



# International NR Newsletter

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International Society for Neutron Radiology

([www.isnr.de](http://www.isnr.de))



Participants of the WCNR-10

## Content

Editorial .....	2	The status of neutron imaging activities – in a PSI-internal and international context .....	12
Some words from the other side of the planet .....	3	Actual status of standardization .....	14
Election of the new board of members at WCNR-10 .....	4	Summary of NEUWAVE-6 .....	15
Results of the elections .....	4	ITMNR-8 (Announcement) .....	15
Current officers and board members .....	5	WCNR-11 - A first advertisement .....	17
A summary of WCNR-10 .....	8	News from the Board .....	17
Marton Balasko became honorary member of the ISNR .....	10	Taskgroups.....	17
		Deputy of president announced .....	22
		New publications .....	23
		Upcoming Conferences .....	24

## Editorial

The 10<sup>th</sup> World Conference on Neutron Radiography (WCNR-10), held at Grindelwald, Switzerland, was last year's main ISNR event. Many participants, great organization, interesting (mainly high level) presentations, wonderful surrounding and lovely weather made the conference an outstanding event. "A summary of WCNR-10" on page 8 gives an impression on what you may have missed, or, when participating, a reminiscence about this wonderful week. During the conference Marton Balasko was celebrated as new honorary member for his pioneering work in the application of neutron radiography techniques for engineering and industry related projects (see page 10).

At WCNR-10 statutory elections of the board members, the president, the vice-president and the secretary of the ISNR were held. The results are presented on page 4. With Ulf Garbe from ANSTO being elected as new ISNR President, we can look forward to another interesting and exciting event in 2018 in "down under".

In the run-up to the elections some discordance came up, mainly caused by different interpretations of the ISNR regulations. This was the origin for the installation of task groups by the newly elected board, each conducted by a board member and supported by appropriate volunteers. In addition to the constitutional revision work will be performed on several other topics. In the "News from the Board" (page 17) the actually established task groups and their work programs are briefly summarized.

As indicated by the increasing number of members of ISNR (256 on February 17, 2015), the application of neutron radiography and imaging methods for the investigation and / or characterization of objects gains increasing interest. This becomes apparent on many neutron radiography (NR) and imaging (NI) facilities worldwide, although in some countries outstanding facilities will be shut-down. An survey of NI facilities is presented by the article "The status of neutron imaging activities – in a PSI-internal and international context" on page 12.

A solid comparison of the performances of different NI facilities requires standardized approaches, not to compare apples and oranges. In the framework of an IAEA initiative a group around some INSR members teamed up for the purpose of pursuing standardization. Particularly, the enhancements in the field of neutron imaging (e.g. electronic detections systems, new measurement procedures etc.), not considered by existing standards so far, will be in the focus of this group. A brief summary of the actual situation is presented in "Actual status of standardization" on page 14.

Sincere thanks are given to all volunteers of ISNR for their engagement. Without their support and help ISNR and exemplarily this newsletter won't be possible. I hope that in the near future more members contribute actively to our community, e.g. by joining the task groups, sending in information on recent publications in our field of application and research, as well as provide us with short contributions on actual results and research projects to be published on the ISNR webpage and in one of the next newsletters.



## Some words from the other side of the planet

I would like to welcome all new members of the ISNR and I would like to thank all existing members for their enthusiasm and contributions to neutron radiology. With still fresh impression from the last WCNR-10 in Grindelwald (Switzerland) I would like to thank Eberhard Lehmann and his team for their great effort organizing a fantastic conference in a very impressive environment and welcoming atmosphere. 170 participants from 29 countries is a great demonstration that neutron radiography is an important factor at neutron research facilities (reactors and spallation sources) at eye level with neutron diffraction and neutron spectroscopy. The community was growing significantly in the past and I want to ensure that this growth will proceed over the next four years. In Grindelwald we saw promising new method development in several fields like wavelength dependent neutron imaging and neutron microscopy as an example and we saw a strong presenting end-user community as well.

I would like to focus on the end-user community and try to build a bridge for new users to get in contact with the neutron imaging experts. Next to the already established fields of neutron imaging in non-destructive testing, mining industry, archaeology, to name a few, I want to encourage everyone to explore new fields of application potentially in agricultural research and / or recycling. In addition the cultural heritage sector is already strong but still developing and has experienced strong support from the IAEA through the CRP "Neutron Imaging in Cultural Heritage".



*Ulf Garbe, giving a presentation at WCNR-10*

The ISNR and especially the ISNR homepage is an important tool to generate attention and can offer potential new users a first guide into neutron imaging. We as the existing a community should work on filling the gaps on the home-page. Starting the new task groups

- Terminology
- Characterization and standardization
- Contact to other organizations
- Constitutions
- Promoting young scientists and technicians
- Newsletter
- ISNR website
- Publications
- Small or low cost systems
- Computational imaging

already does a first step in the right direction. By the emails previously being sent around in these task groups we could see highly motivated participants. Thanks to all involved.

To increase visibility and promote neutron imaging to a broader scientific and industrial community I would like to add the section of scientific highlights to the ISNR website. Everyone is encouraged to submit his or her achievements to our secretary, who takes care of our website (thomas.buecherl@tum.de). The best research will be promoted through the ISNR as research highlight.


I am looking forward to organize the next world conference in Sydney. *Ulf Garbe*

*ISNR-President*

## Election of the new board of members at WCNR-10


### Results of the elections

As stated by the constitution of the ISNR (see <http://www.isnr.de/index.php/about-isnr/constitution>) the election of the president, the vice-president, the secretary and the board of members should take place on the last day of the conference. For organizational reasons the board of members decided in its meeting prior to WCNR to have it one day earlier. This was announced to the participants of WCNR during the opening ceremony. From Monday to Wednesday evening candidates could be nominated by writing their name on one of the lists published at different places of the conference venue. Based on these nominees two ballots were created and distributed among the participants being present on Thursday morning's session, one for the election of the three officers, one for the ten board members. At the end of the session, the ballots were collected and counted by Renate Bercher (secretary of WCNR-10) and Thomas Bücherl (secretary of ISNR). The results were announced on the last day of the conference.



**Ballot for general election at WCNR-10**  
Wednesday, October 8, 2014, 10:30 - 11:00

<b>1. President (1 vote)</b> <input type="checkbox"/> Ulf Garbe (Australia) <input type="checkbox"/> Hassina Bihoué (USA) <input type="checkbox"/> .....
<b>2. Vice-President (1 vote)</b> <input type="checkbox"/> Michael Larche (USA) <input type="checkbox"/> Markus Strobl (Sweden) <input type="checkbox"/> Hassina Bihoué (USA) <input type="checkbox"/> .....
<b>3. Secretary (1 vote)</b> <input type="checkbox"/> Thomas Bücherl (Germany) <input type="checkbox"/> .....



**Ballot for general election at WCNR-10**  
Wednesday, October 8, 2014, 10:30 - 11:00

<b>Board-Members (10 votes)</b> <input type="checkbox"/> Acl. M. (USA) <input type="checkbox"/> Bennett, Les (Canada) <input type="checkbox"/> Bihoué, Hassina (USA) <input type="checkbox"/> Chen, Dongfeng (China) <input type="checkbox"/> de Beer, Frikkie (South Africa) <input type="checkbox"/> Garbe, Ulf (Australia) <input type="checkbox"/> Grünzweig, Christian (Switzerland) <input type="checkbox"/> Hussey, Daniel (USA) <input type="checkbox"/> Kaestner, Anders (Switzerland) <input type="checkbox"/> Kardjilov, Nikolay (Germany) <input type="checkbox"/> Kockelmann, Winfried (United Kingdom) <input type="checkbox"/> Kosterko, Denis (Russia) <input type="checkbox"/> Larche, Michael (USA) <input type="checkbox"/> Saito, Yasushi (Japan) <input type="checkbox"/> Schillinger, Burkhard (Germany) <input type="checkbox"/> Schulz, Michael (Germany) <input type="checkbox"/> Shinohara, Takanori (Japan) <input type="checkbox"/> Strobl, Markus (Sweden) <input type="checkbox"/> Triß, Pavel (Switzerland) <input type="checkbox"/> ..... <input type="checkbox"/> .....
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Elected as new president of ISNR was **Ulf Garbe** (ANSTO, Australia) herewith taking over the duty to organize the next World Conference on Neutron Radiography (WCNR-11). Vice-President became **Markus Strobl** (ESS, Sweden) and re-elected as secretary was **Thomas Bücherl** (TUM, Germany).

In the election of board members some additional constraints had to be taken into account. First, Ulf Garbe and Markus Strobl, both nominated and elected for board members, were withdrawn, as they already were elected for president and vice-president, respectively. A hardship case was Burkhard Schillinger. Although elected as board member, he had to be canceled from the list of new board members as only one German representative was allowed according to the number of papers presented at WCNR-10, and Nikolay Kardjilov, Germany, had received more votes.

The final list of the new board members in alphabetical order is:

- **M. Arif** (USA)
- **Frikkie de Beer** (South Africa)
- **Les G.I. Bennett** (Canada)
- **Dongfeng Chen** (China)
- **Christian Grünzweig** (Switzerland)
- **Daniel S. Hussey** (USA)
- **Anders Kaestner** (Switzerland)
- **Nikolay Kardjilov** (Germany)
- **Winfried Kockelmann** (UK)
- **Yasushi Saito** (Japan)

As former president **Eberhard Lehmann** became automatically board member. The three officers and the board members are acting until the next WCNR, most probably taking place in 2018.

Next you will find short curriculum vitae (CV) of your elected representatives.



*The former (Eberhard Lehmann, right) and the new (Ulf Garbe, left) ISNR president enjoying the relaxed atmosphere at WCNR-10.*

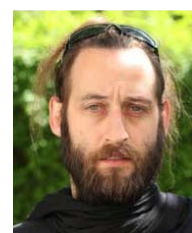
## Current officers and board members

**Ulf Garbe** was the project leader to design and build the new radiography / tomography / imaging station DINGO at the Bragg Institute, ANSTO and is now operating DINGO in a team of four instrument scientist. Prior to this appointment he was working as an instrument scientist on the neutron strain scanner Stress-Spec at FRM-2, Germany (2005-2008) and as a postdoc at ANSTO (2008-2009). He has a PhD in the application of high energy synchrotron radiation techniques to measurements of texture development in two-phase streams HASYLAB (DESY) and University of Goettingen (2005). His main research activities involve the application of neutron imaging to a broad community like physics, chemistry, medical research, engineering and materials science, geoscience, food science, archeology and cultural heritage. Additionally he has a strong interest in texture and residual-stress analysis using neutron and synchrotron X-ray diffraction with the goal of relating them to manufacturing procedures and integrity requirements for various types of engineering and geological components.



*Ulf Garbe*  
*President*

**Markus Strobl** received his diploma and Ph.D. degree in physics from the Technische Universität Wien in 1998 and 2003, respectively. In his Ph.D. work he studied novel neutron imaging contrast methods with neutrons including monochromatic imaging, differential phase and dark-field contrast imaging. From 1999 till 2011 he worked as instrument scientist for the Hahn-Meitner Institute Berlin, the University of Applied Sciences Berlin, the University of Heidelberg and the Helmholtz Zentrum Berlin operating, designing and building several neutron scattering and imaging instruments at the BER 2 reactor. Amongst other he designed the new V12 USANS diffractometers as well as the time-of-flight reflectometer BioRef and made significant contributions to the cold neutron imaging instrument CONRAD. Since 2011 M. Strobl is working for the European Spallation Source (ESS) in Lund Sweden, as instrument scientist for Imaging and Engineering Diffraction and Deputy Head of the Instrument Division. Since May 2014 he is additionally affiliated to the Niels Bohr Institute of Copenhagen University as a Prof. for X-ray and Neutron Imaging Techniques and since Oct 2014 he is Vice President of the International Society for Neutron Radiology (ISNR).



*Markus Strobl*  
*Vice-President*

**Thomas Bücherl** received his diploma and the Ph.D. degree in physics from the Technische Universität München in 1988 and 1993, respectively. In his Ph.D. work he studied neutron tomography using thermal neutrons. Since 1993 he is scientific research assistant with the Institute for Radiochemistry of TUM, which became Central Technical-Scientific Unit "Radiochemie München" (RCM) in 2011. He was coordinator and partner in several EC-, federal- and country-projects in the field of non-destructive characterization of radioactive waste packages. He designed, set up and operates the radiography and tomography facility NECTAR at the Forschungs-Neutronenquelle Heinz Meier-Leibniz FRM II at the Technische Universität München. Dr. Bücherl organized ITMNR-5 and is personal member of the German Society for Non-Destructive Testing (DGZfP) and since 2002 secretary of the International Society for Neutron Radiology (ISNR).



*Thomas Bücherl*  
*Secretary*

**Muhammad Arif** received a Ph.D. degree in Neutron Physics from University of Missouri-Columbia in 1986. His research was in the field of Neutron Interferometry and Optics involving measurements to test postulates of quantum mechanics and theoretical studies of dynamical diffraction with neutrons. After graduation he joined the National Institute of Standards and Technology (NIST) as a US National Research Council post-doctoral fellow. He became a permanent staff Physicist soon after and became the leader of the Neutron Physics program at NIST in 2003. He is one of the principal architects in the design and construction of the NIST neutron interferometer and neutron imaging facilities. His current principal research interests include measurement of the neutron MDM/EDM, Quantum Information Processing (QIP) studies with neutron interferometry, and neutron imaging. M. Arif served as the Research Advisory Committee chair to the NIST director and as a member and chair in various committees for US and foreign scientific institu-



*Muhammad Arif*

tions including Los Alamos National Laboratory, Oak Ridge National Laboratory, Argonne National Laboratory, NASA, National Science Foundation (NSF), and the European Spallation Source (ESS). He also advises Ph.D. students from various academic institutions including MIT, Tulane, Harvard, and Indiana University and is the principal investigator for a number of research agreements between NIST and various US federal agencies and industries, including US Department of Energy and General Motors. M. Arif was awarded US Department of Commerce Bronze and Gold medals, Arthur S. Flemming award, R&D 100 award, and the Washington Academy of Sciences Physical Sciences award for exceptional federal service and scientific research. He is a member of Sigma Xi and is a fellow of the American Physical Society (APS), a fellow of the Washington Academy of Sciences, and in 2014 he became a fellow at NIST.



*Frikkie de Beer*

**Frikkie de Beer** received his BSc (Ed) degree in maths and physics education from the Rand Afrikaans University in Johannesburg in 1981 and since 1988 he worked at the South African Nuclear Energy Corporation (Necsa), near Pretoria. He started as experimental officer and was responsible for the Non-destructive investigations of radioactive fuel pins in the PIE program of the Koeberg nuclear power plant, applying also film neutron radiography. In 1995, as technician in Neutron Radiography, Frikkie obtained the first digital neutron radiograph and in 2003 the first neutron tomogram in the Southern Hemisphere in collaboration with PSI. He became Radiography/tomography section head in 2007 and initiates the installation of the Micro-focus X-ray tomography facility in 2011 and is currently instrumental in the upgrade of the Nrad facility at SAFARI-1 in collaboration with TUM, Germany. He is corporate member of the South African Institute of Non-Destructive testing (SAINT) and member of the ISO-subcommittee 135 (Non-destructive testing) in South Africa. Frikkie was president of the ISNR from 2006-2010 and hosted the WCNR-9 in Kwa-Maritane, South Africa in 2010.



*Les Bennett*

**Les G.I. Bennett** received his B.Eng. in chemical engineering (nuclear option) from Royal Military College in 1970 and his M.A.Sc. and his Ph.D. in nuclear science and nuclear engineering from the University of Toronto in 1972 and 1983, respectively. Since 1972, he was involved in investigating transportable neutron radiography systems using Californium-252 and their applications, mainly for aircraft inspections. With the installation of a small research reactor at RMC in 1985, along with colleagues, he developed a neutron beam tube, the first for this reactor type. The main use was for the investigation of water ingress of an aircraft's flight control surfaces, mainly, the rudder. A non-intrusive and cost-saving procedure was later developed to allow the rudders to return to service. Dr. Bennett is now Professor Emeritus at RMC and organized ITMNR-7 in 2012.



*Dongfeng Chen*

**Dongfeng Chen** is a Senior Professor and the Director of Department of Nuclear Physics, CIAE. He is also the Vice President of China Neutron Scattering Society (CNSS) and the board member of the Asia-Oceania Neutron Scattering Association (AONSA). He is the leader of neutron scattering and neutron imaging project of 60 MW China Advanced Research Reactor (CARR) and the chief scientist of Project "The Key Technology of Neutron Beam on CARR", which is supported by the National Basic Research Program of China. He graduated from Jilin University, China in 1991 specializing in solid state physics. Then he worked in CIAE in the field of neutron scattering for more than 20 years. He received a Master of Science degree from CIAE in 1995 specializing in condensed matter physics, and received PhD degree in 1998 specializing in nuclear physics, and then worked in Argonne National Laboratory, USA as a postdoc fellow in the field of inelastic neutron scattering. In October of 2000, he returned to CIAE as the Director of Neutron Scattering Laboratory of CIAE. Now, he is engaged in the development and application of neutron imaging in China and Asia area. The advanced thermal and cold neutron imaging facilities being built at CARR are expected to be commissioned in 2017 and they will provide more efficient and versatile tools for basic scientific and industrial non-destructive investigation.

**Christian Grünzweig** studied physics at the University in Tübingen where he received his Diploma in 2006. From 2006 to 2009 he conducted his PhD project at ETH Zurich in collaboration with the Paul Scherrer Institut (PSI), where he studied magnetic domain structures using neutron grating interferometry. Since 2009 he is scientist in the neutron imaging and activation group (NIAG) at PSI. His research interests are grating interferometry, dynamic neutron imaging and scintillator development. Additionally he is responsible for the collaboration with industrial customers. Dr. Grünzweig is board member of the International Society for Neutron Radiology (ISNR) and member of the Review Panel Imaging, Analysis, Nuclear and Particle Physics at the Technische Universität München.



*Christian Grünzweig*

**Daniel S. Hussey** is a research scientist at the National Institute of Standards and Technology where his primary research is on neutron optics including neutron imaging of proton exchange membrane fuel cells. Dr. Hussey started at NIST as a National Research Council Postdoctoral Fellow in 2004. Dr. Hussey earned a PhD in physics from Indiana University in Bloomington, IN, in 2003 where he used dense samples of polarized  $^3\text{He}$  in polarized neutron reflectometry studies of magnetic thin films. Dr. Hussey earned his bachelor of science in physics from the University of New Hampshire in 1999. Dr. Hussey has authored or co-authored over 100 peer-reviewed journal articles and book chapters, was awarded the Presidential Early Career Award for Scientist and Engineers in 2010, and was a co-PI on a 5-year NIST Innovations in Measurement Science grant awarded in Fiscal Year 2014 titled "A Neutron Microscope For Energy And Materials Research".



*Daniel Hussey*

**Anders Kaestner** is a scientist at the SINQ neutron spallation source at Paul Scherrer Institut with responsibility for the development and operation of the cold neutron imaging facility, ICON. He has a background in computer systems engineering (specialization in mechatronics) and electrical engineering. He received his PhD in signal processing in 2002 from Chalmers University of Technology (Gothenburg, Sweden), having carried out research on microwave tomography with the application of wood inspection being stationed at Halmstad University, Sweden. During his PostDoc in the Soil Physics Group at ETH, Zurich, he worked with image processing and reconstruction of CT data from large scale facilities (neutrons and synchrotron). After a few years as CT algorithm specialist at Varian Medical Systems he started his current position in 2008 as instrument scientist at ICON. His scientific interests are in the field of computational imaging for neutron imaging aiming at extracting the information available in the data (computed tomography, low-dose imaging, multimodal imaging, etc.) with applications to dynamic processes in porous media and the development of instrument characterization methods.



*Anders Kaestner*

**Nikolay Kardjilov** is a senior scientist at the Helmholtz Center for Materials and Energy Berlin (HZB), Germany. He is responsible for the design and operation of the CONRAD-2 neutron imaging facility at the BER-2 research reactor. He is a physicist and received a PhD from the Technische Universität München in 2003 with a topic related to development of innovative neutron imaging methods. During his PhD he was based at the neutron imaging group at the FRM-I research reactor in Garching near Munich, Germany. From 2003 he is working at the HZB Institute where he was in charge of design and construction of the new imaging facility CONRAD-1 at the BER-2 research reactor. After the instrument commissioning in 2005 he worked actively for establishment of a broad user community. In 2010 he guided the upgrade project of the imaging facility CONRAD-2. His scientific interests include imaging with polarized and monochromatic neutrons, phase-contrast and high-resolution imaging.



*Nikolay Kardjilov*

**Winfried Kockelmann** is a senior scientist at the ISIS neutron spallation source with responsibility for the design and operation of the new IMAT neutron imaging and diffraction facility. He is a physicist and received a PhD from the University of Bonn in 1995 having carried out research on magnetic properties of rare earth intermetallics. During his PhD he was based at the neutron diffraction group of Bonn University at the DIDO neutron source in the Forschungszentrum Jülich. From 1995 he worked at the ISIS facility at the Rutherford Appleton Laboratory in the UK, initially on assignment from Bonn



*Winfried Kockelmann*

University and Forschungszentrum Jülich. As a member of the Crystallography Group at ISIS he supports the materials science programme of ISIS and is actively involved in instrument development and upgrade projects. His scientific interests include crystallographic phase transitions, structural magnetism, and the development of neutron techniques for the analysis of cultural heritage objects.



Eberhard Lehmann

**Eberhard H. Lehmann** studied physics at the University of Leipzig and got the diploma degree for a work about „molecular dynamics calculations of proteins“ in 1974. Later he started a carrier in reactor physics at the nuclear research center Rossendorf (near Dresden) with the focus on the physics of fast breeder reactors. His PhD about “Integral cross-section data of structural materials” was finished in 1983. In 1991 he went to the Paul Scherrer Institut (Switzerland) to operate the 10 MW research reactor “SAPHIR” and to implement new applications using neutrons. With the erection of the spallation neutron source SINQ he got the responsibility to install irradiation facilities and beam lines for neutron imaging purpose. Today, he is leader of the “Neutron Imaging & Activation Group” within the “Laboratory for Neutron Scattering & Imaging”. He was elected as president of the International Society for Neutron Radiology in order to organize the 10th World Conference on Neutron Radiography, which was held successful in October 2014 in Grindelwald, Switzerland.



Yasushi Saito

**Yasushi Saito** is currently working for Research Reactor Institute, Kyoto University, where he is studying mainly multiphase flows in relation to nuclear thermal hydraulics and also development of measurement technique by using neutron radiography. He gained his doctoral degree from the department of chemical engineering at Kyoto University (1996). His main research interests are nuclear thermal hydraulics, refrigeration system and neutron radiography. His recent research is directed to thermal hydraulics of heavy liquid-metal in relation to development of accelerator driven system (ADS) and dynamic neutron radiography at nuclear research reactors.

## A summary of WCNR-10

The tenth World Conference on Neutron Radiography (WCNR-10) took place from 5th to 10th October in Grindelwald, a beautiful site surrounded by the Swiss Alp Mountains. The Paul Scherrer Institut (PSI) was elected as host 4 years ago on WCNR-9 (Kwa-Maritane, South Africa). A team around the current ISNR president Eberhard Lehmann tried the very best to provide optimal conditions for the participants from all parts of the world to discuss latest developments in the field of neutron radiography and imaging.

The resonance from the call for abstracts was already very positive and it was a difficult job to select the very best contributions out of more than 200 for the tight program of the conference. At the end, about 80 talks were given, including presentations by some companies during workshops. The poster session with more than 100 contributions was very well visited.

The four days of talks and discussions (Oct. 6<sup>th</sup> to 9<sup>th</sup>) were structured into a morning session and a night session with a longer break over lunch time. This gave a chance to get familiar with the Swiss mountains and the county side. Alternatively, three mini-workshops were offered to the participants in the afternoon to exchange knowledge and experience on the following topics: neutron imaging detectors, data handling and treatment, link to neutron scattering.





The conference was attended by 170 persons from 29 countries, representing all major centers where neutron imaging activities are running. For the first time, more users than operators of the neutron imaging facilities participated. This clearly indicates how much neutron imaging has been developed from a tool for non-destructive testing towards research techniques with sophisticated new options applicable in many fields.

The progress in neutron radiography and imaging was documented during the conference by the description of 12 new projects and finalized installations, including upgrades. Most important are the planned beam lines at all new spallation neutron sources (IMAT at ISIS (UK), RADEN at JPARC (Japan), VENUS at SNS (USA) and ODIN at ESS). In the same way, it is important that countries like Russia, China, Australia, Argentina and France come into the game at their established neutron sources. The bottlenecks are still developing countries with modern reactor sources but low utilization, in particular for neutron radiography and imaging. A few countries, partly supported by IAEA, enabled the participation in WCNR-10 in order to get information about state-of-the-art in the field.



From the methodical point of view, progress was reported and discussed in the field of grating interferometry, energy selective imaging, imaging with polarized neutrons and the improvement of the spatial resolution. Applications with currently highest impact are the storage of hydrogen, the in-situ study of fuel cells and batteries, non-invasive studies of cultural heritage objects and geo-sciences and paleontology. However, the link to neutron scattering techniques was explicitly enhanced (interferometry – small angle scattering, diffractive imaging, diffractometers using imaging detectors ...).

The presenting companies dealing with scintillator development and production, camera support and software development gave reason to discuss about new set-ups and system improvements.

The majority of the participants moved on October 10th to PSI where a presentation of the institute and its large scale research facilities was given. Hands on dis-



*Some impressions during the sessions*



Poster price winner Mihails Scepanskis

cussions about the two neutron imaging facilities at SINQ and for the one for X-rays at SLS were possible during the visits.

The conference was successfully finished by the ceremony for the new Honorary Member of the ISNR Marton Balasko (Hungary) and the hand-over to the newly elected president Ulf Garbe who took over the responsibility to host the WCNR-11 in Australia in 2018. The ISNR board was completed by 6 new members after the retirement of several former members.

*Eberhard Lehmann*



Meeting of ISNR-presidents at WCNR-10. Former presidents John Barton, M. Arif and Frikkie de Beer, acting president at WCNR-10 Eberhard Lehmann and new elected president Ulf Garbe (from left to right).

## Marton Balasko became honorary member of the ISNR

At WCNR-10 Marton Balasko was honored for his outstanding work in the field of neutron radiography techniques. The laudation was given by Eberhard Lehmann:

**“Marton Balaskó** is a pioneer in the application of neutron radiography techniques for engineering and industry related projects.

He was born on June 15th 1944 in Budapest (Hungary) and studied at the Technical University where he graduated in the Department of Electrical Engineering in 1974. He got his PhD in 1984 about the topic of “Qualification of epitaxial layers grown from liquid phase” before he changed that field towards the neutron research, in particular for radiography applications. Probably, it was his wife Erzsebet Sváb, a still active expert in neutron scattering, who pushed the interest into the neutrons direction?



*Marton Balaskó*



*Eberhard Lehmann (right) handing the certificate of honorary member to Marton Balasko (left)*

At the 10 MW WWS reactor of Russian origin he started to build a neutron radiography facility in 1984, mainly based on a video camera system, a precursor of the presently very common detection systems. This system was very unique in the Eastern part of Europe where such kind of experimental infra-structure was rare and the access to Western components quite limited. The goal was dynamic radiography and the visualization of two-phase flow phenomena.

Since 1990, M. Balaskó qualified very professionally and consequently for all kinds of degrees in non-destructive testing according to national rules and to EN 473.

M. Balaskó was very active in the promotion of neutron imaging techniques and their practical application, predominantly for defect analysis (e.g. Hungarian army's helicopter blades, refrigerator operation failures) or material research (super critical water behavior with respect to heat and pressure). Therefore, he became member of several national, European and international boards like International Society of Neutron Radiology (1996-2010), Applied Vehicle Technology Panel (AVT) of the Research Technology Organization (RTO) in the NATO (2003-2008), ACADEMIA NDT International (2009 -today) and the Advisory Committee for Neutron Imaging for SINQ, PSI, Switzerland.

Based on his knowledge he also practiced many teaching activities such on Schools abroad, for supervision of PhD students and for IAEA trainees. Until today he is co-author of 213 published papers and owner of 7 patents.

Because of the preliminary shut-down of the Budapest reactor M. Balasko had to move his equipment and he succeed to establish new setups at the ASTRA research reactor in Seibersdorf/Austria (1987), and at the Maria research reactor in Swierk/Poland (2001). After the upgrade in Budapest, he reinstalled and improved the neutron radiography system again.

His emphasis was on the comparison of the results of radiography methods to other non-destructive testing methods as vibration diagnostics, acoustic emission, thermo vision, ultrasonic and liquid penetration.

What is to highlight most:

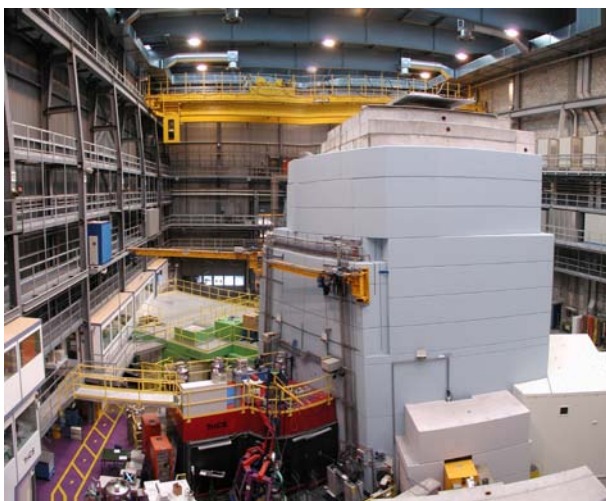
- M. Balaskó has been pioneering in film-free neutron imaging, in particular with dynamic options.

- He built one of the first imaging facilities in Europe under complicate conditions. He established very early the close link to industry and to engineering aspects.
- He managed to overcome difficulties in an Eastern country for collaboration and exchange of know-how before 1989. After «change of the system» Marton Balaskó became good moderator between East and West, e.g. transfer of the imaging device to Seibersdorf (A) and as active member of the COST action 524 about "Non-destructive testing using neutrons". "

*Eberhard H. Lehmann*

## The status of neutron imaging activities – in a PSI-internal and international context

The spallation neutron source SINQ is the national base for neutron research in Switzerland, successfully in operation since 1997. From the early days of its neutron delivery, the facility NEUTRA has been used for thermal neutron imaging investigations. Later in 2006, a facility for cold neutron imaging (ICON) was built, complimenting NEUTRA in many respects. Recently, we were able to get access to a beam line at SINQ with an even colder neutron spectrum and with a high degree of neutron polarization. In this way, we can decide which beam conditions are preferred for the particular investigation.



*Photo of SINQ experimental hall.*

Neutron imaging, at PSI previously entitled "neutron radiography", has been developed from a pure instrument for non-destructive testing, complementarily to the X-ray methods, towards a research tool for many users from science and engineering.

The most essential step into this direction was the substitution of film-type detectors by digital systems which enables a direct quantification of the content of the sample or the process under investigation. As one film based image was available after about 1/2 hour it is possible now to obtain neutron image data within a few milli-seconds.

Although the radiography type studies on different length and time scales are still very common, neutron tomography has been established on routine basis for the access of the third dimension.

However, there is a clear trend to use the neutron imaging signal more sophisticated than by transmission measurements of the white beam only.

On the one hand, narrow bands of the neutron spectrum allow getting access to the Bragg edge region of the scattering cross-sections of crystalline solid-state materials. This energy selective imaging enables to study the properties of macroscopic crystalline structures in a straightforward way. With even higher energy resolution it will be possible to detect directly stress and strain phenomena in metal components in single images with high spatial resolution.

Next to these transmission studies, it is possible to evaluate the scattered neutron signal simultaneously by means of a second detector. In this manner, we are able to characterize the crystal orientation all over a sample.

Table 1: State-of-the-art facilities for neutron imaging suitable for user operation

Country	Site	Institution	Facility	Neutron source	Spectrum	Power in MW	Status
Australia	Sydney	ANSTO	DINGO	OPAL reactor	thermal	20	in operation
Germany	Garching	TU München	ANTARES	FRM II	cold	20	in operation
Germany	Garching	TU München	NECTAR	FRM II	fission	20	in operation
Germany	Berlin	HZB	CONRAD	BER-2	cold	10	standby
Hungary	Budapest	KFKI	ib*	WWS-M reactor	thermal	10	in operation
Japan	Kyoto	Kyoto University	ib*	MTR reactor	thermal	5	standby
Japan	Tokai	JAEA	ib*	JRR-3M reactor	thermal	20	standby
Japan	Tokai	JAEA	RADEN	J-PARC spallation	cold	0.3**	in operation
Korea	Daejon	KAERI	ib*	HANARO reactor	thermal	30	in operation
Switzerland	Villigen	PSI	NEUTRA	SINQ spallation	thermal	1**	in operation
Switzerland	Villigen	PSI	ICON	SINQ spallation	cold	1**	in operation
USA	Gaithersburg	NIST	BT-2	NBSR reactor	thermal	20	in operation
USA	Sacramento	UC Davis	ib*	TRIGA reactor	thermal	2	in operation
USA	Oak Ridge	ORNL	CG-1D	HFIR reactor	cold	85	in operation
South Africa	Pelindaba	NECSA	SANRAD	SAFARI reactor	thermal	20	in operation

\* *ib*: abbreviation for imaging beamline;

\*\* *due to the higher neutron yield in spallation the power of the sources result in neutron intensities by at least a factor of 10 higher compared to reactor sources.*

Table 2: Current projects for neutron imaging facilities

Country	Site	Status
Australia	DINGO at OPAL reactor	in operation
Germany	PONTO-2, BER-2 reactor (polarized neutrons)	in operation
Russia	imaging station at IBR-2 pulsed reactor	in operation
USA	NIST: new imaging beamline at a cold neutron guide	under construction
UK	IMAT at ISIS-TS 2 pulsed spallation source	under construction
France	IMAGINE at OSIRIS reactor Saclay	under construction
China	two facilities at CARR research reactor	under construction
Japan	RADEN at J-PARC pulsed spallation source	in operation
USA	VENUS at SNS pulsed spallation source	project
EU	ODIN at ESS pulsed spallation source	project
...	upgrades of existing facilities (e.g. CONRAD-2, Germany and SANRAD, South Africa)	upgrades

More demanding but challenging is the use of neutron grating interferometer devices which enable to derive the phase contrast and the dark-field image signal for a sample. It can be used to visualize e.g. the magnetic domain structure in bulk magnetic samples.

These advanced techniques are established only in a few labs world-wide until now, including PSI. The reasons for the lack of facilities is caused by the decreasing number of powerful neutron sources, the limited access to suitable beam ports and the missing qualified manpower.

With the projects for neutron imaging facilities at the pulsed spallation sources in Japan, UK, Lund and USA we have the opportunity to implement latest developments in neutron imaging, however now with the time-of-flight = energy selectivity capabilities of best flexibility and performance. In particular, the project ODIN at the European Spallation Neutron Source ESS will enable to provide many new approaches for scientific and industrial applications. With its unique intensity and the narrow energy bands energy selective studies will become possible in short acquisition time.

The potential of neutron imaging techniques is by far not fully exploited. New approaches are seen in the imaging with polarized neutrons for the visualization of magnetic phenomena and structures, the cross-correlation with X-ray beams in the sense of data fusion and the usage of epithermal and fast neutrons. It is a real challenge to increase the spatial resolution until the physical limits in order to compete with X-ray imaging techniques, however enabling the unique neutron contrast conditions.

Underutilized neutron sources should be equipped more with neutron imaging options for a broader applicability of this valuable research tool with the high potential for industrial applications.

*Eberhard H. Lehmann*

## Actual status of standardization

The standardization of neutron radiography and tomography is an important process which helps to increase the interest of industrial customers in non-destructive investigations with neutrons and provides criteria for estimation of the level of performance for different neutron imaging facilities. The process includes theoretical considerations about the facility parameters (estimation of the collimation ratio  $L/D$ , simulation of the spectral distribution, estimation of the achievable resolution, calculation of detector efficiency, shielding calculations, scattering corrections and simulations of secondary effects as beam hardening and background contribution) and procedures for experimental confirmation of these parameters (preparation of round robin tests, performing experiments at different facilities, data procession and estimation).

Some test samples dedicated for characterization of the neutron imaging performance in radiography and computed tomography experiments were developed at Paul Scherrer Institute (PSI) recently. Two different types of samples targeting the characterization of resolution and contrast in CT measurements were distributed among 10 facilities and the results were analyzed. A new contrast sample is designed to quantify the ability to distinguish between different materials with the used neutron energy spectrum; this sample is a revision of the contrast sample used in the first IAEA round robin carried out in 2011-2012. Two sample types are proposed to quantify the resolution; one for radiography using a slanted Gd edge and the other a line pair object intended for computed tomography. First results from measurements performed at the cold neutron imaging beamline ICON (Paul Scherrer Institut, Switzerland) were presented at the IAEA Technical Meeting

on Standardization of Neutron Imaging for Industrial Applications held in Vienna, Austria; 23-26 June 2014.

On this meeting all standards related to neutron radiography were intensively discussed with focus to adapt them to the new detector systems and new facilities. It was concluded that all existing standards on film methods can be adapted to the new detector systems. Some new standards for characterization will be proposed by the neutron imaging group at PSI (contact person A. Kaestner). The results from this meeting was summarized in a technical meeting report.

*Nikolay Kardjilov, Anders Kaestner*

## Summary of NEUWAVE-6

In 2014 NEUWAVE-6 returned back to Garching where 42 experts from 13 countries were discussing actual developments and new plans for the future in energy-dependent neutron imaging.

In 2008 when plans for setting-up instrumentation at neutron spallation sources became more concrete, the knowledge on the energy-dependent effects on neutron imaging was quite limited. Scientists of the FRM II around Burkhard Schillinger organized a first workshop allowing scientists from all over the world to discuss scientific instruments and methods using time-of-flight as well as other energy selective methods.



*Participants at  
NEUWAVE-6  
(photo Schürmann)*

Originally the workshop was intended to be a single event. But due to its success it took place nearly every year in another country. NEUWAVE (NEUtron WAVElength-dependent imaging) contributed essentially to establish projects for neutron imaging like IMAT at ISIS (UK), RADEN at J-PARC (Japan), VENUS at SNS (USA) and ODIN at ESS (Sweden). Furthermore the NEUWAVE series resulted in the development a large amount of today's knowledge on energy-dependent neutron imaging.

On the last day of NEUWAVE-6 the participants visited the rebuild ANTARES facility at FRM II with its velocity selector and double-crystal-monochromator for energy resolved measurements using thermal and cold neutrons. At the NECTAR facility measurements fission neutron imaging is available, too.

NEUWAVE-7 will take place at J-PARC (Japan) in 2015 and at ISIS (UK) in 2016 celebrating the inauguration of the new instruments RADEN and IMAT, respectively.

## ITMNR-8 (Announcement)

The 8<sup>th</sup> International Topical Meeting on Neutron Radiography (ITMNR-8) will be held at Peking University (PKU), Beijing, China, on September 4-8, 2016. This meeting will follow the traditions of previous ITMNRs. The main meeting will last for three and a half days with oral and poster presentations as well as a half-day excursion. The language of this meeting will be English.



*Campus of Peking University*

Differ from the World Conference on Neutron Radiography, which is an inclusive conference, the Topical Meeting will be focused on some particular sub topics of the broad usage of neutron imaging. The topic of ITMNR-8 is still under discussion and any suggestions are welcomed.

Some optional activities might be arranged before and after the main meeting. The optional laboratory tours will be arranged. A one-day Neutron Imaging School for the young scientists and PhD students might be held before the main meeting. Following the tradition of ITMNR-7 a Review Workshop might be held after the main meeting if there are enough people like it.



*Photography of the Great Wall*

Beijing is a famous historic and cultural city. There are many historical spots such as Great Wall, Forbidden City, Summer Palace, Temple of Heaven etc. There will be colorful program for the accompanying persons.

ITMNR-8 will set up an International Advisory Committee (IAC). All the members of ISNR Board and honorary members of ISNR will be the member of IAC. The Local Organizing Committee (LOC) will exchange the ideas with IAC to determine the schedule of ITMNR-8. Any suggestions from anyone are also welcomed. The First Announcement of ITMNR-8 will be distributed around June 2015. We hope the frame of ITMNR-8 can be fixed before that time.

Contact persons:

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## WCNR-11 in 2018 - A first advertisement

As a first step we are now forming our organizational committee and start to distribute first tasks. I am already in contact with professional conference organizers and started to work on potential venues in collaboration with Business Event Sydney. The main task to agree on a final venue is now mainly driven by me and Joseph Bevitt (deputy). The decision will be made by end of this year. We still have in mind the large number of contributions at the last WCNR-10 in Grindelwald and we would like to accommodate the option of parallel sessions if required. The neutron radiography and imaging community is still growing and will hopefully grow even more over the next 4 years, which makes the setup for parallel session unavoidable. There are further announcements planned on the progress we made through the ISNR newsletter and conferences like NEUWAVE and XNPIG2015 in the near future.

In addition I plan to organize a workshop similar to the ITMNR-7 one. I experienced the idea of gathering in a location without any potential escape was excellent for developing new ideas and networking. Australia has plenty of these locations to offer and I am sure we will find an adequate venue.



I am looking forward to see you all in Australia in 2018, but if you can't wait we have a running instrument and looking for proposals twice a year.

*Ulf Garbe*

## News from the Board

In the chapter "News from the Board" the board members inform on the status of ongoing or newly established activities as well as on important decisions made in board meetings.

### Task groups

A first initiative initiated by the newly elected board of members was the establishment of so called task groups on some specific topics being of relevance and importance for our community. As an example, some discordance in the run-up to the elections at WCNR, mainly caused by different interpretations of the regulations of ISNR, resulted in the task group "Constitution". In a similar manner other topics were identified and related task

groups created. Each task group has a convener, being a board member or officer and being responsible for the performance of the group. The convener reports on a regular basis to the board of members on the ongoing activities.

As the different task groups started work in November 2014 earliest, only preliminary results are to be reported, mainly on the starting of the task group and the planned work.

Table 3: Topics of actually running task groups, convener and group members

Topic	Convener	group members
Terminology	Strobl	de Beer, Strobl, Lehmann, Garbe, Hussey
Characterization and standardization	Kardjilov	Saito, Kardjilov, de Beer, DongFeng, Kaestner, Lehmann, Hussey, Arif
Contact to other organizations	Grünzweig	Saito, Kardjilov, Grünzweig
Constitution	Bennett	Bennett, Strobl, Bücherl, Arif
Promoting young scientists and technicians	DongFeng	Strobl, Grünzweig, DongFeng, Kaestner, Lehmann, Garbe, Arif
Newsletter	Bücherl	
ISNR website	Bücherl	
Publications	Kockelmann	Kockelmann
Small or low cost systems	Lehmann	Lehmann, Hussey, Arif
Computational imaging	Kaestner	Kaestner, Kockelmann, Strobl

### Task group: Terminology

The terminology task developed during the last presidency already based on the issue of different terminology used traditionally and in more recent publications. While a certain high level terminology is defined in the context of non-destructive testing communities and organizations in which neutron radiography and imaging had a strong focus for a long time, more recent terminology used is more oriented towards similar scientific methods e.g. with X-rays and other types of radiation. Not only has terminology from these fields been introduced with the introduction of new neutron imaging methods related to such already existing with other types of radiation, but also has this broadening of potential and applications of neutron imaging shifted the focus also into other more scientific communities. Hence not only the reality of usage of terms but also a significant shift and broadening of the focus of neutron radiography and imaging, justify and even require a reconsideration of terminology in order to assure visibility and communication in and with related target communities even beyond the traditional non-destructive testing societies.

Though the discussion on the “correct” terminology is already ongoing since a while and involving different entities and experts, partly with very different approaches and foci, it

has been judged useful, that the ISNR, as the international organization, develops a proposal for a future terminology for consideration by others, for publications and its own communication.

In the framework of and based on earlier discussions a first proposal for a future terminology is currently under preparation by the convener, which subsequently shall be discussed and iterated first with the members of the task group and then within the board. It might later also be proposed to other large, related and relevant organizations (IAEA, non-destructive testing organizations etc.).

*Markus Strobl*

### **Task group: Characterization and standardization**

The characterization and standardization task group is approved and is operating. The participants have been contacted and a work program will be defined soon.

The lack of new standardization procedures for the digital based neutron imaging made real troubles in the estimation of the facility performances and in the comparison of results obtained at different beam lines. Sometime industrial customers and external users were confused by obtaining different results for experiments performed under the "same" conditions. This shows that the discussion about the standardization should be started in the neutron imaging community and new standard tools and procedures should be developed.

The task of standardization in neutron imaging has two aspects – standardization of components and facilities and standardization of experimental methods. The first procedure is used for a comparison of facility parameters such as beam quality, spatial and temporal resolution. The standardization of experimental methods (absorption radiography and tomography, phase-contrast and energy-selective imaging) is needed when the methods are provided to external users (e.g. industrial customers) where problems like safety reliability and insurance, life time guarantee and safety inspection are addressed.

The convener and the members of this group have already started by rewriting the present available standards and strategy for their adaptation to the current state-of-art installations is discussed. Next, any input that would be worthwhile to include will be considered. Then the strategy for the definition of new standards in neutron imaging will be presented to the Board for consideration, revisions and approval.

Once the group is satisfied with the revisions or if advice is needed, any other members, regular or honorary, will be consulted for their input and advice.

*Nikolay Kardjilov*

### **Task group: Contact to other organizations**

The task group is approved and is operating.

The aim of the task group is to establish, keep and extend contacts to other organizations. This can be on the one hand neutron based networks with people working in the field of neutron science like our colleagues from the scattering community or organizations dealing with neutron aspects like the collaboration with the International Atomic Energy Agency (IAEA) in respect to education and standardization initiatives in the field of neutron imaging. On the other hand, these are organizations in the industrial environment dealing with non-destructive testing (NDT) methods, where neutron imaging can

be used and promoted further. The goal should be to advertise neutron imaging further on national and international levels.

*Christian Grünzweig*

### **Task group: Constitution**

The constitution task group is approved and is operating. The participants have been contacted and a work program has been defined as rounds between the convener and the two members.

At the last WCNR, with the board members as well as with the participants, there was noticed a lack of clarity in some parts of the constitution. There have also been several amendments that have not been incorporated which make it difficult to read. The aim of the "constitution" work group is to clarify the constitution to bring it up to date with the present operation of the society and to write down guidelines for present practices to ensure consistency with the intent of the constitution. These additional guidelines would be for practices such as election procedures (e.g. nominations, eligibility, voting, tie-breaking, etc.) and for selection of honors to society members.

The convener and the members of this group have already started by rewriting the present constitution clarifying the intent and incorporating already approved amendments. Next, any input that would be worthwhile to include will be considered. Then the constitution will be presented to the Board for consideration, revisions and approval.

Once the group is satisfied with the revisions or if advice is needed, any other members, regular or honorary, will be consulted for their input and advice.

*Les Bennett*

### **Task group: Promoting young scientists and technicians**

Here we listed some actions to promote young scientists and technicians training in the area of neutron imaging for fundamental research and various industrial applications, and you are very welcome to sending us your comment and suggestions.

(1) Neutron imaging school: The school format will include the invited experts' lectures, hands-on-experiments and post-experimental analysis in small groups. On the ITMNR-8 LOC Meeting, it was suggested that a small neutron imaging school with 30 students can be held before the ITMNR-8 in Beijing in 2016.

(2) IAEA technical workshop and projects: IAEA has made great efforts and contributions to the development and application of neutron imaging, especially in developing countries. ISNR should take full use of IAEA's resources through technical workshop and projects (TC and CRP). With Mr. Lehmann and Mr. Kardjilov, China has agreed on sending two young scientists as TC fellowships to PSI and HZB for training.

(3) Local and International Meeting: As the Vice President of CNSS and the board member of the AONSA, I would like to promote NR experts to take part in the National Meeting on Neutron Scattering in China and the AONSA Conference on Neutron Scattering to deliver the scientific-technological knowledge to the young scientists.

*DongFeng Chen*

### **Task group: Newsletter**

Up to now there are no volunteers to work within this task group. As can be seen by this NR Newsletter, there are contributions but only given on direct request. The idea of this task group is to gather a group of five or more people, who actively contribute to the newsletter by selecting information on ongoing or new activities in our community, transferring them into short articles to be published in one of the next issues. Interesting activities might be updates or improvements of facilities or components required for neutron radiography and imaging as well as latest neutron radiographs, tomographs and images and/or changes in personal positions. There will be a direct interaction with the task group of the ISNR website.

*Thomas Bücherl*

### **Task group: ISNR website**

The ISNR website aims in being a link between ISNR-members, the ISNR-board and any interested people. Therefore it shall offer general as well as specific information on neutron radiography and imaging. This requires a flexible website, where all the required information can be found quickly, while new input can be integrated easily. For this purpose the ISNR-website is based on the content management system (CMS) Joomla! With this framework the requirements can be tackled although a lot of further improvement and work will be necessary. As an actual example, the list of members lacks on a search option. Its programming and integration will be one of the next steps, as this tool will be used with the planned databases on publications (see task group on publication). and cultural heritage, too.

For the next years further improvements are planned on content and layout, both. The latter considers the usability with tablets and smartphones, the first more information like the presentation of latest results of the task groups, of the different neutron radiography and imaging methods, of examples of state-of-the-art neutron radiographs and images, of a FAQ website, of a regular update of information on upcoming conferences and other events etc. All this will only be possible having your direct support by mailing me related information.

*Thomas Bücherl*

### **Task group: Publications**

**Aim:** to set-up a database of neutron imaging publications on the ISNR website

There is a recognized interest in the community for a publications database of historic and current publications on neutron radiography, tomography and other neutron imaging techniques. Over the past decade the field of neutron imaging has advanced substantially; the community has grown, and an increasing number of neutron imaging facilities is available for the academic and industrial user communities. Moreover, the field of neutron imaging has diversified considerably, with developments of methods such as magnetic and phase contrast imaging, dark field contrast and energy-selective imaging. Accordingly, the number of neutron imaging publications per year has more than doubled in the past decade. The task group will aim for setting up a publications database on the ISNR website which will help ISNR members and users of the facilities to keep track of publications and of work of colleagues. The database will also be useful to effectively direct new academic and industrial users to the relevant publications, method descriptions and case studies.

The database will effectively need to be operated with minimum resources and costs, and as such will be kept as simple as possible. The database will include current neutron imaging papers, but also entries and references to World Conference proceedings, as well as references of MsC and PhD theses. The database will have search and filter functions, and will be set-up in a format that is compatible with bibliographic statistical analysis and display tools. The site will have links to other related publications sites such as the Munich x-ray and neutron phase contrast imaging site. A basic version of a neutron radiography publications database already exists, with lists of publications back to 2012, at the RadSci Consultancy website (<http://www.radsci.co.uk>). The latter database will be supported by the task group until such time that the ISNR publications plans have been approved by the ISNR board and the ISNR database is up and running. In any case, the databases rely on the community to submit references which, for the time being, should be emailed to Thomas Bücherl ([thomas.buecherl@tum.de](mailto:thomas.buecherl@tum.de)) or John Rogers ([john@radsci.co.uk](mailto:john@radsci.co.uk)).

*Winfried Kockelmann*

### **Task group “Small or low cost systems”**

The purpose of this task group is to define and to propose the options for digital neutron imaging detectors to potential users and facility operators. The motivation arose from the high number of under-utilized beam ports at neutron sources, preferentially in developing countries. We understand this kind of “detector prototypes” as “starter kit” for neutron imaging activities in the related research centers and countries.

The task group will establish contacts to potential partners and their institutions, based on the existing ISNR/IAEA data base and private communication. From the technical point of view, low cost detection system will be defined and proposed. The funding might be supported by organizations like IAEA or national supporting organizations. In a further stage, training and education activities are foreseen and the exchange of specialists envisioned.

*Eberhard Lehmann*

### **Task group: Computational imaging**

Computational imaging is a field of imaging where computation plays an integral role in the image formation process. There are different reasons to introduce a computational step in the image formation process; the radiographs are acquired in a space that does not represent the intended physical parameters or geometry (e.g. computed tomography, grating interferometry) or to go beyond the apparent instrument limitations using direct methods (e.g. resolution enhancement, low-dose imaging). This is a branch of image processing that is becoming increasingly important to neutron imaging due to the development towards more advanced instrumentation with little possibility to increase the neutron flux from the sources. Therefore, a central topic is the development of robust and accurate processing methods, which work also at low signal to noise ratio conditions. In many cases processing methods are already developed for other applications (image processing, medical imaging, mathematics), but are not yet evaluated and applied to neutron imaging. A workshop on computational methods for neutron imaging should be arranged to identify the state of the art in computational imaging applied to neutron imaging.

Identifying processing tasks and developing methods is just a small fraction of the work needed to let the neutron imaging user community enjoy the benefits of the newly developed methods. Unfortunately, little time and resources are devoted to the work making

advanced processing method available to the user community. Enthusiasts often develop software tools on off-hours, a situation which is not acceptable considering the impact of the use of such tools. The task group will collect information about existing development initiatives and if possible evaluate and compare user performance and user friendliness. In addition to this inventory task the task group will act to recruit voluntary contributors for structured and professional development preferably for development in an open source community. Common development has the advantage that users and beam-line staff can use the high quality tools on all instruments without the overhead of learning new tools for every experiment.

*Anders Kaestner*

## Deputy of president announced

**Joseph Bevitt** has been announced by Ulf Garbe as deputy to the president. More about Joseph in the next NR Newsletter.

## New publications

If you are aware of some new publications related to neutron radiography, imaging etc. please send me the references. Until the database on publications on the ISNR website is completed please refer to the website of John Rogers ([www.radsci.co.uk](http://www.radsci.co.uk)).

## Upcoming Conferences

NEUWAVE 7

**7<sup>th</sup> Workshop on NEUtron WAVElenth-dependent imaging**

May 31st to June 3rd, 2015

Ibaraki Prefectural Culture Center in Mito city, Ibaraki, Japan

**NDT Canada 2015**

The NDT in Canada 2015 Conference

June 14-16, 2015, Edmonton AB, Canada

International Symposium on

**Digital Industrial Radiology and Computed Tomography**

June 22-25, 2015, Ghent, Belgium

**NDCM 2015**

14<sup>th</sup> International Symposium on Nondestructive Characterization of Materials

June 22-26, 2015, Marina del Rey Marriott, Los Angeles, CA, USA

**XNPIG2015**

Third Meeting of X-Ray and Neutron Phase Imaging with Gratings (XNPIG2015)

September 8 - 11, 2015

Natcher Conference Center, NIH, Bethesda, Maryland, United States

**7<sup>th</sup> Middle East Nondestructive Testing Conference & Exhibition**

September 13 to 16, 2015 - Gulf International Convention Center, Kingdom of Bahrain

**19<sup>th</sup> WCNDT 2016**

19<sup>th</sup> World Conference on Non-Destructive Testing

June 13-17, 2016, Munich, Germany

**ITMNR-8**

8<sup>th</sup> International Topical Meeting on Neutron Radiography

September 4-8, 2016, Peking University, Beijing, China

**WCNR-11**

11<sup>th</sup> World Conference on Neutron Radiography

2018, Sydney, Australia

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