International Society for μSR Spectroscopy

Newsletter No. 1 - Summer 2003

Greetings from the President of ISMS, Robert Heffner

Welcome to the first μSR eNewsletter since the founding of our new International Society for μSR Spectroscopy (ISMS). Look for additional and updated news about your society on our Web page.

Your Executive Committee has met in person twice so far, in Vancouver, Canada, and Tsukuba, Japan. A third meeting is scheduled for this August in the UK (in case you are wondering, the financing of these meetings is not from ISMS funds). We have laid out an agenda of things to accomplish in the next year to further the interests of μSR internationally and to improve communications within our community. We refer to these as 'inreach' (things we do for our own community) and 'outreach' (things we do to increase our contacts and visibility in other science communities and funding agencies). There are several actions underway - more details on these can be found in this newsletter:

- Establishment of official mailing and email addresses (see below).

- Establishment of an ISMS Toshimitsu Yamazaki Prize for μSR Science, to be awarded at future international μSR conferences.

- Chartering of a μSR Facilities Subcommittee concerned with current and future μSR facility capabilities. One of the aims of the ISMS is to identify the needs of the μSR community with regard to instrumentation, sources and access. With this in mind, the Facilities Subcommittee will be collecting information on μSR capabilities and future plans, and disseminating this to the community.

- Updating our Web Page to make it more professional and user friendly, and to include information of real interest to the user community.

- The establishment of this μSR eNewsletter to keep the μSR community informed.

- Ken Nagamine and I are planning to solicit input from our community for an issue of the *Journal of Physics: Condensed Matter* focused on μSR. This is part of our 'outreach' initiative, and will feature short review papers covering outstanding μSR work in condensed matter physics.

- As everyone knows there is no current μSR facility in the U. S. We are, therefore, going to hold a workshop this Fall, probably in New Mexico, to investigate possible new muon sources to complement the facilities already in N. America at TRIUMF. Stay tuned.

- Finally, a key initiative of ours is to increase our worldwide membership. You can help by signing on to the Web Site and making sure that your email address and other information is up-to-date. Also, please encourage your colleagues who have an interest in μSR, even if they are not present practitioners, to sign up too. In this way we can become a larger, more dynamic and successful society.

Best Regards, Bob

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.triumf.ca/~isms/

News from the regions . . .

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

TRIUMF is currently in the midst of developing its plan for the upcoming 2005-2010 funding period. I am pleased to report that the present plan includes a major upgrade to the μSR User Facility, of the likes not seen at TRIUMF in a long time. The proposal calls for the addition of *two* new state-of-the-art high-luminosity positive surface-muon beam lines, each outfitted with dual spin rotators and automated data acquisition/analysis systems. One of the beam lines will be equipped with a general-purpose spectrometer that is based on the *MULTI* prototype designed and built at TRIUMF. The *MULTI* spectrometer utilizes arrays of scintillators in a low-temperature environment. It can be used to enhance data collection rates for large samples, to study very small samples, to study multiple samples, or make sensitive Knight shift measurements.

The second upgrade is a reconfiguration of beam line M20B to provide a second simultaneous operating leg by accommodating the highly efficient mode of operation (invented at TRIUMF, but first implemented at PSI), "Muons On REquest" (MORE). This will provide the capability to measure out to 20 microseconds with high timing resolution and full spin rotation.

Our primary goals for the TRIUMF 5-year plan are to provide more efficient and effective support to more μSR users, and to broaden the scope of μSR applications by providing the capabilities needed for new kinds of experiments. Consequently, dedicated instrument scientists will be hired to make proper and efficient use of the new beam lines, and to accommodate smaller and "less experienced" research groups. While these new initiatives will provide a support structure for μSR similar to that at PSI and ISIS, the existing muon beam lines will continue to operate with sufficient flexibility, so as to preserve TRIUMF's "hands on" reputation for specialized experiments and to facilitate the development of new μSR technologies. Given the large volume of scientific output from the μSR User Facility over the past 5 years (*i.e.* ~ 250 refereed publications) and the strong impact of this work on a variety of scientific fields, I am confident that the proposed upgrade will be fully funded. Indeed, these are exciting times for μSR in North America!

TRIUMF is now home to a unique β-NMR facility, which uses low-energy radioactive ions to probe matter in much the same way many of us are accustomed to using muons. While the principles of μSR and β-NMR are nearly identical, the low energy of the radioactive ions makes them most suitable for depth-controlled experiments on thin films and interfaces. In this way they are much like the ultra-low energy muons used at PSI, except that the intensity of the beams are 3 to 5 orders of magnitude greater, and most of the nuclei to be used possess both quadrupole and magnetic moments. The β-NMR apparatus has now been successfully commissioned, and several proof of principle experiments have been carried out. Because of the strong complementarity of the techniques, we anticipate that users of TRIUMF's μSR facility will eventually also want to take advantage of the unique capabilities of β-NMR. Recently, the decision was made to reorganize the μSR and β-NMR User Facilities into one organization - Centre for Molecular and Materials Science (CMMS) - whose mandate is to provide unified representation for groups carrying out condensed matter physics and chemistry experiments at TRIUMF. This new identity will help provide long-term stability for μSR by intimately connecting it to newer materials science initiatives at TRIUMF.

Jeff Sonier.

Rob Kiefl working on the β-NMR apparatus at TRIUMF.

. . . from the Vice President - Asia

KEK-MSL Facility Status and Operation

The Meson Science Laboratory was the original facility using pulsed (50 ns pulse width, 20 Hz repetition) muon beams produced by a rapid-cycling 500 MeV proton synchrotron. The facility enabled the excellent features of pulsed muons to be recognised, and so influenced the development of both RIKEN-RAL and EC-RAL muon facilities at ISIS.

At present, there are three different channels producing muons for the Inter-University experimental program: (a) π-port, a surface muon channel for 4 MeV positive muons; (b) μ-port, a "decay" muon channel for up to 100 MeV positive and negative muons; and (c) P4 line, Large Solid-Angle and Axial-Focusing Superconducting beam channel (Dai-Omega channel), now providing the world-instantaneously-strongest pulsed surface 4 MeV μ^+ beam. The μ-port includes a 5 mK dilution fridge and 4 T longitudinal field, and intense lasers are available at π- and μ-ports. An advanced 256 channel segmented μSR spectrometer is now installed at the Dai-Omega channel.

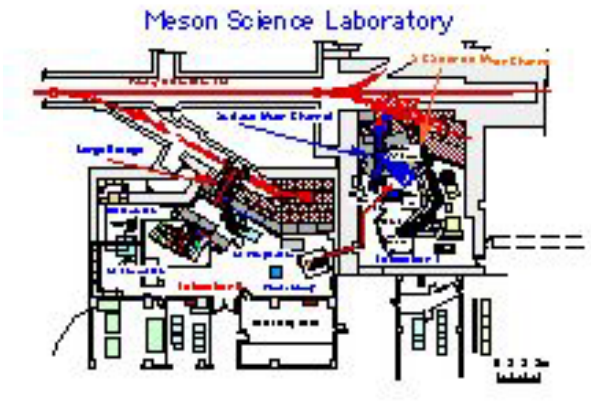
Anticipating the future J-PARC project (the Japanese high-intensity proton accelerator research complex project), the ultra-slow μ^+ project at RIKEN-RAL is being upgraded. Slow muons are produced by thermal muonium emission into a vacuum from the surface of hot tungsten followed by laser resonant ionization of the muonium. Some new types of slow beam development are also under preparation at the Dai-Omega.

Construction of Muon Science Facility at J-PARC Project

Construction of the Muon Science Experimental Facility at JAERI-KEK J-PARC Project has now started upstream of the neutron facility, after approval by the Japanese government of the whole project in 2001. The whole neutron and muon facility is called the Material and Life Science Facility.

Because of a budget limitation, the first phase of construction will be focused on a general purpose superconducting muon channel and a part of the surface μ^+ channel. Detailed design studies are now being performed for all the components of the Muon Facility.

A symposium on the muon science program at J-PARC muon facility was jointly hosted by JAERI Advanced Science Research Center and KEK-MSL on February 5 and 6, 2003, under the sub-tile of *What is seen by μSR - complementarity to Neutron scattering and NMR*. Topics included the status of the facility, technical

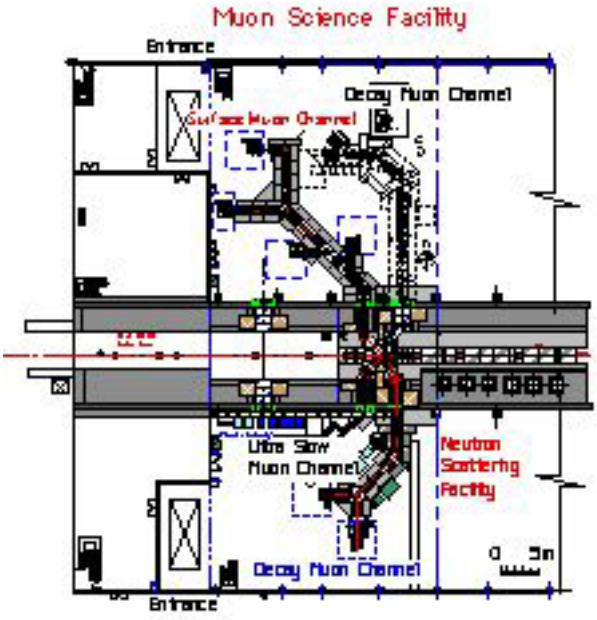


The KEK-MSL muon facility.

developments and scientific investigations. There were 33 presentations and around 80 participants.

In order to review both the plan of the J-PARC Muon Science Experimental Facility construction and the flagship experiments for the 1st phase of the Muon science Experimental Facility, the Muon Science Experimental Facility Advisory Committee (MUSAC) has been organized under the project director of J-PARC. The members of the committee are: J. Akimitsu (Aoyama Gakuin U), S. Ikeda (KEK), Y. Ikeda (JAERI), M. Iwasaki (RIKEN), K. Nagamine (KEK, Secretary), N. Nishida (Tokyo Inst. Tech.), Y. Miyake (KEK), Y. Yamazaki (JAERI), H. Yasuoka (JAERI), R. H. Heffner (Los Alamos Lab.), C. Petitjean (Paul Scherrer Inst.), L. I. Ponomarev (Kurchatov Inst.) and J. M. Poutissour (TRIUMF, Chair). The first MUSAC meeting was held on February 7, 2003, and included an overview of the project together with technical presentations of the muon science experimental facilities and of the flagship experiments envisaged.

Ken Nagamine.



The proposed J-PARC muon facility.

. . . from the Vice President - Europe

The μSR Facility at the Swiss Muon Source (SμS) consists of six instruments - three for 4.2 MeV μ^+ (GPS, LTF, Dolly), one for higher energy muons (GPD, max. 60 MeV μ^+ or μ^-), an avoided level crossing (ALC) apparatus, and the unique low energy (0 and 30 keV) μ^+ beam (LEM). GPS and LTF benefit from a beam sharing device (MORE), allowing one muon to be extracted at a time, thus providing unrivalled frequency resolution and high sensitivity to slow relaxation. The GPS, LTF and GPD instruments are permanently installed at dedicated beam lines whereas the others share beam time with particle physics experiments.

A new, very high acceptance muon beam (semi-dedicated to low energy μSR) is under construction. It will increase the available surface muon flux by almost an order of magnitude. The LEM instrument is also undergoing a significant upgrade, leading to expected operation at 5000 low energy μ^+ per second.

A good step towards a high magnetic field (>10 T) μSR instrument at PSI was taken in January 2002 at a workshop attended by over 50 scientists from all over the world. This resulted in a strong science case for such a facility, encouraging us to start R&D work on fast timing detectors in high magnetic fields.

The European Muon Facility at ISIS consists of two fully-scheduled instruments, EMU and MuSR, together with the DEVA spectrometer which is partly scheduled and partly used for development work. Over recent years, much of that development has concerned RF-μSR, which is ideally suited to a pulsed source such as ISIS, and this technique is now being exploited by some 11 different groups for investigations across a wide range of systems in chemistry and physics. Other recent developments have included dedicated facilities for gas and liquid handling, which can also be used with the RF technique.

In January 2003, a successful training course on μSR was held at ISIS, allowing 18 young researchers from the UK and Europe to spend a week learning the basics of the muon technique and running muon experiments. The course provided a good grounding in the theory and practicalities of the technique, to help younger researchers and their groups use the method in their research.

Finally, we continue to explore possibilities for providing significantly higher data rates through improvements to spectrometer detector arrays and enabling new science through provision of higher applied fields. The science case for these developments has been written – we are now exploring funding opportunities.

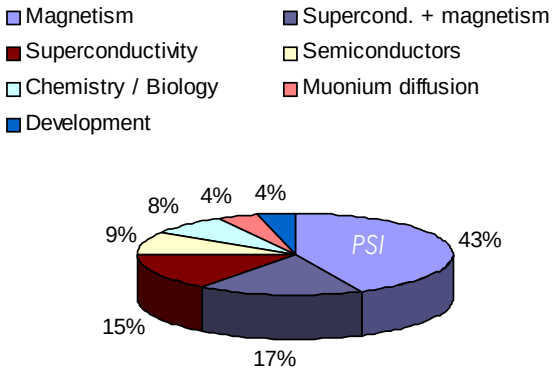
The European Commission encourages collaborations between institutes and facilities working on similar research topics. Its 'Framework Programmes' provide funds for European researchers to use facilities outside their own country, together with mechanisms for forming networks between partners in different EC countries. Framework Programme 6 will start next year, and funds have been applied for to support a muon research and development network involving ISIS, PSI, Oxford, Technion and Parma plus other interested groups around Europe. The network will focus on technical developments of the muon technique. In addition to the network, ISIS and PSI have also applied for funds which will provide beam fees and expenses for EC researchers to use ISIS and PSI.

Elvezio Morenzoni, Thomas Prokscha, Hubertus Luetkens and Ted Forgan with the LEM beam and instrument in area piE3.

ISMS-Europe. The large European μSR community is extremely fortunate in having free access to two major and complementary muon facilities, ISIS and PSI. However, the continuing development of advanced μSR techniques and facilities is dependent upon cooperation and collaboration between users and providers of muon beams. In this respect ISMS-Europe can, and must, play a crucial role in maintaining the health of the existing muon community and extending the use of μSR into the wider science base. Indeed, I believe that ISMS-Europe should, as its key objectives: *promote μSR in the wider scientific community; liaise with muon facilities on behalf of users; explore possibilities for new facilities (eg the European Spallation Source); organise European conferences, workshops and summer schools; and coordinate activities in muon science*. In order to achieve these objectives it its essential that the activities of ISMS-Europe are well structured, and for this purpose I suggest that we establish a formal ISMS-Europe Executive Committee, bringing together the regional ISMS-Europe Vice President and single delegates elected by the individual national μSR user communities within Europe. Such an Executive Committee could meet perhaps biannually with observers from the muon facilities and other interested bodies. I would be extremely pleased to hear your views on the formation of the ISMS-Europe Executive Committee, or indeed on any other issues that you feel should be raised at the regional or global level (e-mail: R.Cywinski@leeds.ac.uk).

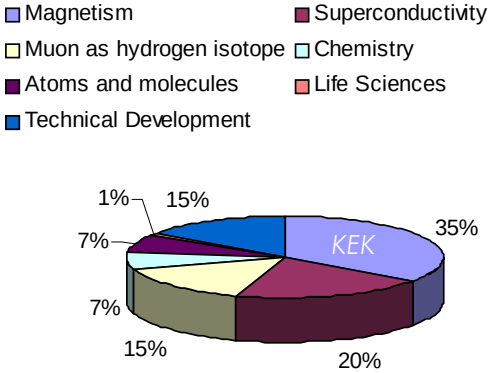
Facility Proposals . . .

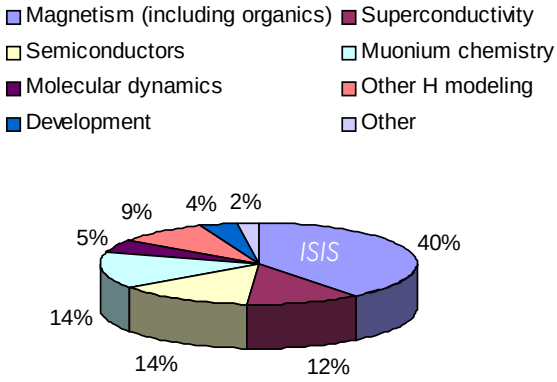
One of the strengths of the μSR technique is the very wide variety of systems to which it can be applied, either as a local probe in, for example, studies of magnetic materials, superconductors, a variety of charge transfer processes and molecular dynamics; or to model proton and hydrogen atom behaviour in semiconductors, hydrogen storage materials, proton conductors and chemical reaction investigations. Here we have a brief look at recent proposals to the main μSR facilities.



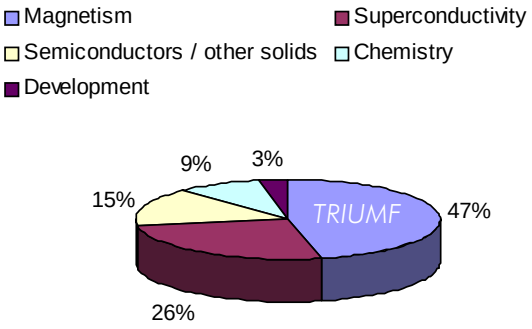
In 2002 the Swiss Muon Source SμS at PSI has seen 79 proposals (11 for the low-energy muon beam) from proposers from 21 countries (8 non-European). Bulk μSR investigations have included highly frustrated magnetic compounds like the pyrochlore system $Yb_2Ti_2O_7$, the interplay between magnetism and superconductivity in underdoped High-T_c cuprates, magnetism in the transition metal oxide hydride $LaSrCoO_3H_{0.7}$, and the partitioning of amphiphilic molecules between aqueous and lipid environment and corresponding conformational changes (the latter by ALC-μSR). The low energy muons have been used to study non-local effects in type-I superconductors, the induced spin polarization below the magnetic interface of an Fe/Ag bilayer and in the Ag layer of an Fe/Ag/Fe trilayer, and the internal magnetic fields in both the superconducting and magnetic layers of a superlattice of alternating $YBa_2Cu_3O_7$ and $SrRuO_3$ layers. A breakdown by subject area is given above.

At KEK-MSL there have been some 270 active proposals in the period 1997-2002, with the chart below showing the breakdown by subject category.





In the two proposal rounds in the last year, ISIS has seen 92 separate proposals from researchers in 15 countries. Investigations have included molecular dynamics in polybutadienes and around the glassy transition in ethanol; superconductivity in molecular charge-transfer salts and high-T_c materials (including novel use of RF-μSR in the latter case); laser excitation of molecular systems; gas phase reactions and radical chemistry; a wide variety of magnetic materials, including frustrated, organic and superparamagnetic systems; and modelling hydrogen / proton behaviour in oxides, battery electrode materials, hydrogen storage systems and a variety of pure and applied semiconducting materials. Many science areas are benefiting from continued development of the RF-μSR technique, ideally suited to a pulsed source such as ISIS. The ISIS 2002 proposal breakdown is given above.



TRIUMF has seen 20 proposals accepted recently. They include investigations of radical behaviour in sub- and super-critical water, in fullerene solutions and in carbenes; low-dimensional, molecular / polymeric and frustrated magnetic systems; muonium behaviour in semiconductor alloys and II-VI chalcogenides; and magnetism and flux-line lattice behaviour in superconductors, including the effects of pressure. A breakdown of the 65 proposals received over the past five years is shown above.

The ISMS announces a call for nominations for the first ISMS Toshimitsu Yamazaki Prize for μSR Science

The Toshimitsu Yamazaki Prize

The $3000 prize is made available by the ISMS every three years to any scientist for outstanding, sustained work in μSR science with long-term impact on scientific and/or technical μSR applications. The 2005 prize will be awarded at a special ceremony session of the International Conference on μSR, to be held in Oxford, UK.

Selection Committee

Nominations for the prize will be considered by a Selection Committee which consists of the President and three Vice Presidents of the ISMS, together with authorities representing the major scientific disciplines to which μSR contributes. The Committee includes acknowledged experts both inside and outside the μSR community. Membership in the Selection Committee is by invitation of the ISMS Executive Council. Committee members are not eligible to receive the prize.

Call for Nominations

Nominations for the 2005 ISMS Toshimitsu Yamazaki Prize may be submitted by scientists as individuals or on behalf of a Group. To establish a high standard it is necessary that the Committee receive nominations that demonstrate a sustained, long-term impact on particular fields of science using μSR and/or on substantial development of innovative μSR-related techniques or technology. Nominations should include a cover letter describing the motivation for the award, a brief curriculum vitae of the nominee and a short list of major, relevant publications. At least two additional supporting letters of recommendation should be included. Nominations will be treated in confidence, and will be acknowledged, but no further communication from the Selection Committee will be sent.

Deadline

Nominations should be sent before June 1, 2005, to the Chairman of the Selection Committee:
Dr. Robert H. Heffner, President ISMS
MS K764
Los Alamos National Laboratory
Los Alamos, NM 87545 USA
Telephone: +1 505 667 4838
Fax: +1 505 665 7652
Email: heffner@lanl.gov

Toshimitsu Yamazaki

Professor Toshimitsu Yamazaki was born in 1935 and graduated from the University of Tokyo. His career has been characterized by a love of science, and his innovation and creativity have produced many new developments in intermediate-energy, nuclear-particle and condensed matter physics. He pioneered the application of μSR to solid-state physics, introducing in the late 1980's the zero-field relaxation technique, which is based upon the theoretical treatment of Kubo and Toyabe. This technique has become a distinguishing capability for μSR and has revolutionized the role of μSR in condensed matter studies. In addition, his influence on his students and those he has mentored has resulted in the spread of the μSR technique to facilities in North America, Europe and, of course, Japan. His research activities, other than μSR-related subjects, cover nuclear structure spectroscopy, meson-exchange effects in magnetic moments, hypernucleus spectroscopy with stopped kaons, deeply bound pion spectroscopy in nuclear matter, and antiprotonic helium atom spectroscopy.

Other News and Information

μSR 2005

The next international conference on muon spin rotation, relaxation and resonance will be held in Oxford in 2005. This conference is usually held every three years and follows the previous conferences in Rohrschach (1978), Vancouver (1980), Shimoda (1983), Uppsala (1986), Oxford (1990), Maui (1993), Nikko (1996), Les Diablerets (1999) and Williamsburg (2002). Whether your interest is in chemistry, semiconductors, magnetism, superconductivity, or any of the other fields in which implanted muons can play a unique role, this conference aims to provide a forum in which ideas can be exchanged and the latest developments can be presented. Information on the conference will be available soon at the conference web-site *http://musr05.physics.ox.ac.uk*.

ISMS Statistics

As of 12th June 2003, the ISMS had 180 members. Of these, 60% use PSI, 41% use ISIS, 37% use TRIUMF, 17% use KEK and 7% use other facilities. The majority (81%) say that some or all of their research falls in the condensed matter physics area, with 31% involved in atomic physics or chemistry and 28% subatomic physics. 15% describe their research area as life sciences, and 15% as accelerator science.

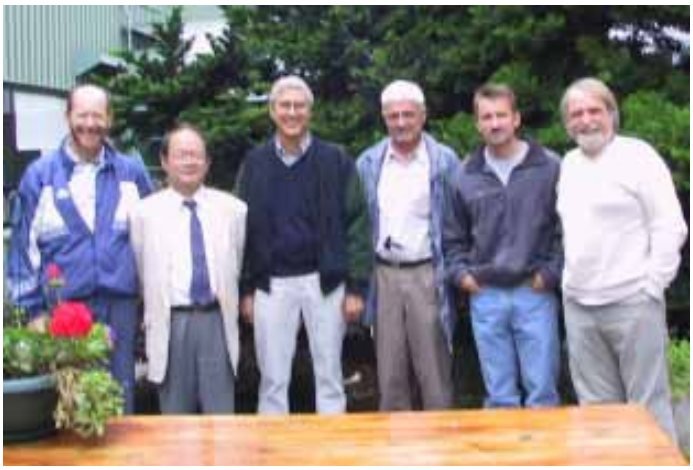
Facility Proposal Deadlines and Contact Details

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/

KEK
Deadline: 2 per year; next one is 5th September 2003
Contact: Ken Nagamine (kanetada.nagamine@kek.jp)
http://msl-www.kek.jp

PSI
Deadline: 1 per year - next one is November 2003
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/



Some of the ISMS Executive at the first committee meeting in Vancouver in December 2002. From left to right: Jess Brewer (UBC), Ken Nagamine (KEK), Bob Heffner (Los Alamos National Laboratory), Uli Zimmermann (PSI), Jeff Sonier (Simon Fraser University) and Bob Cywinski (Leeds University).

Comments on this newsletter?

The ISMS newsletter will be distributed twice per year, 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, philip.king@rl.ac.uk) if you have suggestions.