International Society for µSR Spectroscopy

Newsletter No. 17 – March 2019

Greetings from the President of ISMS

The past year has seen several exciting opportunities for the future of muon science. The Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) has approved the Research Center for Nuclear Physics (RCNP) in Osaka to be an International Joint Usage/Research Center, strongly supported by ISMS. This means that RCNP will receive additional resources to strengthen the support for muon science carried out at the DC muon beam facility MuSIC. Having a second international research center for muon science in Japan means there will be plentiful opportunities in combination with the complementary pulsed muon source at J-PARC and this will help to strengthen and expand the international muon users' community. Similar good news comes from the Chinese EMuS project team at the Chinese Spallation Neutron Source (CSNS). The EMuS project has now been included in the CSNS Upgrade Project CSNS-II, which is a major step towards the realization of the first Chinese muon facility (see the contribution of Jingyu Tang in this newsletter). I wish to convey my congratulations to both facility teams for their big success, which will help to attract new users for the muon community and to give users better access to muon instruments.

As mentioned in the last newsletter ISMS now offers financial support to muon schools and workshops to help young scientists to attend these meetings. In 2018, ISMS sponsored the ISIS Muon Training School in March, and the 3rd Neutron and Muon School at J-PARC in November. For 2019, an International Advanced School in Muon Spin Spectroscopy will be held between 15th – 23rd August at ISIS, with details to be published soon. This school receives financial support by ISIS, PSI, the University of Oxford, and the European SINE2020 program. In order to help non-European young scientists to attend the meeting ISMS will provide a contribution of 3000€. Due to the tight financial situation of ISMS, we recently sent to you a letter with a fundraising request to help ISMS in this important task. I warmly thank all of you who already made a donation, and I hope that more members of ISMS will help to support financially the society's activities to promote the next generation of muon scientists. Organizers of other muon schools/workshops may contact me or someone else from the Executive Committee, if they want to ask for support by ISMS.

Finally yet importantly, the next µSR conference MuSR2020 in Parma, Italy, organized by Roberto de Renzi/University of Parma and the ISIS muon group, will be held from July 6 – 10th, 2020. More information is available on the last page of this newsletter and the conference web page http://www.musr2020.unipr.it. I greatly look forward to this stimulating meeting in Parma!

On behalf of the ISMS Executive Committee, I wish you all a happy and very successful year 2019!

Thomas Prokscha, President of ISMS

Progress report about the muon facility EMuS at CSNS

A study team who is composed of members from different institutions in China and different divisions at IHEP has been working on the design and R&D of a future muon beam facility at CSNS (or EMuS project). EMuS aims to provide intense muon beams for different research fields with emphasis on μSR applications, which will be competitive and complementary to the existing muon facilities. Following the recommendation by the experts during the First Workshop on Muon Sources and Applications held in December 2017, the team organized the international review meeting for the EMuS Conceptual Design on Nov. 20-21, 2018, in Dongguan, Guangdong, China. Six international experts from the world leading labs or institutions together with five domestic experts joined the review committee. After having listened to the reports from the EMuS study team, and discussions with the team and among themselves, the committee submitted a formal review report that affirms the design concept, technical schemes and R&D efforts and provides very valuable comments for further studies.

Other progresses about EMuS include: 1) the CSNS Science and Technology Advisory Committee recommended that EMuS be included in the CSNS Upgrade Project (or CSNS-II project) that IHEP is pursuing to start in the next few years. IHEP and CAS managements accepted the recommendation with a phased construction of EMuS. 2) A few EMuS members from University of Science and Technology of China (USTC) conducted two test experiments at the ISIS muon source, and tested the detector prototype of a μSR spectrometer, with the great help from the ISIS colleagues. 3) IHEP and PSI are going to sign a Framework Agreement on the collaboration on muon science.

Jingyu Tang

News from PSI

Even though the beamtime period was strongly reduced, the year 2018 has been marked by a very strong beamtime demand. The beamtime reduction was planned and devoted to the first upgrade of the resonators of the Injector II of the HIPA accelerator complex. The second upgrade of the resonators will take place in 2019, which will also be characterized by a reduced beamtime period extending from July to December. Despite the continuous strong beamtime demand, leading to oversubscriptions ranging from a factor 2 to a factor 4, the instrument scientists and technicians of the Laboratory for Muon-Spin spectroscopy (LMU) could provide a strong support to the external users. In parallel, several instruments and beamline developments were conducted, as illustrated below.

In addition, LMU is keen fostering international collaborations with the other muon sources, where LMU representatives are involved in different committees and work-groups. In August, a numerous delegation of Chinese scientists, led by Prof. Y Tang of the Institute of High Energy Physics (IHEP), involved in the experimental muon source (EMuS) at the Chinese Spallation Neutron Source (CSNS) in Dongguan has visited SμS. A Framework Agreement to promote PSI/IHEP collaborations has been finalized.

Decommissioning of LTF and start of the FLAME setup

For more than 30 years, the first user facility instrument LTF at SμS has provided the scientific community with excellent experimental capabilities for μSR experiments at millikelvin temperatures. The multitude of successful experiments lead to more than 400 publications in scientific journals. In October 2018, the LTF era has ended and the disassembly of the instrument has started. In the last months, the instrument, the old support infrastructure as well as the measurement cabin have been removed from the area PiM3.3 to start with a clean slate for the new μSR user facility instrument FLAME (FLexible and Advanced MuSR Environment). FLAME is designed to possess vastly more experimental capabilities with respect to LTF. To name a few of its characteristics, FLAME will cover a broad temperature range from 20 mK to room temperature with magnetic fields from true zero fields smaller than 5 μT up to 3.5 T in longitudinal as well as transverse field geometry, it will allow measuring small samples with an area of a few square millimetres with practically no background due to an active veto system and it will have an estimated time resolution of 150 ps for high spectroscopic accuracy. In a second development step, an in-situ modification of the sample properties at all temperatures by external stimuli e.g. by electric fields or uniaxial pressure will be possible. Now, the new infrastructure in the area is being built starting with a new paint of the area and the installation of a local area crane. Then successively the new infrastructure of the area and the instrument will be installed during 2019. First expert user operation at FLAME is planned for the beam period 2020.

The International Society for μSR Spectroscopy

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Instrument scientist Chris Baines switching off the dilution fridge of LTF for the last time before its disassembly.

LEM: New Record Rate and High-Voltage Box

At the LEM instrument, just before the long accelerator shutdown, a solid Neon moderator was successfully tested for 24 hours at the µE4 beam line for the first time. s-Ne has 60-70% higher moderation efficiency compared to the routinely used s-Ar moderator, and we could generate a new world record low-energy muon rate at the moderator of about 15k/s at a proton beam current of 1.9 mA and 4-cm-long target E. This is expected to increase to about 24k/s for a slanted target E (to be tested in Dec 2019), and for a normal proton beam current of 2.3 mA, which will be again available from 2020 on. s-Ne has not been used so far due to high-voltage instabilities at the moderator during bombardment with the highest intensity beams. This caused unacceptably high background rates of > 500k/s at the start detector of the LEM setup. Using the low-energy muon spin rotator in separator mode allows removing most of the background ions generated at the Ne layer. Up to 12 kV extraction voltage can be applied to the s-Ne moderator (compared to 18 kV with s-Ar), which allows implantation energies between 1 and 20 keV. Longterm feasibility tests with s-Ne will be continued in 2019. For routine operation, we continue to use the much more stable s-Ar moderator.

At the LEM sample environment a "high-voltage cage" was successfully tested which allows biasing a normal current/voltage source meter up to +-12.5kV. With this setup, for the first time, we could carry out LE-µSR experiments where a current of 300 mA was sent through a thin film sample, which was biased between -4 kV and 6 kV. In 2019, the option to remotely control the source meter will be implemented.

Staff News

We are pleased to announce that two new instrument scientists have recently joined our Laboratory. Zurab Guguchia, who obtained his Ph.D. degree with Prof. Hugo Keller at the University of Zurich and recently spent some time as a PostDoc at the Columbia University, has obtained a PSI tenure track position. Zurab is most probably familiar to many of you, as he already stayed at PSI on a PostDoc position working on the GPD instrument.

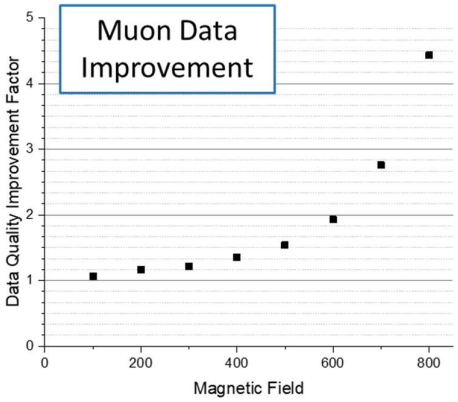
Toni Shiroka, who obtained his Ph.D. degree with Prof. Roberto De Renzi at the University of Parma working with µSR and NMR, has been transferred to our Laboratory from another PSI unit. Toni has worked for a few years at PSI, first in our Laboratory, then for the SwissFEL project and finally with our former Director Joël Mesot to perform NMR. As Joël Mesot has recently been nominated President of the ETH Zurich, Toni is back to his second scientific roots, i.e. µSR.

Alex Amato, Thomas Prokscha, and Hubertus Luetkens

News from ISIS

Proton Pulse Compression

The ISIS accelerator team developed a phase space rotation technique to compress the proton bunches leaving the synchrotron that means we now get shorter muon pulses. After testing, pulse compression is now the standard mode of ISIS operation and has run successfully for a few cycles. The muon pulses are ~15% shorter so the time resolution on all the instruments is improved accordingly.



Advanced Muon School

ISIS, OXFORD and PSI are jointly running an advanced muon school. The dates are 15th -23rd August 2019. A wide range of topics relating to muon spin relaxation, rotation and resonance will be covered along with complementary techniques.

Details will be available soon at: www.isis.stfc.ac.uk/Pages/Muon-Spectroscopy-Advanced-School.aspx.

ISIS long Shutdown

ISIS will go into a long shutdown starting September 2020 and lasting for approximately 14 months. This is to complete two major accelerator tasks, tank 4 of the linac and an upgrade of the first neutron target station. During this downtime, we will take the opportunity to upgrade the RIKEN-RAL facility. This will result in upgrading the power supplies, vacuum systems, water cooling circuit, superconducting power supply, instrument electronics and sample environment.

RIKEN-RAL

On April 1st 2018, ISIS assumed responsibility for the RIKEN-RAL facility as it transfers to STFC ownership. Acquiring the RIKEN facility is an exciting prospect and we are currently looking to refurbish the facility to develop unique capabilities and provide greater capacity. To celebrate the continuing collaboration, on the 16th & 17th July 2018, at The Cosener's House, Abingdon, UK, we held a Muon Spectroscopy User Meeting to discuss Future Developments and Site Calculations. Key themes of the meeting were SuperMuSR and the new agreement between ISIS and RIKEN for future operation of the RIKEN-RAL facility. Talks focussed on the scientific opportunities that these developments will bring.

e-learning

Since the last ISMS newsletter we have extended the range of muon materials covered at www.e-neutrons.org to include full lecture videos for the past two ISIS Muon Training Schools (2018 lectures are also available on YouTube), guides to using the data analysis programs Mantid and WiMDA, as well as the

MuESR muon site identification tool, notes on the different types of µSR, and some simple introductions to µSR for absolute beginners. These materials will continue to grow over the coming year and suggestions are welcome for areas we're yet to cover.

Platform Extension

Over the summer, we extended the south-side muon platform to allow much more working space for users, staff and for the storage of equipment. This should make for a safer working environment and lays the foundation for future improvements.

Adrian Hillier

ISMS Executive Committee

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Secretary: ***Dr Peter Baker, ISIS, UK***

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

News from the Centre for Molecular and Materials Science (CMMS) at TRIUMF

TRIUMF is currently in its annual winter shutdown and the CMMS group is preparing for the upcoming year of operation. μSR experiments in the Meson Hall will begin around May 7th, 2019. There will be a mini-shutdown in the beginning of October and the beam will continue until the beginning of December. We are currently scheduling μSR experiments for the period from May 7th to September 3rd, 2019. The remainder of the year will be scheduled after the summer MMS-EEC meeting, which will be held on June 17th-18th, 2019. There will be a call for proposals with a submission deadline of May 8th, 2019. More information about the beam application process can be found here: https://www.triumf.ca/research-program/planning-experiments/how-submit-proposal/mms-eec-process

Recent and ongoing developments at the CMMS:

1) The CMMS group has hired two new scientists; Kenji Kojima and Sarah Dunsiger. They have been hired as TRIUMF Board Appointed Employees (BAEs), which are equivalent to faculty at Canadian universities and are eligible to apply for external funding. In addition, Iain McKenzie has been promoted to a BAE position. These three new BAE scientists will advance the in-house scientific program and form collaborations to bring in new users.

2) The repair of the M9 beam line its re-connection to the pion/muon production target is ongoing. A new front-end quadrupole magnet doublet will be installed in the 2020 winter shutdown which will enable the commissioning of M9A with surface muons. We anticipate beam delivery to M9A at the beginning of the Summer 2020 beam period when the beam line and new, dedicated 3 T spectrometer with APD detectors will be commissioned. We are anticipating user operations in the Fall 2020 beam schedule. The M9A beam line and spectrometer will be optimized for rapid sample characterization with user-friendly operation.

3) A collaboration of Canadian μSR groups (led by Jeff Sonier) and TRIUMF has received funds from the Canadian Foundation for Innovation (CFI) and matching funds from the provincial governments of British Columbia, Ontario, Quebec and New Brunswick for a $10.7M project to redevelop the high-momentum M9B channel into one geared for μSR research into quantum systems under extreme conditions of high pressures, high magnetic fields, and very low and very high temperatures. The beam line, to be re-christened as M9H, will be optimized to produce transversely-polarized muons at all practical momenta and thus excel at high transverse-field (TF) μSR. To this end, the new M9H includes a new spectrometer based upon on a 4 T superconducting omni-directional Helmholtz magnet that will accommodate a 50 mK dilution refrigerator specifically designed for high-pressure cell experimental targets (~ 2.5 GPa). M9H will also support the insertion of high-pressure liquid or gas target sample cells under extreme conditions (temperatures to 1000 K and pressures to 0.6 GPa). We anticipate commissioning of the M9H beam line and spectrometer in 2023 with user operation shortly thereafter.

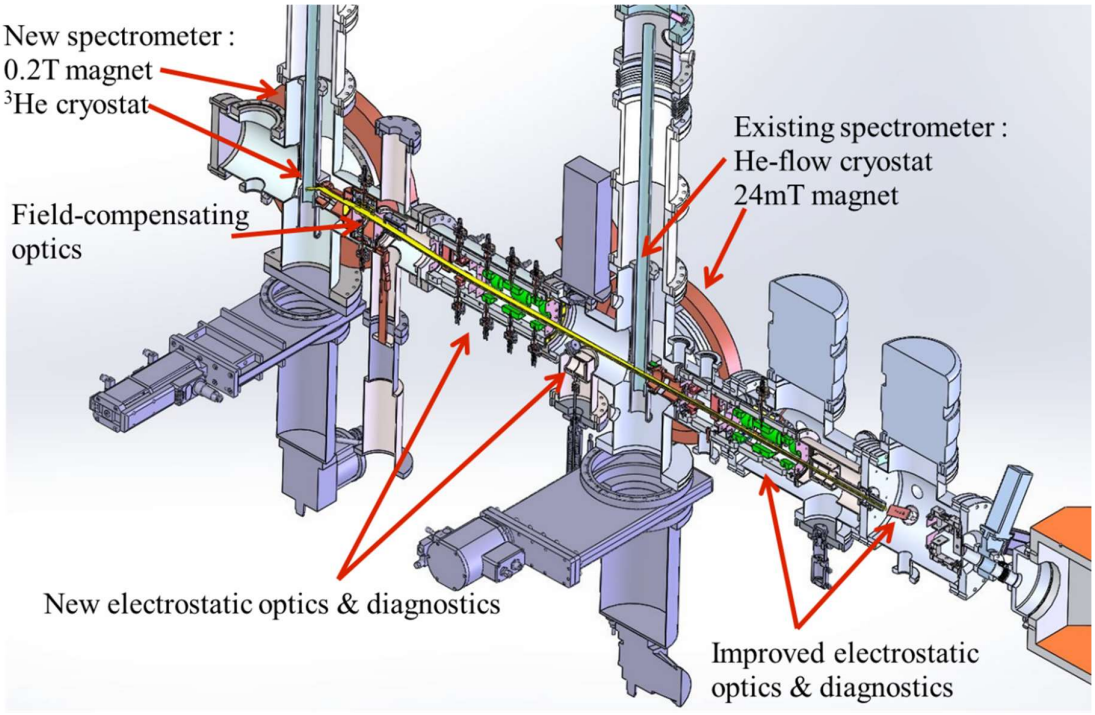
4) Graeme Luke, Jeff Sonier, Rob Kiefl and Andrew MacFarlane were recently awarded a grant from the NSERC Research Tools and Instruments Grants Program for a ^{3}He cryostat for the NuTime spectrometer. This will be

ready for user operation in the Summer 2019 beam period.

5) An upgrade to the βNMR facility capabilities is in development (shown below), to achieve up to 2 kG in-sample-plane magnetic fields and temperature down to 300 mK. The first stage, which involves rebuilding the βNQR beam line to with new electrostatic optics and beam tuning diagnostics, will be completed in the 2019 winter shutdown. The second stage, which will involve extension of the beam line past βNQR and installation of the mid-field magnet, is planned for Fall 2019 with user operation in 2020.

6) There will be reduced availability of βNMR in 2019 due to the delayed startup of ISAC. This year, as in 2018, we are anticipating approximately four weeks of ^{8}Li βNMR, instead of the usual five weeks, and one week of ^{31}Mg βNMR. The delayed startup is due to personnel being shifted to tasks related to the completion of the Advanced Rare IsotopE Laboratory (ARIEL). ARIEL is TRIUMF's flagship multidisciplinary research facility and will broaden Canada's research capabilities in particle physics, nuclear physics, nuclear medicine, and materials science by tripling TRIUMF's output of rare isotopes for research upon completion in 2023. The βNMR facility will see an increase in beam time starting in 2021 and eventually reaching 15 weeks of beam per year upon the completion of ARIEL. Additional developments to increase the amount of beam delivered to the βNMR facility are in progress, including rapid beam switching (kHz) between the βNMR and βNQR, which will allow simultaneous and independent running of both spectrometers.

Iain McKenzie



News from J-PARC

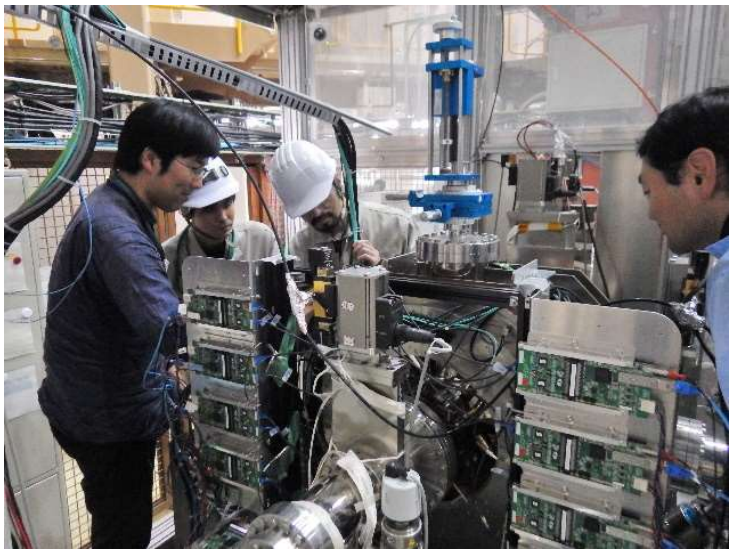
The beam commissioning at the ultra-slow muon beam line (U-line), J-PARC MLF is in progress in order to improve the intensity and quality of the muon beam, towards the final goal that the beam line is open for users.

The magnetic shielding around the muonium production target has been enhanced to avoid the beam orbit being disturbed.

The optimization of the Lyman-alpha laser has been also studied.

At the downstream of the U-line, a μSR test measurement is simultaneously carried out by using a foil sample, where the thickness is approximately 10 nm, showing good beam performance obtained by the beam line development.

Akihiro Koda



Mr Iwashita, Drs Adachi and Ohishi are preparing the foil sample for the muSR measurement.

Muon Facility Contact Details

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The organisation of the 15th International Conference, μSR2020, has started. The International Advisory Committees and the Scientific Program Committee have been appointed. We are very glad to announce that the conference will have two Honorary Chairs, Professor Cesare Bucci and Professor Steve Cox, whom we look forward to welcoming in Parma from 6th until 10th July 2020. Registration will open around December this year.

The 2020 Yamazaki Prize and the Young Scientist Prize will be announced by The International Society for μSR Spectroscopy during the Conference.

A brief tutorial school, intended for newcomers and students is foreseen, according to a recent tradition on Sunday 5th, the registration day. A limited number of local support awards is foreseen for students that cannot get full support from their own institutions. Cheaper accommodation for students will also be available.

Accompanying persons may enjoy visiting Parma, with its nice ancient centre and a notable cultural heritage. Parma is the Italian Capital of Culture for 2020 and our Conference is listed also as an official event within that programme, with a special public engagement session. Many other destinations are within just over one hour travel and major Italian art cities may be reached in a one day tour. Very good food is another local incentive.

We are looking forward to welcoming you all in Parma!

Adrian Hillier and Roberto De Renzi, Co-chairs
on behalf of the Local Organizing Committee

Comments on this newsletter?

The ISMS newsletter will be distributed annually 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 ISMS Secretary at peter.baker@stfc.ac.uk if you have suggestions.