



Greetings from the President of ISMS

Welcome to the latest ISMS newsletter. After the conference is before the conference. After the wonderful 14th International Conference on Muon Spin Rotation, Relaxation and Resonance (μ SR2017) held last June in Sapporo, Japan, we are already looking forward to our next meeting, μ SR2020, organized by Roberto de Renzi and the ISIS muon group in Parma, Italy. Parma is a beautiful lively town, with beautiful art and nature within easy reach, and labelled UNESCO City of Gastronomy. The conference will be held on the campus of the university, either in the week of June 29 – July 3, or one week later, July 6 – July 10, 2020. Please start noting these alternatives on your agenda. The final date of the conference will be announced early this summer.



The Sapporo conference was again a great meeting of the μ SR and β -NMR community demonstrating the broad activities and wide field of applications of both techniques. For the organization of the conference I would like to express my sincere thanks to the conference chair Jun Sugiyama and the two co-chairs

Yasuhiro Miyake and Hiroshi Amitsuka, as well as to the chair of the Scientific Program Committee, Ryosuke Kadono, and the chair of the International Advisory Committee, Yoji Koike. The conference began with the μ SR2017 pre-school on Sunday, June 25th, followed by the conference opening on Monday. We had then the first highlight of the conference, the Yamazaki Prize Award Ceremony and the Yamazaki Prize Lecture by Rob Kiefl. It was a special honour to have two of the μ SR pioneers, Toshimitsu Yamazaki and Kanetada Nagamine, attending the conference and the prize ceremony as Guests of Honour. The conference had 61 talks, including 7 excellent invited presentations, and 135 posters covering a rich scientific program. Besides the status reports of the existing muon facilities we heard about several new exciting muon facility projects. At the moment, scientific groups are examining the possibilities of muon sources at the Chinese Spallation Neutron Source (CSNS) in Dongguan, at the Spallation Neutron Source (SNS) in Oak Ridge, and at the RAON facility in Daejeon, South Korea. More advanced is the Japanese DC Muon Beam Facility RCNP-MuSIC in Osaka, where first beam tests have been successfully carried out. If all of the proposed projects are realized there will be a doubling of muon facilities in the world in the near future – these are really bright prospects for μ SR and will certainly lead to a boost of μ SR applications in modern science, together with a significant increase of the number of muon users worldwide. We should wish them all success and offer all support they need from us, the international μ SR community and ISMS.



With the end of the conference also the term of office of the previous ISMS Executive Committee ended. Thanks are due to the outgoing members of the Committee, especially to the former President Khashayar Ghandi for operating ISMS in the past three years, and also to those who agreed to serve for ISMS for the next three years: the regional vice-presidents, Akihiro Koda (Asia), Rui Vilão (Europe and Africa), Robert Kiefl (Americas), and the President-Elect, Tom Lancaster. We are grateful to Jess Brewer (Webmaster), Hubertus Luetkens (Treasurer), and Peter Baker (Secretary) who agreed to continue to serve.

The support of educational activities, the promotion and the broadening of the knowledge and use of μ SR is one of the main objectives of ISMS. To become more active in this direction we decided in the Executive Committee to offer financial support to muon schools and workshops to allow young scientists with limited travel funds to attend these meetings. To keep administrative effort low we decided to offer up to US \$1000 to the organizers of those events, allowing them to distribute the fund in the most useful way. As a return the organizers should mention ISMS on their web page/poster as a sponsor. The first school supported in this way is the ISIS Muon Training School, which was run 19th – 23rd March 2018, and we offered support to the next J-PARC Neutron and Muon School in November. We are planning to support up to three muon schools/workshops per year and we are asking organizers of such meetings to directly contact me or someone else from the Executive Committee, if ISMS should provide financial assistance.

Of course, this kind of activities relies on stable financial resources of ISMS. So far, ISMS earnings are solely due to possible financial surpluses of the μ SR conferences. The trend of these surpluses is negative and it allows at the moment only the sustainable funding of the Yamazaki Prize and the Young Scientist Awards, but no additional activities. There are two simple solutions to overcome this problem:

i) adapt/increase the μ SR conference fees for senior scientists to guarantee a conference surplus of US \$10,000, and ii) use a crowdfunding scheme and ask the community for sponsorship. We are intending to pursue both options. Assuming a typical conference attendance of senior scientists of about one hundred this would mean an increase of the conference fee by US \$100, which we think is acceptable, since μ SR conference fees are typically lower compared to fees of other international conferences. The crowdfunding could be implemented on a per year basis. If each member of ISMS would donate only US \$10 we easily could collect US \$3000 per year which would cover the costs of muon school/workshop financial support. We are planning to setup a crowdfunding project this year with one of the professional providers and we will inform the ISMS members by an extra bulletin when the project is set up to accept donations. In view of the benefit for the future generation of μ SR users and the future of the community we think that these are affordable efforts. We are open to your comments and other suggestions. As a final note: we discarded the idea of an annual fee for the ISMS membership, because the administrative work would exceed the personnel resources of ISMS.

On behalf of the ISMS Executive Committee I wish you all a happy and very successful year 2018 with lots of interesting muon experiments!

Thomas Prokscha, President of ISMS

The 2017 ISMS Yamazaki Prize for μ SR Science

The Yamazaki Prize for 2017 was awarded to Prof Robert Kiefl, University of British Columbia and TRIUMF, Canada, who has had an eminent career within muon and β -NMR science as well as solid-state physics. The prize, which includes a sum of US \$3000, was presented to Rob at a special ceremony at the 14th International Conference on μ SR in Sapporo, Japan, in June 2017. The prize is made available by the ISMS every three years to any scientist for outstanding, sustained work in μ SR science with long-term impact on scientific and/or technical μ SR applications. Previous winners of the Yamazaki Prize are Y.J. Uemura (2005), E. Morenzoni (2008), J.H. Brewer (2011), and R. de Renzi (2014).

Rob was awarded the Yamazaki Price for his excellence in applications of μ SR and β -NMR in solid-state physics. His contributions had far-reaching impacts beyond the μ SR and β -NMR communities. Rob also has excelled as a

developer of several muon and β -NMR methodologies and facilities, and as an advocate of a wider user base for both μ SR and β -NMR based methods as tools for materials and molecular science. Over many years, he and the team at TRIUMF have built up excellent β -NMR facilities and his research has also included significant contributions to an eclectic range of topics within condensed matter physics and materials science.

I warmly congratulate Rob on a very well deserved award.

Khashayar Ghandi, President of ISMS 2014-2017



μ SR2017 Conference Prizes

μ SR2017 Poster Prizes

The following young scientists were awarded poster prizes for their excellent poster presentations at the conference:

- Vadim Grinenko, TU Dresden, for PA-09: "Superconductivity with broken time reversal symmetry in $\text{Ba}_{0.27}\text{K}_{0.73}\text{Fe}_2\text{As}_2$ single crystals"
- Jean-Christophe Orain, PSI, for PB-10: "Nature of $\text{Ba}_3\text{MlIr}_2\text{O}_9$ (M=Sc, Y, In) ground state probed by μ SR"
- Koji Yokoyama, QMUL, for PC-39: "A new method for measuring excess carrier lifetime in bulk silicon: photoexcited muon spin spectroscopy"

ISMS Young Scientist Awards

The ISMS Executive Committee decided to award two prizes for young scientists for their outstanding oral and poster presentations:

Oral presentation:

- Rhea Stewart, Univ. St. Andrews, "Anomalous Meissner screening probed using low energy muon spin spectroscopy"

Poster presentation:

- Yuta Ishii, Tohoku Univ., PA-34, "Observation of oxygen magnetism in multiferroic materials RMn_2O_5 (R=Y, Eu) by μ SR measurement"

The International Society for μ SR Spectroscopy

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News from PSI

The year 2017 has been marked by continuous developments of the facility instruments and by once again a very strong beamtime demand. The PSI μ SR facility $S\mu$ S received a total of 250 proposals, which represents an increase of 9% compared to the previous record year 2016. As in 2018 and 2019 the HIPA accelerator complex at PSI will experience 6 month shutdowns, this record number is due to hold for some time. Even though this continuous high demand puts a heavy work load on the $S\mu$ S instrument scientists to secure an appropriate support to the external users, they still found time and resources to develop existing instruments and project new ones.

New Spin-Rotator for the piM3 Beamline

In September 2017, a new spin-rotator has been installed on the piM3 beamline serving both the piM3.2 area (GPS) and the piM3.3 area (presently LTF and soon FLAME, see below). The new spin-rotator has been entirely designed at PSI and built in collaboration with several Swiss companies. After a very smooth and successful commissioning, the new device provides an increase of more than 20% of the asymmetry parameter for transverse-field experiments.

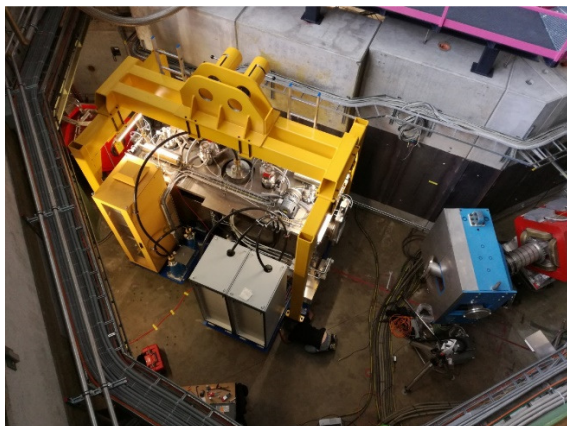


Figure 1: Spin Rotator being installed on the piM3 beamline

New SiPM-based Detectors for the GPD Instrument

In order to improve the time resolution, and at the same time vastly improve the overall flexibility, a compact and versatile new detectors system has been built for the GPD instrument. Each detector is read by several SiPMs on both ends. The compactness of the detectors readout has led to an important reduction of the entire system footprint, allowing one to increase the granularity of the positron detectors. The complete detector system has been commissioned on December 2017 during a plug-and-play action lasting less than 48 hours. The next step will be the installation before June 2018 of an improved collimation system and the installation of new remote-controlled motors controlling the perfect alignment of the sample with the incoming beam.



Figure 2: View of the complete GPD spectrometer after installation.

Zero-Field for the High-Field Instrument

The high-field instrument HAL-9500 is now also equipped with a zero-field setup. In order to respond to user wishes, the capability for true zero-field experiments has been implemented. This new setup is sitting outside the superconducting magnet and is equipped with a new set of the last generation of SiPM detectors.

LEM: Rates, Low Temperatures & Turnover

In 2017, the LEM instrument has benefited from the installation of a long carbon production target (6cm) on the main proton beam. This has led to a 40% increase of the good positron events reaching now 2.5k/s. As in the future the use of a long target will be dependent of the operation of the neutron spallation source, the LEM group is looking for alternative ways to permanently increase the low-energy muon rate. In this vein, we have started promising simulations to tackle possible improvements of the beamline transport to the moderator.

A challenge posed to the low-energy muon experiments is the availability of low temperatures, as the impossibility to install windows on the muon path considerably increases the undesired thermal radiation on the sample plate. Several modifications of the so-called “low-temp” cryostat have now pushed the lowest available temperature down to 2.2 K (from previously 2.7 K).

Work on an in situ sample changing system for LEM, without the need to break the UHV, has started. Tests of a sample loading mechanism onto the cryostat, while maintaining a good thermal contact, have been successful. Next, we will start working on a load lock system for the LEM spectrometer, which will shorten the time required for a sample change from its

current 3 hours to 20 minutes. This project brings us one step closer to incorporating a sample preparation system which will be coupled to the LEM spectrometer.

FLAME: “FLexible and Advanced MuSR Environment”

As the LTF instrument is reaching the end of its life, our Lab is proposing to build a new μ SR user facility instrument with a FLexible and Advanced MuSR Environment (FLAME). It is foreseen that FLAME will cover a broad temperature range from 20 mK to room temperature with magnetic fields from true zero fields smaller than 5 μ T up to 3 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 and allow for in-situ modification of the sample properties at all temperatures by external stimuli e.g. by electric fields or uniaxial pressure.

In 2017, backed by several Swiss groups, we have submitted a proposal to the Swiss national funding agency and to the PSI directorate. The proposal has been warmly accepted by both parties and a substantial part of the funding is already secured. We are in the process to finalize the spectrometer design and the magnet specifications. A WTO tender is foreseen for the Q2 of 2018. If everything is going according to plans, we hope to start pilot experiments in 2020.

*Alex Amato
Thomas Prokscha
Hubertus Luetkens
Zaher Salman*

News from TRIUMF

TRIUMF is currently in its annual winter shutdown and the CMMS group is preparing for the upcoming year of operation. The M15 and M20 μ SR beamlines operate with a nominal 7-month schedule. μ SR experiments will begin around May 7th, 2018, with a mini-shutdown in October. We are currently scheduling μ SR experiments for the period from May 7th to September 4th. The remainder of the year will be scheduled after the summer MMS-EEC meeting, on June 4th, 2018, following a proposal call at the end of April. There will be reduced availability of β NMR in 2018 due to the delayed startup of ISAC as personnel have been shifted to tasks related to the completion of the Advanced Rare IsotopE Laboratory (ARIEL). ARIEL is TRIUMF's flagship multidisciplinary research facility and will triple TRIUMF's output of rare isotopes for research upon completion in 2022. This year we are anticipating approximately four weeks of ^8Li β NMR, instead of the usual five weeks, and one week of ^{31}Mg β NMR.

Developments at the CMMS:

1) A collaboration of Canadian μ SR groups (led by Jeff Sonier) and TRIUMF has received funds from the Canadian Foundation for Innovation (CFI) matched by 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 μ SR research into quantum systems under extreme conditions of high pressures, high magnetic fields, and very low or very high temperatures. The beam line, rechristened M9H, will be optimized to produce transversely-polarized muons at all practical momenta and thus excel at high transverse-field (TF) μ SR. To this end, the new M9H includes a new TF 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 ($T \leq 1000$ K and $P \leq 0.6$ GPa). As part of this project we will complete the repair of the M9 front-end, finally allowing operation of the new M9A beam line. This beam line will have a dedicated 3 T spectrometer with APD detectors and will be optimized for rapid sample characterization. The radiation-resistant front-end quadrupoles have been sent to tender and we anticipate beam delivery to M9A in summer 2019.

2) The CMMS group is currently hiring for a new position that will be funded for 5 years by the Stewart Blusson Quantum Matter Institute (<http://qmi.ubc.ca>) at the University of British Columbia. This person will lead an active research program that will engage with the North American physics community and attract new users through collaborations.

3) 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 ^3He cryostat for the NuTime spectrometer. We anticipate this will be ready for use early in 2019.

4) An upgrade to the β NMR facility capabilities is in development, to achieve up to 2 kG in-sample-plane magnetic fields and temperature down to 300 mK.

5) R&D into the use of SiPM based detectors for μ SR continues. To date, a timing resolution of about 67 ps has been achieved with a 1cm diameter muon counter delivering 16 photoelectrons to a set of 24 of SiPM detectors arrayed around its circumference.

*Iain McKenzie,
Syd Kreitzman,
Gerald Morris*

News from ISIS

International review of ISIS muon facility

This year, muons at ISIS were appraised by a panel of international experts whose remit was to look at the current state of muon research and how the spectrometers, and supporting infrastructure, may be developed in the future. The review panel's response was extremely positive, particularly with regard to the new scientific opportunities afforded by the upgrade to the MuSR spectrometer (SuperMuSR), the high quality science produced, the future development plans to transfer RIKEN-RAL operation to ISIS, and the promise shown by the 'MuX' negative muon initiative. Comparative strengths of the facility on the international landscape were praised, as was demand for muon beam access over the past 5 years and the strong collaborative relationships developed with the Mantid software team to advance data analysis capabilities. Further details can be found at

<https://www.isis.stfc.ac.uk/Pages/Internationalreviewsignspraisesofisismuonfacility.aspx>.

RIKEN update:

The current agreement between ISIS and RIKEN ends on 31 March 2018 and RIKEN and ISIS have been in discussion about a further agreement. We are planning for a further agreement from 1 April 2018 – 31 March 2023. The Facility will pass to ISIS ownership on or shortly after 1 April 2018 and ISIS will be responsible for facility operations and refurbishment. A continued user programme for Japanese scientists is planned.

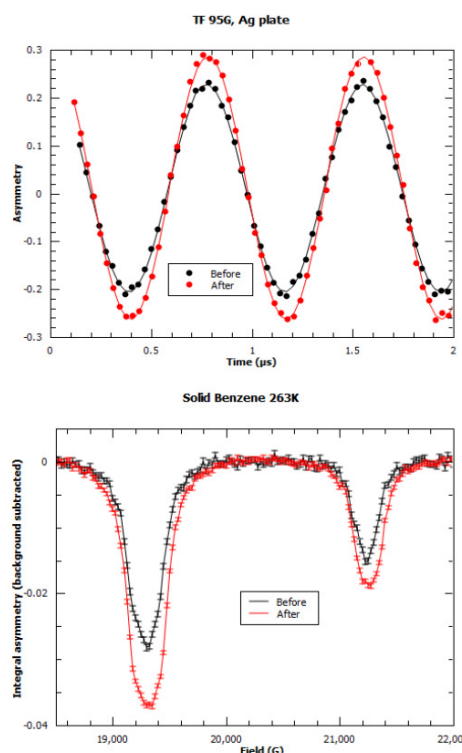
Instrument updates:

All the instruments are working well. Recent improvements to the south-side beamline have seen dramatic improvements in rate and

asymmetry EMU (150 MEV/h), HiFi (80MEV/h or 400MEV/h for some ALC measurements), MuSR (70MEV/h). The RIKEN-RAL instruments ARGUS and CHRONUS have maintained their performance over the momentum range from 20MeV/c to 90MeV/c and for both muon polarities.

HiFi: A degrading upgrade

Over the summer positron degraders were fitted to the HiFi detectors to improve the asymmetry and figure of merit. The asymmetry in low field has increased from about 22 to 29% (see top figure) with more modest improvement above 1.5T. For most users this means an increase in beam slit width can be tolerated – keeping the rate the same yet improving data quality.



Sub 1K update

The gas handling systems for all the Oxford dilution fridges have been updated with the latest triton based system. This should ensure

future maintain ability and increased reliability. We are in the process of purchasing a number of 4He cryostats, together with dilution and 3He inserts. We anticipate a staged introduction of this new apparatus, with the first delivery expected later this year.

Dedicated Radio Frequency cryostat for muonium chemistry experiments

Within the SINE2020 project a dedicated insert for muonium chemistry experiments has been produced for operation on the EMU spectrometer enabling studies of the addition and abstraction reactions of muonium (Mu) under in-situ conditions.

This sample environment features leak-tight and O₂-proof sample cells granting access for muons, temperature control in the range -50/+200 °C and tuneable radio frequency solenoid. Liquid samples can be prepared and loaded in-situ with both the available options of a continuous circulation and of sealed sample space.

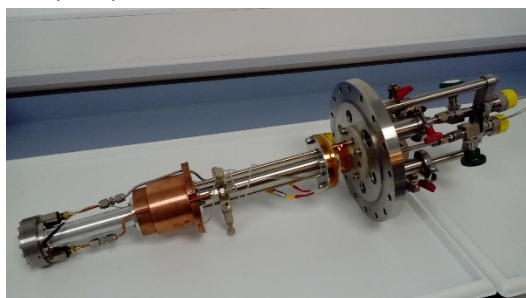


Figure 3: Insert for RF muonium studies.

Mantid latest version

The next release of Mantid has just been released with new features added. Frequency domain analysis is now included, able to perform both maximum entropy and Fourier transforms. Several minor changes make the muon analysis GUI easier for users to navigate and manipulate their data.

Magnetic structure and mUon Embedding Site Refinement (MUESR) is a python library that

can be used to calculate the magnetic dipole interaction due to a muon embedded within a material. It is possible to examine the behaviour of the magnetic field as a function of pressure and how the dipole tensor varies with the position of the muon. The code uses a classical approach (spin polarized electronic orbitals and classical dipoles at the nuclei) to calculate the magnetic fields, which results in a fast running calculation. The installation script for this library has recently been added to the Mantid script repository.

Training School

Between 19th-23rd March thirty-five students from the UK, Europe, and the rest of the world came to our biennial muon spectroscopy training school.



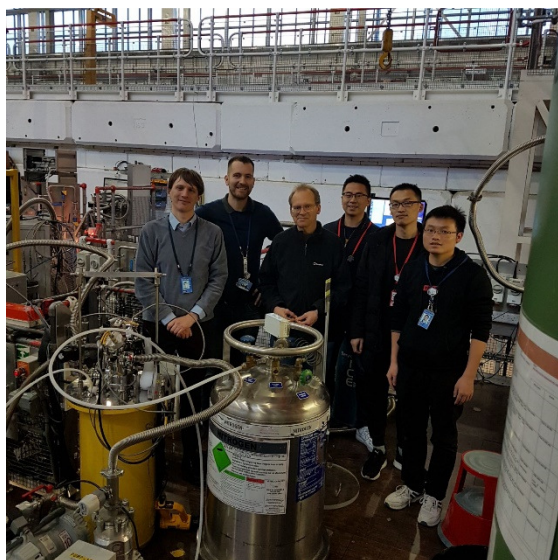
Figure 4: Muon Training School group photo

e-learning

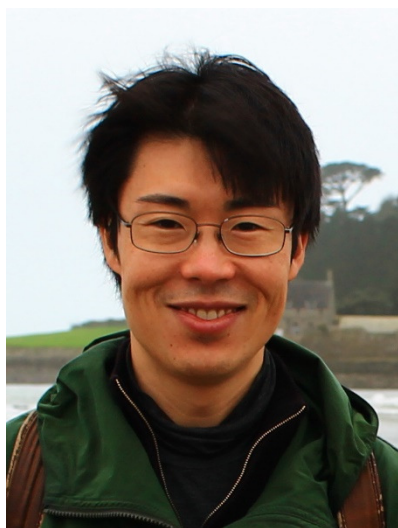
Muon spectroscopy and neutron scattering exercises and simulations of experiments are now available online for free at e-neutrons.org. The platform was developed, with support from NMI3-II and SINE2020, and features a bespoke introductory course in μ + spectroscopy. This has been extensively updated for the training course. If you have additional material you would like to see uploaded then please contact us.

Detector tests for the CSNS muon project

Zi-Wen Pan from Prof. Bangjiao Ye's group at USTC has been visiting ISIS this year to learn about detector design and construction for muon instruments. In early March he was joined by two fellow group members to test the first prototype detectors and electronics for their instrument, in collaboration with the ISIS detector group and muon group.



Staff News



We are pleased to announce that we have recruited a new instrument scientist to the group. Koji Yokoyama from Queen Mary

University of London has joined us as an instrument scientist. Koji will be familiar to many of you, as he has been working on the laser programme on HiFi.

Muon Spectroscopy User Meeting – Future Developments and Site Calculations

Monday 16th and Tuesday 17th July 2018, at The Cosener's House, Abingdon, UK

To mark a new agreement between ISIS and RIKEN for future operation of the RIKEN-RAL facility and to highlight the developing plans for a major upgrade of the ISIS MuSR spectrometer, we are planning a User Meeting discussing the development of new instrumentation at ISIS. Talks will focus on the scientific opportunities that these developments will bring.

We are also planning to include a session within this meeting discussing muon site calculations. There is currently a major effort by a number of groups to develop new techniques in this area; talks are planned with the opportunity for group discussion of these methods.

Also planned is an informal session giving students an opportunity to present their PhD work in a few minutes - everyone will get the chance to speak!

All are welcome to attend. For UK-based academics full costs of will be covered; otherwise we are happy to pay local costs associated with the meeting.

Further details and a link to a registration website will be available shortly from: <https://www.isis.stfc.ac.uk/Pages/Muons.aspx>.

Adrian Hillier

News from J-PARC

After the summer shutdown in 2017, the Materials and Life Science Experimental Facility (MLF) at J-PARC resumed its operation utilizing a proton beam power of 300 kW. During the shutdown, the neutron production target was replaced by an improved target vessel, which was produced with keeping the final goal of 1 MW operation in mind. After a stable operation for two months, MLF finally decided to accept a proton beam power of 400 kW in 2018. It is planned to further increase the power up to 500 kW this coming April. However, the time structure of the proton pulse will be a double bunch when a beam power of 500 kW is achieved, so the effective muon beam intensity will slightly decrease for users who desire a single pulsed muon beam.

At the D- and S-lines, the user program is in progress. The most exciting news is that the muon spin rotation signal on a Ag plate was finally confirmed at the ultra-slow muon (USM) beamline (U-line). By using a MCP beam detector, we observed 73 hits per second upstream of the experimental area U1A. Various efforts for improving the USM production and transportation have been carried out, e.g., applying unbalanced voltages on electrical quadrupole for beam steering.

In November 16-20, 2017, the AONSA/Neutron and Muon School was held. Five young researchers and graduate students from Asia-Pacific countries enjoyed hands-on

experiments using the surface muon beam at area S1. On the final day, they made an oral presentation on their results, and won the presentation award. Congratulations!

In February 2018, Prof. Lei Shu of Fudan University, China, stayed at J-PARC for about two weeks. She was invited by the "Athena Program", which is intended to invite young or mid-career female researchers from Asia-Pacific countries to KEK in order to provide opportunities for cooperative research with Japanese groups. Lei and three graduate students in her laboratory conducted μ SR experiments at area S1, and enjoyed many active discussions with J-PARC MUSE group.

Finally, Assoc. Prof. Kenji M. Kojima of KEK/J-PARC was awarded the Koshiba Prize in February 2018, which is given to a single or a group of researchers who have made ingenious and internationally recognized development work of particle detectors for elementary particle researches. Kenji has energetically led the development of the Si-PM based μ SR detector, so-called KALLIOPE. Now, two μ SR spectrometers located in areas D1 and S1, each consisting of 1280 Si-PMs, successfully handle the data taking rate as high as 200 million events per an hour. Congratulations, Kenji!

Akihiro Koda

ISMS Executive Committee

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Treasurer: ***Dr Hubertus Luetkens, PSI, Switzerland***

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

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

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First Workshop on EMuS and μ SR Applications Held at CSNS

The first workshop on experimental muon source (EMuS) and muon spin rotation (μ SR) applications held on December 13th, 2017, at CSNS, IHEP Dongguan Campus. 41 scientists from RIKEN (Japan), RAL (UK), Saga University (Japan), Institute of Physics, University of Science and Technology of China, Renmin University of China, Fudan University, Zhejiang University, Peking University, Beijing Normal University, Sun Yat-Sen University, Southern University of Science and Technology, University of Macau and "Physics" magazine joined the workshop. This is the first workshop on muon science held in China.

"The construction of the CSNS project is completing, and it is expected that national acceptance will begin in early 2018 as scheduled. Now it is time to prepare for user development and the expansion of applications." said Prof. Hesheng Chen, the CSNS project manager, in his welcome speech. "The application of muon sources is an

important part of the CSNS platform. Spallation neutron sources abroad have very successful experiences in building and operating muon sources. So we hope to carry out further related collaboration with them."

During the meeting, the invited talks by distinguished guests introduced the current status and future prospects of muon sources and μ SR applications, and domestic speakers presented their experience in using μ SR techniques. The CSNS muon source group introduced the design and key technology R&D efforts of the CSNS experimental muon source (EMuS).



Comments on this newsletter?

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