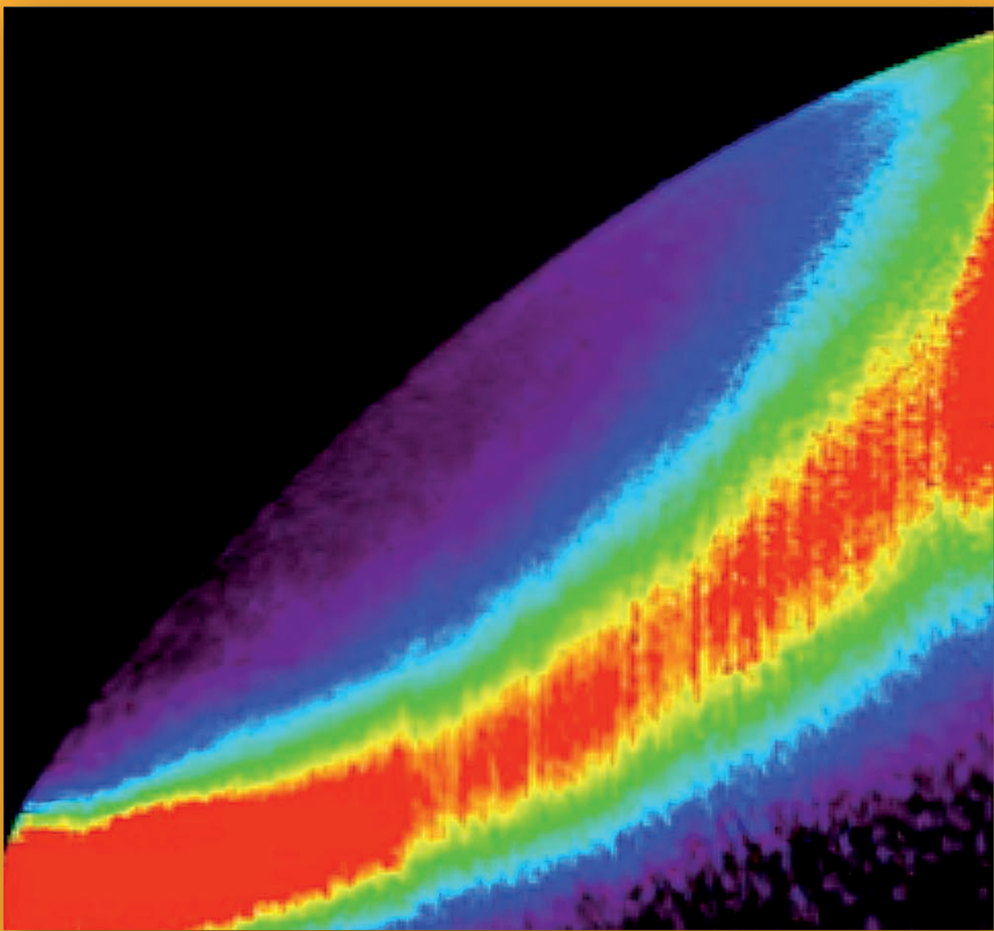
NOTIZIARIO

Neutroni e Luce di Sincrotrone

ISSN 1592-7822 - Vol. 16 n. 2 June 2011 - Aut. Trib. Roma n. 124/96 del 22-03-96 - Sped. Abb. Post. 70% Filiale di Roma - C.N.R. p.le A. Moro 7, 00185 Roma



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SUMMARY

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published by CNR
(Publishing and Promotion of Scientific Information)
in collaboration with the Physics Department of the
University of Rome Tor Vergata

Consiglio Nazionale delle Ricerche

Vol. 16 n. 2 Giugno 2011
Aut. Trib. Roma n. 124/96 del 22-03-96

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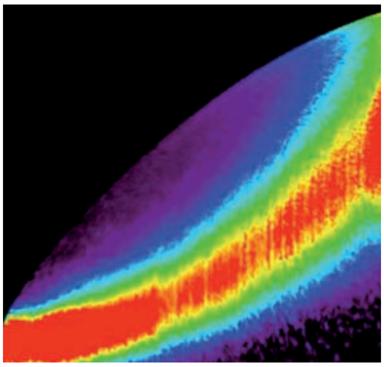

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Finito di stampare nel mese di Giugno 2011

Cover photo.
Scattering from water at 3 eV incident energy.
The scattering is centered at the proton recoil energies.

Supercooled water researcher finds Sequoia's power "amazing"

C. Andreani
University of Rome Tor Vergata

ORNL's Spallation Neutron Source services include rescuing user in a snowstorm

East Tennessee generally enjoys a temperate climate, even in winter. But when a research team from the Università degli Studi di Roma "Tor Vergata", Italy, visited the SNS on the Oak Ridge National Laboratory campus last December, the area was hit by one of its rare winter snowstorms. Roberto Senesi, the principal investigator on the experiment the team was doing at the SEQUOIA chopper spectrometer, narrowly escaped having to spend the night at the instrument and miss his plane home the next morning – he was rescued by ORNL Neutron Sciences Director Ian Anderson.

The international collaboration also included Davide Flammini from Rome Tor Vergata, Roberto Car from Princeton University, and Alexander Kolesnikov from the Neutron Scattering Sciences Division at ORNL. They took advantage of SEQUOIA's unique high neutron flux and fine energy resolution to study the vibrational spectrum of supercooled water (below 273 K) close to the triple point.

"There is a strong relationship between supercooled water and confined water, such as water around the surface of proteins", Senesi said. "Understanding the mechanisms by which protons vibrate in water around the temperature of freezing can help to understand how water assists the functional properties of proteins and macromolecules, such as DNA".

Even before they arrived, the Italians worked with the SNS Sample Environment team to design and make the unique containers for the experiment. The aluminum containers were designed and manufactured at SNS and then shipped to Rome, where they were PFTE-coated by Praxair-Smaltiriva, a company in Mantova, northern Italy. The newly-coated containers were then shipped back to SNS. "People at SNS liked the coating. They have since asked for another 50 cell coatings from the same company for other projects", Senesi recalls.

Senesi arrived two days before the experiment. "The User Office and the Experiment Hall team are of top quality", he said, "and very efficient. I was particularly impressed by the Instrument Hall coordinators, who are there 24 hours a day, 7 days a week, to assist users with their experiments – this is an amazing resource and one that I greatly appreciated".

"I was impressed by the lively atmosphere at the facility. People seemed to enjoy their work, having the possibility to put in practice their passion about what is done at the SNS. I was also able to meet friends and colleagues – it's becoming a hub", said Senesi.

To begin, Senesi and his team got thorough training in radiation safety. Then they were taken in charge by Garrett Granroth, lead instrument scientist on SEQUOIA, and instrument scientist Alexander Kolesnikov. "In our previous study using the Vesuvio spectrometer at ISIS in the UK, we found that the kinetic energy of protons in water is greatly enhanced when liquid water is cooled below 273 K (supercooled liquid water)", Senesi said. "During a conference in 2009 in Knoxville, Dr. Kolesnikov discussed this result with me and proposed that the mechanism for this unusual behavior may be ascribed to the behavior of the OH stretching motion in water in the different phases. We agreed to prepare an experiment proposal for SEQUOIA", Senesi recalled.

During the final preparation of the sample environment, "the technical staff was very proactive, making all the final leak, temperature, and other tests. The container was designed to hold a sample of water in the temperature range 260 K to 280 K, accessing the liquid, the solid, and the liquid supercooled phases below 273 K". It was designed to have the maximum scattering intensity from the sample, the minimum scattering intensity from the container, the minimum multiple scattering, the most favorable geometry (flat), and a perfectly flat hydrophobic internal surface. The latter requirement is crucial to allow water to remain liquid below freezing temperature (supercooling below 273 K).

"The power of the neutron source is amazing," Senesi said. "I am used to 12 to 24 hours of acquisition for one sample temperature, but here the acceleration factor makes a big difference, and not just quantitative". SEQUOIA was able to access the entire spectroscopic range required for the investigation of the OH vibrations in a single experiment, and the very high intensity made it possible to measure at many different temperatures, across the various phases. "We also wanted to access the high incident neutron energies, greater than 3 eV, where it is possible to measure the proton kinetic energies directly. SEQUOIA had the intensity and flexibility to fulfill all these requirements".

The science went smoothly over the three-day experiment. On the third day came the snow. "Sunday, December 12, was my last day, so I came to the lab to look after the experiment", Senesi recalled. During that day, snow started to fall in Oak Ridge, and it became very intense in the afternoon. I had a dinner appointment in Oak Ridge that evening, so at 6.30, I left SEQUOIA and went to the main SNS entrance to wait for my taxi.

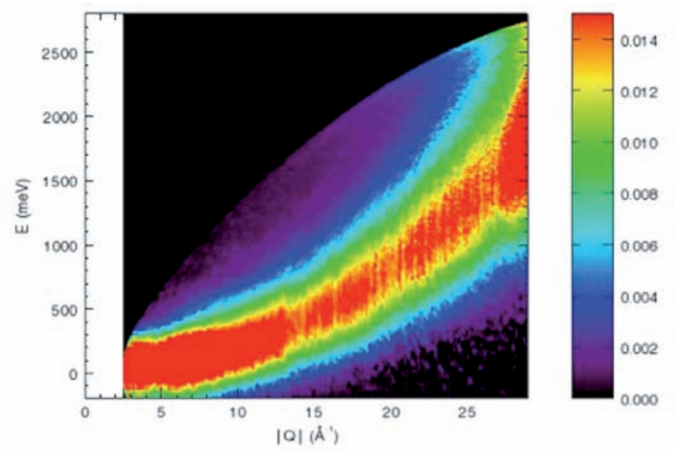
"The taxi never arrived, and I phoned them several times, without response. At 7 p.m. I went back to the Experiment Hall team, and they contacted four or five companies, but because of the snow, no taxi was driving in the area, including my early morning taxi that was booked to get me to Knoxville airport".

"I was a bit lost, since there was no easy way to get back to my hotel and I was worried about getting to the airport the next morning. Fortunately for me, Ian Anderson was in the building, checking on activities, and he offered to brave the storm to take me back to the hotel. After dinner I managed, after several internet searches and phone calls, to book a taxi for 3 a.m. to get me to the airport. "I feel very grateful to Ian! I must admit that I was prepared to spend the night in the lab, since it is not easy to reach the ORNL main entrance on foot, or by hitchhiking!".

Senesi said the research done at SEQUOIA complements the team's first set of measurements taken at ISIS. The researchers are now analyzing their data. NSSD's Kolesnikov showed Senesi the user interface and the main data reduction routines that are applied to treat the raw data. "It is possible to access all routines remotely from a Web interface, and save all intermediate steps of the data processing, to be recovered at any later stage".

The international collaboration is returning to SEQUOIA for another water experiment, but this time at high temperature/pressures, in the supercritical phase. This is a state of water that is relevant for the development of novel nuclear reactors. C. Loong of Tsinghua University in China is the principal investigator.

This work is funded by University of Roma Tor Vergata and the other partner institutions. The experiment at SNS was sponsored by the Scientific User Facilities Division, Office of Basic Energy Sciences, U.S. Department of Energy. ORNL is managed by UT–Battelle, LLC, under contract DE-AC0500OR22725 for the U.S. Department of Energy.



Scattering from water at 3 eV incident energy. The scattering is centered at the proton recoil energies.

LET: A low energy multiple chopper spectrometer at ISIS

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ABSTRACT

LET is a multi chopper direct geometry cold neutron spectrometer which has just started user operation on target station 2 (TS2) at the ISIS spallation neutron source. LET sits on a straight 25m super-mirror guide viewing the new highly efficient coupled solid methane moderator system. This combination yields a high incident flux of neutrons with a wide dynamic range of 0.6 - 80 meV. LET employs a novel flux compression guide design which in combination with two 300Hz counter rotating choppers can produce fine energy resolutions of 0.8% ΔE/Ei to be realised with less flux sacrifice compared to conventional methods. TS2 is a 10Hz target station and therefore a single frame is 100ms. The chopper system on LET has been carefully designed to make full use of this long frame by allowing multiple measurements, typically 4-5, to be made within a single frame.

The secondary spectrometer is characterised by a wide area position sensitive ^{3}He multi detector with π steradians of nearly gapless coverage over an angular range of -40° to +140° in the horizontal plane and ±30° in the vertical plane. The multi detector utilises the world's first 4m long ^{3}He position sensitive neutron detector tubes.

LET has been designed specifically to allow larger pieces of sample environment equipment, in particular the use of a dedicated 9T magnet specifically designed for LET which allows the use of large samples with a 30 degree vertical opening to make use of the large multidetector. In addition LET has been designed to allow the use of full XYZ neutron polarisation analysis.

INTRODUCTION

TS2 is a new 48 KW target station at ISIS designed to produce high fluxes of cold neutrons. TS2 takes one pulse in five from the existing 50 Hz machine and therefore has a duty cycle of 10 Hz.

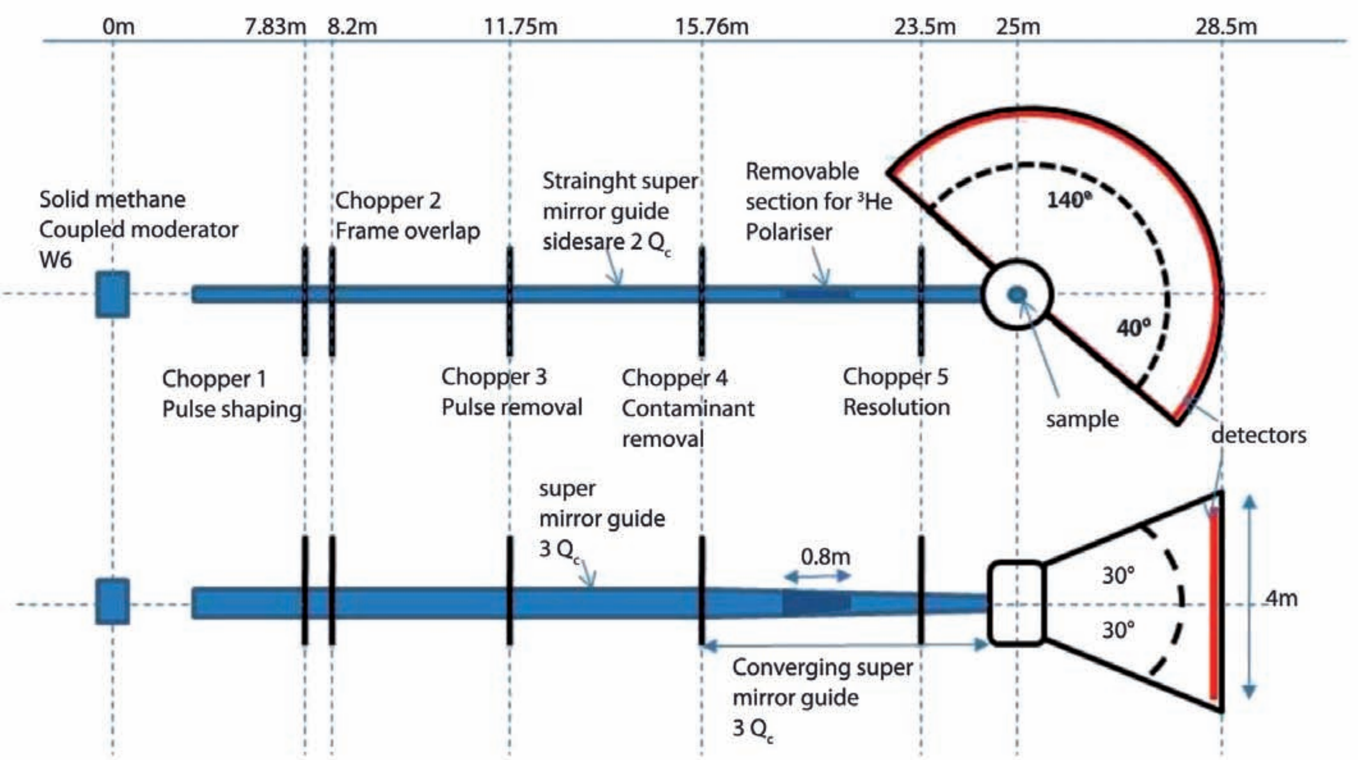
The comparatively low power of TS2 has enabled the use of very efficient solid methane moderators which are well coupled to a small solid tungsten target. Phase one of the instrument build consists of seven 'day one' beamlines with LET being the sole inelastic instrument. Like CNCS and CNDCS at Oak Ridge National Laboratory and J-PARC at Tokai, respectively, LET is one of a new breed of direct geometry cold neutron spectrometers that fully exploits the high-flux, cold-neutron, coupled moderators at spallation sources. Because this type of instrument benefits from a high peak-flux rather than a large time averaged flux, LET has a very similar incident neutron flux to IN5 at the ILL even though IN5 views a 50 MW reactor compared to the 48 KW power of the TS2 target. The other beneficial characteristic of a spallation neutron source is the broad wavelength range emitted by the moderator, this results in a large dynamic range characteristic of spallation neutron source based chopper instruments. There are few instruments available that bridge the gap between high resolution spectrometers capable of measuring quasi-elastic neutron scattering and those capable of measuring atomic and molecular excitations.

The new LET spectrometer has been designed to allow the user to access an exceptionally wide dynamic range of inelastic energy scales from 8 μeV to 80 meV. Perhaps one of the greatest advantages of this type of instrument is in its versatility. It is possible to any incoming energy and resolution (obviously within the constraints of flux availability and the mechanical limits of the resolution choppers). This enables one to trade flux for resolution, very important if you are measuring a very small or weakly scattering sample where perhaps getting fine energy resolutions are not so important. LET will typically run with energy resolutions ranging from around 1% to 5% of ΔE/Ei.
LET was built to be ready for the installation of XYZ polarization, making it possible to install the necessary components as they become available. It was designed for use of extreme sample environments; an essential prerequisite as more and more experiments require high magnet fields, ultra-low temperatures and high pressures.

INSTRUMENT DESCRIPTION

A schematic of the LET spectrometer is shown in figure 1. It comprises of a primary flight path of 25 m with neutrons transported from the moderator to the sample position via a straight super-mirror guide. A total of five chopper systems are installed on the beamline to allow moderator pulse shaping, contaminant removal, pulse removal and fast time slicing of the incident neutrons. The sample to be measured is positioned inside a 110 m^3 vacuum tank with no windows between the sample and the detectors to eliminate any spurious scattering.

Figure 1. Schematic of LET



The detectors are 4 m long position sensitive detectors and form a cylindrical curtain around the sample. The design characteristics and performance of these individual system components are discussed in the following sections.

MODERATOR

The moderator is a composite design, with a thin water pre-moderator surrounding a half liquid hydrogen half solid methane inner moderators. The low power of the target has allowed the use of solid methane as a moderator material for the first time, which is a very effective low temperature moderator. To give an idea of how efficient TS2 is, on average it produces around 12 times the number of useful neutrons per pulse than on the 25 year old TS1. Some of this increase in flux is in the peak intensity but much of it is from a broader pulse. This would be detrimental to final achievable resolution on LET if not controlled by the choppers.

THE CHOPPER SYSTEM

All the chopper disks on LET are carbon fibre composite disks which are coated with 10B as a neutron absorber, with cutaway sections in the disk as neutron transparent windows. The first and last sets of choppers on the beamline, choppers 1 and 5, are high speed 300 Hz counter rotating disks which control the incident energy and the energy resolution of the instrument.Chopper 1 is designed to control theeffective moderator pulse width seen at the detectors. This effective moderator width is matched to the time width as seen at the detectors from Chopper 5. This pulse width matching of the main resolution components ensures that the maximum flux possible is extracted from the moderator for the energy resolution required. The energy resolution is directly related to the neutron burst time of the high speed counter rotating resolution chopper 5.

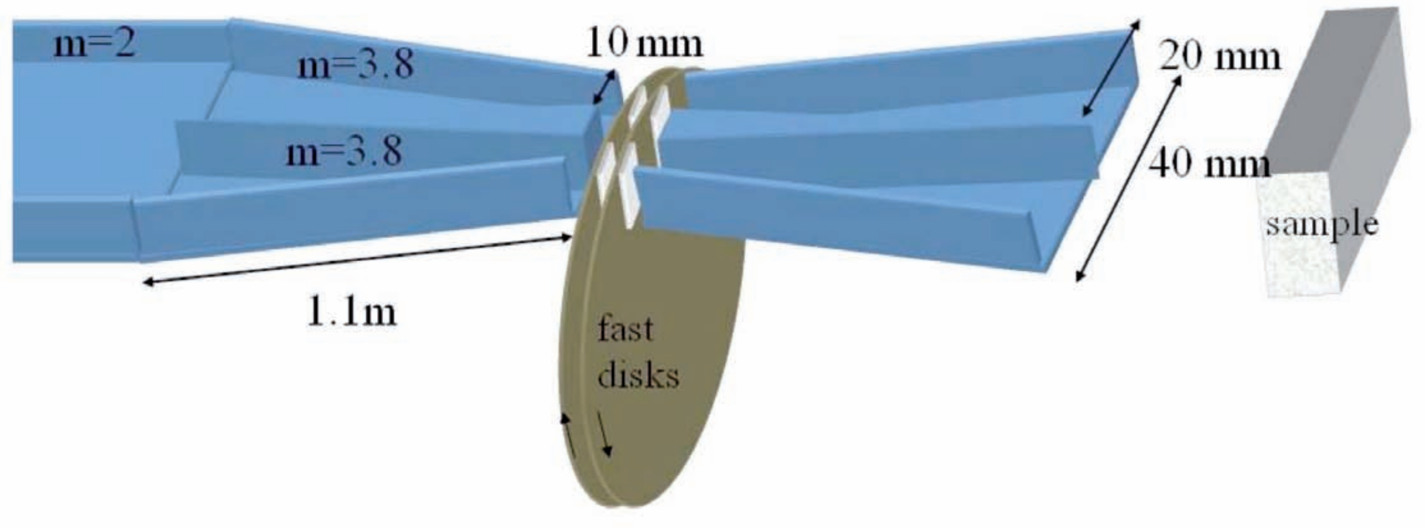


Figure 2. Schematic cross section through the LET monochromator, chopper set 5. The m values of the super-mirror coatings are given. Drawing is not to scale.

However, even at 300 Hz the burst time is too long for high resolution measurements if one uses a wide chopper aperture to maximise flux. The common method for reducing the neutron burst time in this scenario is to use multiple sets of apertures of differing widths on the chopper disks. A narrow set of windows is used on the counter rotating disks for high resolution mode and a wider set (usually equal in width to the neutron guide) is used for lower resolutions. This traditional method has two major draw backs, firstly, in high resolution mode flux loss is immediately an issue as the window aperture is smaller than the guide width, secondly the sample is illuminated by varying beam widths depending on resolution mode chosen, which severely limits the size of sample one can measure.

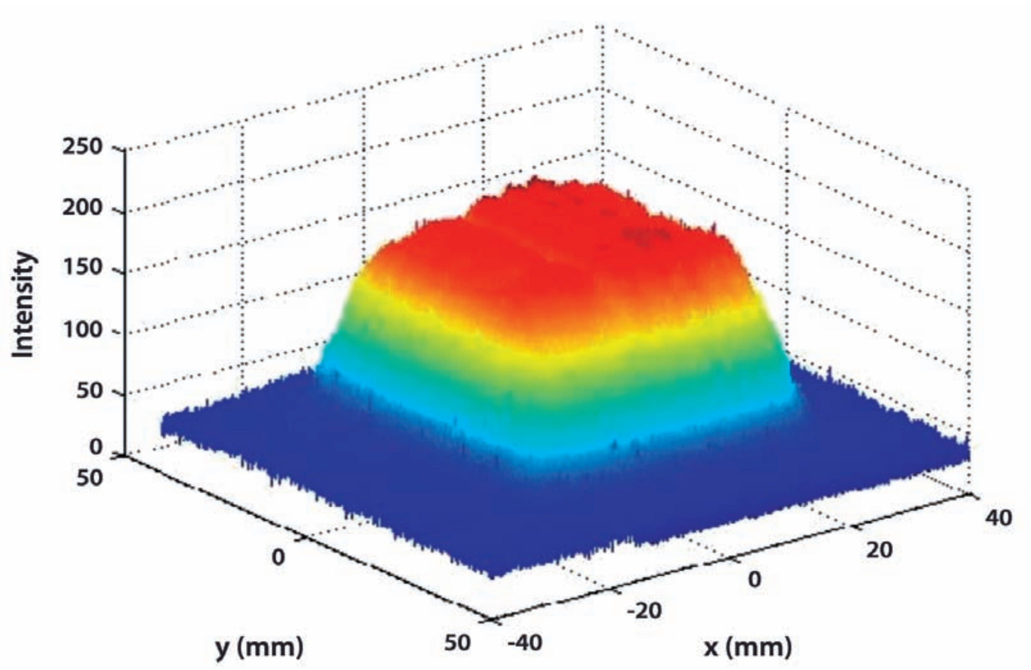
LET circumvents both these limitations by employing a novel guide/chopper system shown in figure 2, and described fully in Ref. [1]. This design is actually a combination of two previous efforts to circumvent these problems.

One previous attempt was to use masks at the end of the guide with multiple slits and matching openings in the chopper [2], the other uses a single super-mirror funnel to compress the neutrons through a single narrow slit in the chopper [3]. Combining these two techniques gives the best possible transmission for a very short burst time.

This system is a part of the final fast chopper system and operates to split and compress the incident beam from 40 mm x 50 mm into two separate beams of dimension 10 mm x 50 mm. The apertures in the final discs matches the two compressed beams producing a much faster burst time. Downstream of the final chopper, the two individual beams are recombined in an expanding double funnel to a single beam of dimension 40 mm x 50 mm. The expanding double funnel not only recombines the beams but also removes the extra divergence added to the neutrons during the compression stage.

Our measurements show that this system can produce neutron burst times as low as 8 μs full width at half maximum and a transmission of around 90%.

Figure 3. Neutron flux profile at the sample position taken with a pixilated neutron camera.



To check the uniformity of the recombined beam at the sample position we took a picture using a pixilated neutron camera. The image taken is shown in figure 3. The image shows that the two beams are recombined at the sample position to give a flat topped profile; an essential part of the design specification from the user community as many of the experiments use multiple crystals which are rotated in the beam.

Apart from the two high speed resolution choppers mentioned there are also three slower choppers on LET. Chopper 2 runs at 10 Hz and prevents very

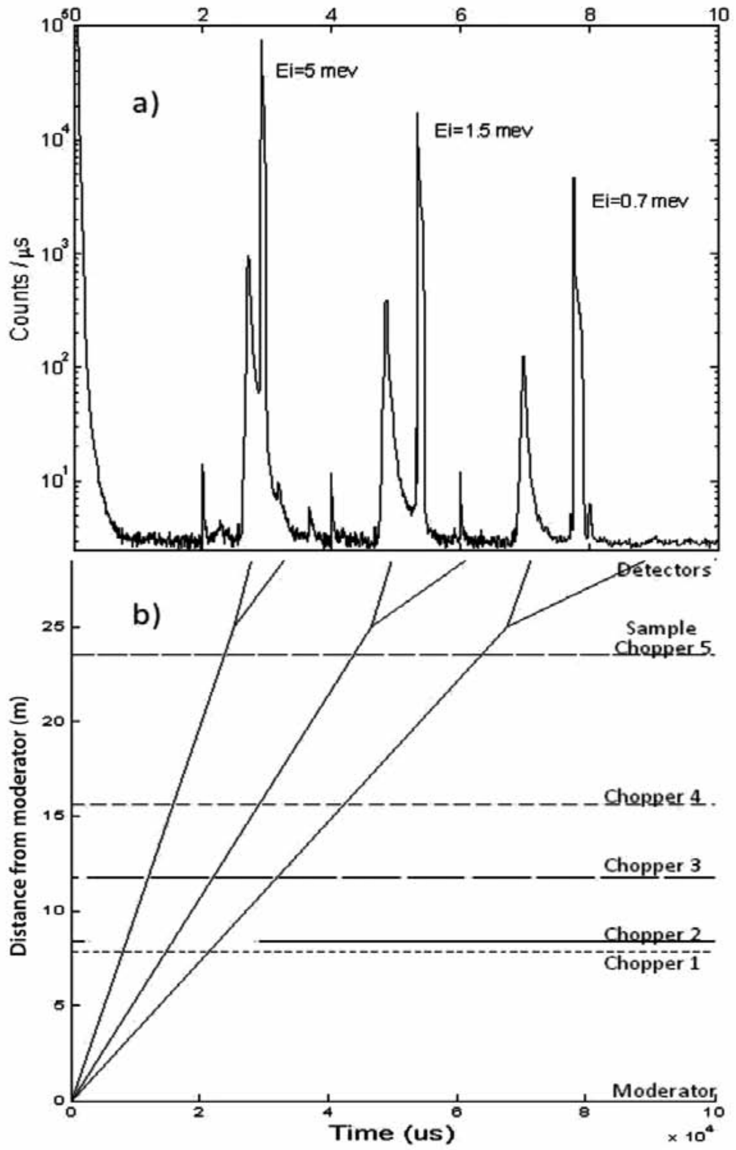


Figure 4. (a) Integrated flux from detectors for a vanadium sample as a function of time. There are three measurements within the time frame at 5, 1.5 and 0.7 meV.
(b) Distance-time diagram showing the roles of the five chopper sets down the beam line.

slow neutrons from one time frame reaching the next and causing potential spurions in the data. Chopper 4 also prevents potential spurions as it stops neutrons from the very long exponentially decaying tail of the moderator from getting through the chopper system.

The whole chopper system has been specifically designed to allow LET to operate as a multiplexing spectrometer [4,5]. That is to say that in a single time frame the spectrometer can collect data from incident neutrons of different energies. This can be seen in figure 4 which was a measurement made on Vanadium with three incident energies within the time frame. This fully utilises the long 100 ms time frame and is clearly a far more efficient mode of data collection. The role of chopper 3 is to remove pulses so as to space out the measurements so they do not overlap in time of flight.

POLARISATION

A short 0.8 m removable section of guide is installed upstream of chopper 5, see figure 1, which can be replaced by a composite ^{3}He neutron spin filter and RF flipper. All the sections of guide upstream of the polarizer are coated with a non-depolarising super-mirror, and this combined with. magnetised soft iron guide-fields make it possible to preserve the neutron spin-state all the way to the sample position. In addition the beam defining jaws are driven by piezoelectric motors which have no stray magnetic field that would depolarize the beam.

The neutrons are analysed after scattering using a banana shaped ^{3}He cell which wraps around the sample and sits inside XYZ field coils. This allows one to use the full detector coverage. LET has been designed from day one with polarisation in mind with everything in the surrounding areas is non-magnetic. The design is such that polarisation experiments should be routine, with fast swap over times between polarisation and non-polarisation experiments. Wehave an in-house dedicated polarisation team at ISIS who are designing and building theequipmentnecessary [6] and we plan to start commissioning much of the polarization equipment on LET in the autumn of 2011.

Figure 5. The inside of the LET detector tank. The whole tank is lined with Cadmium. Detectors are 4 m high and are in packs of 32 tubes separated by vertical vanes.

SAMPLE TANK AND DETECTORS

Figure 5 shows the view inside the sample tank. To stop any spurious scattering in the secondary spectrometer there are no windows between the sample position (in the centre on the right hand side of the photo) and the detectors 3.5 m away. The whole tank is lined with cadmium and there are vertical vanes to eliminate scattering from the detector tubes in one bank reaching other detector banks. The vanes are just one detector tube in width to minimise gaps in the coverage. The whole 120 m^3 tank is evacuated to a cryogenic vacuum of 2x10^{-6} mbar, making it possible to minimise the thickness of any tails on cryostats. For example: the standard top-loading CCR has less than 0.5 mm of aluminium in the beam.

The detectors are 4m long position sensitive ^{3}He tubes, the longest ever used in a neutron instrument, ensuring that there are no gaps in the detector coverage in the vertical plane. Packs of 32 tubes are mounted onto a frame which is loaded via a vacuum port on top the tank. Ultimately there will be 12 packs in total covering 180° in the horizontal plane and ±30° vertically, with a minimum scattering angle of 3°. At the time of writing only 5 packs of detectors are installed with remaining 7 to be installed during 2011.

New electronics were designed and manufactured by the ISIS detector group. They digitise the analogue signal from each pre-amp installed at either end of the detector and programmable chips process this signal in real time to calculate the position.
This design is much more versatile and efficient than the existing analogue electrons, and makes it possible for new algorithms to easily programmed onto the chip, at any time. Currently, the system discriminates between real neutrons and photons on both signal size (as was the case previously) but also on width of the time pulse. Tests show that the positional accuracy of these tubes is approximately 25 mm and since the diameter of the tubes is also 25mm, each detector 'pixel' is approximately a square with an angular resolution from the sample of about 0.4°.

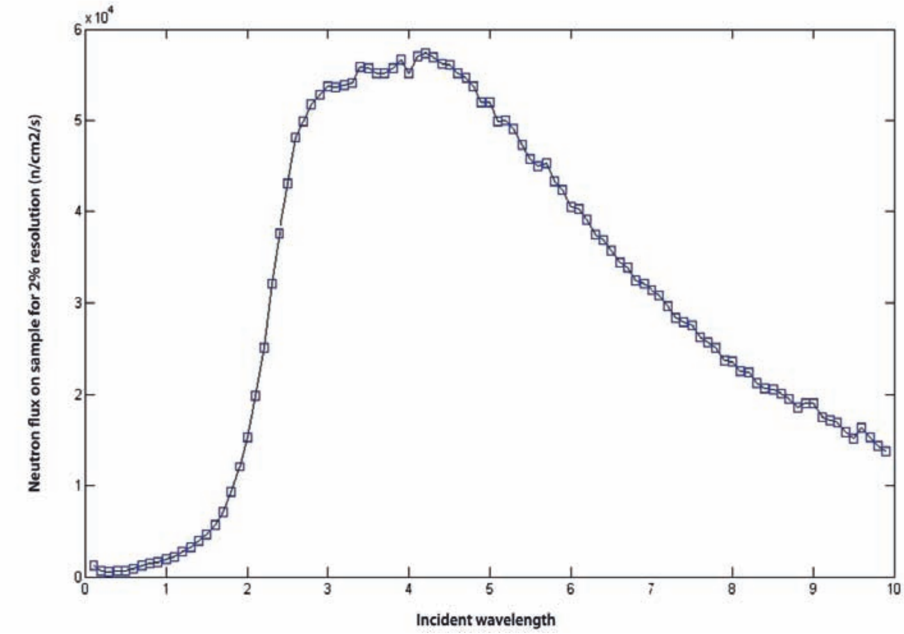


Figure 6. Measured flux per cm_2 per second at the sample position for a 2% energy resolution.

SAMPLE ENVIRONMENT
One of the original scientific aims for the instrument was to allow the use of large and complex sample environment equipment. Therefore, in addition to the standard ISIS 400 mm diameter sample flange, LET has a larger 700 mm diameter flange.
This makes it possible to use the Oxford Instruments 9 T magnet. This is a split bore solenoid which has been designed to give good field homogeneity over a large sample volume of 25 mm x25 mm x 25 mm. Also, the tails of this magnet are designed to view scattering over a very wide angular range, ±15° in the vertical plane and 90° in the horizontal plane, thus maximising the view of the large position sensitive detector array.
This can beused in conjunction with a dilution insert with a base temperature of 50 mK. The piezoelectric beam defining jaws are affected by the stray field from the magnet.

FIRST RESULTS FOR LET

The following sections describe the results of the commissioning and the first two experiments.

FLUX

Unfortunately at present the composite moderator viewed by LET contains no solid methane and it is thought that this will reduce the flux measured by around a factor of two.
The measured neutron flux at the sample position per unit area and time for 2% energy resolution is shown in figure 6. The intensity has been multiplied by a factor of two to account for the lack of methane.

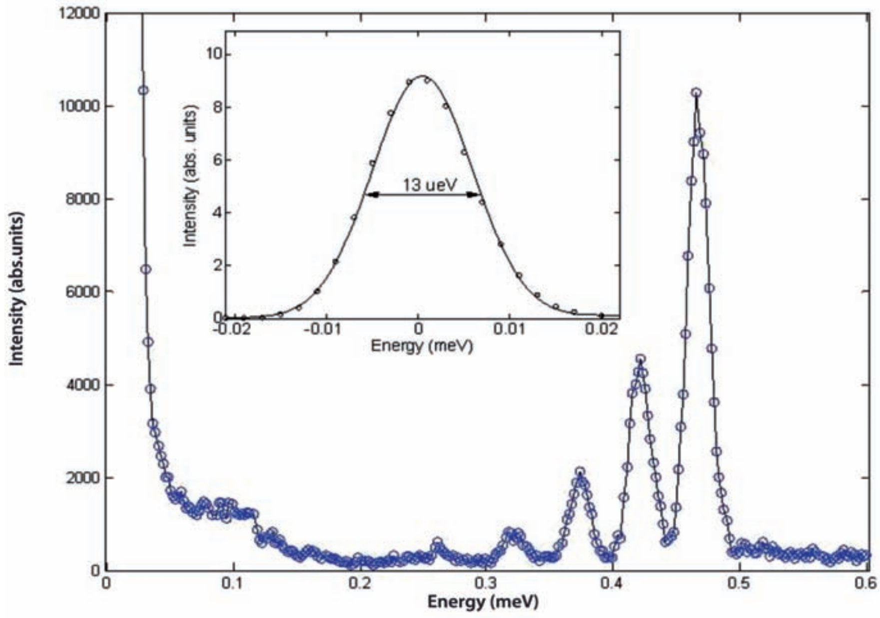


Figure 7. First inelastic measurement on a Fe8 molecular magnet at 5 K. The data are taken from a scattering angle ranging from 4° to 20°. Insert shows a Gaussian fit to the elastic line as a guide to the eye.

This result was obtained by measuring the scattering in the detectors from a vanadium sample and then correcting for solid angle, detector efficiency and scattering percentage to deduce the flux at the sample position.
The flux density at the sample is very similar to that quoted for IN5 at the ILL [7]. For example at 5 meV incident energy and 2% energy resolution LET has around $5.6x10^4$ $n/cm^2/s$ compared to around $7x10^4$ $n/cm^2/s$ on IN5. However, it should be remembered that this is just the flux for a single pulse in the 100 ms time frame, and typically the user can collect 4–5 pulses with varying incident energies. Also, this is the flux per cm^2 at the sample position and with the unique monochromator design on LET the sample beam area is 4x5 cm^2. Although the flux at lower energies is excellent and as simulated, the flux at higher energies is lower than expected falls of rapidly above 2 Angstroms. We are not sure at this stage if this is due to misaligned guide or other factors.
The First inelastic measurement. The first inelastic measurement performed on

LET during the commissioning was a 1 gram powder sample of an Fe8 single molecular magnet. The measurement was taken at 5 K with an incident energy of 1.5 meV and with choppers 1 and 5 running at 200 Hz.

The resulting spectrum (figure 7) agrees very well with a measurement on the same sample taken on IN5 [8], showing transitions between the ground state S=10 multiplets. The signal is clean with a low background (no background subtraction performed) and no sign of any spurious signals. The inset of Figure 7 shows an elastic line with a width of 13 μeV as predicted from the simulations. The inelastic features at 0.4 meV have a width of 20 μeV some 2.5 times larger than predicted probably due to the intrinsic linewidths of the sample. Although theoretically the lineshape is a convolution of the triangular transmission function of the choppers with that from detector and sample, in practice it can be closely approximated by a Gaussian, as can be seen from the fit in the inset.

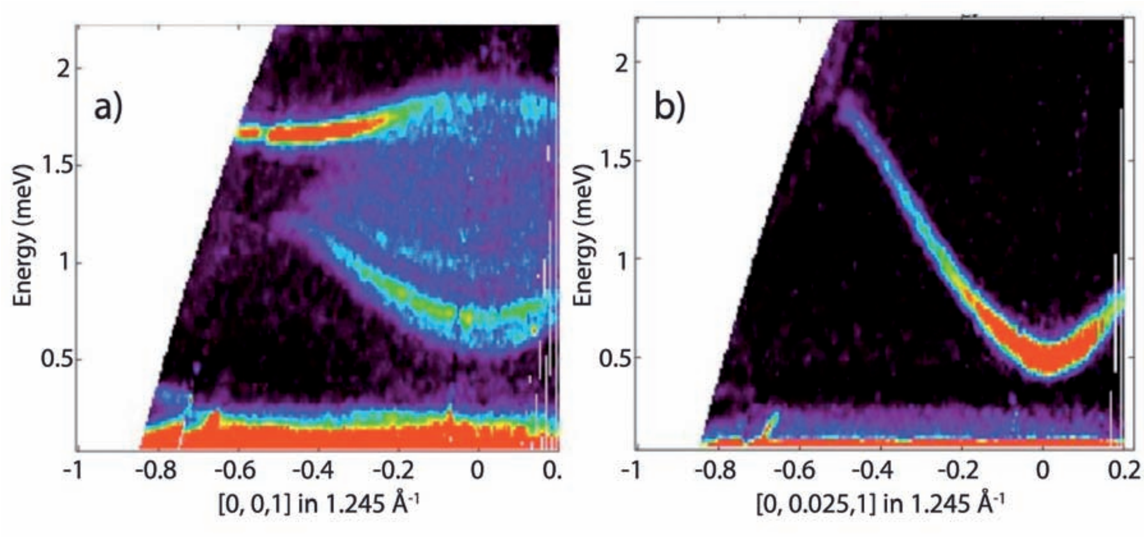


Figure 8. Spin excitation spectrums of $CoNb_2O_6$ taken at 50 mK and with an incident energy of 4 meV. a) 4T field and b) 7T field

THE FIRST USER EXPERIMENT

The authors would like to thank Radu Coldea for allowing us to show the following data which is from the first experiment on LET as it has not yet been published elsewhere. The sample is a single crystal (approx. 6g) of $CoNb_2O_6$, a quasi-one-dimensional Ising ferromagnet. Below a critical magnetic field the observed spin excitations are from pairs of 'kinks' in the ordered phase, see figure 8 a). However, above a critical field the system undergoes a quantum phase transition to a quantum paramagnet and the spin excitations observed are those of spin-flips in the paramagnetic phase, figure 8 b)[9].

This was a complex experiment: a single crystal mounted on a rotation stage, in a dilution fridge at 50 mK in the 9T magnet. However, the experiment was highly successful as shown from the two sets of data taken below and above the critical field (figure 8). Both sets of data were taken with an incident energy of 4 meV and a resolution at the elastic line of approx. 1% of $\Delta E/E_i$. This data shown in figure 8 has had no background subtractions and has only been converted from time to energy transfer.

The signals are clean with no spurious signals and demonstrate the low background on LET and high energy resolutions achievable.

SUMMARY

LET is now a fully scheduled spectrometer. It offers the user community high fluxes of cold neutrons, fine energy resolutions and large solid angles of position sensitive detectors with low flat backgrounds. It is able to measure from the quasi-elastic regime up to 80 meV, which combined with the possibility of extreme sample environments such as high fields and low temperatures and XYZ polarization, offers unique scientific possibilities for a wide range of scientific fields, from soft matter through to hard condensed-matter physics.

The Spectrometer	
Moderator	Coupled composite (solid CH4)
Primary flight paths L1	25 m
Secondary flight paths L2	3.5 m
Beam size (HxW) at sample	50 mmx40 mm
Scattering angles	Horizontal -40 to +140°, Vertical ±30°
Detector resolution	25 mmx25 mm or 0.4° x 0.4°
Incident energy	0.6–80 meV
Energy resolution	ΔE/Ei ≥ 1.5% at 20 meV, ΔE/Ei ≥ 0.8% at 1 meV
Qmax, Qmin	11.8/λ (Å-1), 0.32/λ (Å-1)
Sample environment	
CCR	5–600 K sample size 40 mmx50 mm
Orange cryostat	1.5–310 K sample size 40 mmx50 mm
Dilution fridge	50 mK–4 K sample size 35 mmx40 mm
Cryomagnet	9 T, 1.6–310 K sample size 25 mmx25 mm

Table 1. Characteristic parameters for LET.

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FERMI@Elettra: from the first flashes of light towards the experimental programs

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Sincrotrone Trieste
S.C.P.a.

The night between December 13 and 14 2010 was very gratifying for the Sincrotrone Trieste team. FERMI@Elettra, the newly-built free-electron laser for materials analysis and the development of nanoscience, generated its first flashes of coherent light in the far ultraviolet.

In the last decade the use of free electron lasers has become an important tool for several fields of science and the number of user facilities based on such a kind of source are rapidly increasing. In order to provide users with the capability offered by this, Sincrotrone Trieste has been engaged in an intensive teamwork since 2006.

The light of FERMI has a similar coherence and intensity as that of the most powerful lasers, but it can reach intensities and wavelengths that are outside the range of traditional lasers. Additionally, it can be synchronized with the internal dynamics of the materials and processes under observation, allowing to perform new kind of experiments that would not be possible on the existing synchrotron radiation sources.

FERMI is housed in a long tunnel – over 300 meters in length – dug 5 meters below ground in the karst rock. It is a single pass free electron laser based on a 200 m long linear accelerator that produces high quality electron beams with energy variable between 0.9 and 1.5 GeV. In FERMI these electrons will be sent into two seeded FEL lines that cover the whole spectral range from 100 nm down to 4 nm with fully coherent pulses.

Using the high gain harmonic generation scheme initiated by a tunable laser in the UV, FERMI will be characterized by high quality FEL pulses both in term of spectral purity and temporal reproducibility. Indeed, the adopted scheme allows FERMI to produce light characterized not only by transverse coherence, that can be also achieved with simpler schemes like the Self Amplified Spontaneous Emission, but also by a very high temporal coherence.

Parameter	FEL1	FEL2	Units
Output Wavelength (fundam.)	100 – 20	20 – 4	nm
Output Pulse Length, rms	≤50	≤50	fs
Peak Power	1 – 5	> 0.3	GW
Photons per Pulse	$> 10^{13}$	$> 10^{12}$	
Peak Brightness (ph./(sec.•mm²•mmrad²•01%Bdw))	$>10^{28}$	$>10^{29}$	
Power Stability	<30	<50	%
Transverse Stability	<10%		e-size
Repetition Rate	10	50	Hz

Table 1. Photon beam parameters of the two FERMI@Elettra FELs.

This will also improve the capability to perform pump and probe experiments, where an initial flash (the “pump”) illuminating the sample provides the energy required to initiate the reaction, and it is followed by a second pulse (the “probe”) photographing the process status at a precise point in time.
Both FERMI FELs will produce their coherent radiation using specially designed APPLE-II undulators that allow the control of the FEL polarization. Both horizontal and vertical and circular polarizations are possible.
The parameters that describe the FERMI FELs photons are reported in table 1.
After less than two years of commissioning of the linear accelerator, FERMI entered into its final commissioning in December 2010, till the first evidence of a coherent signal in the range from 60 to 20 nm has been demonstrated (see figure 1).

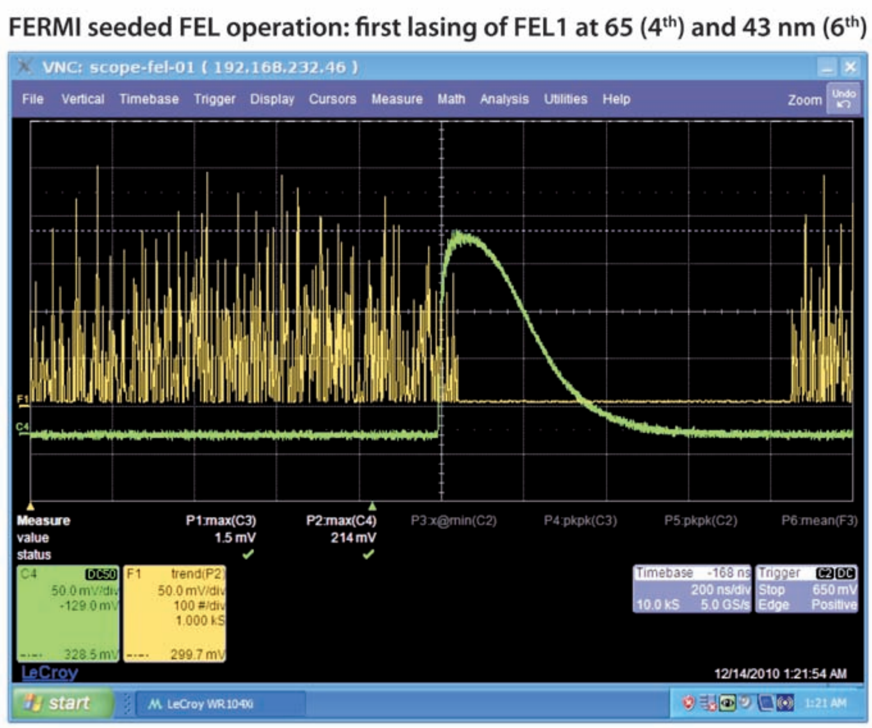


Figure 1. Seeded coherent emission from FEL-1 measured by means of a fast photodiode located in the FERMI experimental hall. The undulators were tuned at 43 nm. The green trace shows the time profile of a single pulse with the photodiode in saturation. The yellow trace shows a series of seeded FEL pulses being turned on (left) and off (center-right) by changing the superposition between seed laser pulses and electron pulses.

A second phase of commissioning started in January 2011 with the goal of producing the first FEL light to be sent into the experimental chambers. After a careful optimization of the electron beam parameter and of the FEL system in the last commissioning run, it has been possible to clearly show the evidence of coherent emission from the various undulators of FEL-1.
The further system optimization necessary to reach the final FEL performance, to allow the FERMI users to start performing their new experiments, is now ongoing at Sincrotrone Trieste.

SNS target reaches end-of-life

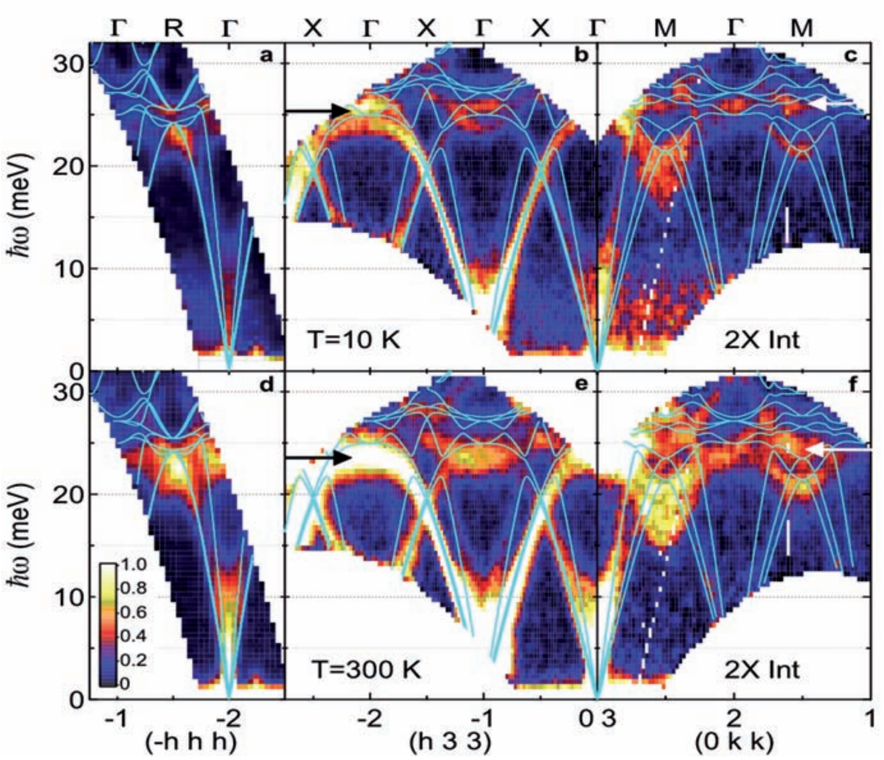
A.E. Ekkebus
Oak Ridge National Laboratory
Tennessee, USA

On Sunday, April 3, 2011, the Spallation Neutron Source (SNS) target reached an end-of-life condition, so user operations were shut down to change the stainless steel target housing the liquid mercury. This is the third change out of the target vessel; it is an expected event and took about two weeks. We took advantage of this time to do maintenance work that was planned for the longer summer shutdown. This will shorten that shutdown and recover the neutron production time. SNS restarted user operations on April 20.

Robert McGreevy.

COMMITTEES REVIEW 700 PROPOSALS

ORNL hosted 85 members of the proposal review committees on site on April 11–12 to review more than 700 proposals for neutron beam time at SNS and HFIR. The proposal review committee chairs gave us excellent feedback as to the quality and diversity of the proposals that they had reviewed. Both the proposal quality and the range of science that researchers are trying to address with our neutron facilities are increasing rapidly as the competition for the limited time available heats up.

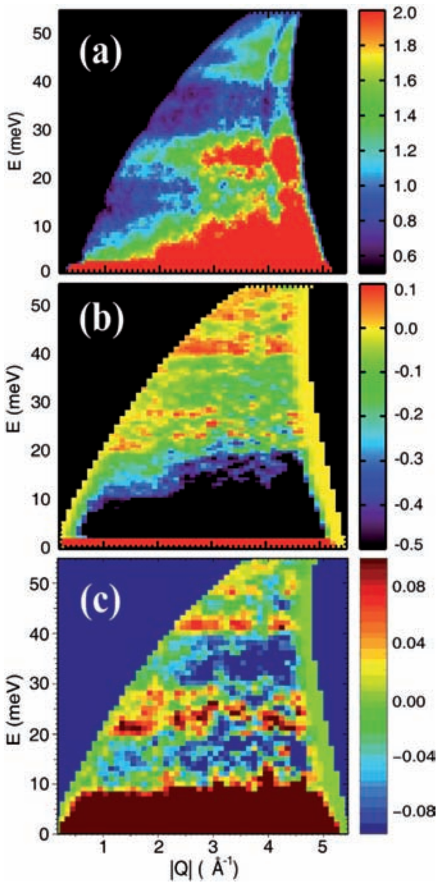


Single crystal phonon dispersions of FeSi measured using time-of-flight inelastic neutron scattering. Comparison of these data with calculations (light blue lines) provides clear evidence of the unusual softening of the atom motions with increasing temperature.

Because of damage to neutron scattering facilities in Japan, ORNL has offered to help our Japanese colleagues with beam time at SNS and HFIR, and we have received the first batch of requests from our Japanese colleagues. Recognizing that the ORNL facilities are already in high demand, they forwarded only their top priority proposals, including those that are time-critical for students to finish their degrees. Our task now is to fit these requests into the time available. Kudos to the User Office for efficiently handling this very complex and intense process.

THERMOELECTRIC MATERIALS ARE IMPORTANT FOR MANY POTENTIAL ENERGY APPLICATIONS

At present, they are at best on the order of 10% efficient. An increase to 30% efficiency would be significant for potential energy applications. Neutron scattering is unmatched in its ability to probe atomic vibrations in the crystals of thermoelectric materials. Such materials in the form of crystals can be measured on the time-of-flight instruments at a series of orientations, each orientation giving a comprehensive data set. Combining these sets taken at the SNS ARCS instrument and a HFIR triple-axis spectrometer gives the researchers a complete picture of the microscopic dynamics. Researchers successfully showed that sharp features in the arrangement of electrons in a crystalline solid can have a surprisingly strong effect on how the atoms vibrate. This insight should help them better understand how heat is transported in a solid and could provide guidance on how to make better superconductors for the transmission of electricity without loss over large distances. See Delaire et al., *PNAS* **102**, 4725–4730 (2011).



Maps of inelastic neutron scattering intensity, S(Q,E), for TiOBr at T = 8K.
(a) S(Q,E) after empty can background subtraction to eliminate scattering from sample environment.
(b) S(Q,E) after high temperature (80 K) background subtraction to isolate magnetic scattering.
(c) S(Q,E) after high temperature background subtraction weighted by an appropriate Bose correction.

MAGNETIC EXCITATION STUDIES REVEAL EXOTIC PHYSICS

An international collaboration has used the Fine-Resolution Fermi Chopper Spectrometer (SEQUOIA) at the Spallation Neutron Source to successfully measure for the first time the energy gap between the ground state and the first excited state in the one-dimensional material TiOBr, a titanium oxyhalogen. See Clancy, J.P., et al., *Phys. Rev. Lett.* **106**, 117401 (2011).

ORNL ADDS SENIOR NEUTRON SCATTERING STAFF

Robert McGreevy joins ORNL as deputy Associate Laboratory Director in May 2011. Robert comes to ORNL from the ISIS facility, where he served as head of the diffraction and muon division. Before joining ISIS, Robert was director of the Studsvik Neutron Research Laboratory in Sweden. In addition, four new senior staff joined the Neutron Scattering Science Division. Thomas Proffen leads the powder diffraction group, Mike Simonson directs science programs, John Katsaras heads biological and biomedical sciences, and Paul Langan guides the Center for Structural Molecular Biology.

ORNL WILL HOST A BOOTH AT IUCr

Please visit the ORNL booth at the Madrid meeting of the International Union of Crystallography in August 2011 and learn more about efforts at SNS and HFIR in crystallography. The TOPAZ single-crystal and POWGEN powder diffractometers at SNS and the HFIR Powder Diffractometer are becoming strong contributors to the scientific output of these facilities.

NUFO holds Science Exhibition on Capitol Hill

A.E. Ekkebus
Oak Ridge National Laboratory
Tennessee, USA

The National User Facility Organization (NUFO) was officially invited by several Members of Congress to hold an exhibition on Capitol Hill to inform Members and staff about the research being conducted at national user facilities, as well as the ultimate benefit of this research to the United States. NUFO represents the interests of all users who conduct research at U.S. national scientific user facilities, as well as scientists from U.S. universities, laboratories, and industry who use facilities outside the United States. NUFO facilitates communication among users, user organizations, facility administrators, and other stakeholders.

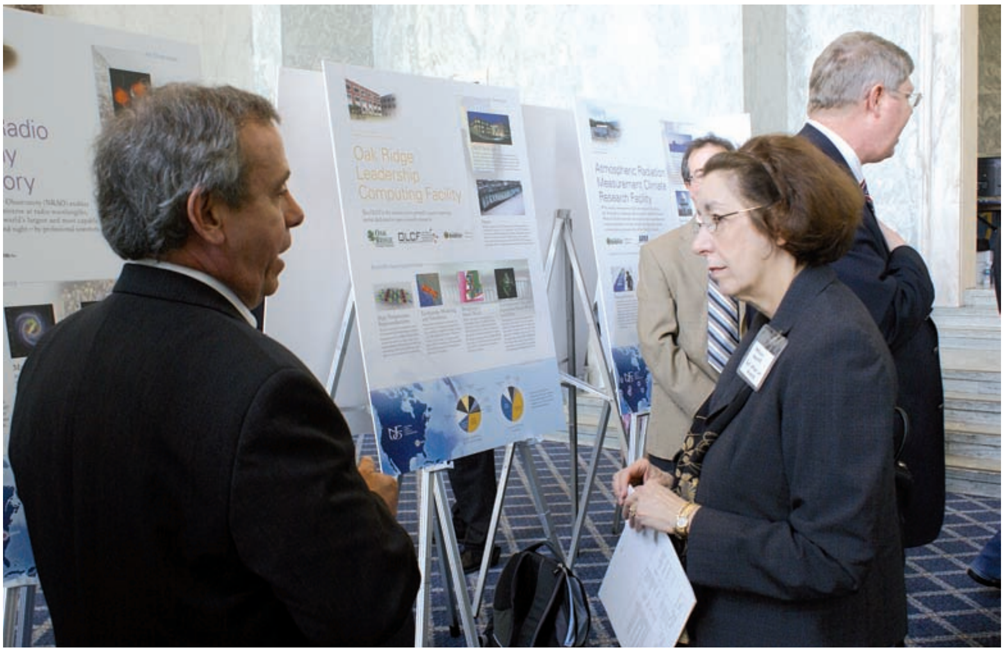
Jen Klare and Aditi Risbud, users of Lawrence Berkeley National Laboratory's Molecular Foundry, participated in the NUFO exhibit.

These user facilities include synchrotron and neutron sources, as well as nanocenters and materials laboratories; astronomical observatories; and particle and nuclear physics, environmental, and computer facilities. Nearly 600 U.S. universities, 300 international universities and more than 500 industrial partners conduct research at these federal facilities. They are funded by a diverse group of government agencies including the US Department of Energy and the National Science Foundation.

The User Science Exhibition was held on April 7 in the Rayburn House Office Building on Capitol Hill. Scientists from almost 40 facilities representing 30,000 users presented posters to Members of Congress, their staff and the general public. NUFO has also participated in other outreach activities over the past year, which includes the U.S. National Science and Engineering Festival held in October 2010 on the Mall in Washington, DC, and attendance at several professional society annual meetings in 2011.

The User Exhibition included five major displays representing NUFO as a whole. NUFO's "four pillars" posters focused on Science Education, Scientific Achievements, Economic Competitiveness, and Fundamental Knowledge. These were supplemented by a large map of the United States that illustrated the locations of NUFO facilities and institutions represented at each NUFO facility. NUFO seeks to provide a unified message at the national level on resources for science, economic competitiveness, and education for the next-generation scientific workforce. NUFO is organized into two major branches: User Organization Representatives and User Administrators.

User organizations focus primarily on outreach activities, whereas user administrators focus on streamlining processes to facilitate access. Both branches work together closely to fulfill the overall NUFO mission. Recently, NUFO has worked to improve access to user facilities by foreign nationals by identifying



Patricia Dehmer (right), Deputy Director for Science Programs at DOE, discusses science research agendas with a facility user.

mechanisms to speed processing access requests while maintaining appropriate levels of security. In addition, NUFO has prepared a white paper on increasing industrial usage by reducing barriers to industrial participation and focusing on the needs of the industrial research community. An educational outreach report containing long-term recommendations for NUFO has also been completed.

In addition joint benchmarking studies performed by NUFO user administrators, include those on shipping policies and procedures, first aid services to users, publications, proposal call closure, cyber security and site and facility access requirements.

More information about NUFO, including the results of the June 2011 annual meeting and copies of the reports, can be found at the NUFO website http://www.nufo.org.

Call for Proposal [Deadlines for proposal submission]

Neutron Sources

http://pathfinder.neutron-eu.net/idb/access

October 15, 2011 (for January-June)	**BNC** http://www.bnc.hu/modules.php?name=News&file=article&sid=39
March 1 and September 1 annually	**BENSC** http://www.helmholtz-berlin.de/userservice/neutrons/user-info/call-for-proposals_en.html#c63361
September 16, 2011	**FRM-II** http://www.frm2.tum.de/en/user-office/news-dates/index.html
To be announced, 2011	**GeNF - Geesthacht Neutron Facility** http://www.helmholtz.de/en/news/helmholtz_calls_for_applications/
September 14, 2011	**HFIR** http://neutrons.ornl.gov/
September 15, 2011	**ILL** www.ill.eu/users/experimental-programme/
To be announced, 2011	**ISIS** http://www.isis.stfc.ac.uk/apply-for-beamtime/apply-for-beamtime2117.html
To be announced, 2011	**JCNS FZ-Jülich** http://www.jcns.info/jcns_proposals/
May 1 and November 1, annually	**LLB - Laboratoire Léon Brillouin** http://www-llb.cea.fr/en/Web/avr2000_e.php
Any time	**NPL - Neutron Physics Laboratory** http://neutron.ujf.cas.cz/en/instruments/user-access/item/60-proposals
To be announced (Particle Physics all) **To be announced** SLS/SINQ joint powder diffraction (X+N) **To be announced** (SμS GPS, LTF, GPD and DOLLY) **November 15, 2011** (all)	**SINQ - Swiss Spallation Neutron Source** http://user.web.psi.ch/user/deadlines.html
September 14, 2011	**SNS** http://neutrons.ornl.gov/users/user_news.shtml

Synchrotron Radiation Sources

www.lightsources.org

Deadline	Facility
July 15, 2011 (Structural Biology Beamlines for the period between September - October 2011) **July 15, 2011** (All other Beamlines for the period between January - June 2012) **September 15, 2011** (Structural Biology Beamlines for the period between November - December 2011) **November 15, 2011** (Structural Biology Beamlines for the period between January - February 2012)	**ALS** http://www-als.lbl.gov/index.php/component/content/article/58.html
To be announced	**ANKA** http://ankaweb.fzk.de/website.php?page=userinfo_guide&id=1#subpart2
October 28, 2011 (2012-1: for the period between January and April, 2012)	**APS** http://www.aps.anl.gov/Users/Calendars/GUP_Calendar.htm
To be announced	**AS - Australian Synchrotron** http://www.synchrotron.org.au/index.php/features/applying-for-beamtime/proposal-deadlines
September 1, 2011	**BESSY** http://www.bessy.de/boat/www/
Proposals are evaluated twice a year	**BSRF - Beijing Synchrotron radiation Facility** http://www.ihep.ac.cn/bsrf/english/userinfo/beamtime.htm
September 30, 2011 (January-April 2012 Cycle)	**CFN - Center for Functional Nanomaterials** https://pass.nsls.bnl.gov/deadlines.asp
October 30, 2011	**CHESS - Cornell High Energy Synchrotron Source** www.chess.cornell.edu/prposals/index.htm
September 7, 2011	**CLS - Canadian Light Source** http://www.lightsource.ca/uso/call_proposals.php
November 30, 2011	**CNM Center for Nanoscale Materials** http://www.lightsources.org/cms/?pid=1000336
October 1, 2011	**DIAMOND - Diamond Light Source** www.diamond.ac.uk/ForUsers/Welcome
September 15, 2011	**ELETTRA** https://vuo.elettra.trieste.it/pls/vuo/guest.startup
September 1, 2011 (for beam time between March and July 2012)	**ESRF** http://www.esrf.eu/UsersAndScience/UserGuide/Applying
December 1, 2011	**FELIX - Free Electron Laser for Infrared experiments** www.rijnh.nl/research/guthz/felix_felice/

July 14, 2011 - January 16, 2012	**FOUNDRY - The Molecular Foundry**	https://isswprod.lbl.gov/TMF/login.aspx
September 1, 2011 (DORIS III and PETRA III)	**HASYLAB - Hamburger Synchrotronstrahlungslabor at DESY**	http://hasylab.desy.de/user_info/write_a_proposal/2_deadlines/index_eng.html
To be announced, 2011	**ISA**	http://www.isa.au.dk/
July 12, 2011 (New LCLS proposals for summer 2012)	**LCLS - The Linac Coherent Light Source**	http://www-ssrl.slac.stanford.edu/lcls/users/
August 1 01 - September 23, 2011 (D04A-SXS D04B-XAFS1 D05A-TGM D06A-DXAS D08A-SGM D09B-XRF D10A-XRD2 D10B - XPD D11A-SAXS1 D12A-XRD1 OUTUBRO/11) **September 30 - October 31, 2011** (D03B-MX1)	**LNLS - Laboratório Nacional de Luz Síncrotron**	https://www.lnls.br/lnls/cgi/cgilua.exe/sys/start.htm?UserActiveTemplate =lnls_2007_english&tpl=home
To be announced, 2011	**MAX-lab**	http://www2.maxlab.lu.se/members/proposal/index.jsp
September 30, 2011 (for the period between January and April 2012)	**NSLS - National Synchrotron Light Source**	https://pass.nsls.bnl.gov/deadlines.asp
Septemebr 30, 2011 (for the period between January and April, 2012)	**NSRRC - National Synchrotron radiation Research Center**	http://portal.nsrrc.org.tw/
To be announced, 2011	**PF - Photon Factory**	www.nsrrc.org.tw/
September 15, 201 (all except PX beamlines) **October 15, 201** (PX beamlines)	**SLS - Swiss Light Source**	http://sls.web.psi.ch/view.php/users/experiments/proposals/opencalls/index.html
To be announced, 2011	**SOLEIL**	http://www.synchrotron-soleil.fr/portal/page/portal/Recherche/SUN
Twice a year	**SPRING-8**	http://www.spring8.or.jp/en/users/proposals/
Twice a year in January/February and August, 2011	**SRC - Synchrotron Radiation Center**	www.lightsources.org/cms/?pid=1000336
July 1, 2011 (Crystallography Proposals for beam time November 2011-2013) **September 1, 2011** (Xray/VUV proposals for beam time March 2012-2014) **December 1, 2011** (Xray/VUV proposals for beam time June 2012-2014) **December 1, 2011** (Crystallography Proposals for beam time March 2012-2014)	**SSRL - Stanford Synchrotron Radiation Laboratory**	http://www-ssrl.slac.stanford.edu/userresources/deadlines.html

Calendar

July 3-7, 2011
Zurich, Switzerland
iWoRID 2011: 13th International Workshop on Radiation Imaging Detectors
http://indico.psi.ch/conferenceDisplay.py?confId=29

July 17-22, 2011
Biddeford, ME, USA
Thin Film and Crystal Growth Mechanisms. Gordon Research Conference
http://www.grc.org/programs.aspx?year=2011&program=thinfilm

July 17-22, 2011
Prague, Czech Republic
5th EUROPEAN CONFERENCE ON NEUTRON SCATTERING (ECNS 2011)
http://ecns2011.org/joomla_15/

July 19-22, 2011
Lüneburg, Germany
LMT 2011. 5th International Light Metals Technology Conference 2011
http://www.chemistryviews.org/details/event/1037419/5th_International_Light_Metals_Technology_Conference_2011_LMT_2011.html

July 21-23, 2011
Dublin, Ireland
I-SWAMP 2011
Intense field Short Wavelength Atomic and Molecular Processes
http://www.physics.dcu.ie/~I-SWAMP/

July 23-24, 2011
Prague, Czech Republic
MCNSI7 simulators workshop
http://neutron.ujf.cas.cz/events/mc2011

August 1-5, 2011
Colorado Springs, CO, USA
DXC 2011. 60th Annual Denver X-ray Conference
http://www.dxcicdd.com/

August 1-5, 2011
Quebec, QC, Canada
THERMEC-2011
Neutron Scattering & X-Ray Studies of Advanced Materials
http://www.thermec2011.ca/

August 1-5, 2011
Hong Kong
10th International Conference on the Structure of Surfaces and e-ICSOS-10
http://www.ap.cityu.edu.hk/icsos10/icsos10.html

August 6-7, 2011
Waterville, ME, USA
Gordon Research Seminar
Inaugural seminar related to X-ray Science Gordon Research Conference
http://www.grc.org/programs.aspx?year=2011&program=grs_cellc

August 7-12, 2011
Waterville, ME, USA
X-ray Science. Gordon Research Conference
http://www.grc.org/programs.aspx?year=2011&program=xray

August 13-20, 2011
Zug, Switzerland
10th PSI Summer School on Condensed Matter Research: Phase Transitions
http://www.psi.ch/

August 14-19, 2011
Beijing, China
REI-16: 16th International Conference on Radiation Effects in Insulators
http://www.rei2011.org/

August 21-25, 2011
San Diego, California, USA
SPIE Optics + Photonics 2011
http://spie.org/optics-photonics.xml?WT.mc_id=RCal-OPW

August 22-29, 2011
Madrid, Spain
IUCr2011. XXII Congress and General Assembly
http://www.iucr2011madrid.es/

August 31-September 2, 2011
Oak Ridge, Tennessee, USA
Neutron Powder Diffraction Workshop
http://neutrons.ornl.gov/conf/npd2011/

September 2-5, 2011
Beijing, China
Challenges in Organic Materials & Supramolecular Chemistry
http://www.rsc.org/ConferencesAndEvents/ISACS/OrganicMaterials
AndSupramolecularChemistry/Home.asp

September 4-7, 2011
Potsdam, Germany
ECMS2011. 7th European Conference on Mineralogy and Spectroscopy
http://www.physchemgeo.com/ECMS/

September 5-16, 2011
Jülich/Garching, Germany
15th JCNS Laboratory Course Neutron Scattering
http://www.jcns.info/wns_lab_now/

September 5-8, 2011
Campinas, Sao Paulo, Brazil
ICXOM21. 21th international congress on x-ray Optics and Microanalysis
http://icxom21.lnls.br/

September 6-7, 2011
Oak Ridge, Tennessee, USA
Introduction to the EQ-SANS
http://neutrons.ornl.gov/conf/eqsans2011/

September 7-9, 2011
Hamburg, Germany
MecaSens 2011. 6th International Conference on Mechanical Stress Evaluation by Neutrons and Synchrotron Radiation
www.chemistryviews.org/.../6th_International_Conference_on_Mechanical_
Stress_Evaluation_by_Neutrons_and_Syn.html

September 11-14, 2011
Namur, Belgium
ACIN 2011: International Symposium on Advanced Complex Inorganic Materials
http://webapps.fundp.ac.be/acin2011/

September 12-13, 2011
Oak Ridge, Tennessee, USA
Getting to know the NOMAD
http://neutrons.ornl.gov/conf/nomad2011/

September 13-16, 2011
Zürich, Switzerland
ISIC18. 18th International Symposium on Industrial Crystallization
http://www.isic18.ethz.ch/

September 15-16, 2011
Villigen, Switzerland
JUM@P 11: Second Joint Users Meeting at PSI
http://indico.psi.ch/conferenceDisplay.py?confId=42

September 18-22, 2011
Aussois, France
DyProSo XXXIII
http://www.ill.eu/news-events/events/dyproso-xxxiii/home/

September 20-24, 2011
Salzburg, Austria
Joint Meeting of the German Crystallographic Society (DGK) German Mineralogical Society (DMG) and Austrian Mineralogical Society (ÖMG)
http://www.salzburg2011.org/

September 20-October 1, 2011
Oak Ridge, Tennessee, USA
Neutron Diffraction @ TOPAZ
http://neutrons.ornl.gov/conf/topaz2011

October 10-12, 2011
DESY Hamburg, Germany
GISAXS 2011
https://indico.desy.de/conferenceDisplay.py?confId=4072

October 12-14, 2011
Grenoble, France
ADD 2011-Workshop on Analysis of Diffraction Data in Real Space
http://www.ill.eu/news-events/events/add2011/

October 26-28, 2011
Grenoble, France
Topological Materials
http://www.ill.eu/news-events/events/sense2010/

April 29-May 3, 2012
Brookhaven National Laboratory, Upton, NY (USA)
Operando IV - 4th International Congress on Operando Spectroscopy
http://www.nsls.bnl.gov/newsroom/events/workshops/2012/OperandoIV/default.asp

April 29-May 4, 2012
Vancouver, Canada
ARRS 2012: Meeting of the American Roentgen Ray Society
http://www.clocate.com/Conference/The-American-Roentgen-Ray-Society-ARRS-112th-Annual-Meeting-2012/3655/

May 31-June 10, 2012
Erice, Italy
Present and Future Methods for Biomolecular Crystallography
http://www.crystalerice.org/Erice2012/2012.htm

September 9-13, 2012
Frankfurt, Germany
First European Mineralogical Conference (EMC2012)
4th International Congress on Operando Spectroscopy
http://emc2012.uni-frankfurt.de/

November 18-23, 2012
Sydney, Australia
International Small-Angle Scattering Conference (SAS2012)
http://www.sas2012.com/

Facilities

Neutron Scattering

WWW SERVERS IN THE WORLD
http://idb.neutron-eu.net/facilities.php

ANSTO
Australian Nuclear Science and Technology Organisation

Phone Switchboard: + 61 2 9717 3111 (hours 7am to 6pm)
Fax: + 61 2 9543 5097
http://www.ansto.gov.au/home

BNC - Budapest Research reactor

Type: Swimming pool reactor, 10 MW
Phone: +36 1 392 2222
Fax: +36 1 395 9162
Email: tozser@sunserv.kfki.hu
http://www.kfki.hu/brr/indexen.htm

CAB - Centro Atómico Bariloche

Phone: ++54 2944 44 5100
Fax: ++54 2944 44 5299
Email: info@cab.cnea.gov.ar
http://www.cab.cnea.gov.ar/

CSNS

Phone: 86 10 68597289
Fax: 86 10 68512458
Email: cas_en@stimes.cn
http://english.cas.ac.cn/

ESS - European Spallation Source

http://neutron.neutron-eu.net/n_ess

FLNP - Frank Laboratory of Neutron Physics

Phone: (7-49621) 65-657
Fax: (7-49621) 65-085
E-mail: belushk@nf.jinr.ru
http://flnp.jinr.ru/25/

FRG-1

Type: Swimming Pool Cold Neutron Source
Phone: +49 (0)4152 87-1200
Fax: +49 (0)4152 87-1338
Email: peter.schreiner@gkss.de
http://www.gkss.de/about_us/contact/research_reactor/index.htm

FRJ-2

Forschungszentrum Jülich GmbH
Type: DIDO(heavy water),23 MW
http://www.fz-juelich.de/iff/wns/

FRM II

Type: Compact 20 MW reactor
Phone: +49 (0) 89 289 10794
Fax: +49 (0) 89 289 10799
Email: userinfo@frm2.tum.de
http://www.frm2.tum.de/en/index.html

GKSS

Phone: +49 (0)4152 87-1713
Fax: +49 (0)4152 87-1618
http://www.hzg.de/about_us/foerderverein/index.html.de

HANARO
Center for applications of radioisotopes and radiation korea atomic energy research institute

Phone: +82 42 868-8120
Fax: +82 42 868-8448
http://hanaro.kaeri.re.kr/english/index.html

HFIR

ORNL, Oak Ridge, USA
Phone: 865-576-0214
Fax: 865-574-096
Email: burnettese@ornl.gov
http://neutrons.ornl.gov/facilities/HFIR/experiment.shtml

HIFAR

Phone e phone Numbers:
ANSTO Switchboard: + 61 2 9717 3111
ANSTO Facsimile: + 61 2 9543 5097
Email: enquiries@ansto.gov.au
http://www.ansto.gov.au

IPEN
Peruvian Institute of Nuclear Research

Phone: 226-0030 - 226-0033226-
http://www.ipen.gob.pe/site/index/index.htm

ILL

Type: 58MW High Flux Reactor
Phone: + 33 (0)4 76 20 71 11
Fax: + 33 (0)4 76 48 39 06
Phone: +33 4 7620 7179
Fax: +33 4 76483906
Email: cico@ill.fr and sco@ill.fr
http://www.ill.eul

IPNS
Intense Pulsed Neutron at Argonne

Phone: 630/252-7820
Fax: 630/252-7722
for proposal submission by e-mail send to cpeters@anl.govor
mail/fax to IPNS Scientific Secretary, Building 360
http://www.pns.anl.gov/

ISIS Didcot

Type: Pulsed Spallation Source
Phone: +44 (0) 1235 445592
Fax: +44 (0) 1235 445103
Email: uls@isis.rl.ac.uk
http://www.isis.rl.ac.uk

JCNS
Juelich Centre for Neutron Science
Forschungszentrum Juelich

D-52425 Juelich, Germany
E-mail: neutron@fz-juelich.de
http://www.jcns.info

J-PARC
Japan Proton Accelerator Research Complex

Phone: +81-29-284-3398
Fax: +81-29-284-3286
Email: j-uo@ml.j-parc.jp
http://j-parc.jp/index-e.html

JRR-3M

Fax: +81 292 82 59227
Phoneex: JAERIJ24596
Email: www-admin@www.jaea.go.jp
http://www.jaea.go.jp/jaeri/english/index.html

JEEP-II Reactor

Type: D2O moderated 3.5% enriched UO2 fuel
Phone: +47 63 806000 / 806275
Fax: +47 63 816356
Email: kjell.bendiksen@ife.no
http://www.ife.no/index_html-en?set_language=en&cl=en

KENS
Institute of Materials Structure Science
High Energy Accelerator research Organisation

1-1 Oho, Tsukuba-shi, Ibaraki-ken,?305-0801, Japan
Email: kens-pac@nml.kek.jp
http://neutron-www.kek.jp/index_e.html

KUR
Kyoto University Research Reactor Institute

Kumatori-cho Sennan-gun, Osaka 590-0494, Japan
Phone: +81-72-451-2300
Fax: +81-72-451-2600
http://www.rri.kyoto-u.ac.jp/en/

LANSCE

Phone: 505 665 1010
Fax: 505 667 8830
Email: lansce_users@lanl
Email: tichavez@lanl.gov
http://lansce.lanl.gov/

LENS
Low Energy Neutron Source

http://www.indiana.edu/~lens/index.html

LLB

Type: Reactor
Flux: 3.0 x 1014 n/cm2/s
Secrétariat Europe:
Phone: 0169085417
Fax: 0169088261
Email: experience@llb.cea.fr
http://www-llb.cea.fr

McMASTER NUCLEAR REACTOR

Phone: 905-525-9140
http://mnr.mcmaster.ca/

MIT - Nuclear reactor Laboratory

http://web.mit.edu/afs/athena.mit.edu/org/n/nrl/www/

MURR

Phone: 1 573 882 4211
Email: MURRCustomerService@missouri.edu
http://www.murr.missouri.edu/

NFL
Studsvik Neutron Research Laboratory

Uppsala University - Studsvik Nuclear AB, Stockholm, Sweden
Type: swimming pool type reactor, 50 MW,
with additional reactor 1 MW
Phone: +46 155 21 000
Fax: +46 155 63 001
http://cordis.europa.eu/data/PROJ_FP5/ACTIONeqDndSESSIONeq112302005919ndDOCeq4269ndTBLeqEN_PROJ.htm

NIST - Center for Neutron Research
Phone: (301) 975-6210
Fax: (301) 869 4770
Email: Robert.dimeo@nist.gov
http://www.ncnr.nist.gov/

NPL - NRI
Type: 10 MW research reactor
Phone: +420 2 20941177 / 66173428
Fax: +420 2 20941155
Email: krz@ujv.cz and brv@nri.cz
http://neutron.ujf.cas.cz/

NPRE
Phone: 217/333-2295
Fax: 217/333-2906
http://npre.illinois.edu/

NRU - Chalk River Laboratories
Phone: 613 584 8293
Fax: 613 584 4040
http://neutron.nrc-cnrc.gc.ca/home_e.html

RIC - Reactor Infrasctructure Centre
Phone: +386 1 588 5450
Fax: +386 1 561 2335
http://www.rcp.ijs.si/ric/index-a.htm

RID - Reactor Institute Delft (NL)
Type: 2MW light water swimming pool
Phone: +31 (0)15 278 5052
Fax: +31 (0)15 278 6422
E-mail: secretary-rid@tudelft.nl
http://www.rid.tudelft.nl/live/pagina.jsp?id=b15d7df9-7928-441e-b45d-6ecce78d6b0e&lang=en

RISØ DTU
Phone: +45 4677 4677
Fax: +45 4677 5688
E-mail: risoe@risoe.dtu.dk
http://www.risoe.dtu.dk/

PETERSBURG NUCLEAR PHYSICS INSTITUTE
Phone: +7(813-71) 46025 - +7(813-71) 46047
Fax: +7(813-71) 36025 - +7(813-71) 31347
http://www.pnpi.spb.ru/

SINQ
Type: Steady spallation source
Phone: +41 56 310 4666
Fax: +41 56 3103294
Email: sinq@psi.ch
http://sinq.web.psi.ch

SNS - Spallation Neutron Source
Phone: (865) 241 5644
Fax: (865) 241 5177
Email: ekkebusae@ornl.gov
http://neutrons.ornl.gov

Synchrotron Radiation Sources

WWW SERVERS IN THE WORLD
www.lightsources.org/cms/?pid=1000098

ALBA
Synchrotron Light Facility
Phone: +34 93 592 43 00
Fax: +34 93 592 43 01
http://www.cells.es/

ALS
Advanced Light Source
Phone: 510 486 7745
Fax: 510 486 4773
Email: alsuser@lbl.gov
http://www-als.lbl.gov/als

ANKA
Phone: +49 (0)7247 / 82 6188
Fax: +49-(0)7247 / 82 8677
Email: info@fzk.de
http://ankaweb.fzk.de/

APS
Advanced Photon Source
Phone: (630) 252 2000
Fax: +1 708 252 3222
Email: fenner@aps.anl.gov
http://www.aps.anl.gov/

AS
Australian Synchrotron
Phone: +61 3 8540 4100
Fax: +61 3 8540 4200
Email: info@synchrotron.org.au
http://www.synchrotron.vic.gov.au/content.asp?Document_ID=1

BESSY
Berliner Elektronenspeicherring Gesellschaft.für Synchrotronstrahlung
Phone: +49 (0)30 6392 2999
Fax: +49 (0)30 6392 2990
Email: info@bessy.de
http://www.bessy.de/

BSRF
Beijing Synchrotron Radiation Facility
Phone: +86 10 68235125
Fax: +86 10 68186229
Email: houbz@mail.ihep.ac.cn
http://www.ihep.ac.cn/bsrf/english/main/main.htm

CAMD - Center Advanced Microstructures & Devices
Phone: +1 (225) 578 8887
Fax: +1 (225) 578 6954
Email: leeann@lsu.edu
http://www.camd.lsu.edu/

CANDLE
CANDLE - Center for the Advancement of Natural Discoveries using Light Emission
Phone/Fax: +374 1 629806
Email: baghiryan@asls.candle.am
http://www.candle.am/index.html

CESLAB
Central European Synchrotron Laboratory
Phone: +420 541517500
Email: kozubek@ibp.cz
http://www.xray.cz/

CFN
Center for Functional Nanomaterials
Phone: +1 (631) 344 6266
Fax: +1 (631) 344 3093
Email: cfnuser@bnl.gov
http://www.bnl.gov/cfn/

CHESS
Cornell High Energy Synchrotron Source
Phone: 607 255 7163
Fax: 607 255 9001
http://www.chess.cornell.edu/

CLIO
Centre Laser Infrarouge d'Orsay
Email: accueil-clio@lcp.u-psud.fr
http://clio.lcp.u-psud.fr/clio_eng/clio_eng.htm

CLS - Canadian Light Source
Phone: (306) 657 3500
Fax: (306) 657 3535
Email: clsuo@lightsource.ca
http://www.lightsource.ca/

CNM
Center for Nanoscale Materials
Phone: 630 252 6952
Fax: 630 252 5739
Email: carrieclark@anl.gov
http://nano.anl.gov/facilities/index.html

CTST
UCSB Center for Terahertz Science and Technology
University of California, Santa Barbara (UCSB), USA
http://sbfel3.ucsb.edu/

DAFNE Light
INFN-LNF
Phone: +39 06 94031
Fax: +39 06 9403 2582
http://www.lnf.infn.it/acceleratori/btf/

DELSY
Dubna ELectron SYnchrotron
Phone: + 7 09621 65 059
Fax: + 7 09621 65 891
Email: post@jinr.ru
http://wwwinfo.jinr.ru/delsy/variant-21june.htm

DELTA - Dortmund Electron Test Accelerator FELICITA I (FEL)
Fax: +49 (0)231 755 5383
http://usys.delta.uni-dortmund.de/

DFELL - Duke Free Electron Laser Laboratory
Phone: (919) 660 2669
Fax: (919) 660 2671
Email: beamtime@fel.duke.edu
http://www.fel.duke.edu/

Diamond Light Source
Phone: +44 (0)1235 778000
Fax: +44 (0)1235 778499
Email: useroffice@diamond.ac.uk
http://www.diamond.ac.uk/default.htm

ELETTRA - Synchrotron Light Laborator
Phone: +39 (040) 37581
Fax: +39 (040) 938 0902
http://www.elettra.trieste.it/

ELSA - Electron Stretcher Accelerator
Phone: +49 228 735926
Fax: +49 228 733620
Email: roy@physik.uni-bonn.de
http://www-elsa.physik.uni-bonn.de/elsa-facility_en.html

ESRF - European Synchrotron Radiation Lab.
Phone: +33 (0)4 7688 2000
Fax: +33 (0)4 7688 2020
Email: useroff@esrf.fr
http://www.esrf.eu/

FELBE - Free-Electron Lasers at the ELBE radiation source at the FZR/Dresden
Phone: +49 351 260 0
Fax: +49 351 269 0461
E-Mail: kontakt@fzd.de
http://www.fzd.de

FELIX- Free Electron Laser for Infrared experiments
Phone: +31 30 6096999
Fax: +31 30 6031204
Email: B.Redlich@rijnh.nl
http://www.rijnh.nl/felix/

FOUNDRY - The Molecular Foundry
1 Cyclotron Road Berkeley, CA 94720, USA
http://foundry.lbl.gov/index.html

HASYLAB
Hamburger Synchrotronstrahlungslabor
DORIS III, PETRA II / III, FLASH
Phone: +49 40 8998 2304
Fax: +49 40 8998 2020
Email: HASYLAB@DESY.de
http://hasylab.desy.de/

HSRC
Hiroshima Synchrotron Radiation Center HISOR
Phone: +81 82 424 6293
Fax: +81 82 424 6294
http://www.hsrc.hiroshima-u.ac.jp/english/index-e.htm

Ifel
Phone: +81 (0)72 897 6410
http://www.fel.eng.osaka-u.ac.jp/english/index_e.html
http://www.eng.osaka-u.ac.jp/en/index.html

INDUS -1 / INDUS -2
Phone: +91 731 248 8003
Fax: +91 731 248 8000
Email: rvn@cat.ernet.in
http://www.cat.ernet.in/technology/accel/indus/index.html
http://www.cat.ernet.in/technology/accel/atdhome.html

IR FEL Research Center - FEL-SUT
Phone: +81 4 7121 4290
Fax: +81 4 7121 4298
Email: felsut@rs.noda.sut.ac.jp
http://www.rs.noda.sut.ac.jp/~felsut/english/index.html

ISA - Institute for Storage Ring Facilities - ASTRID-1
Phone: +45 8942 3778
Fax: +45 8612 0740
Email: fyssp@phys.au.dk
http://www.isa.au.dk/

ISI-800
Phone: +(380) 44 424-1005
Fax: +(380) 44 424-2561
Email: metall@imp.kiev.ua

Jlab
Jefferson Lab FEL
Phone: (757) 269 7100
Fax: (757) 269 7848
http://www.jlab.org/FEL

Kharkov Institute of Physics and Technology Pulse Stretcher/Synchrotron Radiation
Phone: +38 (057) 335 35 30
Fax: +38 (057) 335 16 88
http://www.kipt.kharkov.ua/.indexe.html

KSR - Nuclear Science Research Facility Accelerator Laboratory
Fax: +81 774 38 3289
http://wwwal.kuicr.kyoto-u.ac.jp/www/index-e.htmlx

KSRS - Kurchatov Synchrotron Radiation Source Siberia-1 / Siberia-2
Phone: 8 499 196 96 45
http://www.lightsources.org/cms/?pid=1000152
http://www.kiae.ru/ (in Russian)

LCLS - Linac Coherent Light Source
Phone: +1 (650) 926 3191
Fax: +1 (650) 926 3600
Email: knotts@ssrl.slac.stanford.edu
http://www-ssrl.slac.stanford.edu/lcls/

LNLS - Laboratorio Nacional de Luz Sincrotron
Phone: +55 (0) 19 3512 1010
Fax: +55 (0)19 3512 1004
Email: sau@lnls.br
http://www.lnls.br/lnls/cgi/cgilua.exe/sys/start.htm?UserActiveTemplate=lnls%5F2007%5Fenglish&tpl=home

MAX-Lab
Phone: +46 222 9872
Fax: +46 222 4710
http://www.maxlab.lu.se/

Medical Synchrotron Radiation Facility
Phone: +81 (0)43 251 2111
http://www.nirs.go.jp/ENG/index.html

MLS - Metrology Light Source
Physikalisch-Technische Bundesanstalt
Phone: +49 30 3481 7312
Fax: +49 30 3481 7550
Email: Gerhard.Ulm@ptb.de
http://www.ptb.de/mls/

NSLS - National Synchrotron Light Source
Phone: +1 (631) 344 7976
Fax: +1 (631) 344 7206
Email: nslsuser@bnl.gov
http://www.nsls.bnl.gov/

NSRL National Synchrotron Radiation Laboratory
Phone: +86 551 3601989
Fax: +86 551 5141078
Email: zdh@ustc.edu.cn
http://www.nsrl.ustc.edu.cn/en/

NSRRC National Synchrotron Radiation Research Center
Phone: +886 3 578 0281
Fax: +886 3 578 9816
Email: user@nsrrc.org.tw
http://www.nsrrc.org.tw/

NSSR - Nagoya University Small Synchrotron Radiation Facility
Phone: +81 (0)43 251 2111
http://www.nagoya-u.ac.jp/en/

PAL - Pohang Accelerator Laboratory
San-31 Hyoja-dong Pohang Kyungbuk 790-784, Korea
Email: ilguya@postech.ac.kr
http://pal.postech.ac.kr/eng/index.html

PF - Photon Factory
Phone: +81 (0) 29 879 6009
Fax: +81 (0) 29 864 4402
Email: users.office2@post.kek.jp
http://pfwww.kek.jp/

PSLS Polish Synchrotron Light Source
Phone: +48 (12) 663 58 20
Email: mail@synchrotron.pl
http://www.if.uj.edu.pl/Synchro/

RitS Ritsumeikan University SR Center
Phone: +81 (0)77 561 2806
Fax: +81 (0)77 561 2859
Email: d11-www-adm@se.ritsumei.ac.jp
http://www.ritsumei.ac.jp/se/re/SLLS/newpage13.htm

SAGA-LS - Saga Light Source
Phone: +81 942 83 5017
Fax: +81 942 83 5196
http://www.saga-ls.jp/?page=173

SESAME Synchrotron-light for Experimental Science and Applications in the Middle East
Email: hhelal@mailer.eun.eg
http://www.sesame.org.jo/index.aspx

SLS Swiss Light Source
Phone: +41 56 310 4666
Fax: +41 56 310 3294
Email: slsuo@psi.ch
http://sls.web.psi.ch/view.php/about/index.html

SOLEIL
Phone: +33 1 6935 9652
Fax: +33 1 6935 9456
Email: frederique.fraissard@synchrotron-soleil.fr
http://www.synchrotron-soleil.fr/portal/page/portal/Accueil

SPL - Siam Photon Laboratory
Phone: +66 44 21 7040
Fax: +66 44 21 7047 / +66 44 21 7040 ext 211
http://www.slri.or.th/new_eng/

SPring-8
Phone: +81 (0) 791 58 0961
Fax: +81 (0) 791 58 0965
Email: sp8jasri@spring8.or.jp
http://www.spring8.or.jp/en/

SRC - Synchrotron Radiation Center
Phone: +1 (608) 877 2000
Fax: +1 (608) 877 2001
http://www.src.wisc.edu/

SSLS - Singapore Synchrotron Light Source - Helios II
Phone: (65) 6874 6568
Fax: (65) 6773 6734
http://ssls.nus.edu.sg/index.html

SSRC
Siberian Synchrotron Research Centre - VEPP3/VEPP4
Phone: +7(3832)39 44 98
Fax: +7(3832)34 21 63
Email: G.N.Kulipanov@inp.nsk.su
http://ssrc.inp.nsk.su/english/load.pl?right=general.html

SSRF - Shanghai Synchrotron Radiation Facility
http://ssrf.sinap.ac.cn/english/

SSRL - Stanford Synchrotron Radiation Laboratory
Phone: +1 650 926 3191
Fax: +1 650 926 3600
Email: knotts@ssrl.slac.stanford.edu
http://www.ssrl.slac.stanford.edu/users/user_admin/ura_staff_new.html

SuperSOR - Synchrotron Radiation Facility
Phone: +81 (0471) 36 3405
Fax: +81(0471) 34 6041
Email: kakizaki@issp.u-tokyo.ac.jp
http://www.issp.u-tokyo.ac.jp/labs/sor/project/MENU.html

SURF
Synchrotron Ultraviolet Radiation Facility
Phone: +1 (301) 975 4200
http://physics.nist.gov/MajResFac/SURF/SURF/index.html

TNK - F.V. Lukin Institute
Phone: +7(095) 531 1306 / +7(095) 531 1603
Fax: +7(095) 531 4656
Email: admin@niifp.ru
http://www.niifp.ru/index_e.html

TSRF
Tohoku Synchrotron Radiation Facility
Laboratory of Nuclear Sciente
Phone: +81 (022) 743 3400
Fax: +81 (022) 743 3401
Email: koho@LNS.tohoku.ac.jp
http://www.lns.tohoku.ac.jp/index.php

UVSOR
Ultraviolet Synchrotron Orbital Radiation Facility
Phone: +81 564 55 7418 (Receptionist's office)
Fax: +81 564 54 2254
Email: webmaster@ims.ac.jp
http://www.uvsor.ims.ac.jp/defaultE.html

VU FEL
W.M. Keck Vanderbilt Free-electron Laser Center
Email: b.gabella@vanderbilt.edu
http://www.vanderbilt.edu/fel/

Consiglio Nazionale delle Ricerche

www.cnr.it/neutronielucedisincrotrone