



# International NR Newsletter

No. 6, February 2010

International Society for Neutron Radiology  
(www.isnr.de)

## Editorial

Non-destructive inspections by means of radiography and tomography using neutrons are proclaimed as giving complementary and/or new information on the specimens under investigation, making these methods indispensable for industrial and research applications. Are you familiar with this sentence? At least, I have heard it many times during the last two decades. But what is the actual status? Where is NR one of the key components in new developments? Where is NR thoroughly accepted as standard tool in NDT? Where exist NR facilities operating on funding not provided by government but financed by their customers? Can you answer these questions satisfactorily?

I am aware that these sentences are provokingly. But keeping track the development of the NR community during the last decade and its place within NDT, these questions are obvious - at least to me. Has NR just become a playfield for scientists and engineers, or is the introductory sentence really true? This is the main question showing the future of NR - and of the ISNR itself. It is up to ourself - each individual - where the journey will takes.

Thomas Bücherl  
Secretary ISNR

## News from the Board

During 2008 at the ITMNR-6 in Kobe, Japan, the Board of the ISNR made a decision to add an amendment-III to the current constitution about neutron radiography practitioners who dedicated their whole career to promote and exploit neutron radiography as a non-destructive technique.

## Amendment-III

„The ISNR-Board awards honorary membership to nominated individuals who have made outstanding contributions in the field of Neutron Radiology throughout their career. Nominations from ISNR members will be evaluated by the ISNR-board once every 2 years and the honorary membership award will be presented to the successful nominees at the next WCNR“

## Explanation about the new amendment

It is the purpose of Honorary Membership in the Society to honour individuals who have performed eminent service in the advancement of Neutron Radiography (or related aspects) and the science thereof internationally. Such contributions shall represent substantially a lifetime's work inasmuch as Honorary Membership shall be the supreme accolade of the Society.

## Nomination criteria of honorary members of ISNR

- a) Any person may be elected an Honorary Member by the ISNR-Board on the grounds of exceptional interest in and services towards the furtherance of Neutron Radiology. This membership shall be limited and conferred only upon persons possessing exceptional qualifications and who has rendered outstanding service to the Neutron Radiography Community and related sciences, on the basis of distinction in his or her field, and/or service to the Society.
- b) Honorary membership will be awarded only to an individual.
- c) The election of an Honorary Member by the ISNR-Board is made only on the strength of a substantiated written suggestion by any member of the ISNR-society to the current elected secretary of the ISNR-Board.

- d) „Honorary members“ will be a normal discussion point on the agenda of the regular ISNR-board meetings. The nominations will be discussed and voted for, to be implemented immediately and to be presented formally at the forthcoming WCNR.
- e) Honorary Members must be elected unanimously by the ISNR-Board.

#### Function of Honorary members of ISNR

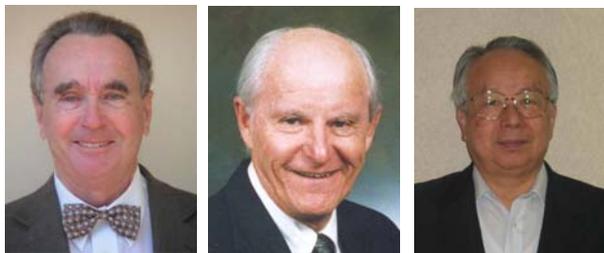
- a) Honorary members shall be entitled to all of the benefits of the Society except to the right to vote or to hold office.

#### Awards to Honorary elected members of ISNR

- a) The award to be presented to the elected honorary member(s) at the Gala dinner of the forthcoming WCNR by the current President of the ISNR.
- b) Recognition of Honorary elected members on ISNR-website by a short biography and a photo

### New Honorable Members of ISNR

The Board of the ISNR received 3 proposals for honorable membership and at the Kobe meeting the Board unanimously decided to present Honorable membership to Dr. John Barton, Mr. Harold Berger and Prof. Hisao Kobayashi.



from left to right: Dr. John Barton, Mr. Harold Berger and Prof. Hisao Kobayashi.

### Upcoming Events



#### Preparations for WCNR-9 in South Africa from 3 – 8 October 2010 underway

An exiting week in the African Bush is awaiting delegates to the 9<sup>th</sup> World Conference on Neutron Radiography from 3 – 8 October 2010, to be hosted at Kwa-Maritane, a 5 star bush lodge in the Pilansberg, 150 km north of Johannesburg.

Peer reviewed papers from the conference to be collected into Proceedings of the conference and will be published in a special edition of NIM-A. The NIM-A review process will be followed and the first papers from the conference could be available on the WEB as soon as end of March 2011. Each delegate will receive a hard copy of the Proceedings by July 2011.

#### Important dates:

- Opening of Website Registration:  
1 February 2010
- Deadline for Abstract Submission:  
31 May 2010
- Notification of Acceptance:  
30 June 2010
- Deadline for Early Registration:  
31 July 2010
- Deadline for Submission of Full Paper:  
30 Sept 2010

Newcomers to the field of neutron radiography are exposed to high technology systems with limited time within the WCNR-conference program to familiarize themselves with the basic scientific principles of radiation imaging. The Local Organising Committee (LOC) of the 9<sup>th</sup> WCNR has therefore decided to organize a 2-day School prior to WCNR-9 to educate newco-

mers, with minimal or no experience, in the basic principles of imaging with radiation. The aim of this School is to expose South African and visiting young scientists, lecturers and post graduate students to the basic principles of radiography, thus allowing improved benefit from attending the conference. At the same time the school provides the necessary training and capacity building to assist with the creation of an expert knowledge base for the South African R&D community that can act as a platform to promote the use of radiography in Africa in general. Various international experts in selected fields, who will participate in the WCNR-9 conference, will be approached as lecturers for this purpose. The intended venue for the School is at iThembaLABS (Gauteng) situated in Johannesburg, close to WITS and UJ universities and the OR Tambo International airport.

Please visit the web-site  
[www.wcnr-9.co.za](http://www.wcnr-9.co.za)

Detail information for intended participants will be found on the web-site. Please activate the „School for Imaging with Radiation“ link.

I want to, on behalf of the LOC of the WCNR-9, invite you all to join and participate in the WCNR-9 in South Africa in October 2010, just after the World Cup soccer tournament.

Frikkie de Beer  
President ISNR 2006 - 2010  
[Frikkie.debeer@necsa.co.za](mailto:Frikkie.debeer@necsa.co.za)

### First Announcement for the 3<sup>rd</sup> Workshop on Neutron Wavelength Dependent Imaging NEUWAVE-3

We are very pleased to invite you to the NEUWAVE3 Workshop held from **June 6<sup>th</sup> to 9<sup>th</sup>, 2010**, at **Hokkaido University** (<http://www.hokudai.ac.jp/>) in Sapporo, Japan. As on the previous conferences, we are planning to have initial discussions during a walking tour on 6<sup>th</sup>, and presentations and general discussions from 7-9<sup>th</sup> June. Afterwards, a tour to J-PARC will be offered for those who are interested.

### Call for hosts for WCNR-11 and ITMNR-7

If you are interested in hosting one of the next meetings please send a written request to the ISNR secretary  
[thomas.buecherl@radiochemie.de](mailto:thomas.buecherl@radiochemie.de)

The aim of the workshop is to provide a platform to discuss the latest scientific, technological, and instrumental advances in energy-selective neutron imaging. The meeting follows the successful first NEUWAVE workshop held at FRM-II TU München in Garching in April 2008 and the 2<sup>nd</sup> workshop held in Abingdon in the UK in July 2009. The speciality of this workshop series is extended time for discussions for each contribution, so not every participant may give his own talk, but is encouraged to contribute to the discussions. (Please advise your travel departments accordingly, should they demand an oral contribution for your travel permission) Participants from the same institute are requested to give joint talks if on the same or similar subjects, in order to leave more time for discussion.

Energy selective neutron imaging is now being developed by many groups in the world since this method significantly extends the capability of neutron imaging. There is an increasing need for discussing instrumental developments, experimental facilities, simulation and analysis methods and so on. The NEUWAVE forum is very important for the progress of wavelength dependent imaging.

We would like to ask you to keep your schedule free for NEUWAVE-3 held at Hokkaido University, Sapporo, Japan, and also would like you to distribute this announcement to participants and colleagues who might be interested in the workshop. Detailed information will be sent in the near future and a web site will be also opened.

Y. Kiyanagi  
Local Organizer for NEUWAVE3  
E-mail: [kiyanagi@qe.eng.hokudai.ac.jp](mailto:kiyanagi@qe.eng.hokudai.ac.jp)

## News from the Labs

### Instrumentation Upgrade Program at Helmholtz Zentrum Berlin (HZB)

An Instrumentation Upgrade Program is started at the Berlin Research Reactor BER-II at HZB. In the frame of this program the cold source will be replaced with a new one providing 50 % more flux as well as the old neutron guides with 58Ni coating will be replaced by supermirror guides. The instruments in the neutron guide hall will be optimized for the higher neutron flux and the new guides where additional upgrade will be performed in order to improve their performance. The instruments involved in this program are the three-axis spectrometer FLEX, the time-of-flight spectrometer NEAT, the neutron tomography station CONRAD, the single crystal diffractometer V1, the time-of-flight reflectometer BioRef, the autoradiography station B8 and the polarized neutron tomography instrument PONTO.

The simulation stage is completed and the final design of the neutron guide system and the instruments is now prepared.

The upgraded imaging station CONRAD will be moved to another position which means that the instrument will be redesigned. It will be placed at the end of neutron guide with curved section (length of 22 m) with supermirror coating of  $m=3$  which is followed by straight section (length of 4 m) with supermirror coating of  $m=2$ . The length of the facility will be enlarged from 5 m to 12 m which will allow for larger beam size of up to 30 cm x 30 cm. The use of supermirror coating of the neutron supplying guide system will reflect in increase of the neutron flux by factor of 2. At the new position the space limitation due to the neighbor guides is relaxed due to the smaller radius of the curved section which provides much more space at the sample position. The upgraded instrument will have a second beam line where the beam will be deflected by a solid state bender placed at the end of the guide. This way the conduction of time consuming experiments will not block the main beam line of CONRAD. With the upgrade of the CONRAD instru-

ment at HZB we hope to satisfy the high requirements of our users and to strengthen the neutron imaging community with one high-class instrument.

Kardjilov, Nikolay  
kardjilov@helmholtz-berlin.de

### KAERI HANARO Neutron Image Facility: Korea

Head: Cheul Muu Sim  
Phone: +82 42 868 8612  
No. of employees: 3 x scientist  
Post graduate students full time: 2 x M.Sc  
Affiliation Company: Radpharm, 2 x staff

HANARO Neutron Image Facility was installed to test the defects in nuclear fuel rod and general specimen by using an imaging technique known as neutron radiography in 1996. This facility was primarily designed for these applications and has almost the highest beam quality in the world with beam size of 35 cm x 50 cm, beam intensity of  $10^7$  n/cm<sup>2</sup>s and thermal neutron energy of 14 meV. In addition, it has been upgraded for image processing system with high speed camera/image intensifier and tomography which has fully automatic sample changers using high-resolution with a spatial resolution of 0.070 mm since 2004.

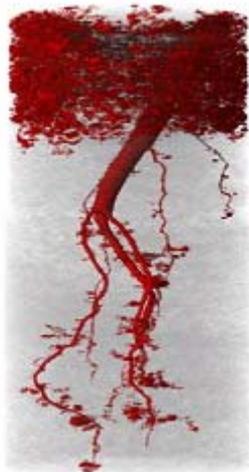
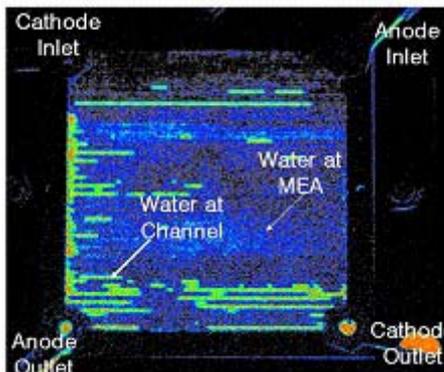


*HANARO Thermal Neutron Image Tomography and Hydrogen Fuel cell station (2010)*

The HANARO NRF facility is qualified in accordance with ISO 17025 which comprises ASNT Level 1, 2 and 3 certified neutron radiographers for inspecting aircraft component. Hydrogen facility has been installed for fuel cell neutron image for evaluating its performance in collaborating with automobile company.

Our primary service is the neutron-radiographic inspection of manufacture parts used within industrial applications. We inspect both new components and those requiring in-service inspection. Our most common application has been the inspection of air-cooled turbine blades. We have experience with examinations of objects ranging from dinosaur embryo to high-reliability explosives, nuclear fuels and Ginseng root in soil. Cold neutron image facility will be opened in 2013.

Cheul Muu Sim  
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Visualization on water hydrogen fuel cell (upper) and ginseng root in soil (lower)

**Paul Scherrer Institut (PSI) is preparing its third beam line for imaging purpose**

After the successful installation of the NEUTRA facility at the thermal neutron beam line 32 of the spallation neutron source SINQ at PSI just after the inauguration in 1997 a second facility

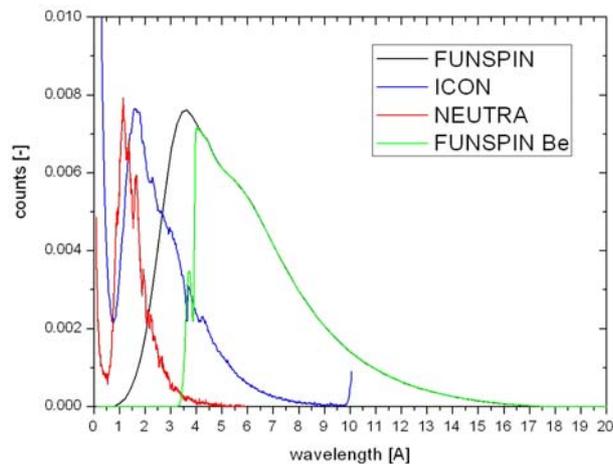


Spallation neutron source SINQ at PSI

for cold neutrons (ICON) has been initiated and build until 2006. Both neutron imaging facilities are highly overbooked now by scientific and industrial customers. They enable a wide range of different techniques covering radiography, tomography (including a micro-option), time dependent studies, phase contrast imaging, energy selective imaging and referencing with X-rays.

Recently, a project was started to convert a beam line with very cold neutrons which has been used for fundamental neutron physics experiments towards a test facility for neutron optics, neutron imaging and pre-studies for advanced diffraction experiments. The neutron imaging contribution will be in the first stage a CCD camera based detector, a flight tube and a setup with a turbine energy selector.

The challenge of the new device at beam line 51 is its much softer neutron spectrum compared to ICON, the high beam intensity and a high polarization state of the beam. These parameters will enable the extension of the user program in neutron imaging towards improved



Neutron spectra available at the different beam lines for imaging purposes

micro-tomography, energy-selective imaging at the Bragg edges of structural materials and imaging with polarized neutrons.

In 2010, we started the conversion work of the beam line (now named BOA - due to its high flexibility) with the aim to have first data after the shutdown in May. The further upgrade and the installation of the needed components will be done step by step, depending on the availability of the needed funding. The facility will be used mainly for internal research purposes until the conditions will be stabilized to enable the invitation of external users.

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eberhard.lehmann@psi.ch

## Review of Past Events



### A Summary of the ITMNR-6

The Sixth International Topical Meeting on Neutron Radiography (ITMNR-6) was held at Kobe University Centennial Hall in Kobe city on September 14-18, 2008 in a series of the Internatio-

nal Topical Meeting on Neutron Radiography. The first meeting of the ITMNR was held in Pembroke (Canada) 1990, and then, held in Shonan (Japan) 1995, Lucerne (Switzerland) 1998, State College, Pennsylvania (USA) 2001, and Garching, Munich (Germany) 2004. Each meeting of the ITMNR had topics. The focus of ITMNR-6 in Kobe was on „Imaging Technique of Continuous and Pulse Source and Industrial Applications“.

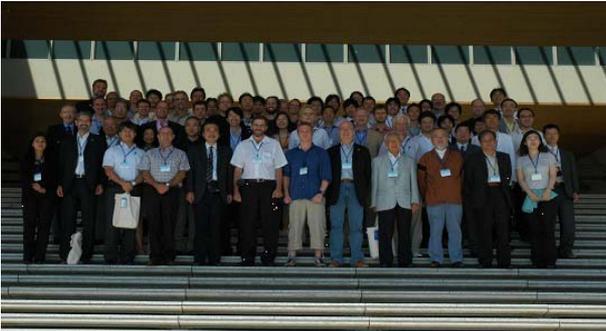
Mountains are closed to seashore in Kobe area. Buildings of Kobe University stand on hills with a view of the sea. The Centennial Hall stands on the hill about 100 meters above sea level and we can get a fine view of Osaka bay. The top image of the meeting home page shown above is the night view from the meeting hall.

The meeting was attended by 99 participants from 14 countries. Numbers of the participants from each country are shown in the table.

The scientific program was divided into the technique and the application of the neutron radiography and 46 presentations for oral and 42 for poster were accepted. They were

Australia	1
Austria	1
Canada	1
China	2
Germany	10
Hungary	1
Italy	2
Japan	61
Korea	5
Russia	1
South Africa	1
Switzerland	4
United Kingdom	1
United States	8
Total	99

Number of participants per country at ITMNR-6



*Participants at ITMNR-6*

subdivided into ten oral sessions and two poster sessions with a short oral presentation.

New development of imaging techniques, facilities, systems and devices were presented and many applications were introduced. The spatial resolution of the neutron imaging was discussed in a special session since high spatial resolution by the neutron radiography has been required for the industrial applications. An oral presentation titled „Latest trends in the Analysis of Fuel Cells for FCV“ by Dr. K. Shinohara in Nissan Motor Co., Ltd., was invited.

The registration and the reception started in the afternoon on Sep. 14 at Takikawa Hall near the Centennial Hall. Lunches during the meeting were served in a restaurant closed to the meeting hall. An excursion to Kyoto University Research Reactor Institute and a banquet were held in the afternoon on Sep. 16. Participants to the excursion were invited to a Japanese tea ceremony in a traditional Japanese house near KURRI. The banquet was a cruising dinner with a fine night view in Osaka bay. Short tours to Kyoto city and Japan Atomic Energy Agency in Tokai were planned as the post conference tour on Sep. 19.

The review of the submitted full papers had started before the meeting and the refereeing procedures were completed after the meeting for the detail reviewing of the papers and for the early publication of the proceeding.

A total of 54 papers presented in the meeting were accepted in this proceeding as the Special Issue of the Nuclear Instruments and Methods in Physics Research, Section A 605.

The special issue was arranged in following 5 sessions:

1. New imaging
2. Facility and system
3. Device and technique
4. Spatial resolution
5. Application.

The chairman would like to thank all researchers, engineers and students who contributed to the meeting as well as the members of the organizing committee and the international advisory committee for their efforts to make the meeting and the publication successful. He also thank to Graduate School of Engineering in Kobe University, Commemorative Organization for the Japan World Exposition ,70, Kansai Research Foundation for Technology Promotion and Kobe Convention & Visitors Association Meet in Kobe 21st Century for their financial supports.

Nobuyuki Takenaka  
Chairman of ITMNR-6



*Participants at NEUWAVE-2 in front of Cosener's House*

## **NEUWAVE-2**

### **Experts in neutron imaging met for the second time to discuss the energy selective option**

After the successful event NEUWAVE-1 in 2008 the neutron imaging community decided to

continue its considerations about neutron imaging using the energy selective mode by another such meeting in 2009. This topic has raised high relevance for future progress of neutron imaging as research tool but also in respect to initiatives to build dedicated imaging beam lines at the new pulsed spallation neutron sources.

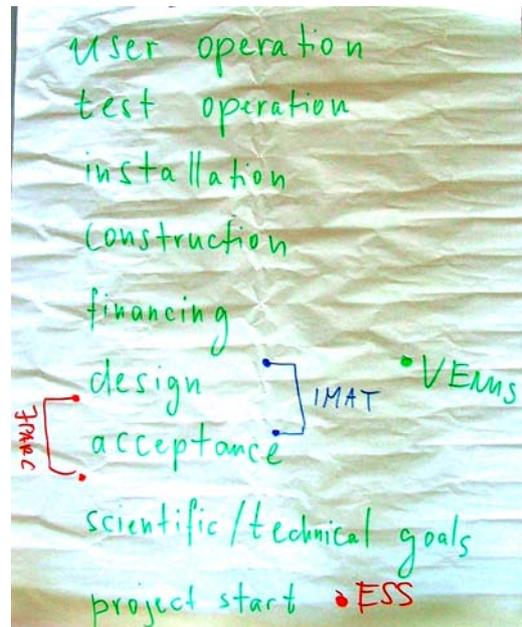
This year, the ISIS colleagues took over the responsibility to organize the workshop for 3 (plus 1) days in Abingdon using the guesthouse „Cosener's House“ facilities. The Sunday in advance to the real lectures was used as „get together“ by a work along Thames towards Oxford with a lunch break in the middle to dry shoes and clothing.

It was in particular Winfried Kockelmann, who prepared an exiting program from the submitted contributions which delivered enough space for discussion and exchange of knowledge. Main lectures were done in 40 minutes time slots, other contributions had the limit of 15 minutes only.

It was not surprising that at least three main questions were in the focus of the workshop:

1. Will energy selective neutron imaging be able to visualize strain components in macroscopic sample. This approach would excellently complement the diffractive approach in the strain analysis.
2. How to build the most useful neutron imaging beam line at a pulsed neutron source. Compared to the diffraction devices, there is only limited practical knowledge about the image option at pulsed sources.
3. What will be the most suitable neutron imaging detector at the pulsed sources to enable both high spatial and high temporal (=energy) resolution.

According to the character of a workshop, no final answers were given to all these questions, but promising approaches and statements were presented. Although one clear answer to question 1) by Anna Paradowska (ISIS, ENGINE-X) was „YES, WE CAN!“, this statement has to be



"Working paper"

cross-checked and verified by further dedicated measurements. The existing data for steel welds and rolled Al plates gave already very nice and promising indications that „something special occurs“ near the Bragg edges. Obviously, not such high resolution in energy is needed to enhance this structural information as it is needed in the direct strain determination.

In the afternoon of the second day an intensive discussion was held, mainly about the core topics mentioned above. It gave clearly the conclusion to continue the effort in all three directions and to meet again in 2010 despite the „World Conference on Neutron Radiography“ will be held in South Africa in October 2010 (see: <http://www.wcncr-9.co.za/>). The meeting place is not yet fixed: either NEUWAVE-3 will be held in Japan or the meeting comes back to its initial place, Garching near Munich.

The third day was used for a visit to the ISIS facilities in the Rutherford Labs, in particular to have a look onto the target station 2 (TS-2) which will host the IMAT beam line in near future. This project is the most advanced one for the moment in respect to an imaging option at a pulsed source. The most challenging aspect is the synergy between the diffractive and transmissive investigations of material samples.

All 45 participants from the 11 countries agreed with a memorandum to be sent to the leaders of the four new sources (SNS, JPARC, ISIS, and ESS) which underlines the importance of neutron imaging at these facilities.

W. Kockelmann  
E. H. Lehmann  
B. Schillinger

### **Memorandum of the NEUWAVE-2 Workshop**

During July 12<sup>th</sup> to 15<sup>th</sup> 2009, the NEUWAVE-2 workshop on „Energy resolved neutron imaging“ - with 45 participants from 11 countries - was hosted by the ISIS neutron facility, and held at the Coseners House in Abingdon, Oxfordshire, England. It was the second such workshop; NEUWAVE-1 was organised successfully in Garching, Munich, Germany in 2008.

The special aim of the meeting was survey the present status, future potential and further options of neutron imaging techniques at pulsed sources. Due to the high degree of innovation in the field of neutron imaging in the last few years, the workshop provided a platform to hear and discuss about new experimental techniques, new installations, and new applications in the laboratories and institutes involved.

It was underlined by the participants that the emerging intense pulsed spallation sources would bring new and exciting options to the field of neutron imaging. The time-of-flight technique on a pulsed source will enable high spectral resolution that is to be fully exploited. Furthermore, there was considerable potential identified by the workshop participants for the study of complex engineering components, and for instance, repetitive processes, like engines, enabling and hinting to a strong industrial use of neutron imaging capabilities.

Present knowledge in the field of neutron imaging, and data from preliminary energy selective studies of relevant engineering materials clearly indicate a high potential for materials science and engineering science,

which might justify dedicated installations at the new pulsed sources. For example, it has been demonstrated in pilot experiments that textures and strains of materials can be visualised and studied with unprecedented spatial resolution by exploiting the Bragg edges in the cross sections of materials. This novel approach of structure mapping by neutron imaging is only one example of how the gap between imaging and scattering communities can be bridged.

We would wish that the science managers at the new spallation sources include neutron imaging and its new capabilities in their planning considerations of beam lines. Anyway, the current support of neutron imaging instrumentation projects and pilot studies by the pulsed sources is very much appreciated.

The participants of NEUWAVE-2 strongly support the activities at the new sources, especially with respect to energy-selective neutron imaging, and will endeavour to offer their expertise and knowledge in the best possible way. Some of the outcomes of NEUWAVE-2 can be made directly available and used for discussion and planning.

We hope for a bright future for neutron imaging, last but not least at the new intense pulsed spallation sources.

The participants of the NEUWAVE-2 Workshop  
Abingdon, England, July 15<sup>th</sup> 2009

## Dates

### NEUWAVE-3

5 - 8 June 2010, Sapporo, Japan

### WCNR-9

3 – 8 October 2010, South Africa

### 2010 IEEE Nuclear Science Symposium and Medical Imaging Conference

30 October - 6 November 2010, Knoxville, USA

### International Symposium on Nondestructive Testing of Materials and Structures

May 15-18, 2011, Istanbul, Turkey

### 18th World Conference for Non-Destructive Testing

April 16 - 20, 2012, Durban, South Africa

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