International Society for μSR Spectroscopy

Newsletter No. 11 - October 2011

Greetings from the President of ISMS

Welcome to the latest ISMS newsletter. It has been a year of new initiatives and exciting results in the muon facilities around the world and this issue of the ISMS newsletter contains a digest of developments.

2011 has also been the year of the 12th International Conference on Muon Spin Rotation, Relaxation and Resonance that was held back in May. I would like to record particular thanks to Jeff Sonier, first for his work in leading ISMS during his Presidency, and second for organizing a wonderful meeting for the muon community in Cancun, Mexico. We are all grateful to him, his co-chair Graeme Luke and their team who worked tirelessly to arrange a rewarding meeting several thousand miles from their home institutions.

The Cancun conference turned out to be a great meeting for sharing the latest research results, discussing the latest controversies and also for swimming in the wonderfully warm ocean. It was also an opportunity to award the Yamazaki Prize to Jess Brewer and to hear his Prize lecture. In his fascinating address, Jess was able to speak about many (though of course not all) of the highlights of his long and productive career, though seeing him wading in the ocean each afternoon many of us suspected that he had mainly turned up for the fishing!

Thanks are due to the members of the outgoing ISMS Executive Committee, and also to those who stepped up to serve for the next three years: the regional vice-presidents, Kenji Kojima (Asia), Alan Drew (Europe) and Andrew MacFarlane (Americas) and the President-Elect, Khashayar Ghandi. We are grateful to Hubertus Luetkens (Treasurer) and Philip King (Secretary) who have agreed to continue to serve.

The devastating earthquake and tsunami that hit Japan on 11 March 2011 has also been much in our minds this year, and thus it was a particular pleasure that one of the invited speakers in Cancun had come from Sendai and also that many colleagues from Japan were able to attend. Despite the damage that has been caused to numerous laboratories near the Pacific coast of Tohoku, it is encouraging to see the dedication and determination of so many of our Japanese colleagues in rebuilding their labs and continuing their work. This is particularly true in the muon community with the J-PARC project and more information on the current status of the facilities at Tokai can be found on page 6 of this newsletter.

2011 has also been another year of important papers published using μSR and it is always worth remembering that the strength of our research field derives from the scientific impact of the published journal articles. 2011 also saw the release of the long-awaited monograph from Pierre Dalmas de Réotier and Alain Yaouanc: Muon Spin Rotation, Relaxation, and Resonance (Oxford University Press). Buy your copy while stocks last! New research of course derives from the development of new techniques and the commissioning of innovative spectrometers; thus, the construction of a number of new instruments across the μSR facilities worldwide is a good sign that the field remains healthy and that there are plenty of research opportunities using muons in the future. I wish you every success!

Steve Blundell

The International Society for μSR Spectroscopy
c/o Philip King (Secretary), ISIS Facility, STFC Rutherford Appleton Laboratory, Chilton, Oxfordshire, OX11 0QX, UK. email: philip.king@stfc.ac.uk. Web: http://musr.org

Cancun, Mexico
May 16 - 20, 2011

muSR2011.triumf.ca

Date for diaries:

MuSR 2014

The 13th International Conference on Muon Spin Rotation, Relaxation and Resonance will be held in Grindelwald, Switzerland, 1-6 June 2014.

More details to follow!

Yamazaki Prize for μSR Science 2011

The Yamazaki Prize for 2011 was awarded to

Prof Jess Brewer

University of British Columbia and TRIUMF, Canada

The prize, which includes a sum of US$3000, was presented to Jess at a special ceremony at the International Conference on μSR in Cancun, Mexico, in May 2011.

Jess has had a distinguished career within muon science. He describes himself as 'a developer of the methodology of (and facilities for) muon spin rotation, relaxation and resonance, and a promoter of its wider user as a general-purpose tool of materials science and chemistry'. Over many years he has built up the excellent muon facilities at TRIUMF. His research has included significant contributions to the areas of high temperature superconductivity, muonium dynamics and solid state chemistry, and charge transport, amongst others.

We warmly congratulate Jess on a very well-deserved award.

The award to Jess in 2011 follows the awards to Yasutomo Uemura (2005) and Elvezio Morenzoni (2008).

ISMS Executive Committee

Following the election results announced at the MuSR 2011 Conference, the new ISMS Executive Committee is:

President: ***Prof. Stephen Blundell, Oxford, UK***
President-elect: ***Prof. Khashayar Ghandi, Mount Alison University, Canada***
Vice-president, Americas: ***Prof. Andrew McFarlane, UBC, Canada***
Vice-president, Asia: ***Prof. Kenji Kojima, KEK, Japan***
Vice-president, Europe, Africa: ***Dr Alan Drew, Queen Mary University London, UK***
Treasurer: ***Dr. Hubertus Luetkens, PSI, Switzerland***
Secretary: ***Dr. Philip King, ISIS, UK***

If you have comments on any aspect of the ISMS, please contact a committee member.

News from Europe

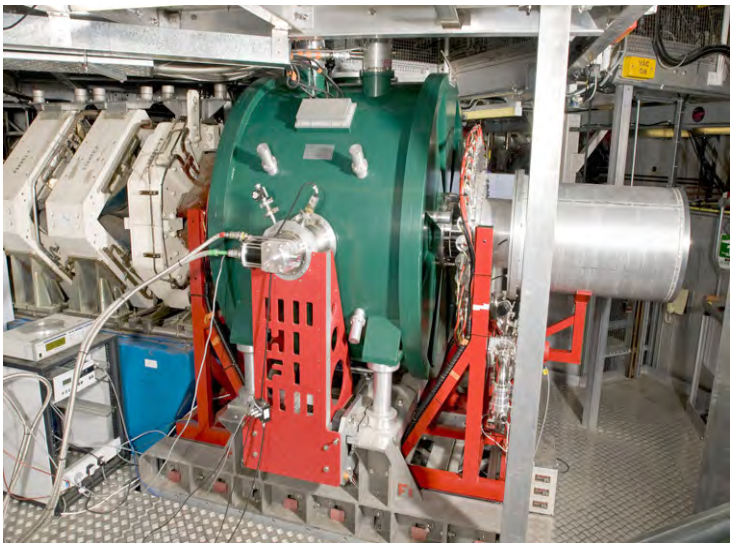
ISIS Muons

The **newest ISIS muon instrument** – HiFi, the high field spectrometer – has now been running for over a year and is producing excellent science: three examples of HiFi science have appeared as highlights on the Journal of Condensed Matter Physics website. A full description of HiFi has now been published in Review of Scientific Instruments 82(7) 073904 (2011).

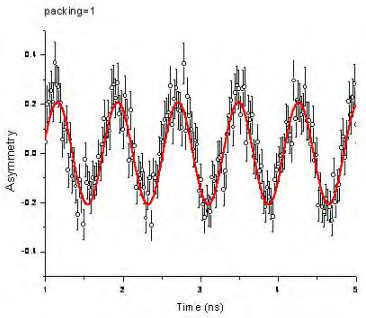
Other recent developments at ISIS include a double-resonance radio-frequency cryostat stick for HiFi, gas cells for muonium chemistry and exploration of in-situ NMR methods. ISIS is also rolling out its new data analysis platform (called 'Mantid'). Mantid will become the standard analysis tool for ISIS neutron data, and it is also being used at the Spallation Neutron Source in the USA and at European Neutron Facilities. We are developing Mantid for muons, and this will be available in due course.

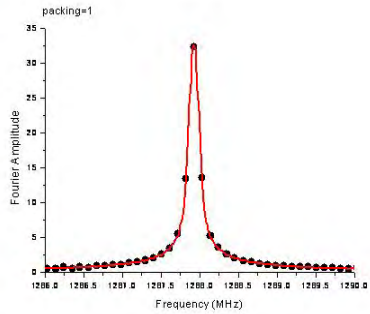
We have recently started a 3-year project to completely **refurbish the primary ISIS muon beamline**. This will include replacement of all the beamline quadrupole magnets – many of which are over 40 years old - together with other components. This will keep the ISIS muon beamlines up and running for many more years – and we are also exploring whether changes to the quadrupole magnet numbers and positions might provide an increase in muon flux as well.

The next **ISIS muon training school** will run from 19-23 March 2012. We are able to fully support postgraduate or early post-doctoral scientists from the UK or Europe who wish to get hands-on experience of using the muon technique – so do be thinking now whether you or a member of your group would benefit from attending. There will also be an ISIS muon user meeting, focusing on pressure applications of the muon technique, in April 2012 – further details to follow.



The new HiFi 5T muon spectrometer at ISIS.





Left: 9.5 T magnet with detector system installed at PSI. Right: First data obtained at 9.5 T transverse field on a silver plate. Red curves represent the results from a fit in the time domain (time window 10 μs) and its Fourier transform.

PSI Muons

An important milestone of the **High Field project** at PSI was fulfilled in May 2011 with the installation of the 9.5 T magnet (*Oxford Instruments*) with fast-timing detector system on a provisional beamline. The commissioning of the magnet has been completed with demonstrated field homogeneity of 10 ppm. First TF spectra obtained with a spin rotation of 42 degrees (use of the existing spin rotator) also show the excellent time resolution and signal asymmetry that can be achieved at this instrument with the APD spectrometer that is based on *Hamamatsu* MPPCs and in-house developed broadband amplifiers. Another key and novel component of the High Field facility, the horizontally mounted dilution fridge from *BlueFors* providing the 15mK sample temperature, is in the final manufacturing stage.

The two new **spin rotators** which will rotate the spin by 90 degrees before injection into the High Field magnet have been completed at PSI during the summer. First commissioning tests have shown that positive and negative voltages up to 200kV can be applied to the electrodes according to the specifications. Reconstruction of the piE3 area which will accommodate the High Field facility from 2012 has also started and will be completed during the 2011/2012 shutdown.

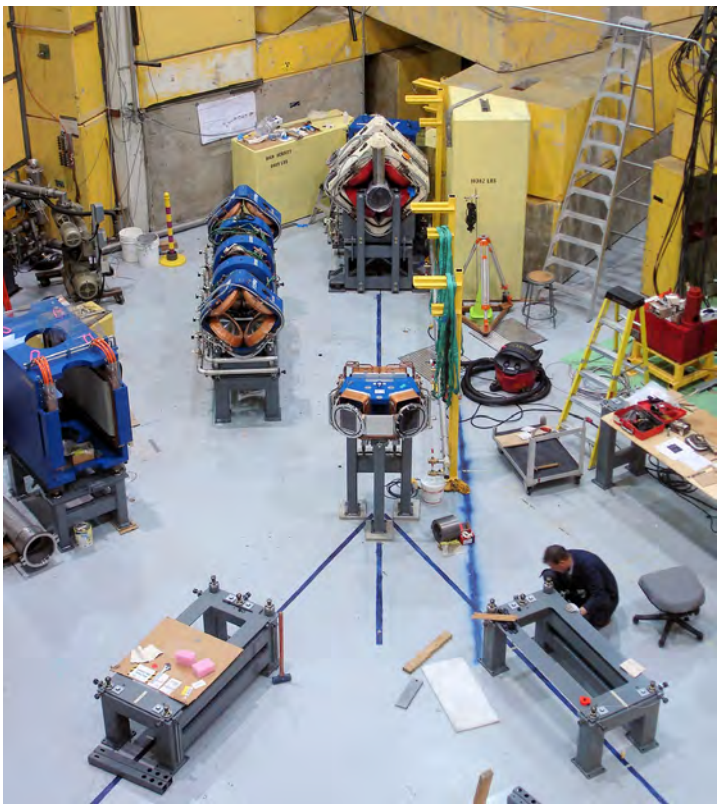
For the **Low Energy Muon (LEM)** instrument an important step has been the completion of the low energy spin rotator, which will provide the instrument with longitudinal field capabilities. Commissioning is underway and it is planned to install the spin rotator during the 2011/2012 shutdown.

Alan Drew

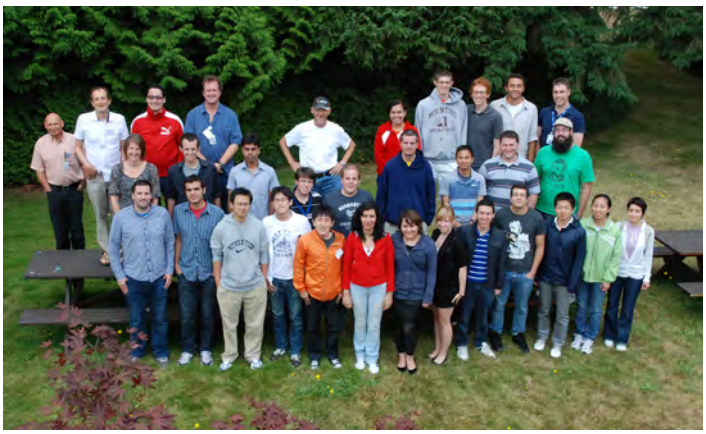
News from TRIUMF

At this time, several of the secondary muon beamlines used by TRIUMF's Centre for Materials and Molecular Science (CMMS) for μSR are undergoing complete renovation, specifically the surface muon channel M20, and a new beamline M9A is being built. Each will have a Muons On REquest (MORE) capability, and M20 will be able to run experiments at two end stations. These developments were funded in part by TRIUMF and in part by Canada's Foundation for Innovation and the provinicial British Columbia Knowledge Development Fund (competitively awarded infrastructure grant funding). The renovation is progressing well, and M20 is scheduled for commissioning in the spring of 2012. However, it has been difficult for the industrial suppliers of the high voltage elements (separators, kickers) to meet operational design specifications. Despite this the magnetic and vacuum elements have begun to be installed and work is progressing well.

Lurking in the background of this optimistic renovation and expansion of CMMS facilities, there are significant problems with aging infrastructure at TRIUMF. The primary proton beamline for the production of muons at TRIUMF, BL1A, spans two production targets: T1, that feeds the M15 surface muon channel, and T2, that provides muons to M20 and M9. BL1A and, in particular, the T2 target have been showing signs of age. Recently, vacuum problems near T2 have plagued the M9 channel to the extent that it was decided to blank off the channel and run without the T2 target (and backward muons) for the entire fall 2011 schedule. This procedure will also delay the regular startup of beam at the end of September and cause significant schedule perturbations. The vacuum problems occur in a region of high radiation fields, making repair difficult. At the time of this writing, it is not yet clear when M9 will be available again for μSR.



Initial stages of the new M20 beamline at TRIUMF.



The TRIUMF Summer Institute 2011.

TRIUMF has begun work on the ARIEL facility, a newly funded high current superconducting electron linear accelerator, which may be a boon to the CMMS' ßNMR facility, expanding its annual beamtime from 3 weeks to perhaps 12, and thus opening more opportunities for low energy depth resolved experiments analogous to those of the PSI LEM facility. However, one impact of ARIEL is a substantial shortage of manpower at TRIUMF, making response to aging infrastructure problems even more difficult and slow.

This summer the CMMS ran their first graduate student summer school under the auspices of TRIUMF's annual Summer Institute (TSI2011). Students from around the world spent two weeks in August attending lectures and practical sessions including experiments using muon beams.

The Experiments Evaluation Committee will meet to assess proposals for μSR and ßNMR experiments on Dec. 1 and 2 2011, with a deadline for written proposals of Nov. 2; email sciencediv@triumf.ca for more information on making a proposal.

Andrew MacFarlane

News from Asia

Ultra-slow muon microscope research project

Start of the project

The ultra-slow muon microscope (USMM) research project started in August 2011 with the support of "Grant-in-Aid for Scientific Research on Innovative Areas" by MEXT, Japan (FY 2011-2015). The project, which is entitled “Frontier of Materials, Life and Elementary Particle Science Explored by Ultra Slow Muon Microscope”, involves 60 participants from a variety of science fields; 31 from countrywide universities and institutes of public or private organizations, 14 from KEK, 10 from RIKEN and 5 from JAEA including both experimental and theoretical researchers, with Eiko Torikai (Univ. of Yamanashi) as the principal investigator.

This research project aims to establish a μSR imaging method with an ultra-slow muon beam, i.e., "ultra-slow muon microscopy", to create a new scientific research field for elucidating ultimate mechanisms of surface/interface related phenomena in physics, chemistry and life sciences, focusing upon the underlying concept of “space and time correlation between spins”.

In contrast to conventional muon beams, ultra-slow muons are generated by laser resonant ionization of thermalized muonium in vacuum. The principle of ultra-slow muon generation was verified in 1986 in KEK BOOM and the fundamental properties of extremely low emittance, sharp beam size with reacceleration, and good time resolution have been already confirmed by the collaborating research works between KEK and RIKEN for 15 years. The two world best pulsed techniques, one the world strongest pulsed beam at the U-line of J-PARC MUSE under construction and the other the most intensive all solid state laser scheme developed by RIKEN, support the project for the practical application of ultra-slow muons.

The depth resolution in the low energy range is expected to be in the order of nanometers, providing a well-separated μSR depth profile from the near surface and up to a few hundred nanometer depth of materials. It will open cutting-edge science on a variety of phenomena characteristic to a surface, interface and thin film. The time resolution depends on the time width of the pulsed laser light, with less than 1 ns resolution being the targt. We are creating a novel three-dimensional microscope using the unique technique of reaccelerating and focusing the muon beam.

In addition, further cooling and sharpening of the beam will allow tests in particle and fundamental physics, the so-called “new physics” frontier beyond the standard model.

We are aiming to deliver the first USMM beam in 2013 at the U-line of J-PARC. During the research period, the U-line will be dedicated to the USMM research project.

Kenji Kojima, Eiko Torikai

J-PARC MUSE

March 11, 2011: Tohoku-Pacific Ocean Earthquake

At 14:46 Japanese time, M9.0 earthquake hit the eastern part of Japan. At the time of the earthquake, the J-PARC accelerator was doing RFQ conditioning at the Linac, delivering no beam to the 3GeV Rapid Cycle Synchrotron nor to the 50GeV Main Ring. The power outage which occurred due to the earthquake stopped all the J-PARC facilities. There was a Tsunami (tidal-wave) hit to J-PARC, but the height was below the prepared design assumption of 10 meters.

Fig.1: Outside the MLF experimental hall, the pipes to and from the compressor facility were bent and partly damaged the wall.

The experimental hall where MUSE is located (Material and Life-science Facility: MLF) has deep enough foundations so that the MLF building stayed horizontal and did not sink. But the surrounding ground sank by ~1m, damaging roads and utility lines (Fig 1).

Fig.2: Concrete shield blocks above the secondary muon channel moved and broke the anchoring bolts.

Inside the hall, the earthquake was so severe that the concrete shield blocks moved and destroyed their anchoring bolts (Fig.2). Fortunately, no shielding block fell and no one was injured within the entire J-PARC site. After the earthquake, the first expedition team entered MLF building on March 17. Since that time, recovery efforts have made steady progress. The first test beam is planned to be delivered to MLF in Dec 2011.

Some of the muon user experiments cancelled at J-PARC will be performed at RIKEN-RAL. Also, PSI and TRIUMF kindly offered priority handling for experimental

proposals from Japanese researchers. We would like to express our sincere thanks to all the supporting hands from the world-wide muon community.

Muon beamline construction

In addition to the recovery from the earthquake, MUSE is planning the following improvements and constructions in the muon beamlines:

(1) In FY2011, installation of a kicker and septum magnet in D-line, to separate the double pulse structure. This will allow D1 and D2 experimental areas to run simultaneously.

(2) Construction of the U-line which is characterised by the large-acceptance curved solenoid superconducting magnet. This beamline is dedicated to the ultra-slow muon microscope (USMM) project, aiming to deliver the world's brightest surface muon beam to the USMM production target. In FY2011, the curved solenoid will be installed and in FY2012 the entire beamline will be completed.

Kenji Kojima

News from RIKEN/RAL

RIKEN/RAL completed upgrades and maintenance of the muon facility, experimental apparatus and other facilities during the ISIS proton accelerator shutdown from August 2010-February 2011:

(1) Update of control software as well as regular maintenance of the helium refrigerator for the superconducting solenoid used for pion to muon decay.

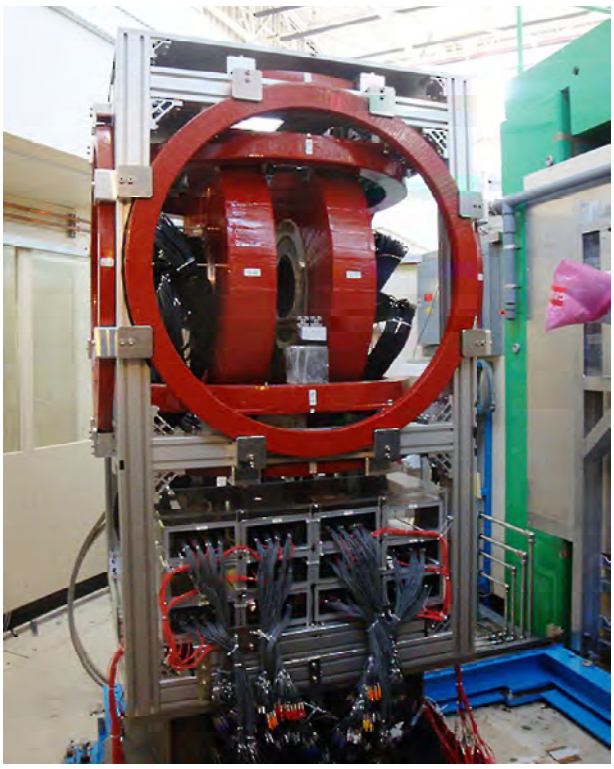
(2) Cooling test of high-pressure solid deuterium target system for µCF at port 1. Successfully formed high pressure D_2 solid target at 29K with 510 bar. However, leakage from connection part of pressure gauge was found requiring welding. The final goal is D_2 solid formation at 30K with 1,000 bar.

(3) Improvement of µSR spectrometer ARGUS at port 2: adjustment of phototubes and high-voltages.

(4) Research of room-temperature target for ultra slow muon (USM) production at port 3. The laser system for USM project has been developing to produce high intensity Lyman-alpha to ionize muonium. Evaluation of muonium generators at room temperature has been performed at TRIUMF.

(5) At port 4, we are building a new µSR spectrometer named CHRONUS. During this shutdown, we designed the top platform which will be placed above the spectrometer.

The 7th Program Advisory Committee (PAC) Meeting for Material & Life Experiments at RIKEN Nishina Center was held 11-12 January 2011, approving 21 research proposals for µSR. The 8th meeting was held 5-6 September 2011 for experiments starting before July 2012.



CHRONUS spectrometer installed at port 4, RIKEN/RAL.

RIKEN/RAL had an international review committee on February 24-25. Research activities from FY 2008-2010 were reviewed.

RIKEN Nishina center has a research collaboration agreement with three Indonesian universities (Institut Teknologi Bandung, Universitas Padjadjaran and Institut Teknologi Sepuluh November) which started in June 2008. This agreement on material science was renewed for three years on April 27, 2011. To commemorate the extension, an International Symposium on Functional Material Science: “Developments of Research Activities on Material Sciences using Accelerators” was held in Indonesia.

Kenji Kojima, Tei Matsuzaki

Committee members of RIKEN-Indonesian universities collaboration: left to right, Drs I.A.Dharmawan (UNPAD), L.Safriani (UNPAD), Darminto (ITS), I.Watanabe (RIKEN) and Risdiana (UNPAD).

Staff and scientists of J-PARC/MLF (including neutron and beamline people) determined to revive the facility. Taken on June 24, 2011.

Muon Facility Contact Details

ISIS
Contact: Philip King (philip.king@stfc.ac.uk)
http://www.isis.stfc.ac.uk/groups/muons

J-PARC
Contact: Yasuhiro Miyake (ymiyake@post.kek.jp)
http://www.j-parc.jp/MatLife/en/index.html

PSI
Contact: Elvezio Morenzoni (elvezio.morenzoni@psi.ch)
http://lmu.web.psi.ch/

RIKEN-RAL
Contact: Tei Matsuzaki (matsuzak@riken.jp)
http://riken.nd.rl.ac.uk/ral/ral_form.html

TRIUMF
Contact: Syd Kreitzman (syd@triumf.ca)
http://musr.triumf.ca/

Comments on this newsletter?
The ISMS newsletter will be distributed periodically to inform the μSR community of ISMS activities, and to provide other information and news of interest to community members. We would welcome comments and thoughts on the content and distribution method - please email the Secretary, Philip King, at philip.king@stfc.ac.uk if you have suggestions.