



International Society for μ SR Spectroscopy

Newsletter No. 9 - June 2010

Welcome to the latest ISMS e-Newsletter!

In this issue you will find:

- The first official announcement of next year's μ SR2011 conference in Cancun, Mexico. The conference is being organized by Canadians associated with TRIUMF. We hope most of you are planning to attend.
- Updates on regional activity, including progress at the world's newest μ SR facility at J-PARC, construction of new beam lines at TRIUMF, a new high-field muon spectrometer at ISIS, . . .

We are launching the ISMS Top Paper of the Year Award. Each year ISMS will select a top μ SR-based paper from published works in all fields. The 2009 winners will be announced in our next e-Newsletter.

As always we strongly urge you to get new students and postdoctoral fellows to sign up for ISMS membership at <http://musr.ca/isms/>. There is no cost and it only takes a minute to do so. We are currently redeveloping the ISMS web site. Soon your ISMS membership will allow you to access μ SR images that can be used in documents or presentations.

Jeff Sonier



The 12th International Conference on Muon Spin Rotation, Relaxation, and Resonance will be held in Cancun, Mexico, May 16-20, 2011.

All sessions and accommodations will be at the [Fiesta Americana Condesa](http://www.fiestaamericanacondesa.com), which is an all-inclusive resort located on one of the most beautiful beaches in Cancun with a magnificent view of the Caribbean Ocean and the Nichupte Lagoon.

Further information will soon be available on the conference web site:
<http://muSR2011.triumf.ca>.



News from the VP - Americas

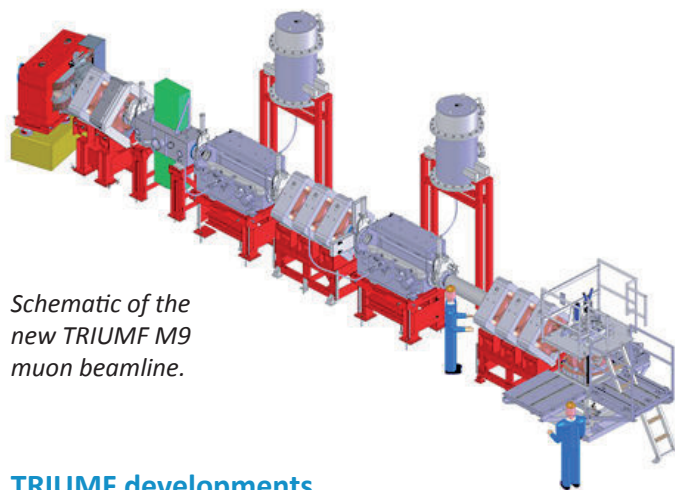
During the last year, the Centre for Molecular and Materials Science (CMMS) at TRIUMF has continued to be at the cutting edge of research in a wide range of topics: High Temperature Superconductors (with 13 experimental programs), Exotic Magnetism, Strongly Correlated Systems, Quantum Phase Transitions (with 8 experimental programs), Semiconductors (with 4 experimental programs), Spintronics (with 5 experimental programs), Interface science (with 3 experimental programs), Chemistry of Transient Intermediates, Material Chemistry and Green Chemistry (with 6 experimental programs), Nuclear Reactors (with 1 experimental program) and Industrial Basic Research for Automobiles and Energy Storage (with 6 experimental programs).

Awards to American μ SR scientists

Dr. Graeme Luke was named a Fellow of the American Physical Society in 2009. Graeme received his PhD from the University of British Columbia in 1988. He was a post-doctoral fellow at Columbia University from 1988-91 and a faculty member there from 1991 to 1998. He moved to McMaster in 1998. His research interests are in the area of highly correlated electron systems, with an emphasis on superconductivity and magnetism. He was named a fellow of the American Physical Society for his significant contributions in the area of superconductivity and magnetism. Two of his students that did μ SR research for their Ph.D. and have received their Ph.D. recently have gained jobs at Oak Ridge National Laboratory (Greg MacDougall) and PSI (Jose Rodriguez).

Dr. Robert West from the Chemistry Department of University of Wisconsin, who was awarded Honorary Membership of Japan Chemical Society in 2008, received another well-deserved honor, serving as 'World Class University Distinguished Professor' at Yonsei University in Korea. He will also continue his research at the University of Wisconsin and TRIUMF.

Dr. Khashayar Ghandi from the Chemistry Department of Mount Allison University was awarded the Japan Laboratory for High Energy Physics (KEK) Visiting Scientist Fellowship in 2009. During his fellowship, his group along with J-PARC scientist collaborators successfully started the first muon chemistry experiments at J-PARC.



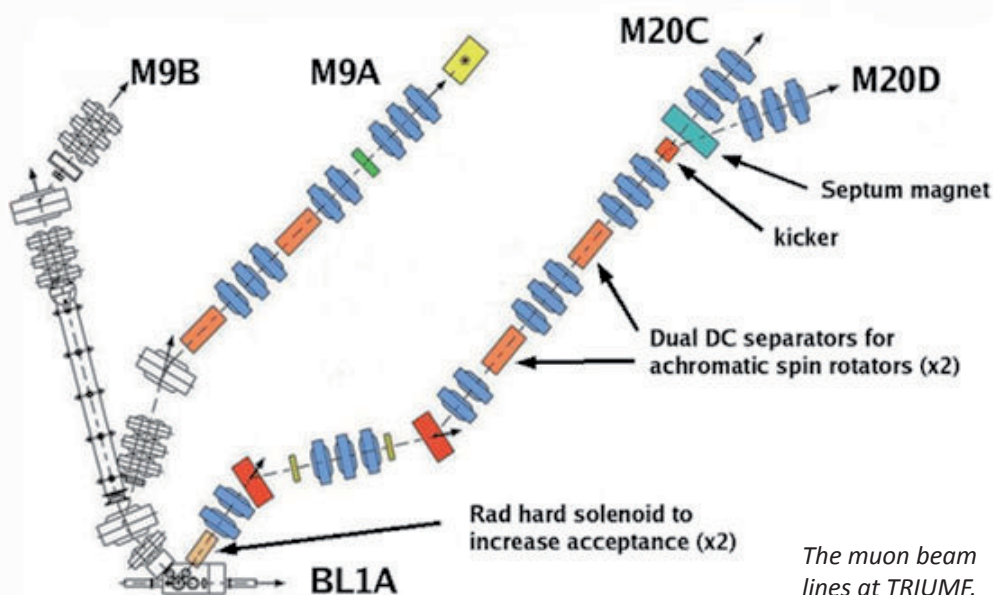
Schematic of the new TRIUMF M9 muon beamline.

TRIUMF developments

While the construction of the new M9 beam line is underway at TRIUMF and the beam line is expected to be complete by the end of summer 2010, the cyclotron will be upgraded to allow for extraction of a 300 μ A beam current. As well, future planned additions include an e-linac, second proton beamline, and a second ISAC production target.

Other announcements

- 1) Schedule 117 of TRIUMF is released and is available at <http://musr.ca/sched/beam-sched.html>. The final scheduling meeting was held on February 18th, 2010 at 11:00 a.m. (PST).
- 2) The weekly maintenance schedule at TRIUMF is being changed. The once-compulsory 12-hour weekly maintenance has been replaced now by "maintenance if required," except in designated weeks to accommodate specific tasks.
- 3) The 2010 National Nuclear Physics Summer School (NNPSS) will be held jointly with the TRIUMF Summer Institute (TSI) from June 21 to July 2, 2010, in Vancouver, BC, Canada, prior to the International Nuclear Physics Conference.

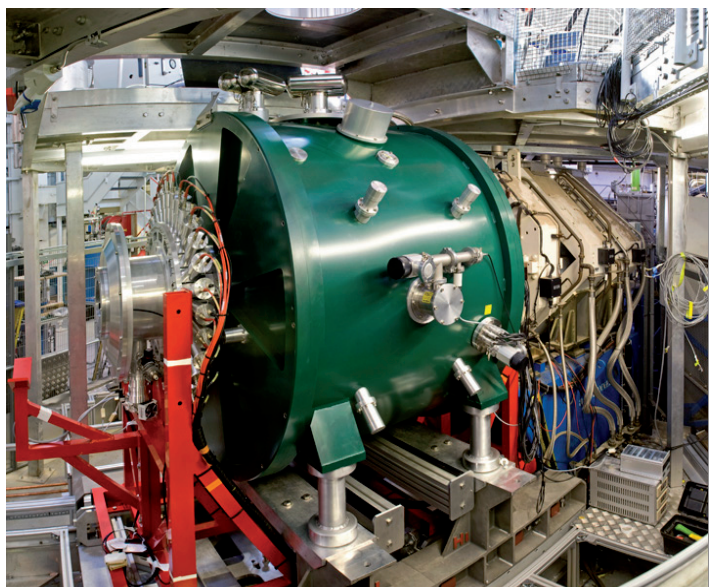


The muon beam lines at TRIUMF.

News from the VP - Europe and Africa

New high-field spectrometer at ISIS

HiFi, the latest addition to the ISIS muon instrument suite, provides an order of magnitude improvement in applied field (up to 5T), opening up new possibilities for time-differential longitudinal field muon studies at ISIS. The instrument is now available to the ISIS user programme, and has just seen its first successful user experiments.



HiFi extends the range of muon studies that are possible at ISIS: for example, its large field range improves capabilities for measurement of fluctuations, dynamics and diffusion. There are new opportunities for state preparation and studies of wider regions of magnetic phase diagrams. And it gives access to level crossing resonances in molecular systems, normally falling in the 1T-3T range, which provide additional information on structure and dynamics in molecular systems.

First studies on the new instrument have seen explorations of spin scattering processes in organic materials with spintronics applications (A Drew et al, Queen Mary University of London) and studies of organic magnetic systems based on oxalate-bridged transition metal ions (FL Pratt, SJ Blundell et al, ISIS and Oxford University).

HiFi was built with funds provided by the UK Science and Technology Facilities Council Facility Development Programme. The 4-year project involved significant instrument simulation using the CERN GEANT4 package, together with design and construction. Further information can be found at www.isis.stfc.ac.uk/groups/muons.

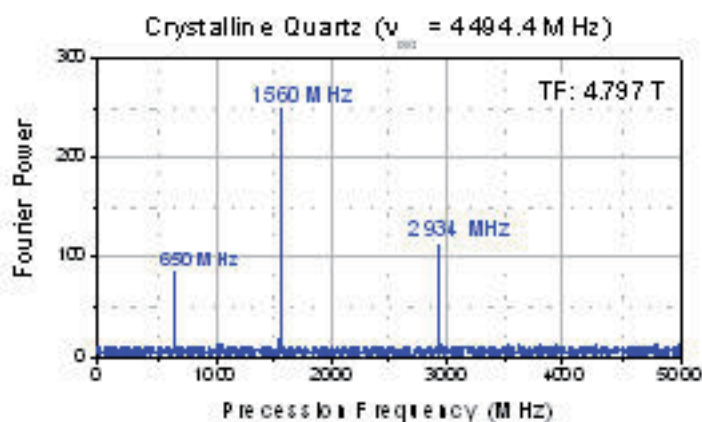
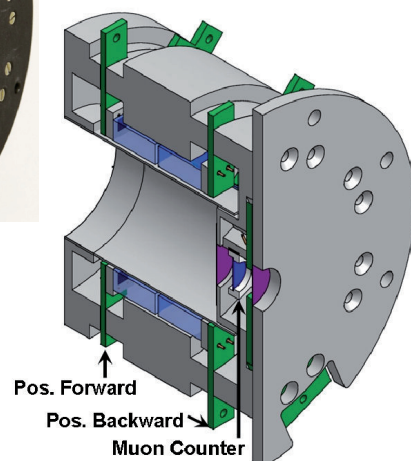
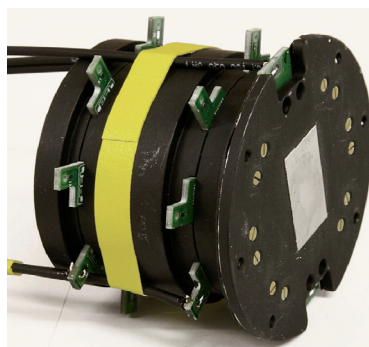
Upgraded EMU instrument at ISIS

The EMU spectrometer at ISIS has also been upgraded. It now has 3x the detector complement, giving much higher data rates, has lower background for the 'fly-past' technique for small samples, and improved flexibility for sample environment equipment. First experiments with the upgraded instrument have taken place.

News from PSI

At PSI the proposal to build a new instrument for muon spin spectroscopy research in high magnetic fields (up to 10T) and at low temperatures (20 mK) was approved and granted high priority. The realization of this very challenging project will provide μ S at PSI with another unique instrument for detailed investigation of the microscopic properties of unconventional superconductors, low-dimensional magnetic systems, heavy fermions and many other similar systems.

The prototype fast-timing detector module for the high-magnetic field μ SR instrument has been successfully tested in December 2009 in fields up to 5 T. With Geiger-mode avalanche photodiodes (G-APDs) mounted directly on to the plastic scintillators a time resolution better than 90 ps (σ) is achieved which leads to a loss of precession amplitude of only 50% at 2 GHz precession frequency.

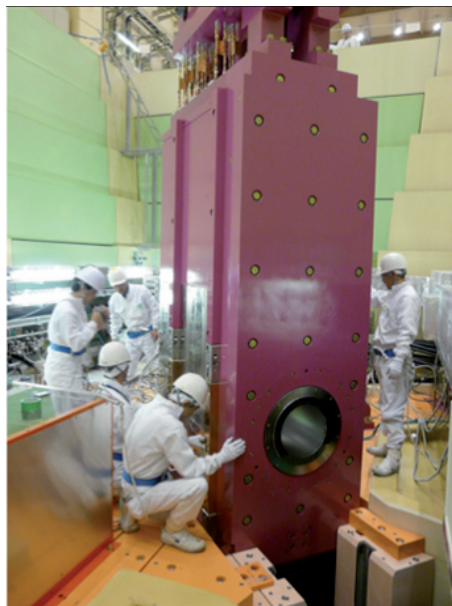


Top: Prototype of the G-APD based fast-timing detector module. Bottom: Fourier spectrum of a measurement on a synthetic quartz crystal in a field of 4.797 T at ambient temperature. The free muon precession and two muonium precession frequencies are observed, from the amplitude ratio a time resolution of $\sigma \sim 90$ ps is obtained.

News from the VP - Japan

From J-PARC-MUSE

At J-PARC MUSE, the world's strongest pulsed muon beam was achieved in November 2009. A surface muons (μ^+) rate of $1.8 \times 10^6/\text{s}$ was achieved with a 120



The large-aperture super-omega solenoid.

kW proton beam, equivalent to $1.5 \times 10^7/\text{s}$ surface muons when the beam reaches 1MW (10x that of the RIKEN-RAL facility). On Dec 25th 2008, we succeeded in extraction of decay muons. As a demonstration of extracting a negatively charged muon beam, we did a trial of non-destructive analysis of the Tempo-Koban (gold coin in Edo period) by measuring the characteristic muonic X-rays from Au and Ag. In Spring 2009 we installed front-end

components of the super-omega muon beamline. This includes a radiation resistant solenoid magnet with a large acceptance of 400 msr to capture surface muons efficiently.

Commissioning of the muon target was also carried out. The muon target is designed to make remote handling simple during maintenance work.

Since January 2009 we have had more than fifteen user runs using surface and decay muons. It is our great honor that Takeshita et al. already published a paper, which is a first scientific paper of J-PARC, demonstrating the presence of macroscopic phase separation between superconducting and magnetic phases in Co-doped iron pnictide $\text{CaFe}_{1-x}\text{Co}_x\text{AsF}$.

From the RIKEN-RAL Muon Facility

RIKEN has been operating the RIKEN-RAL Muon Facility since 1995 at ISIS of Rutherford Appleton Laboratory (RAL). The facility has four experiment ports: Port-1 for muon catalyzed fusion, Port-2 for muon materials science, Port-3 for ultra slow muon beam generation and applications and Port-4 for muonic X-ray measurement for nuclear physics.

In 2009, we replaced the apparatus at Port-4 by a high-performance μSR spectrometer. The new spectrometer is called "CHRONUS" (multi-CHANNEL Riken muON Universal Spectrometer). Its 4 kG longitudinal field coil has a large bore and separation. The spectrometer is equipped with multi segmented $\mu\text{-e}$ counters of 303

channels for each of the backward and forward sets. Counters consist of 1cm x 1cm x 5cm scintillator with an embedded a wave-length-shifter fiber have been developed.

At Port-2, we have developed a high-pressure apparatus up to 0.7 GPa for μSR experiments operating down to 2 K. We have studied pressure induced magnetic orderings in organic materials and quantum spin systems. We have also developed a laser system for laser stimulated μSR experiments. We have observed a conduction electron spin polarization in n-type GaAs by laser irradiation, relevant to spintronics. We have also succeeded in measuring an enhanced chemical reaction rate of $\text{Mu} + \text{H}_2 (\nu=1) \rightarrow \text{MuH} + \text{H}$ with pumping Raman laser irradiation.

For the ultra slow muon project at Port-3, work has been progressing on increasing Lyman- α laser-intensity, developing muonium generators operating at room temperature and improving the low-energy muon beam optics. This work aims at low energy muon beam generation with a small emittance for surface science research and measurement of muon g-2.

For muon catalyzed fusion at Port-1, we have been manufacturing a high-pressure solid hydrogen target system. For the first step toward scientific break-even of muon catalyzed d-t fusion, we will commence muon catalyzed d-d fusion with solid D_2 target.

Finally, on Port-4, we have succeeded in measuring muonic X-rays from ^{148}Sm (spherical) and ^{152}Sm (deformed) nuclei implanted in solid D_2 layer with about 1 ppm. We have observed clearly the 2p hyperfine structure in the spectrum of ^{152}Sm , which is characteristic for deformed nuclei. We have established the experimental method of muonic X-ray measurement of implanted stable/unstable nuclei in solid D_2 to study the nuclear charge density distributions.

The ISIS facility will be shutdown for the period from September 2010 to February 2011. We have decided not to hold the Program Advisory Committee (PAC) in spring. The next PAC will be scheduled in early December, and new proposals will be called in October 2010.



The J-PARC MUSE muon target assembly.

High Field Workshop at ISIS

Following the successful construction and commissioning of HiFi, the new high-field muon spectrometer, ISIS will be holding a workshop to discuss high-field muon studies from 6-7 September 2010. The meeting will be a chance to see results that have come from HiFi, together with thinking about future experiment possibilities. More details to follow.

Muon Facility Contact Details

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PSI

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TRIUMF

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ISMS Executive Committee

Following the election results announced at the MuSR08 Conference, the present ISMS Executive committee is:

President:

Prof. Jeff Sonier, Simon Fraser University, Canada

President-elect:

Prof. Stephen Blundell, University of Oxford, UK

Vice-president, Americas:

Prof. Khashayar Ghandi, Mount Allison University, Canada

Vice-president, Asia:

Dr. Wataru Higemoto, JAEA, Japan

Vice-president, Europe, Africa:

Prof. Bob Cywinski, Huddersfield University, 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.

Comments on this newsletter?

The ISMS newsletter will be distributed periodically to inform the μ SR 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.