'instrumentation en matière de radiations. Le programme a permis de confronter différents domaines d'application du calcul en temps réel, puisque la moitié environ des sujets présentés concernaient la physique des particules, le reste portant essentiellement sur l'astrophysique et la fusion nucléaire, les applications médicales et les accélérateurs.*

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