International Society for μSR Spectroscopy

Newsletter No. 5 - January 2007

Welcome from the President of ISMS, Jochen Litterst

A very Happy New Year to all ISMS Members!

It is high time to give you a brief report about what is going on in our community.

At a recent meeting at TRIUMF the ISMS officers discussed the priorities needed for our activities over coming months and in my opinion even more essential for coming years.

Increasing the use of the μSR technique

Most necessary is the stabilization and increase of the community interested in using μSR, be it for major research projects connected to μSR or only for casual experiments. Encouraging new users when we already have beamtime oversubscription may appear counterproductive, but we need to demonstrate increasing interest for future facility development.

I think the most effective ways of attracting new users from other communities is by excellent results, together with directly addressing tentative new users and initiating joint projects. This could include spreading our new results in an effective way at conferences. For example, at the M^2S superconductivity conference at Dresden (2006), in addition to several beautiful presentations of μSR results, μSR was mentioned as an essential contributor to progress in several sessions.

However, apart from fields where μSR is already well known, we should also try to enter other communities in physics, chemistry, biology, and also in the engineering sciences where μSR is only viewed as an exotic tool, if known at all.

I think many of us have excellent opportunities to spread information when visiting not only conferences but also within our own institutions and when travelling abroad to other universities. I have tried to do this recently during visits to the academic community in Brazil. Upcoming training courses and seminars should be specifically addressed to such potential new users.

Planning for future facilities

A continuous basis for excellent research requires planning for further facility development. The perspectives for J-PARC despite all difficulties are excellent yet we need ideas for facilities for the next 10-20 years. It is necessary to start preparing the scientific case as well as the political arguments for new developments. We need to develop visions for future directions of research and technological possibilities. Such matters were discussed at a workshop that took place in Abingdon, UK in November (see page 3) and in part also at another European meeting held at Taormina (see page 3).

A very promising closer co-operation between the Japanese and the Swiss groups has been initiated by a bilateral meeting at Tsukuba in September (page 5).

A new ISMS webpage

To stimulate the flow of information we are planning to launch a re-organized ISMS homepage shortly. It will be divided into formal and informal parts, the latter being accessible only to registered members of ISMS. The formal part will contain very general information about μSR suitable for non-specialist scientists and the general public. One section will present short reports on research highlights provided by 'junior reporters', plus contributions from colleagues on conferences recently attended. We would also like to inlcude a list of upcoming events. The informal part of the homepage will contain technical information, etc, together with access to earlier proceedings of the μSR conferences and a collection of doctoral and masters theses. We hope to be able to fill these pages with interesting information in a more regular way in the future. For this purpose we will be grateful to all of you for providing the necessary input.

I would like to wish you all the best, health and happiness for 2007, and especially scientific success for the coming muon experimental periods.

Jochen.

Newsletter Contents

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

News from the regions . . .

. . . from the Vice President - N. and S. America

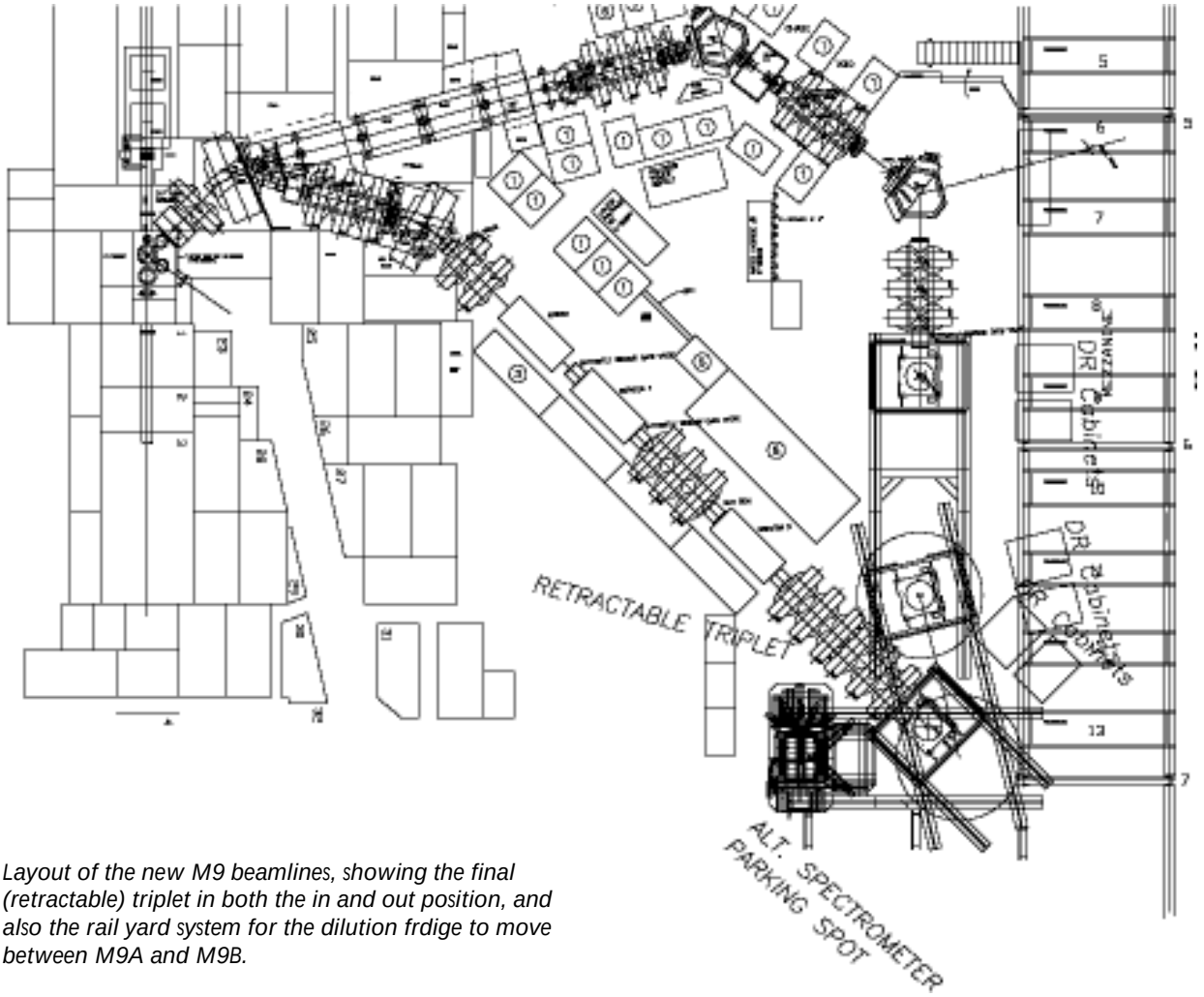
Significant changes are underway to the facilities of the CMMS at TRIUMF. The most recent 5 year plan (2005-2010) proposal submitted by the laboratory contained plans to rebuild the M9 and M20 surface muon channels. Although the plan was well-received, last minute cuts in funding resulted in the M20 rebuild being delayed. In the interim however, an application to the Canadian Foundation for Innovation (CFI) New Initiative Fund was successful. The CFI award ($2,405,525) represents 40% of the total project cost. A matching 40% is due from the province of British Columbia Knowledge Development Fund, with TRIUMF contributing the remaining 20%.

The M9 project is now underway with capital expenditures already started. It will incorporate dual achromatic spin rotators and high luminosity. The separators are to be completed around July 2007. A dedicated general purpose spectrometer for condensed matter specimens will be installed on the beamline, with a 2T field capability and MULTI-type detectors for increased data rates and small sample capability. A muons on request (MORE) capability is part of the design. In addition, the VSU dilution refrigerator will be available for use on either M9A (surface muons) or on the decay channel (M9B). The optical design for M9A is complete and it is scheduled that installation of beamline elements will occur between January and March 2009. First experiments on the beamline will be during the spring 2009 schedule.

The replacement of the M20 front end is complete. This is a necessary first step in rebuilding the M20 channel. Now that the reconstruction is fully funded, we can look forward to the completion of the rebuild towards the end of the present TRIUMF 5 year plan (around 2010). Part of the reason for the later completion towards the end of the plan is competition for engineering and other resources within TRIUMF and a desire to have only one beamline out of commission at a time. The new M20 will have two end stations, with a kicker (MORE-capable) selecting the active beam. Both end-stations will be able to run concurrently.

In other news, TRIUMF has a new director. Dr. Nigel Lockyer of the University of Pennsylvania will begin his term as the lab's 7th director on May 1, 2007. Dr. Lockyer replaces Dr. Alan Shotter who is completing his 5 year term. Dr. Shotter has been a great friend to the TRIUMF μSR community and we thank him for all of his great support over his term.

Graeme Luke



Layout of the new M9 beamlines, showing the final (retractable) triplet in both the in and out position, and also the rail yard system for the dilution frdige to move between M9A and M9B.

. . . from the Vice President - Europe

Visit to the European Science Foundation

On January 30th a small delegation of the ISMS (F.J. Litterst, R. De Renzi, A. Amato, PSI, and P.J. King, ISIS) held a meeting in Strasbourg at the ESF with Neil Williams (Senior Science Officer) and Patrick Bressler (Head of the Standing Committee for Physical and Engineering Sciences), to discuss possible actions of the European muon community towards a broad spectrum of European funding schemes. Given that the ESF does not provide directly any major funding of research activities, the discussion highlighted the scope of the different supporting actions. In particular Networks where discussed, to coordinate development studies for new facilities, which could be considered as a step towards the planning of other international actions, such as those of the European Framework Programme 7.

Research Networking Programmes are also important to bring together topic-oriented interests where muons may have a major role. A good example of the latter is HFM, on Highly Frustrated Magnetism, and having more of these programmes approved would provide a very positive light on muons. The ISMS, hence the community, could benefit by stimulating such actions and by being informed about them. See www.esf.org for more information.

MagmaNet School

A Training school on *NMR, MRI, μSR and Mössbauer techniques*, was held in Pavia between September 17th and 30th 2006, organized by A. Lascialfari and sponsored by the European MagmaNet network of excellence on molecular magnetism. The school had 36 participants from Europe and Canada, mostly PhD students, and featured over 15 lecturers, among whom S.J. Blundell, P. Carretta, R. De Renzi, A. Keren and A. Lascialfari have been either covering or touching on muon subjects.

Some of the participants at the Training School on NMR, MRI, μSR and Mössbauer techniques held in Pavia in September.

Neutron-Muon Initiative

Muons are part of the European FP6 activity NMI-3, whose most relevant aspect for ISMS-E members is the funding of the Access programmes for both PSI and ISIS facilities (enabling, for example, some of the younger people in the community to have their costs for μSR experiments covered). Another relevant aspect is a Joint Research Activity on instrument development, that coordinates the efforts of the two European facilities, together with the Universities of Oxford and Parma. In the past few years simulation of high field spectrometers and high field detectors have been two of the highlights. Planning has started for submitting a similar project within the new Framework Programme 7, starting shortly. These proposals where discussed during a workshop in Taormina, 9-11 October 2006.

Taormina meeting of the ISMS-E

On October, 10th ISMS-Europe held its second meeting in Taormina, during the NMI-3 workshop, with nine delegates from different European countries, including the Presidents (J. Campos Gil, P. Dalmas de Reotier, R. De Renzi, J.L. Garcia Munoz, D. Helrach, A. Keren, S. Kilcoyne, A. Lappas, J.F. Litterst), and three observers (C. Bucci, P. J. King and T. Shiroka). The agenda included discussion of the issues raised by the visit to Strasbourg and the then forthcoming Future Muons Workshop (see below). Participants where keen to guarantee support to future actions leading to the development of the facilities and to the improvement of the perception of MuSR outside its immediate community.

Workshop on Future Developments of European Muon Sources

This workshop was held from 2-3 November 2006 at The Cosener's House, Abingdon, UK, and attracted 35 attendees from 9 countries. The aim was to bring together European users of the muon technique to discuss future possibilities for the development of muon sources within Europe. This included discussion of the present muon sources and their development plans, looking at how the muon technique is developing and what the implications of this are for future sources, thinking about how possible new neutron sources or stand-alone facilities in Europe might be used for muon production, together with thinking about development of the science case for muons. There was a great deal of discussion regarding the nature of the muon technique in the future and what the characteristics of an ideal muon source might be. There was also consideration of how possible future European Framework Programme 7 funding opportunities might enable more detailed work on different future muon source possiblities. A report from the meeting is presently being written and will be made available to the community in due course.

A brief note from ISIS

The ISIS Facility has just entered a 10-month shut-down. During this period, major refurbishment work will be undertaken on the accelerator, proton beamline and neutron target, together with work to connect the new Second Target Station beamline to the ISIS synchrotron. Part of this work inlcudes replacing failed quadrupole magnets in the ISIS proton beamline, something which should enable the muon facility to return to full muon flux when beam is resumed. The next ISIS run cycle will start in October 2007, and there will be a call for proposals in April 2007 (deadline April 16th).

Also during the ISIS shutdown, work will begin to prepare for installation of the new high-field muon instrument (HiFi) which is presently being built. HiFi will operate longitudinal fields up to 5 T, and will be available from around the end of 2008.

Roberto De Renzi

. . . from the Vice President - Asia

An era ended at KEK-MSL

The muon beam facility at KEK (Tsukuba, Japan) maintained by the Meson Science Laboratory (KEK-MSL) ceased beam delivery on March 31, 2006, after 25 years of successful operation. Since its inauguration as the world's first pulsed muon source in July 1980, the facility has made significant contributions to the evolution of muon science. At the closing ceremony, Prof. Nishiyama expressed appreciation on behalf of the KEK-MSL staff to all involved with supporting the facility.

The 12 GeV Proton Synchrotron (KEK-PS) had already shut down in December, and the Booster Synchrotron, which was kept alive solely for the spallation neutron and muon sources, was finally turned off at the closing of the muon facility. This marks the end of the entire experimental program using proton beams on the Tsukuba campus of KEK, which will be succeeded by the new J-PARC Facilities on the Tokai campus. As a part of commemoration for PS activities, a symposium was held by KEK on May 19, 2006, in Tsukuba. Following the closing of the proton facilities at Tsukuba, a new KEK office on the Tokai campus has started its operation with most of the KEK-MSL staff.

Final inter-university experimental programs at KEK-MSL included studies on the magnetism of high-T_c cuprates, skuterudites, and heavy-fermion (HF) compounds, and muonium hunting in various kinds of materials including hydrogen-containers and proton-conductors. Highlights include the study of UPt_3, a famous HF superconductor for which a new magnetic phase has been suggested below 20 mK. A team headed by Higemoto finally succeeded in measuring the μSR spectra at a temperature below 10 mK, the lowest temperature ever reached for the μSR study on UPt_3, and data analysis is now in progress.

Ken Nagamine presses the button to turn off the beam delivery to KEK-MSL for ever.

J-PARC Muon Facility (MUSE)

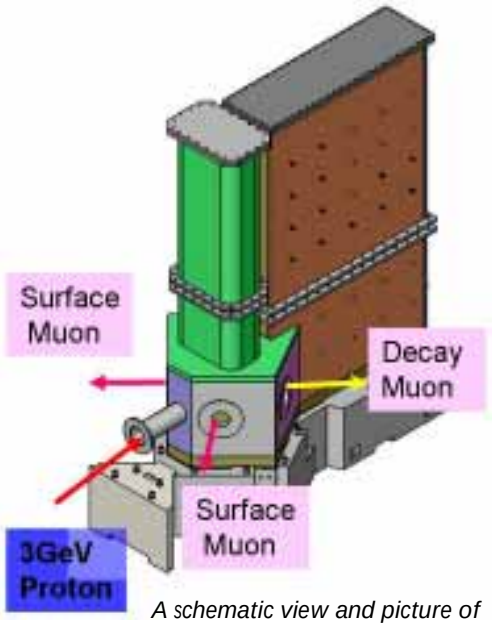
On the Tokai campus of KEK, the construction of the Materials and Life Science Facility (MLF) is in progress. At the end of March 2006, about 90 % of building construction was completed, except for the temporal access gate.

One of the highlights has been the installation of alignment plates on the M2 muon beamline. Considering the precision alignment for heavy-tall magnets and a massive target chamber by means of remote handling, we have been preparing a dedicated level ground consisting of

The alignment plates (red) placed on the floor of the M2 muon beamline at J-PARC.

baseplates 70 mm thick combined with alignment plates 55 mm thick. We installed the iron baseplates with a precision of +- 2 mm for XY and +- 0.2 mm for the vertical direction. Underneath the baseplates, four sets of air ducts were installed and embedded in the concrete floor. On the baseplates, we installed 40 sets of the alignment plates with a precision XY +-0.1 mm and level +-0.1 mm. The alignment plates allow precise positioning of the beamline components such as magnets, guide shields, target chamber and pillow seals.

Another highlight is the fabrication of the target chamber. Upon the completion of Phase 1, we have a single graphite target, from which muons will be extracted to two experimental halls through four secondary beamlines (one decay muon channel, one high momentum line and two surface muon channels). In order to satisfy the requirements for transporting the primary 3 GeV proton beam and for accommodating the four secondary beamlines, we designed a specialized target and scraper chamber. Taking account of the ease of remote handling during maintenance work, the two sets of scrapers and the muon production target are contained in a single large vacuum chamber. Consideration has been given to the target mounting, insertion, cooling, monitoring, and changing procedure. Following fabrication, the target was installed in April 2006.



A schematic view and picture of the J-PARC muon target chamber.

Bob Heffner writes: In April 2005 a new μSR group was formed within the Advanced Science Research Center at the Japan Atomic Energy Agency (formerly JAERI) in Tokai-Mura, the site of J-PARC. The group consists of staff members Robert Heffner and Wataru Higemoto, postdoc Kazuki Ohishi, and a student from Tokyo Institute of Technology, Takashi Ito. Our research is focused on the magnetism and superconductivity of f-electron materials, and recent experiments have included the investigation of unconventional superconductivity in $PuCoGa_5$, $PrOs_4Sb_{12}$, $CePt_3Si$ and UPt_3, as well as a search for field-induced and/or multipolar ordering in $PrPb_3$ and $SmRu_4P_{12}$. We have strong collaborations within Japan, as well as at TRIUMF in Canada, Los Alamos and Livermore National Labs and the University of California in the US.

In addition to our research, we are designing and building a new surface muon μSR spectrometer/beamline optimized for the study of magnetic and superconducting materials. At present this system has two key components: a muon beam slicer and septum magnet to reduce the muon pulse width to about 30 ns, and a detector array of up to 1024 positron counters optimized for the high counting rates anticipated at J-PARC. The sample environment equipment will include a dilution refrigerator and a magnet for fields up to 5 kG. We have begun the purchase of power supplies and beam-line components in preparation for first beam tests towards the end of 2008. All of this work is being carried out in close collaboration with the KEK muon group.

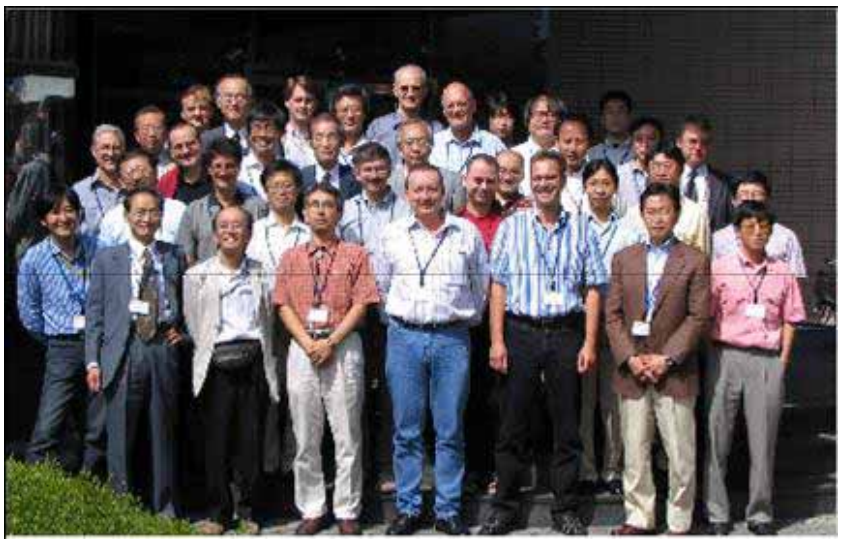
MuSAC-IV: The 4th J-PARC Muon Science Experimental Facility Advisory Committee

The 4th J-PARC Muon Science Experimental Facility Advisory Committee was held on Feb 25-26, 2006 at KEK. Committee members were J. Akimitsu (Aoyama Gakuin U), Y. Hatano (JAEA), R.H. Heffner (JAEA), S. Ikeda (KEK), Y. Ikeda (JAEA), M. Iwasaki (RIKEN), Y. Miyake (KEK), N. Nishida (Tokyo Inst. Tech.), K. Nishiyama (KEK), C. Petitjean (Paul Scherrer Inst.), L.I. Ponomarev (Kurchatov Inst.), J.M. Poutissou (Chair; TRIUMF Lab.) and Y. Yamazaki (KEK). As guest members, K. Nagamine and R. Kadono attended the meeting. Progress with construction of the J-PARC muon facility was reported, including a report from the 1st Muon Source Technical Advisory Committee. Then the committee reviewed several of the 24 Letters of Intent that had been received by the 31st of January, 2006. The final committee report will be submitted to the Project Director shortly.

Japan-Switzerland Seminar

The 1st Japan-Switzerland Bilateral Seminar on the Application of μSR to the Development of New Materials was held at the KEK Tsukuba campus from September 28-30, 2006 (sponsored by Japan Society for Promotion of Science and Swiss National Science Foundation), with 10 visitors from Switzerland and some forty domestic participants. The seminar was intended to be an occasion for seeking collaboration among condensed matter physicists / chemists from both countries, with a particular emphasis on the potential use of μSR facilities at the Paul Scherrer Institute (PSI) for Japanese scientists in the pre-J-PARC era. It covered recent scientific activities over a variety of fields such as strongly correlated electronic systems including high-Tc cuprate superconductors and heavy-fermion compounds, semiconductor physics, and radical chemistry. Beside these scientific activities, the current status of μSR facilities at PSI and some of the recent technological developments for various instruments (low energy muons, high pressure environment, etc.) were introduced. At the end of the seminar, a tour to the Tokai campus was held to observe the construction status of J-PARC.

Ryosuke Kadono



A group photo of the Japan-Switzerland Seminar participants.

Report from the RIKEN-RAL Muon Facility

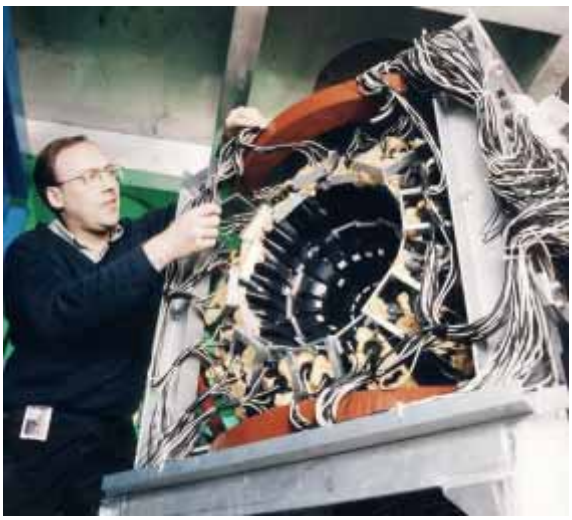
The Institute of Physical and Chemical Research (RIKEN) owns a muon facility at the ISIS spallation neutron facility at the Rutherford Appleton Laboratory (RAL). It was constructed under an agreement between RIKEN and RAL in September 1990, and maintained by a group of scientists from RIKEN since the first beam delivery in November 1994. While the EC Muon Facility (on the other side of the ISIS proton beamline) is optimized for surface muons, the RIKEN-RAL Muon Facility has a superconducting solenoid for pion decay and so can produce both negative and positive decay-muon beams with a momentum range of 20-120 MeV/c. For muon momenta lower than 65 MeV/c, the facility can provide two single-pulsed beams to two different experiment ports enabling two independent experiments to be conducted simultaneously. In the momentum range from 65 to 120 MeV/c, a double-pulsed muon beam is delivered to one experiment port.

The RIKEN-RAL muon facility during construction.

For ISMS members as potential users, here is a brief introduction to the equipment at the RIKEN-RAL Muon Facility. **Port-1** is dedicated to muon catalyzed fusion (μCF) experiments. A superconducting Helmholtz magnet generates a longitudinal field of 3.8 T for confinement at the μCF target. A tritium gas handling facility is used to hold triutium gas of 5.6 x10^{13} Bq (1500 Ci). d-t μCF processes have been studied over a wide range of hydrogen target conditions such as isotope mixtures and temperatures (liquid and solid) to determine the μCF cycling rate and the muon loss probability by observing the X-rays and d-t fusion neutrons.

Port-2 is mainly for condensed matter studies using μSR techniques. A general-purpose μSR spectrometer (ARGUS) is available, which consists of longitudinal (0.4T) and transverse magnets (0.015T) with zero field correction coils. The spectrometer consists of backward and forward μ-e decay counter arrays, which are segmented to 96 counters at each side. A typical μSR event rate is 70 million every hour. Several types of cryostats and furnaces are available to provide temperatures from 30 mK to 800 K. The muon spin RF resonance technique at low temperature has been developed at 30-55 MHz. Two types of high-pressure cells (hydrostatic and variable gas pressure cells) for μSR experiments have been recently developed.

Port-3 is for generation of an ultra slow muon beam and the associated laser system. The laser system produces 122 nm VUV light to ionize muonium. The surface muon beam is moderated in a heated tungsten foil at a temperature of



Francis Pratt with the ARGUS spectrometer.

2000 K to create muonium from the metal surface with thermal energy. The muonium in vacuum is then ionized to generate a free positive muon by irradiation with the resonant laser at 25 Hz in synchronization with the pulsed muons. The free muon is electrically accelerated and a muon beam with ultra low energy is produced. We have recently succeeded in generating the ultra slow muon beam and measuring the asymmetry. Development of the technique and application experiments are in progress.

Port-4 is for observing X-rays from muonic atoms formed by negative muons bound to nuclei implanted in solid hydrogen films. Measuring muonic X-rays is one of the promising methods to observe nuclear charge distributions of stable and unstable nuclei. The negative muons transfer very efficiently to the implanted nuclei to form muonic atoms in the solid hydrogen. We have succeeded in observing the 644 keV (2p-1s) X-rays from muonic argon, where argon atoms at a concentration of 1ppm are implanted in the solid deuterium film.

Finally, we would like to announce that we are now calling for proposals at the RIKEN-RAL Muon Facility. The details are as follows:

1. Deadline date: End of June 2007

2. The format of the proposal document can be found on the web site http://riken.nd.rl.ac.uk/ral/ral_form.html

3. The proposal document should be sent to the following address: Dr. M. Iwasaki, Advanced meson Science Laboratory, RIKEN, Hirosawa 2-1, Wako, Saitama, 315-0198 Japan Phone: +81-48-467-9352; Fax: +81-48-462-4648 e-mail: advanced_meson@riken.jp

4. The Program Advisory Committee (PAC) will be held at RIKEN in Japan at the end of July 2007. It is highly recommend that proposed experiments be explained by the spokespersons in the PAC.

5. Proposed experiments should be well examined with RIKEN muon scientists to be realized at the RIKEN-RAL Muon Facility before the submission of proposals.

For the next ISMS newsletter, we will submit more detailed reports dedicated to the muon science research activities at the RIKEN-RAL Muon Facility. *For further information about the facility and research activities, please visit our web site:* http://nectar.nd.rl.ac.uk/~rikenral/index.html

Teiichiro Matsuzaki

8th-12th August 2005 **http://musr05.physics.ox.ac.uk**

The conference was over a year ago now, but here are a few photos as reminders of the event. The conference website (address above) is still active if you would like to see more photos.

The conference group photo.

Above left: the conference dinner. Above right: the pre-dinner reception. Left: Robert Scheuermann and Andrew MacFarlane in discussion. Right: Steve Cox and Jess Brewer talking about muonium. Below: Participants at the 2-day satellite workshop on pulsed techniques.

μSR2008

As decided at μSR2005, the next muon conference will be held in Japan. Details are being worked out at the moment, but it is likely to be held in the city centre of Tsukuba.

Other news and information

Masa Senba

It is with great sadness that we report the passing of Masayoshi Senba (Semba). Masa Senba passed away peacefully at the QEII Health Sciences Centre in Halifax, NS, Canada on December 30, 2006 at the age of 59. Born in Sendai, Japan on October 24, 1947, Masa showed keen interest in the physical sciences from early on, setting up his first laboratory when he was 11. Convinced that physics held the key to truth, Masa studied at the Tokyo University of Education, and then at Rutgers University where he obtained a Ph.D. in physics in 1980. In 1981 he moved to Vancouver, BC to conduct experimental and theoretical research in solid state, atomic and nuclear physics and physical chemistry at TRIUMF. Masa moved to Halifax in 1996 and later became a Professor Research in the Department of Physics and Atmospheric Science at Dalhousie University.

Masa made original contributions to several fields of physics. In particular he provided a precise theoretical framework, called the time-ordered stochastic method, to investigate spin and charge exchange phenomena involving hydrogen-like species, with the goal to understand various experimentally observable quantities in terms of fundamental physical quantities inherent in the process in question, such as quantum mechanical spin flip rates and atomic collision cross sections. His theoretical method has been applied successfully to a wide variety of experimental situations in solid state physics, physical chemistry, and atomic physics. He lectured regularly at the Russian Academy of Sciences Winter School of Physics in St. Petersburg, Russia since 1998, and gave a series of seminars at the ISIS Facility, Rutherford-Appleton Laboratory, U.K. in 2002.

Masa also taught physics at Dalhousie University, and in 2002 he received from the Dalhousie Undergraduate Physics Society the first Langstroth Memorial Award, which recognizes an instructor of physics who shows the greatest love of teaching and the strongest desire to assist students in all matters. In addition, Masa's interests in philosophy (including Kant) led him to teach Einstein's theories to students at the University of King's College in Halifax.

As a self-taught viola (and violin) player, Masa found great joy in playing in orchestras and cherished playing string quartets and other chamber music throughout his life. Masa is lovingly remembered by his wife Kazue Semba in Halifax and his mother Kazuko Senba and other family members in Tokyo.

Facility Proposal Deadlines and Contact Details

ISIS
Deadlines: 2 per year - 16th April and 16th October
Contact: Philip King (philip.king@rl.ac.uk)
http://www.isis.rl.ac.uk/muons/

PSI
Deadline: 1 per year - next one is November 2007
Contact: Dierk Herlach (dierk.herlach@psi.ch)
http://lmu.web.psi.ch/

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

RIKEN-RAL
Deadline: end June 2007
Contact: Dr. M. Iwasaki (advanced_meson@riken.jp)
http://riken.nd.rl.ac.uk/ral/ral_form.html

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 isms@rl.ac.uk if you have suggestions.