11th International Meeting of the Union for Compact Accelerator-driven Neutron Sources (UCANS11)

Monday, 24 February 2025 - Friday, 28 February 2025

Pinnacle at the Pier

Book of Abstracts

Contents

Session 5 / 1

Advancement of Neutron Imaging Techniques Towards the Highest Resolution and Development of Imaging Application with RANS Using Particle Tracking Detectors

Authors: Hiroyuki Ekawa[1]; Masahiro Hino[2]; Katsuya Hirota[3]; Go Ichikawa[4]; Ayumi Kasagi[1]; Masaaki Kitaguchi[5]; Tomohiro Kobayashi[1]; Satoshi Kodaira[6]; Kenji Mishima[7]; Maki Mizuta[1]; Jameel-Un Nabi[8]; Manami Nakagawa[1]; Naotaka Naganawa[9]; Yasuki Okuno[1]; Yoshie Otake[1]; Michio Sakashita[1]; Norihito Saito[1]; Takehiko R. Saito[10]; Takaoki Takanashi[1]; Satoshi Wada[1]; Junya Yoshida[11]; Nakahiro Yasuda[12]; Abdul Muneem[1]

[1] *RIKEN, Japan*

[2] *KURNS, Kyoto university, Japan*

[3] *KEK, Japan*

[4] *KEK, Japan and J-PARC, Japan*

[5] *Nagoya university, Japan and KMI, Nagoya university, Japan*

[6] *QST, Chiba, Japan*

[7] *J-PARC, Japan and KMI, Nagoya university, Japan*

[8] *University of Wah, Pakistan*

[9] *Nagoya university, Japan and IMaSS, Nagoya university, Japan*

[10] *RIKEN, Japan, GSI, Germany and Saitama Univeristy, Japan*

[11] *Tohuku university, Japan and SRIS, Tohuku university, Japan*

[12] *University of Fukui, Japan*

Corresponding Authors: michio.sakasita@riken.jp, naganawa@flab.phys.nagoya-u.ac.jp, kitaguchi@phi.phys.nagoya-u.ac.jp, swada@riken.jp, norihito@riken.jp, yotake@riken.jp, nyasuda@u-fukui.ac.jp, manami.nakagawa@riken.jp, kmishima@kmi.nagoya-u.ac.jp, junya.yoshida.e5@tohoku.ac.jp, yasuki.okuno@riken.jp, jnabi00@gmail.com, khirota@post.kek.jp, kodaira.satoshi@qst.go.jp, t-koba@riken.jp, ayumi.kasagi@rikkyo.ac.jp, takehiko.saito@riken.jp, hiroyuki.ekawa@riken.jp, takaoki.takanashi@riken.jp, maki.mizuta@riken.jp, abdulmuneemphysics25@gmail.com, hino.masahiro.2x@kyoto-u.ac.jp

Neutron imaging (NI) is a nondestructive and noninvasive inspection technique with a wide range of potential applications. The fundamentals of this technique need to be improved, particularly in achieving micrometer-scale or finer resolution, which remains a challenging task. Recently, we developed a high-resolution NI device utilizing fine-grained nuclear emulsions (FGNE). The NI of gadolinium-based gratings were successfully performed. The calculated imaging resolution, based on grayscale optical images of a gadolinium-based grating with a periodic structure of 9 μm was, 0.945 $\pm$ 0.004 μm, the highest imaging resolution achieved so far. Although these detectors offer exceptionally high resolution, they are not reusable. To address this limitation, we investigated the potential of fluorescent nuclear track detectors (FNTDs) for high-resolution NI. We presented an approach to perform optical bleaching under the required conditions for the imaging applications. It was concluded that FNTDs can be reused for imaging applications at least seven times. The NI of a gadolinium-based grating with a periodic structure of 9 μm was performed, and the grating structure was successfully resolved first using the novel FNTD-based neutron imaging technique. The measured resolution with the FNTD-based neutron detector is 0.887 $\pm$ 0.009 μm. In the near future, these FNTDs will be further developed for use in compact neutron systems RIKEN Accelerator-driven compact neutron systems (RANS), where there is a high demand from industry for research and development in non-destructive observation. We aim to develop a high-resolution neutron computed tomography technique and realize neutron imaging applications with RANS, utilizing FNTDs and FGNEs.

Email Address:

Email Address

Presenter if not the submitter of this abstract:

Funding Agency:

RIKEN, Japan

Abstract classification - track type:

Session 9 / 2

Conceptual Designs for Thermal, Cold, and Very Cold Neutron Moderator Systems for CANS

Author: Rolando Granada[1]

[1] *CNEA*

Corresponding Author: rolando.granada@gmail.com

In recent years there has been a renewed interest in the development of compact neutron sources, as an alternative to large facilities based on reactor or accelerator installations. In fact, compact accelerator-driven neutron sources (CANS) have been in operation for a long time, but different circumstances have recently prompted the design and development of new high intensity CANS projects around the world. The compact character of such installations must be also reflected in their target-moderator-reflector (TMR) systems, where the significant radiation fields they are immersed in and the requirement of optimized configuration to achieve the expected high neutron fluxes, pose new challenges for the design of the appropriate TMR in each case. In this work some conceptual ideas are presented that can be considered as initial guesses for the necessary simulation work, with particular emphasis on moderator configurations able to supply thermal, cold, and very cold neutron beams based on High-intensity CANS (HiCANS) or Medium-intensity CANS (MiCANS). To pursue this endeavor a special effort was made to collect analytical tools and experimental information in support of the proposed concepts.

Email Address:

Presenter if not the submitter of this abstract:

Funding Agency:

CNEA (Argentine Atomic Energy Commission)

Abstract classification - track type:

Cold Moderators and Beyond

Session 4 / 3

CANS at BNL

Authors: Antonino Cannnavo[1]; Giovanni Ceccio[2]; Kazumasa Takahashi[3]; Madhawa Horana Gamage[4]; Masahiro Okamura[1]; Takeshi Kanesue[1]; Toshiro Sakabe[1]

[1] *Brookhaven National Laboratory*

[2] *Nuclear Physics Institute of the Czech Academy of Science*

[3] *Nagaoka University of Technology*

[4] *Columbia University*

Corresponding Authors: tkanesue@bnl.gov, kazumasa@vos.nagaokaut.ac.jp, okamura@bnl.gov

Brookhaven National Laboratory (BNL) has a long history of neutron-related research, including early experiments using reactor-based neutron sources for Boron Neutron Capture Therapy (BNCT)

dating back to the 1950s. Beginning in the 1990s, various Compact Accelerator-driven Neutron Source (CANS) concepts were explored. However, these activities ceased entirely around the turn of the millennium and remained dormant for two decades.

Recently, we have successfully accelerated a highly intense lithium beam using a laser ion source and Direct Plasma Injection Scheme (DPIS) technology. Building on this achievement, our team has initiated a renewed effort to establish a new CANS facility at BNL. Official recognition of this project within the laboratory was granted in 2023, and we have since commenced a detailed feasibility study.

Unlike most current or planned CANS facilities, which typically accelerate protons to produce neutrons from lithium or beryllium targets, our approach involves bombarding a hydrogen target with a lithium beam. This inverse kinematics scheme offers distinct advantages. While the lithium beam requires a threshold energy of around 13 MeV to generate neutrons, we plan to operate at approximately 15–16 MeV. Although this energy appears higher than those commonly used for proton beams, the total accelerating potential required is only about 5 MV because the lithium ions are triply charged. This is actually lower than the voltages typically employed in proton-based systems using beryllium targets.

Currently, we achieve about 40 mA of lithium beam current at the exit of the RFQ (our first-stage RF accelerator). However, since the pulse width is on the order of a few microseconds, we need higher repetition rates to ensure sufficient neutron flux. To meet this requirement, we are considering the use of a liquid lithium target. In parallel, we are developing a linear accelerator to further increase the peak beam current. We are also conducting complementary neutron production experiments using BNL's existing tandem electrostatic accelerator.

At the conference, we will present and discuss the details of our research activities, the design concept of the new CANS facility, and the progress of our ongoing feasibility and construction plans.

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Presenter if not the submitter of this abstract:

Funding Agency:

US DOE

Abstract classification - track type:

Future of CANS

Session 1 / 4

TUCAN, the TRIUMF Source for Ultracold Neutrons

Author: Ruediger Picker[1]

[1] *TRIUMF*

Corresponding Author: rpicker@triumf.ca

The Japanese-Canadian TUCAN (TRIUMF UltraCold Advanced Neutron) collaboration is currently building a next generation ultracold neutron source at TRIUMF, Vancouver, Canada. This superthermal source is based on conversion of fast neutrons from a spallation target to the ultracold regime in liquid, superfluid helium. We expect to deliver around 10^7 UCN per second at the exit of the source. The presentation will provide an overview of the source concept, its moderator and ultracold neutron design and the cryogenic infrastructure required for its operation. Experiments planned will also be briefly introduced.

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Presenter if not the submitter of this abstract:

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NSERC

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Facility Updates

Session 9 / 5

Towards the Development of a Compact Very Cold Neutron Source for the High Brilliance Neutron Source (HBS)

Authors: Dalini Maharaj[1]; Ulrich Rücker[1]; Jingjing Li[1]; Paul Zakalek[1]; Thomas Gutberlet[1]

[1] *JCNS-2, Forschungszentrum Jülich*

Corresponding Authors: u.ruecker@fz-juelich.de, t.gutberlet@fz-juelich.de, d.maharaj@fz-juelich.de, ji.li@fz-juelich.de, p.zakalek@fz-juelich.de

Very cold neutron (VCN) sources present an exciting opportunity for scientists to access unprecedented length and time scales, and achieve improved resolution in neutron experiments [1]. VCNs are defined over a wide spectral range, from 1 meV (9 Å) down to a few hundred neV (> several 100 Å). Recent advancements in the development of thermal scattering kernels for candidate very cold neutron (VCN) moderator and reflector materials under the HighNESS project [2] have opened opportunities for exploring conceptual designs of VCN sources tailored to emerging high-intensity compact accelerator-driven neutron sources (HiCANS) like the High Brilliance Neutron Source (HBS) [3]. In contrast to the expansive moderator designs typical of large reactor and spallation sources, HiCANS, with a smaller source, necessitate highly efficient and compact moderator solutions. For the ESS, moderator concepts have been developed based on solid deuterium; however, at the HBS, a hydrogen-rich moderator is required to effectively slow neutrons to the VCN energy range within the limited volume that aligns with the HBS footprint. Methane, a well-established and highly efficient neutron moderator is a promising candidate to serve as a VCN moderator since it possesses a desirable low-lying rotor mode at ~ 1 meV. Liquid parahydrogen (l-pH_2) is a known efficient cold neutron moderator since it is able to convert thermal neutrons to cold neutrons via a single interaction. Various geometrical configurations combining methane and l-pH_2 have been considered to harness the complementary properties of both materials in potential designs of a VCN moderator for the HBS. Monte Carlo simulations using the PHITS particle transport code were conducted to evaluate the performance of these configurations when fed by the HBS tantalum source. This study presents a comparative analysis of the results obtained for various moderator geometries considered when compared with a pure, low dimensional l-pH_2 cold source.

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Abstract classification - track type:

Cold Moderators and Beyond

Poster Session 1 / 6

Preliminary Evaluation of Alloying Significance of Neutron Target for High Brilliance Neutron Source

Author: Zhen Yang[1]

Co-authors: tianhao zhang [1]; wei ma [1]; liping zou [1]; Liang Lu [1]

[1] *Sun Yat-sen University*

Corresponding Authors: luliang3@mail.sysu.edu.cn, yangzh97@mail.sysu.edu.cn, zoulp5@mail.sysu.edu.cn, mawei25@mail.sysu.edu.cn, zhangth33@mail2.sysu.edu.cn

Accelerator-based neutron sources are critical infrastructures in today's scientific research and industrial fields, with the neutron source target being the key component determining the performance of the neutron source. Traditional accelerator neutron source targets typically use homogeneous elemental materials with high neutron yield as the target material. These materials face challenges in terms of operational lifespan under high-temperature and high-radiation environments. The design of next-generation high brilliance neutron sources demands target materials with better thermal conductivity, longer irradiation lifespan, and superior corrosion resistance. Tungsten has its high neutron yield, and tungsten alloys exhibit these advantageous properties. We employs the Monte Carlo method to calculate neutron yield, radioactivity and radiation damage of two common tungsten alloys, W-TiC and W-ZrC. The results indicate that, with minor doping to improve mechanical properties and manufacturability, the performance of tungsten alloys can also meet the requirements for high-brilliance neutron targets, provide reference for the development of the next generation neutron target.

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Instrumentation and Hardware

Session 8 / 7

FETS-METS: A Small-Scale Test Stand for Advancing Neutron Moderator Systems

Author: Alexandra Chrysafi[None]

Co-authors: Steven Lilley ; Paul Morgan ; Stephen Gallimore ; Stephen Jago

Corresponding Author: alexandra.chrysafi@stfc.ac.uk

The moderator is a crucial component of neutron sources, slowing neutrons from a target to energies suitable for materials science. At large user facilities like ISIS, once moderators are installed, it becomes very difficult to make changes or track issues, as testing on the full-scale facility is highly limited. Therefore, testing moderators and moderator systems prior to installation at the main facility offers significant advantages. A local testing platform would facilitate the continuous development of these complex systems, including cryogenics, diagnostics, and skills development, helping to minimise risks, improve overall efficiency and foster innovation.
This project explores the potential of using an existing small-scale proton accelerator facility, the Front-End Test Stand (FETS) [1], located on the Harwell Campus. A neutron source will be added to the end of FETS to create a Moderator Engineering Test Stand (METS). The METS would include a shielded area with a target, simplified reflector, and moderator space, as well as a diagnostic neutron beamline primarily set up for moderator imaging and resolution calibration.
Currently in the concept phase, the project is investigating both the scientific performance and engineering feasibility of the facility, as well as outline costs and timescales. This paper will focus mainly on the engineering aspects that have been developed so far, including target, moderator and reflector (TRaM) concepts, safety considerations such as shielding requirements, spatial restrictions, and key equipment such as vacuum, cryogenics, services and plant, controls etc. These initial engineering insights will provide a foundation for further development, enabling a better understanding of the project's feasibility, associated costs, and the key specifications for this new facility.

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Email Address

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Future of CANS

Session 6 / 8

IAEA Activities in Support of Development and Utilization of Neutron Sources

Authors: Danas Ridikas[1]; Eugenio Vargas[1]; Haifa Ben Abdelouahed[1]; Kalliopi Kanaki[1]; Natko Skukan[1]; Valentina Semkova[1]

[1] *Physics Section, International Atomic Energy Agency*

Corresponding Authors: d.ridikas@iaea.org, k.kanaki@iaea.org, n.skukan@iaea.org, h.ben-abdelouahed@iaea.org, v.semkova@iaea.org, e.vargas@iaea.org

Neutron sources play a pivotal role for society providing neutrons as a powerful tool for research and broad range of applications. In recent years, new generation of low energy driven neutron sources collectively known as Compact Accelerator-Based Neutron Sources (CANS) emerged, based on the significant progress in lower-energy accelerators as well as neutron production target technologies. The state-of-the-art developments in this field offer neutron sources with intensities comparable to those of the low and medium neutron flux research reactors. Indeed, CANS are versatile, flexible, and very attractive when it comes to capital and operational costs. They also do not require

nuclear materials, what makes this technology neutral with respect to nuclear proliferation. This potentially opens new neutron beam research opportunities and numerous other applications. For example, there is a resurgence in the interest of the accelerator-based Boron Neutron Capture Therapy (BNCT) or in situ non-destructive testing using portable accelerator-based neutron sources.
The IAEA Physics Section support Member States in the development and promotion of nuclear applications and related capacity building including non-destructive testing, materials research, energy, environment, medicine, cultural heritage, forensics, controlled fusion and others. The Section also operates the Nuclear Science and Instrumentation Laboratory (NSIL) at Seibersdorf, Austria. The NSIL is expanding its capabilities in neutron research, demonstration of practical applications and capacity building through the operation of newly established Neutron Science Facility (NSF). The NSF is based on Deuterium-Deuterium and Deuterium-Tritium neutron generators and, among other usage, offers instrumentation development and hands-on-training opportunities for interested users.
The IAEA Physics Section has organised a number of specific activities relevant to CANS technologies and their applications, provided various resources such as publications [1, 2, 3], databases [4, 5] and guidance on strategic planning of research reactors [6] and establishment of ionization radiation facilities like CANS [7]. In November 2024, IAEA and the French Alternative Energies and Atomic Energy Commission (CEA) have launched a new cooperative project Neutrons for Nuclear Sciences and Applications (Neutrons4NA) as a forum to gather interested parties with a common goal in developing access to nuclear science and applications using neutron sources.
The paper will present an overview of the IAEA support to Member States in nuclear physics research and applications with neutrons, including neutron-based analytical techniques, neutron scattering and imaging at low and medium flux accelerator- and research reactor-based neutron sources, BNCT, development and testing of neutron instrumentation, hands-on-training, etc. Key development areas of societal importance and economic growth will also be illustrated. The paper will also highlight the Agency planned activities in support of the CANS development, applications, and international cooperation in the framework of Neutrons4NA project.

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Email Address

Presenter if not the submitter of this abstract:

Funding Agency:

Abstract classification - track type:

Facility Updates

Session 5 / 9

We CANS Do It: A Step Towards a Canadian PC-CANS

Author: Maksymilian Dziura[1]

Co-authors: Drew Marquardt [1]; Stephen King [2]; Stuart Castillo [1]

[1] *University of Windsor*

[2] *ISIS Neutron and Muon Source*

Corresponding Authors: drew.marquardt@uwindsor.ca, dziura@uwindsor.ca, castills@uwindsor.ca

With a globally shrinking supply of neutron and the NIMBY perception that research reactors face, compact accelerator-driven neutron sources (CANS) are on the rise. CANS have potential to produce an intense source of pulsed neutrons, with a capital cost significantly lower than spallation sources and reactor sources along with much less public stigma. A prototype Canadian CANS (PC-CANS) is proposed as a step in rebuilding Canadian neutron capabilities. The PC-CANS is an installation proposed by the University of Windsor in collaborations with TRIUMF. The PC-CANS is envisaged to serve two neutron science instruments (small angle neutron scattering and neutron imaging), a boron neutron capture therapy (BNCT) station and a beamline for fluorine-18 radioisotope productions for positive emission tomography (PET). A computation study has found that there are no technical barriers to our PC-CANS design, and its small-angle neutron scattering (SANS) instrument will be attractive to users. Recent feedback from a submitted grant to fund construction of the PC-CANS facility, questions whether the proposed instrument would give significant data with its projected performance. This led to the use of the LOQ instrument at ISIS Neutron and Muon Source to capture data of a plethora of benchmark samples. Through aperture modifications, native and throttled settings were used to emulate and compare data quality from a proposed PC-CANS setup, employing a flux of about 1/6th the standard flux of LOQ. Data of a variety of disciplines, ranging from protein and lipid biochemistry to polymer chemistry, as well as common instrument standards were measured to compare data quality. Samples measured were able to give usable quality data, enhancing the case behind the utility of such an instrument. This work builds a case towards the feasibility and functionality of the proposed PC-CANS.

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Email Address

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Funding Agency:

NSERC, ISIS Partnership

Abstract classification - track type:

Future of CANS

Session 4 / 10

Status of the Moderator Test Station at ORNL

Author: Erik Iverson[1]

Co-authors: Franz Gallmeier [1]; Kyle Grammer ; Kevin Johns

[1] *ORNL*

Corresponding Authors: gallmeierfx@ornl.gov, grammerkb@ornl.gov, iversoneb@ornl.gov, johnskc@ornl.gov

We present the status of the Moderator Test Station (MTS), under construction at the Spallation Neutron Source. The MTS will provide the ability to test a wide variety of moderators in a prototypic

configuration, simultaneously measuring the neutronic performance of the moderator concepts central to the gains described for upcoming neutron source facilities. The presentation will describe the MTS and its progress, including performance analyses, radiation safety measures, and target development.

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Email Address

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Funding Agency:

US Departement of Energy

Abstract classification - track type:

Instrumentation and Hardware

Session 11 / 11

A New Method to Increase the Cold Neutron Production in Liquid p-H2 Moderators

Author: Rolando Granada[1]

Co-authors: Douglas Di Julio [2]; José Ignacio Márquez Damián [2]

[1] *CNEA*

[2] *ESS ERIC*

Corresponding Authors: douglas.dijulio@ess.eu, jose.marquez@ess.eu, rolando.granada@gmail.com

Historically, the cold moderators first operating in neutron sources were liquid hydrogen and solid methane at temperatures near 20 K. Even today a preferred option for accelerator-based cold neutron sources is liquid para-hydrogen, because it is not subject to polymerization due to radiolysis, as in the case of hydrocarbon moderators. An extensive amount of information has been produced for that material on cross sections, and on emission spectra, pulse widths, and the effect of premoderators for different target/moderator/reflector configurations.
A particular neutronic property of liquid hydrogen at 20 K is reflected by the mean-free path of neutrons, where values of approximately 12 cm for the pure para species correspond to neutrons between 1 and 10 meV. This fact, together with a mean-free path of approximately 1.4 cm for thermal neutrons, is the basis for the low-dimensional concept for increasing the cold neutron brightness of para-H2 moderators. Such concept either for flat or tube moderators has dictated the configurations adopted by almost all new projects using liquid hydrogen cold neutron sources.
In this work a new method is presented to further increase the cold neutron production using p-H2 in different configurations, by exploiting the changes in the parent flux spectra created by different premoderator temperatures and their effects on the emitted cold flux. Simulations on simple premoderator/moderator conditions aimed at confirming the actuality of the method and the magnitude of the gains are shown.

Email Address:

Presenter if not the submitter of this abstract:

Funding Agency:

CNEA (Argentine Atomic Energy Commission)

Abstract classification - track type:

Cold Moderators and Beyond

Session 10 / 12

Elemental Analysis of Construction Materials Using Compact Neutron Systems –Recent Results within the IKUR-RIKEN Collaboration

Author: Felix Fernandez-Alonso[1]

Co-authors: Cristina Macia-Castello [2]; Daniel Blanco-Lopez [2]; Mattia Gaboardi [2]; Tomonori Fukuchi [3]; Yasuo Wakabayashi [3]; Yoshie Otake [3]; Yujiro Ikeda [3]

[1] *Materials Physics Center & Ikerbasque*

[2] *Materials Physics Center*

[3] *RIKEN Neutron Beam Technology Team*

Corresponding Authors: felix.fernandez@ehu.eus, mattia.gaboardi@ehu.eus, daniel.blanco@ehu.eus, cmacia001@ikasle.ehu.eus

Within the remit of the IKUR strategy in the Basque Country [1], we have recently embarked on a critical assessment of available technologies for the provision of neutrons across low-flux compact space. One important aspect of these activities relates to the implementation of scientific and technological demonstrators, with an initial focus on construction materials of direct relevance to the industrial sector in the Basque Country [2]. Following initial efforts using neutron-activation analysis with last-generation DT sources [3], this contribution extends these first results to the implementation of in-situ prompt-gamma activation analysis, as part of an ongoing collaboration across IKUR and RIKEN-RANS. In particular, we have studied in detail the limits of detection and quantitation of exogenous chemical species, present as a result of exposure to harmful environmental conditions. Building upon previous works at RIKEN-RANS [4,5], special attention has been placed on an assessment of the challenges associated with the quantitative analysis of these complex, multicomponent media using neutron-activation techniques. In addition to the above, we have also capitalised from the unique pulsed nature of both RIKEN-RANS I and II to explore current and emerging capabilities across the broad neutron-wavelength range available at these state-of-the-art accelerator-driven compact neutron systems.

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Email Address:

Presenter if not the submitter of this abstract:

Funding Agency:

IKUR Strategy in Neutron & Neutrino Science

Abstract classification - track type:

Applications

Session 10 / 13

Tracking the Progress of Nonuniform Deterioration in a Lithium-Ion Battery Using Bragg-Edge Imaging – an Application of the AISTANS Compact Neutron Source

Authors: Koichi Kino[1]; Takeshi Fujiwara[1]; Tatsunori Shibuya[1]; Brian O'Rourke[1]

[1] *National Institute of Advanced Industrial Science and Technology (AIST)*

Corresponding Author: koichi.kino@aist.go.jp

One of the challenges to overcome for commercial lithium-ion batteries (LIB) is suppression of power-storage degradation due to charge-discharge cycles. Some of the present authors (K. Kino and T. Fujiwara) and their collaborators previously reported nonuniform degradation of LIBs nondestructively and quantitatively by a Bragg-edge imaging experiment conducted at a large neutron facility, the Materials and Life Science Experimental Facility of the Japan Proton Accelerator Research Complex (J-PARC).[1] However, further understanding this process, especially clarifying the degradation progression, requires tracking the deterioration of an LIB cell over a long term by repeating Bragg-edge imaging after some charge-discharge cycles. Compact accelerator-driven neutron sources (CANS) are suitable for this research because of their flexible neutron-beam schedule and machine operation with a small number of researchers.
Therefore, we are conducting a long-term measurement of repeated Bragg-edge imaging of a commercial LIB cell for mobile phones after multiple charge-discharge cycles at AISTANS (Analytical facility for Industrial Science and Technology using Accelerator based Neutron Source) [2-4], which is located at AIST (National Institute of Advanced Industrial Science and Technology) Tsukuba in Japan. AISTANS can provide a thermal-cold pulsed neutron beam from a decoupled solid-methane moderator. Thanks to the optimization of AISTANS for Bragg-edge imaging from the most upstream (an electron accelerator) to the most downstream (a neutron detector), we succeeded in imaging three crystalline phases of a negative electrode (graphite, LiC12, and LiC6) in an area of approximately 50×50 mm2 for an initial fresh state. Currently, measurements after charge-discharge cycles are being conducted.
In this presentation, the latest result of tracking progress of nonuniform deterioration for a LIB cell by Bragg-edge imaging will be shown as an application of CANS.

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Email Address:

Email Address

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Funding Agency:

Abstract classification - track type:

Applications

Poster Session 1 / 14

Precision in Terrestrial Soft-Error-Rate Estimation Using Acceleration Factors Obtained at an 18 MeV Proton Accelerator-Driven Neutron Source

Author: Nagomi Uchida[1]

Co-authors: Hidenori Iwashita [1]; Ryu Kiuchi [1]; Yuji Sunada [1]; Mayu Tominaga [1]; Yoshiharu Hiroshima [1]; Takashi Ikeda [1]; Yoshiaki Kiyanagi [2]; Hirotaka Sato [2]; Takashi Kamiyama [2]; Michihiro Furusaka [2]; Kaito Ishiguro [2]

[1] *Nippon Telegraph and Telephone Corporation(NTT)*

[2] *Graduate School of Engineering, Hokkaido University*

Corresponding Authors: takashik@eng.hokudai.ac.jp, hidenori.iwashita@ntt.com, yoshikiyanagi22@gmail.com, h.sato@eng.hokudai.ac.jp, ishiguro.kaito.q1@elms.hokudai.ac.jp, nagomi.uchida@ntt.com, ta.ikeda@ntt.com, yoshiharu.hiroshima@ntt.com, yuji.sunada@ntt.com, ryu.kiuchi@ntt.com, michifurusaka@icloud.com, mayu.tominaga@ntt.com

With the ongoing miniaturization, high integration, and low power consumption of semiconductor devices, soft errors caused by cosmic-ray neutrons in terrestrial environments have become a concern. The soft error rate in the terrestrial environment can be quantitatively estimated from the soft error rate measured with an accelerator-driven neutron source and the acceleration factor that is defined as the ratio of the soft error rate in an accelerator environment to that in the terrestrial environment. For large-scale accelerator neutron sources with energy spectra that closely represent the shape of the terrestrial neutron energy spectrum, the acceleration factor remains constant regardless of the semiconductor device. In contrast, for compact accelerator-driven neutron sources (CANSs) with energy spectra below about 10 MeV, the effect of the energy dependence of soft error cross-sections varies across devices, resulting in device-dependent variations in the acceleration factor.
To assess the validity for estimating terrestrial soft error rates using CANSs, we measured the variation in acceleration factors for six types of SRAM-based FPGAs with design rules below 100 nm using an 18 MeV proton cyclotron neutron source. Although the acceleration factor showed variations across devices, these variations were found to be within the same order of magnitude and could be explained by differences in the energy dependence of soft error cross-sections for each device. Therefore, we conclude that we can adopt this accelerator to evaluate terrestrial soft error rates with precision within an order of magnitude regardless of the devices.

Email Address:

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Abstract classification - track type:

Applications

Session 11 / 15

Development of Nano-sized Graphene Flowers as Neutron Reflectors -Intensify neutron beam caused by coherent scattering-

Author: Makoto Teshigawara[1]

Co-authors: Yujiro Ikeda [2]; Kazuo Muramatsu [3]; Koichi Sutani [3]; Masafumi Fukuzumi [4]; Koichi Kimijima [3]; Yohei Noda [5]; Satoshi Koizumi [5]; Koichi Saruta [1]; Yoshie Otake [2]

[1] *Japan Atomic Energy Agency*

[2] *RIKEN*

[3] *INCUBATION ALLIANCE INC.*

[4] *Hyogo Prefectural Institute of Technology*

[5] *Ibaraki University*

Corresponding Authors: teshi@post.j-parc.jp, fukuzumi@hyogo-kg.jp, kimijima@incu-alliance.co.jp, satoshi.koizumi.prof@vc.ibara yotake@riken.jp, sutani@incu-alliance.co.jp, muramatsu@incu-alliance.co.jp, yujiro.ikeda@riken.jp, saruta.koichi@jaea.go.jp, yohei.noda.77@vc.ibaraki.ac.jp

Science using neutrons in the nanometer (nm) wavelength region as probes is expanding into a wide range of fields, from basic research in materials and life science to industrial applications. Dramatic increase in the intensity of the beam source is required to drive such research. We have focused on coherent scattering caused by nano-sized particle aggregations to increase the intensity of neutron beams. Nanodiamond is being vigorously researched and developed with the aim of practical application. On the other hand, we have focused on graphene, which has higher van der Waals forces by an order of magnitude and stronger bonding, sp2, between carbons than nanodiamond. This is expected to lead to its processability into a lumped for and to adapt to higher radiation fields. By promoting chemical vapor deposition (CVD), we have established a technique to form nano-sized graphene (called graphene flower) with a shape similar to a sunflower flower. In this talk, we report on the neutron scattering properties that contribute to the coherent scattering of the newly developed graphene flower.

Email Address:

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Cold Moderators and Beyond

Session 11 / 16

Development of Nano-Sized Graphene Flowers as Neutron Reflectors – Structural Control of Nano-Sized Graphene and Application as Neutron Reflectors

Author: Kazuo Muramatsu[1]

Co-authors: Koichi SUTANI [1]; Koichi KIMIJIMA [1]; Arnel CONCEPCION [1]; Makoto TESHIGAWARA [2]; Yujiro IKEDA [3]; Masafumi FUKUZUMI [4]; Satoshi KOIZUMI [5]; Yohei NODA [5]; Yuji KAWAMURA [3]; Koichi SARUTA [2]; Yoshie OTAKE [3]

[1] *Incubation Alliance, Inc.*

[2] *Japan Atomic Energy Agency*

[3] *RIKEN*

[4] *Hyogo Prefectural Institute of Technology*

[5] *Ibaraki University*

Corresponding Authors: saruta.koichi@jaea.go.jp, yotake@riken.jp, yohei.noda.77@vc.ibaraki.ac.jp, kimijima@incu-alliance.co.jp, concepcion@incu-alliance.co.jp, yuji.kawamura@riken.jp, fukuzumi@hyogo-kg.jp, satoshi.koizumi.prof@vc.ibaraki.ac.jp, teshigawara.makoto@jaea.go.jp, sutani@incu-alliance.co.jp, yjiro.ikeda@riken.jp, muramatsu@incu-alliance.co.jp

In order to enhance the intensity of neutron beams, attention has been focused on the coherent scattering caused by nano-sized particle aggregations, and the use of nanodiamonds has been actively considered. Graphene, which has a sp2 carbon crystal structure, has a large van der Waals force compared to sp3 carbon crystal structure such as nanodiamond, and the bonding force between carbon atoms is also strong, so it is expected to be easy to mold into a desired shape and to adapt to higher radiation fields. On the other hand, graphene is prone to agglomeration due to its large van der Waals force, and it has been difficult to form a nano-sized three-dimensional structure. To solve this problem, we focused on the hot isostatic pressing (HIP) method, which uses resin powder as a raw material and produces vapor-grown graphene by HIP. In this presentation, we will report on a method for preparing a graphene flower structure in which nano-sized graphene is three-dimensionally and free-standing, a method for controlling the nano-size of graphene, and the prototype of a graphene neutron reflector.

Email Address:

Presenter if not the submitter of this abstract:

muramatsu@incu-alliance.co.jp

Funding Agency:

Abstract classification - track type:

Cold Moderators and Beyond

Session 3 / 17

A CANS for Canada

Author: Drew Marquardt[1]

[1] *University of Windsor*

Corresponding Author: drew.marquardt@uwindsor.ca

Neutron scattering has proven to be one of the most powerful methods for the investigation of structure and dynamics of condensed matter on atomic length and time scales. Neutron techniques have a broad range of applications in physics, chemistry, magnetism and superconductivity, material sciences, cultural heritage, biology, soft matter, health, and environmental and climate science. A prototype Canadian CANS (PC-CANS) is proposed as the first step towards a national Canadian CANS facility of a next generation CANS. This new source would be the first of its kind in Canada; a source designed by accelerator and material scientists and optimized for the specific investigation of condensed matter and materials and beam for applications like F-18 production for PET and Boron Neutron Capture Therapy (BNCT).

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Future of CANS

Poster Session 1 / 18

Development of a Measurement Method of Neutron Energy-Dependent SEU Cross-Section Less than 0.1 MeV Using the 1/v Law

Author: Kaito Ishiguro[1]

Co-authors: Hidenori Iwashita [2]; Hirotaka Sato [1]; Michihiro Furusaka [1]; Ryu Kiuchi [3]; Takashi Kamiyama [1]; Tomoki Sebe [1]; Yoshiaki Kiyanagi [1]; Yoshihuru Hiroshima [3]; Yuji Sunada [3]

[1] *Graduate School of Engineering, Hokkaido University, Sapporo, Japan*

[2] *Graduate School of Engineering, Hokkaido University, Sapporo, Japan;Space Environment and Energy Laboratories, Nippon Telegraph and Telephone Corporation (NTT), Tokyo, Japan*

[3] *Space Environment and Energy Laboratories, Nippon Telegraph and Telephone Corporation (NTT), Tokyo, Japan*

Corresponding Author: ishiguro.kaito.q1@elms.hokudai.ac.jp

In recent years, the increase in the soft error rate (SER) caused by cosmic ray-neutrons on the ground has become a serious problem due to the miniaturization, high integration, and low power consumption of semiconductor devices. Therefore, it is important to design semiconductor devices considering SER. Estimation of SER for various environments requires the information of the neutron energy-dependent soft error probability (SEU cross-section) of each semiconductor device. We have successfully measured such SEU cross-section data from 10 meV to 800 MeV by the time-of-flight (TOF) method at high intensity short-pulsed neutron source facilities. As the result of these measurements, it was found that SEU cross-sections follow the 1/v law less than 0.1 MeV [1]. Based on this finding, in this study, we developed a measurement method utilizing the 1/v law for deducing the energy-dependent SEU cross-sections less than 0.1 MeV which can be conducted at a compact accelerator-driven (steady-state) neutron source.

First, we measured the SERs of some semiconductor devices induced by thermal neutrons (Data A) and the thermal neutron flux by the gold foil activation method at an 18 MeV proton cyclotron-driven neutron source of SHI-ATEX Co., Ltd. Next, we calculated irradiated thermal neutron energy spectrum (Data B) by Monte-Carlo particle transport simulation calculation code, PHITS, and converted this to the absolute value based on the measured thermal neutron flux. Finally, we derived the 1/v-dependent SEU cross-sections less than 0.1 MeV based on the results of Data A and Data B. Then we compared it with the results obtained by the TOF method. The results showed good agreement in the energy range from 10 meV to 0.1 MeV with an average difference of 3%.

References

[1] H. Iwashita, R. Kiuchi, Y. Hiroshima, Y. Okugawa, T. Sebe, M. Takeda, H. Sato, T. Kamiyama, M. Furusaka and Y. Kiyanagi, IEEE Transactions on Nuclear Science, 70, 216-221 (2023).

Email Address:

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Applications

Poster Session 1 / 19

Simulation of Photonuclear Neutron Yield on the CSNS Spallation Target and Reflector

Author: Liangsheng Huang[1]

Co-author: Bin Zhou [1]

[1] *Institute of High Energy Physics*

Corresponding Authors: lshuang@ihep.ac.cn, binzhou@ihep.ac.cn

The tantalum cladded solid tungsten is applied as the CSNS spallation targets. A large amount of high-energy gamma rays will be generated by the interaction between incident protons, secondary neutrons and the target materials. Furthermore, the radioactive spallation reaction fragments will also release decay gamma rays. These gamma rays could further produce neutrons through (γ, n) reactions on the target and reflector components. The photonuclear neutrons might affect the safe operation, and pose a risk to personnel radiation safety during the devices maintenance, so it is necessary to simulate and evaluate the photonuclear neutron yield as well as the resulting dose rate.

Simulated results show that the tungsten and tantalum, with relatively high photonuclear reaction cross sections but a high reaction threshold energy, will dominate the photoneutrons production during the CSNS operation. The yield and the spectra of the photoneutrons on beryllium reflector are also analyzed for the maintenance period.

Email Address:

Email Address

Presenter if not the submitter of this abstract:

Funding Agency:

Institute of High Energy Physics, Chinese Academy of Science(CAS), Beijing

Abstract classification - track type:

Physics

Session 8 / 20

Development and Application Status of 30 MeV Cyclotron Based Neutron Source in Korea

Author: Dong Won Lee[1]

Co-authors: Bongki Jung [1]; Kihyun Lee [1]; Pilsoo Lee [1]

[1] *Korea Atomic Energy Research Institute (KAERI)*

Corresponding Authors: khlee08@kaeri.re.kr, dwlee@kaeri.re.kr, pilsoolee@kaeri.re.kr, bkjung@qbeamsol.com

In Korea, neutron sources and related research facilities have been developed and utilized for the industrial and defense application with PGNAA and neutron radiography, and also development of fission and fusion energy. Among them, 30 MeV cyclotron-based neutron source development is completed the neutron generation preliminary evaluation is in progress, in which the existing cyclotron was used, and TMRS and new instrumentation devices are added. After the preliminary test, neutron imaging and neutron irradiation tests will be conducted in conjunction with the related facilities.

In the preliminary experiment, neutron spectrum and yield were measured with scintillator-based devices (H3164/9111B series PMTs with HDPE Bonner spheres) and we found that the neutron source can produce 1.6x10^12 n/s at 30 MeV and 0.01 mA. At this time, we obtained neutron radiography with standard samples for neutron radiography and we found the resolution can be up to 0.3 mm.

Email Address:

Email Address

Presenter if not the submitter of this abstract:

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KAERI, National Research Foundation of Korea (NRF)

Abstract classification - track type:

Applications

Session 11 / 21

The CoolGal Target: Core of the Phase 0 NEPIR (NEutron and Proton Irradiation) Facility

Author: Elizabeth Musacchio Gonzalez[1]

Co-authors: Alberto Monetti [1]; Alberto Campagnolo [2]; Jeffery Wyss [3]; Pierfrancesco Mastinu [1]; Luca Silvestrin [2]

[1] *LNL-INFN*

[2] *UNIPD*

[3] *UNICAS*

Corresponding Authors: alberto.monetti@lnl.infn.it, musacchio@lnl.infn.it, mastinu@lnl.infn.it

The NEPIR (NEutron and Proton Irradiation) facility at the SPES (Selective Production of Exotic Species) project at LNL-INFN (Italy), is designed to serve as a unique fast neutron irradiation facility in Italy and a reference point for applied and basic science as well as industrial applications. Driven by the SPES cyclotron, which delivers 35-70 MeV protons at maximum currents of 500 μA, NEPIR will be developed in phases. Phase 0 will produce continuous energy (white spectrum) neutron beams with the possibility to mimic quasi monoenergetic neutron beams (we call it pseudo monochromatic). Phase 1 will provide not only a white spectrum but also true Quasi Mono-energetic Neutron (QMN) beams with controllable energy peaks in the 20-70 MeV range. NEPIR represents a significant step toward addressing the growing demand for accessible, cost-effective neutron sources, filling the gap left by the declining availability of reactor-based neutron facilities. CoolGal, the target system for NEPIR Phase 0, focuses on studying, designing, and testing an innovative target system for proton-induced neutron production. CoolGal is based on a beryllium target, but it is conceived to become a Galinstan liquid metal cooled target with the aim to advance the frontiers of neutron science by enabling the production of high-intensity neutron beams. It will support a wide range of scientific and industrial applications, from radiation shielding studies to developing advanced detectors and medical technologies. CoolGal will allow studies like Single Event Effects (SEE) in electronics, relevant to numerous fields including nuclear energy, space, aviation, and automotive industries. This talk will outline the overall details of the phases of NEPIR and highlight the innovative features of the CoolGal target system, the target assembly as well as the concerns regarding operation and decommissioning. The modular approach of NEPIR and the strategic integration within the SPES infrastructure emphasizes cost-to-benefit efficiency establishing it as a crucial milestone in the advancement of Compact Accelerator-driven Neutron Sources (CANS) technology.

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Funding Agency:

Abstract classification - track type:

Future of CANS

Session 6 / 22

RIKEN Accelerator-Driven Compact Neutron Systems, RANS Project

Author: Yoshie Otake[1]

[1] *RIKEN*

Corresponding Author: yotake@riken.jp

At RIKEN we have developed compact neutron source systems for on-site quantitative evaluation for practical use. There are two major goals of our RANS Project's research and development. One is to establish and realize CANS (Compact Accelerator-driven Neutron Source) models that can be easily operated, non-destructively measured, and quantitatively evaluated, as a floor-standing type for industrial use as non-destructive analysis equipment. Another goal is to invent a novel transportable compact neutron system for the preventive maintenance of large-scale construction such as bridges and highways Two accelerator-based compact neutron source systems, RANS (7 MeV proton, Be target) [1] and RANS-II (2.49 MeV proton, Li target), as well as RANS-μ (252Cf) which have started real bridge measurements, are in constant operation. The transmission imaging, neutron diffractometer towards stress measurement, small angle scattering instruments with thermal and cold moderators at RANS, fast neutron scattering time-of-flight imaging, neutron activation analysis at RANS and RANS-II are available, and neutron-induced prompt gamma-ray analysis with RANS-μ.In addition, RANS-III, a transportable compact neutron system for non-destructive inspection of bridge decks, and cable-stayed bridge anchorage deterioration detection [2] by fast neutron scattering time-of-flight imaging [3] is being developed for onboard use. In 2025, fast neutron scattering imaging experiments with the RANS-III mounted on a trailer are planned to be carried out indoors to visualise the deterioration of the floor slabs of real bridges outdoors.

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[3] Y. Ikeda, et al. Plasma and Fusion Research Vol.13(2018) pp.2406005-1-5

Email Address:

Email Address

Presenter if not the submitter of this abstract:

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Abstract classification - track type:

Facility Updates

Session 5 / 23

Development of Entangled Probe Scattering with Neutrons

Authors: DAVID BAXTER[1]; Gerardo Ortiz[1]; Quan Le Thien[1]; Roger Pynn[1]; Samuel McKay[1]

[1] *Indiana University*

Corresponding Authors: samckay@iu.edu, baxterd@iu.edu, ortizg@iu.edu, mlethien@iu.edu, rpynn@iu.edu

One of the key roles that CANS facilities play in the international neutron ecosystem is providing the abundant beam time necessary for developing novel ideas in neutron instrumentation. Over the last two decades, LENS has devoted considerable effort to the development of spin manipulation devices, in particular the Magnetic Wollaston Prisms that have been used for various spin-echo techniques for high-resolution diffraction, direct measurements of projected density-density correlation functions, dark-field radiography among other techniques. We have recently demonstrated that such devices create mode-entangled states of neutrons. Viewed in this light, the high resolution obtained by SE techniques is seen as an example of quantum-enhanced sensing exploiting an interferometric approach, and we have embarked on an effort to explore the physics that may be investigated with such beams The talk will review the development of the instrumentation and applications along with

describing recent results from experiments performed at international-scale facilities using these ideas.

Email Address:

Presenter if not the submitter of this abstract:

Funding Agency:

US Department of Commerce, US Department of Energy

Abstract classification - track type:

Applications

Session 8 / 24

Facility Update on the Low Energy Neutron Source

Authors: Daniel Loveless[1]; David Baxter[1]; John Ostler[1]; Scott Wissink[1]

[1] *Indiana University*

Corresponding Authors: jostler@iu.edu, wissink@iu.edu, dlovele@iu.edu, baxterd@iu.edu

LENS has had a long and distinct history within the UCANS community. One unique feature of its history has been the evolution of the larger facility within which it has been housed (from an international-scale nuclear user facility, to a medical center, to a stand-alone neutron facility). This history has provided challenges for LENS operations, which will be discussed in this presentation. LENS has not operated since 2020 due to the complications and expense associated with restarting after the long shutdown imposed by the pandemic. Over the last several months, an effort has been launched to restart LENS with a primary focus on radiation effects in electronics. In this update, I will review some of the operational history of LENS, with an eye on lessons-learned that may be useful to the community, and I will provide an update on these most recent efforts to revive the facility and redirect its focus.

Email Address:

Presenter if not the submitter of this abstract:

Funding Agency:

Abstract classification - track type:

Facility Updates

Session 10 / 25

Performance of Neutron Beam System for Accelerator-Based BNCT

Author: Alexander Dunaevsky[1]

Co-authors: Vlad Vekselman [1]; Kirill Martianov [1]; Anatoly Muchnikov [1]; Aleksander Makarov [1]; Yong Jiang [1]

[1] *TAE Life Sciences*

Corresponding Author: adunaevsky@tae.com

Neutron Beam System (NBS) based on electrostatic proton accelerator designed for accelerator-based Boron-Neutron Capture Therapy (BNCT) has been installed in Xiamen Humanity Hospital, China. The NBS is used for patient treatments since October 2023, after more than a year of preliminary studies. By the end of 2024, more than 50 treatments were served. NBS uptime during 2024 was above 96%. Repeatability of the beam parameters were well within 2%. In present configuration with only one treatment room operational, the overall machine usage including clinical use, physics and dosimetry measurements, and biological experiments, reached 27% of its capacity. The presentation also discusses other aspects of the achieved performance.

Email Address:

Presenter if not the submitter of this abstract:

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Abstract classification - track type:

Accelerators / 26

Design Considerations for a Proton Linac for a Compact Accelerator Based Neutron Source for Canada

Authors: Mina Abbaslou[1]; Robert Laxdal[1]; Marco Marchetto[1]; Philipp Kolb[1]; Tobias Junginger[2]

[1] *TRIUMF*

[2] *Triumf*

Corresponding Authors: lax@triumf.ca, tobi@triumf.ca, marco@triumf.ca, mabbaslou@triumf.ca, kolb@triumf.ca

A prototype Canadian compact accelerator-driven neutron source (PC-CANS) is proposed for installation at the University of Windsor. PC-CANS is designed to produce neutrons for science and BNCT and protons for PET isotope production. The source will utilize a high-intensity compact proton RF linear accelerator, delivering a peak current of 20 mA with a 5% duty factor of protons at 10 MeV to the target. The accelerator comprises a short radio-frequency quadrupole (RFQ) to 3 MeV, followed by a drift tube Linac (DTL) structure accelerating to 10 MeV. Various room temperature DTL variants, including Alvarez, APF, KONUS, CH-DTL, , are considered at a frequency of 352.2 MHz, in addition to a superconducting HWR variant at 176.1 MHz.
This paper compares the beam dynamics of the various structures including RFQ variants at the two frequencies and performance with and without a MEBT. Comparisons include beam transmission, longitudinal and transverse emittance growth, Linac length and longitudinal and transverse phase acceptance.
Beam dynamics simulations were conducted using the PARMTEQ, LANA, PARMILA, and Trace-3D codes. This work contributes to the development of next-generation CANS by providing a comparison in performance over several Linac structures.

Email Address:

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Abstract classification - track type:

Session 6 / 27

Development of a High-Intensity Accelerator-Based D-D/D-T Fusion Neutron Source

Author: Zheng Wei[1]

Co-authors: Zeen Yao [2]; Yu Zhang [2]; Junrun Wang [2]; Kang Wu [2]; Qiaoyue Jiang [2]

[1] *School of Nuclear Science and Technology, Lanzhou University, Lanzhou, China*

[2] *School of Nuclear Science and Technology, Lanzhou University, China*

Corresponding Authors: weizheng@lzu.edu.cn, zeyao@lzu.edu.cn, wuk20@lzu.edu.cn, zhyu@lzu.edu.cn, jiangqy2023@lzu.edu.cn, wangjr@lzu.edu.cn

The accelerator-based D-D/D-T fusion neutron source, with mono-energy and high-intensity, is the key equipment to carry out the advanced research of neutron physics and neutron application technology, which provide reliable neutron source for basic research of neutron physics, new nuclear energy utilization system research and development, fusion device research and development, nuclear technology application, etc. A high-intensity accelerator-based D-D/D-T fusion neutron source with a thick adsorption target is developed in Lanzhou university, China. A high-current microwave ion source is used to produce a large current deuteron beam, and neutrons are generated by irradiating the deuteron beam on a deuterium-adsorption target or tritium-adsorption target. The D+ beam spot size is about 20.0 mm. According to the multi-layer computing model, neutron energy spectra, angular distributions and yields for the thick target can be calculated with remarkable precision. The neutron energy spectra are non-mono-energetic neutrons for the developed neutron generator, the neutron angular distributions are anisotropic distributions, and they can provide neutrons with an intensity of 2.8×10^11 n/s (D-D) and 1.4×10^13 n/s (D-T), respectively, with the deuteron of 450 keV/50 mA. In particular, based on the heat conduction theory, the thick adsorption rotating target with water-cooling can withstand the D+ ions beam and ensure that the temperature is less than 200 ℃, which will reduce deuterium or tritium release from adsorption target to ensure neutron beam stability.

Email Address:

Email Address

Presenter if not the submitter of this abstract:

Zheng Wei

Funding Agency:

Abstract classification - track type:

Facility Updates

28

Study on a Gas Target Deuterium-Tritium Fusion Neutron Source

Author: Qiaoyue Jiang[1]

Co-authors: Zeen Yao [2]; Zheng Wei [3]; Yu Zhang [2]; Junrun Wang [2]; Kang Wu [2]

[1] *MOE Frontiers Science Center for Rare Isotopes, Lanzhou University, China*

[2] *School of Nuclear Science and Technology, Lanzhou University, China*

[3] *School of Nuclear Science and Technology, Lanzhou University, Lanzhou, China*

Corresponding Authors: wuk20@lzu.edu.cn, wangjr@lzu.edu.cn, weizheng@lzu.edu.cn, jiangqy2023@lzu.edu.cn, zeyao@lzu.edu.cn, zhyu@lzu.edu.cn

With the continuous development of neutron sources in various fields, achieving efficient miniaturization of accelerator-based neutron sources has become a research hotspot. Traditional large-scale neutron sources devices are limited by their large size and high energy consumption, restricting their feasibility in small laboratories and field applications. Therefore, designing a compact and neutron source with low-energy consumption holds significant scientific and practical value. This research proposes a novel design for a deuterium-tritium (D-T) neutron source, which employs a ring-shaped gas target structure combined with 16 uniformly arranged deuteron beams to enhance neutron yield and uniformity in energy distribution. Neutron field data were extensively simulated using the Geant4 Monte Carlo program. The results show that, under a unit milliampere beam current, the neutron yield at the center of the ring target reaches the order of 10^14 neutrons per second, with good monoenergetic characteristics and a relatively concentrated energy distribution, indicating potential as a quasi-monoenergetic neutron source. Additionally, the angular distribution of the neutron field inside the ring target is stable with minor fluctuations, demonstrating good spatial uniformity. Furthermore, to reduce tritium gas consumption, two design schemes are proposed to optimize gas usage efficiency. This design provides a new approach to the miniaturization and efficiency improvement of accelerator-based neutron sources.

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Abstract classification - track type:

Facility Updates

Session 8 / **29**

CANS Projects Progress and Related Technology Development in China

Author: Xuewu Wang[1]

Co-authors: Qingzi XING [1]; Yigang YANG [1]; Zhe WANG [1]; C-CANS members

[1] *Tsinghua University*

Corresponding Authors: zwang2017@tsinghua.edu.cn, yangyigang@tsinghua.edu.cn, xqz@tsinghua.edu.cn, wangxuewu@tsinghua.edu.cn

There are three grand national neutron sources in operation in China, including, China Spallation Neutron Source (CSNS), China Advanced Research Reactor (CARR) and China Mianyang Research Reactor (CMRR). Chinese Neutron Scattering Society (CNSS) was formally established as a branch of the Chinese Physical Society (CPS) in 2012, which forms a good situation for developing of neutron science and technology.
There are several projects with Compact Accelerator-driven Neutron Source (CANS) in operation, in construction and in proposal in China, such as, the Compact Pulsed Hadron Source (CPHS) and e-LINAC driven bimodal source in Tsinghua University, the Peking University Neutron Imaging Facility (PKUNIFTY), the compact high-energy high-flux D-Be neutron source at Institute of Modern

Physics, China Academy of Science, the CANS and neutron radiography facility of China Academy of Engineering Physics, the cyclotron-based BNCT and neutron imaging facility at China Institute of Atomic Energy, the RFQ-based Boron Neutron Capture Therapy at Dongguan (D-BNCT) supported by CSNS, the electrostatic accelerator-based BNCT (AB-BNCT) of NeuBoron, the intense neutron generator and RFQ-based BNCT of Lanzhou University, the CANS and RFQ-based BNCT in Xi'an Jiaotong University, and so on. The progress of the CANS projects in China, especially the new projects and recent progress, will be presented.
The trend and opportunity of CANS projects will be discussed, especially several AB-BNCT projects have been operated, launched or proposed in recent years. The related technology development along with CANS will also be discussed.

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Presenter if not the submitter of this abstract:

Funding Agency:

Abstract classification - track type:

Future of CANS

Session 5 / 30

Development of RANS-III for Outdoor Measurement

Author: Tomohiro Kobayashi[1]

Co-authors: Shota Ikeda [2]; Yujiro Ikeda [1]; Takeru Ohgo [1]; Maki Mizuta [1]; Yasuo Wakabayashi [1]; Tomonori Fukuchi [1]; Noriyosu Hayashizaki [2]; Yoshie Otake [1]

[1] *RIKEN Neutron Beam Technology Team*

[2] *Institute of Science Tokyo*

Corresponding Author: t-koba@riken.jp

We have been developing the RIKEN Accelerator-driven compact Neutron Systems (RANS) since 2011. Two accelerator-based neutron systems and an RI-based neutron salt meter are already being used for daily neutron scattering measurement experiments. RANS-I consists of 7 MeV proton LINAC (425MHz RFQ+DTL coupled) and a beryllium target with a room temperature polyethylene moderator and a helium-cooled mesitylene moderator. For the RANS-II (200MHz RFQ), the proton energy was lowered to 2.5 MeV to reduce the weight of the accelerator and the shielding. At the same time, we have developed a method to make measurements with a smaller number of neutrons produced. RANS-II is currently used as a stationary compact neutron source.
Based on the measurement technique, accelerator technology, and shielding parameters obtained from RANS-II, we are now developing RANS-III equipped with a 500 MHz RFQ accelerator and preparing it for field measurements on a trailer. RANS-III is currently being developed to irradiate neutrons downward and to detect the bridge deterioration through moisture and salt density measurements with neutron scattering visualization and PGAA from the surface level.
In 2024, the equipment was installed on a 40 foot size custom-built trailer, and operational testing of the equipment is currently underway. The floor of the trailer is reinforced with 22 mm thick steel plates and seven steel gates are installed to ensure rigidity. Protons accelerated horizontally toward the rear of the vehicle are deflected vertically by electromagnets and irradiated to a lithium target installed in the center of the elevating shielding under the floor through an approximately 80 cm square through-hole in the floor. The lithium target is 40 mm in diameter, and the irradiated proton beam diameter is designed to be about the same size to distribute the heat load on the target surface.
In 2025, with the trailer stored in the newly constructed building, we will conduct neutron generation tests, environmental radiation level measurements, and actual sample measurements.

Email Address:

Presenter if not the submitter of this abstract:

Funding Agency:

Abstract classification - track type:

Instrumentation and Hardware

Session 3 / 31

ARGITU, the Spanish High-Current Accelerator-Driven Neutron Source

Author: Felix J Villacorta[1]

Co-authors: Fernando Sordo [1]; Ibon Bustinduy [1]; Mario Perez [1]; Jose Maria Porro [2]; Viktor Petrenko [2]; Senentxu Lanceros-Mendez [2]; Marite Cardenas [3]; Felix Fernandez-Alonso [4]; Armando Maestro [4]; Arantxa Arbe [5]; Juan Colmenero [5]

[1] *ESS-Bilbao*

[2] *Ikerbasque; BC Materials*

[3] *Ikerbasque; Biofisika Institute*

[4] *Ikerbasque; Materials Physics Center*

[5] *Materials Physics Center*

Corresponding Author: fjimenez@essbilbao.org

F. J. Villacorta,1,* I. Bustinduy,1 F. Sordo,1 M. Pérez,1 J. M. Porro,2,3 V. Petrenko,2,3 S. Lanceros-Méndez,2,3 M. Cárdenas,3,4 F. Fernandez-Alonso,3,5 A. Maestro,3,5 A. Arbe5 and J. Colmenero5
1 ESS-Bilbao, Bizkaia Technology Park, Laida Bidea, Building 207 B, Ground Floor, 48160 Derio, Spain
2 BCMaterials, Basque Center for Materials, Applications and Nanostructures, UPV/EHU Science Park, 48940 Leioa, Spain
3 IKERBASQUE, Basque Foundation for Science, Plaza Euskadi 5, 48009, Bilbao, Spain.
4 Biofisika Institute, University of Basque Country and Consejo Superior de Investigaciones Científicas (UPV/EHU, CSIC), Leioa, Spain
5 Centro de Física de Materiales (CFM) (CSIC–UPV/EHU)—Materials Physics Center (MPC), Paseo Manuel de Lardizabal 5, 20018 San Sebastián, Spain

ARGITU is the Spanish initiative framed within the joint European strategy to develop the next generation of high-current accelerator-driven neutron sources (HiCANS). The source consists of a pulsed medium power proton beam accelerator (~ 45 kW), with an energy of 31.5 MeV and a period of 30 Hz. This proton beam hits a beryllium target, producing neutrons moderated at the desired thermal and cold energy ranges to feed a suite of neutron instruments. A modular design allows the integration of up to four instruments per target station.
The development of the ARGITU project has been planned in a staggered manner, based on the implementation of accelerator components to increase the power of the source. The future provision of neutrons for the first stages of ARGITU will allow the possibility of testing new neutron instrumentation, as well as to validate the neutron source at every stage.
After initial demonstrations of the technology and validation of neutron instrumentation at every step, the final layout at full power will allow the implementation of neutron scattering instruments. In this sense, new concepts for diffractometers, large-scale structure instruments, spectrometers and even non-scattering techniques are being proposed and will be described in this presentation.

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Future of CANS

Poster Session 1 / 32

Beam Dynamics Design for Alternating Phase Focusing Proton LINAC for a Compact Accelerator Based Neutron Source

Authors: Mina Abbaslou[1]; Robert Laxdal[1]; Marco Marchetto[1]; Philipp Kolb[1]; Tobias Junginger[2]

[1] *TRIUMF*

[2] *Triumf*

Corresponding Authors: kolb@triumf.ca, lax@triumf.ca, marco@triumf.ca, mabbaslou@triumf.ca, tobi@triumf.ca

A prototype Canadian compact accelerator-driven neutron source (PC-CANS) is proposed for installation at the University of Windsor. The source is based on a high-intensity compact proton RF accelerator that delivers an average current of 10 mA of protons at 10 MeV to the target. This study can serve as a basis for the design of an initial stage of a new high-intensity compact accelerator-driven neutron source (CANS). The accelerator consists of a short radio frequency quadrupole (RFQ), followed by an efficient drift tube Linac (DTL) structure. Different variants of DTL were investigated for our studies. An Alternating Phase Focusing (APF), KONUS, CH-DTL, and Alvarez DTL as normal conducting cavities with a frequency of 352.2 MHz were considered in our Linac design. Details of the beam dynamics of an Alternating Phase Focusing (APF) DTL are presented in this paper.

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Poster Session 1 / 33

Numerical Investigation on the Thermal Performance of the Rotating Target for CANS

Authors: Rui Zhang[1]; Yanzhong Luo[1]; Yibo Shao[1]; Xuewu Wang[1]; Zhe Wang[1]

[1] *Department of Engineering Physics, Tsinghua University, Beijing 100084, China*

Corresponding Authors: shaoyb23@mails.tsinghua.edu.cn, z-r21@mails.tsinghua.edu.cn, luoyz22@mails.tsinghua.edu.cn, zwang2017@mail.tsinghua.edu.cn, wangxuewu@tsinghua.edu.cn

Compact Accelerator-driven Neutron Sources (CANS) demonstrate significant potential for applications in both scientific and industrial fields. A critical challenge for further expanding CANS's applications is to improve the neutron yield, which requires a highly-efficient thermal dissipation

ability for neutron target to bear the high power of incident beam. By employing the rotating target, the bearable thermal load of neutron target can be significantly enhanced. Therefore, a quantitative evaluation of the thermal dissipation capacity of rotating target is in need.
Based on the Compact Pulsed Hadron Source (CPHS) at Tsinghua University, we are developing a neutron target station for Boron Neutron Capture Therapy (BNCT) utilizing the 7Li(p,n)7Be nuclear reaction. Given lithium's low melting point, we conduct systematic simulation studies on the rotating lithium target to improve its thermal dissipation efficiency, which is essential for reducing localized overheating damage and extending operational lifespan. By employing finite element and finite volume methods, we optimize the configuration of target slices and adjust rotational velocities according to various beam intensity distributions, including uniform and Gaussian profiles, at different beam powers. These optimizations ensure an efficient thermal dissipation while meeting stringent engineering criteria. Our results provide robust theoretical and practical foundations for the application of rotating targets in CANS.

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Abstract classification - track type:

Instrumentation and Hardware

Poster Session 1 / 34

Neural Network Approach for Determination of Neutron Beam Directionality in BNCT

Authors: Yanzhong Luo[1]; Hongfei Chen[1]; Pulin Bai[1]; Xuewu Wang[1]; Zhe Wang[1]

[1] *Tsinghua University*

Corresponding Authors: wangxuewu@tsinghua.edu.cn, chenhongfei@hrbeu.edu.cn, bpl19@mails.tsinghua.edu.cn, luoyz22@mails.tsinghua.edu.cn, zwang2017@mail.tsinghua.edu.cn

For accelerator-driven neutron sources applied in Boron Neutron Capture Therapy (BNCT), the directionality of the neutron beam is a critical characteristic, as it directly influences both the penetration depth of the therapeutic beam within tissues and the magnitude of undesired radiation.
We propose a method that combines the gold foil activation technique and the neural network to measure the statistical characteristics of neutron directionality. Firstly, using the Monte Carlo method, we calculate the (n, γ) reaction rates for the AuAl foils under certain spatial distribution by artificially setting different neutron flight direction distributions at the neutron exit. Subsequently, these simulation results are utilized as a training dataset, and a regression model is constructed using a neural network approach. Finally, a series of AuAl foils, placed in the aforementioned spatial configuration at the neutron exit of the target station, are irradiated by neutron beam for certain time. The activity data are then recorded. Based on these experimental data, we employ the regression model to determine the statistical characteristics of the neutron flight direction distribution at the neutron exit, such as the nth order moments of the distribution.
The validity and accuracy of above method are tested by Monte Carlo results based on a neutron target station structure designed for BNCT. Then, we apply this method to process experimental activation data obtained at the BNCT target station at the Compact Pulsed Hadron Source (CPHS) of Tsinghua University, and the results demonstrate a high degree of consistency with the simulation.

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Abstract classification - track type:

Session 9 / 35

A Proposal for the ICONE Cold Neutron Moderator

Author: Richard Wagner[1]

Co-authors: Frédéric Ott [2]; Jacques Darpentigny [2]

[1] *Laboratoire Léon Brillouin, CEA Saclay*

[2] *Laboratoire Léon Brillouin*

Corresponding Authors: frederic.ott@cea.fr, richard.wagner@cea.fr, jacques.darpentigny@cea.fr

Compact Accelerator-driven Neutron Sources (CANS) and their high current variants (HiCANS) with a notably larger neutron yield, have the potential to become an important part in the currently ongoing transformation of the neutron research landscape. One particular effort is the ICONE project, an initiative to build a French HiCANS to serve the needs of the French neutron scattering community (1).
Since in a CANS, neutrons are produced in a smaller and more confined region than e.g. in spallation sources performance gains are expected, when moderators are placed in close proximity to the neutron production region.
Of particular interest is to utilize the concept of a low-dimensional (i.e. disc-like 2D or pencil-like 1D geometries) para-hydrogen neutron moderator (2), that predicts significant gains in emission brightness. The objective of the CONEMO (Cold Neutron Moderator) project is to develop tools and methods for modeling these low dimensional moderators to integrate them into ICONE.

For engineering issues, we are currently focusing our efforts on a 2D flat moderator which enables both a rather simple construction, since there is only one cold cell, while still providing good performances (see Fig.1).

We will describe the constrains which led to this design and the performances which can be achieved in terms of brilliance. The optimal positioning of different scattering instruments around such a moderator is also proposed.

The flux of cold and thermal neutrons has been studied with the open source Monte Carlo particle transport code OpenMC (3). The brightness of the emission surface was used as the figure of merit (FOM) for the comparison of different layouts. As OpenMC is target not capable to simulate accelerated charged particles a strategy to implement a realistic target has been developed for the materials Beryllium and Tantalum for protons with energies 25 MeV respectively 40 MeV.

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2) L. Zanini, F. Mezei, K. Batkov, E. Klinkby, A. Takibayev, Journal of Physics: Conference Series 1021, 012009 (2018)
3) P.K. Romano, N.E. Horelik, B.R. Herman, A.G. Nelson, B. Forget, K. Smith, Annals of Nuclear Energy 82, 90 (2015)

Email Address:

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Presenter if not the submitter of this abstract:

Funding Agency:

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Cold Moderators and Beyond

Poster Session 1 / 36

Progress of Grazing-Incidence Focusing Small-Angle Neutron Scattering (gif-SANS) Spectrometer at CPHS

Authors: Meng Yuan[1]; Xuewu Wang[1]; Zhe Wang[1]; Weihang Hong[1]; Changtong Du[1]; Nan Hua[1]; Hui Gong[1]; Yuxuan Lai[1]; YangYi Yu[1]; Yigang Yang[1]; Dongxu Yu[1]; Wentao Song[2]; Zhong Zhang[2]; Weiliang Cai[3]; Ping Wang[3]

[1] *Department of Engineering Physics, Tsinghua University, Beijing 100084, China*

[2] *School of Physics Science and Engineering, Tongji University, Shanghai 200092, China*

[3] *Dongguan Neutron Science Center, Dongguan 523803, China*

Corresponding Authors: wangxuewu@tsinghua.edu.cn, zwang2017@tsinghua.edu.cn, yuanm23@mails.tsinghua.edu.cn

Small-angle neutron scattering (SANS) spectrometer based on compact accelerator-driven neutron sources (CANSs) faces several challenges: the neutron current is 2~3 orders lower than that of large sources, and the compact size results in stricter constraints between neutron flux and Q_{min}. The grazing-incidence focusing SANS (gif-SANS) at Compact Pulsed Hadron Source (CPHS) of Tsinghua University addresses these challenges by novel neutron optics. A nested neutron-focusing mirror with a large collecting area is used to achieve $> 10^5$ n/s neutron flux at $Q_{\mathrm{min}} < 0.007$ Å^{-1} in gif-SANS, with a pinhole collimation optics that can be switched to achieve higher Q. Two detectors are equipped on gif-SANS, a large collecting area ^{3}He LPSDs detector for normal Q-range measurements, and a high-resolution neutron-sensitive microchannel plate ($^{\mathrm{n}}$MCP) detector for extending the Q_{min} down to 10^{-3} Å^{-1}.
In 2024, we completed the fabrication of major components of the gif-SANS. We have manufactured the seven-layer nested neutron-focusing mirror (coated with m=3 Ni/Ti supermirror), the ^{3}He detector, $^{\mathrm{n}}$MCP detector, and the bandwidth limiting neutron chopper, and conducted preliminary tests. We have completed the design of the overall mechanical structure, including the scattering chamber. In 2025, we plan to conduct more detailed tests on each component, followed by the overall installation and commissioning of the spectrometer, and finally conduct a comprehensive acceptance test.
We have conducted tests on neutron-focusing mirror. The test results show that the gain in flux meets the requirements, but neutron signals with gradual attenuation exist outside the edges of the neutron focused region. These signals may lead to poor resolution and high background, so we have improved and fabricated a new version of the focusing mirror and designed a post-collimation aperture system to optimize resolution and reduce background. The post-collimation aperture system consists of five blocking plates with slits that match the optical path of the focusing mirror. The collimation plates are arranged between the focusing mirror and the sample to block diffuse scattered and crosstalk neutrons.

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Instrumentation and Hardware

Session 3 / 37

Progress Report for the LvB HCANS Project in Martonvásár

Author: Ferenc Mezei[1]

Co-author: Gabor Anda [2]

[1] *Mirrotron Ltd,*

[2] *HUN-REN CER*

Corresponding Authors: ferenc.mezei@mirrotron.com, anda.gabor@ek.hun-ren.hu

F. Mezei1, G. Anda2, M. Csíkos1, Á. Horváth2, A. Kocsonya1,2, P. Konik1,2, R. Mezei1, L. Rosta1,2, H. Shuai1, P. Sipos1, S. Zoletnik2 and G. Zsuga1
1Mirrotron Ltd., 2462 Martonvásár, 1517/1 hrsz. Hungary
2 HUN-REN Centre for Energy Research, 1121 Budapest, Konkoly Thege u. 29-33, Hungary

The compact neutron source project LvB is being completed by a consortium of Mirrotron Ltd and HUN-REN Center for Energy Research and will be operated by Mirrotron Ltd. The construction project is supported by important grants for development of regional industry, amounting to a total equivalent of 4.5 million €. The total project costs until the end of 2025 will amount to about 7.5 million €. The difference is private funding contribution by Mirrotron Ltd. At this stage the facility will consist of a 2.5 MeV linear accelerator and two target stations, that will be used alternatively. The first target station will provide cold and thermal bi-spectral neutron beams for material studies, primarily for industrial use, by a reflectometer with polarized neutron capability and a large solid angle powder diffractometer. The second target station will produce a broad epithermal neutron beam spectrum for the development of cancer therapy and neutron irradiation applications. A foreseen, not-yet funded upgrade is to add a DTL type accelerator afterburner in front of the materials target station in order to enhance the accelerated proton energy to above 5 MeV. This can enhance the generated neutron intensity by an order of magnitude by switching to Be target, while the 2.5 MeV proton energy and Li target will be maintained for the beam for healthcare related irradiation purposes. By now the installation of the 2.5 MeV RFQ accelerator together with its RF power supply, with 300 kW peak power in 1.25 ms long pulses of 40 Hz repetition rate is completed, together with the proton beam target with Li coated copper blocks and a combined cold and thermal neutron beam moderator. The proton beam deflector and focusing magnets are designed and in the manufacturing process. The reflectometer and the diffractometer, together with the beam delivery by choppers and a guide system are designed and manufacturing is largely completed. The neutron detector systems to these instruments have been acquired in connection with the replacement of two old instruments at ILL. The physical design of a substantial part of the proton and neutron optical aspects of the epithermal irradiation target system have been completed very recently, resulting in some innovative solutions. The one outstanding difficulty in our progress was due to the failure of the company which has won the public procurement tender in 2021 for providing the proton ion source for the RFQ accelerator. Alternative efforts are being pursued, with the initial goal of being able to start before long the accelerator system, with a fraction of the designed 20 mA peak proton beam current in the pulsed operation.

Email Address:

Email Address

Presenter if not the submitter of this abstract:

Ferenc Mezei

Funding Agency:

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Future of CANS

Session 10 / 38

Current Status of RANS-μ, a Neutron Salt-Meter for Non-Destructive Inspection of Concrete Bridge at On-Site Use

Author: Yasuo Wakabayashi[1]

Co-authors: Hiroshi Watase [2]; Kyoji Niitani [2]; Masato TAKAMURA [3]; Ryuutarou Ooishi [2]; Tomonori Fukuchi [4]; Yoshie Otake [4]; Yujiro Ikeda [4]

[1] *RIKEN / Ransview*

[2] *Oriental Shiraishi corporation*

[3] *Ransview corporation*

[4] *RIKEN Neutron Beam Technology Team*

Corresponding Authors: y.wakabayashi@riken.jp, masato.takamura@ransview.co.jp

As it has been reported that bridges collapsed and many serious damages occurred due to chloride attack of concrete structure all over the world, strong demands have been addressed to urgent requirement of a non-destructive on-site measuring techniques which can measure the chloride ion concentration in concrete structures distributed from the surface to steel bar. To meet them, we have developed of a ortable type neutron salt-meter, RANS-μ, combining with Cf-252 as neutron source and the method of prompt gamma neutron activation analysis (PGNAA).
In the development, feasibility of RANS-μ has been examined at outdoor test fields and at concrete bridges in real use as national highway from effectiveness of non-destructive way point of view. The results by RANS-μ were compared with data obtained by conventional methods like a concrete core sampling, showing are quite reasonable agreements between them. Eventually, performance of RANS-μ was demonstrated that "the lower detection limit is below 1.0kg/m3 of the chloride ion concentration to know the marginal concentration of 1.2kg/m3 at which steel corrosion starts", "it can measure the chloride ion concentration in 3 depth every 3cm from concrete surface", "it can measure in 15 minutes to 1 hour in total measuring time", "it has around 50kg of total weight", and "it can be installed on the bucket of inspection vehicle".
A company names "Rans View"was established in April 2023 to dedicate RANS-μ to diagnose distribution of salt ion concentration in concrete bridges. Upto January 2025, the 66 bridges and their many parts such as piers and main girders have been measured from Hokkaido in the north to Okinawa in the south in Japan. The development of the system will be proceeded to show the chloride ion concentration near steel bars after measurement immediately.
We report current status of RANS-μ, highlighting specific detector system developments in terms of sensitivity and compactness.

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Presenter if not the submitter of this abstract:

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Abstract classification - track type:

Applications

Poster Session 1 / 39

Neutron Measurement Technology for the Proactive Maintenance of the Social Infrastructure

Author: Tomonori Fukuchi[1]

Co-authors: Hiroki Kusano [1]; Maki Mizuta [1]; Sohei Imajo [1]; Yasuki Okuno [1]; Yoshie Otake [1]

[1] *RIKEN Center for Advanced Photonics*

Corresponding Authors: maki.mizuta@riken.jp, hiroki.kusano@riken.jp, sohei.imajo@riken.jp, tfukuchi@riken.jp, yotake@riken.jp, yasuki.okuno@riken.jp

We have been conducting research on non-destructive inspection techniques using neutron measurement for the proactive maintenance of the social infrastructure. RANS-III (transportable RIKEN Accelerator-driven compact Neutron Systems) is under development and responded to on-site needs to the recent global increase of cable-stayed bridge falls and other accidents that have occurred due to water infiltration in cable-anchorage, unfilled grout in cable, etc. In other words, by detecting the progression of internal deterioration at an early stage, repairs can be made before severe damage occurs, thereby shifting from after-the-fact maintenance to proactive maintenance, aiming to reduce maintenance costs and extend the service life of social infrastructure. This study reports on the development of a floor-standing type RANS-II, a prototype of RANS-III, as a preliminary experiment prior to the operation of the transportable RANS-III. An experiment of non-destructive inspection technology for test cable of cable-stayed highway bridge was conducted to detect infiltrated water in the test cable. In this experiment, a two-dimensional neutron position time-of-flight detector using He-3 gas is used as a neutron detector. As a result, by comparing the amount of flow out neutron to the side of the cable with and without simulated infiltrated water (acrylic rod 15 mm in diameter, containing neutron-sensitive hydrogen) in the cable (160 mm in diameter), increase of the neutron flow out was detected with the presence of simulated infiltrated water even in 1% of the cross sectional area of 160 mm in cable diameter. In the future, we will develop a method for detecting internal deterioration of bridge cable and highway road using the RANS-II neutron beam and neutron position detector, leading to on-site use of the transportable RANS-III.

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Funding Agency:

Abstract classification - track type:

Applications

Poster Session 1 / 40

Skyrmions: SANS, NSE and μSR

Author: Sarah Dunsiger[1]

[1] *TRIUMF / Simon Fraser University*

Corresponding Author: dunsiger@triumf.ca

Topological defects or solitons are irregularities which occur within continuous fields or ordered states of matter. These defects (points, lines, or surfaces) are characterised by their stability and the fact that they cannot be ‘smoothed out’ or removed through continuous transformations. In particle physics, the Skyrmion is a topologically stable field configuration originally proposed to describe the

nucleon. In solid state physics, crystalline materials without inversion symmetry exhibit a variety of exotic magnetically ordered states with canted spin structures like helices, conical states or a periodic array of "Skyrmions", a swirling topologically nontrivial spin structure.

The role of muon spin relaxation (μSR) and neutron scattering in revealing the rich magnetic phase diagram of cubic chiral magnets like MnSi is discussed. This material hosts single Bloch-type skyrmions resulting from competing or "magnetically frustrated" exchange and Dzyaloshinskii-Moriya interactions. Small angle neutron scattering (SANS) has shown that Skyrmion formation may be controlled by an applied magnetic field. This is akin to defining 0 and 1 bits, making skyrmion hosting materials candidates for applications in data storage and structure.

On a fundamental level, a knowledge of the spin excitations in canted spin systems, including chiral fluctuations, is crucial, since they are defined by the magnetic interactions within the system. Boundaries and confined geometries will markedly influence this spin fluctation spectrum. Thermal fluctuations stabilise the Skyrmion phase in only a very small precursor phase in bulk samples. Intrinsically, interfaces break inversion symmetry, leading to greatly enhanced stability of Skyrmion phases in thin films, for reasons which are under research.

The spin dynamics associated with a lattice of Skyrmions are challenging to measure at the microelectronvolts energy scale at small wavevectors needed. The landscape of complementarity between various large scale facility based experimental techniques like small angle neutron scattering (SANS), neutron spin echo (NSE) and μSR will be described, using MnSi as a rewarding example. Some of these techniques are part of the infrastructure within the Centre for Molecular and Materials Science at TRIUMF. Others constitute a wish list for future Canadian accelerator based neutron sources.

Email Address:

Email Address

Presenter if not the submitter of this abstract:

Sarah Dunsiger

Funding Agency:

Abstract classification - track type:

Applications

Session 5 / 41

Boosting the Measurement Capabilities of CANS by Statistical Inference

Author: Chi-Huan Tung[1]

Co-authors: Bobby Sumpter [1]; Changwoo Do [1]; Sidney Yip [2]; Wei-Ren Chen [1]

[1] *Oak Ridge National Laboratory*

[2] *Massachusetts Institute of Technology*

Corresponding Authors: chenw@ornl.gov, syip@mit.edu, tungc@ornl.gov, sumbterbg@ornl.gov, doc1@ornl.gov

SANS is a commonly used technique for structural study of materials. However, its effectiveness is often perceived to depend on the availability of high incident neutron flux. In this work, we introduce a data analysis method grounded in the properties of multivariate Gaussian distributions, which accounts for the proximity relationships among detector pixels. This approach enhances the ability to identify trends obscured by statistical noise while simultaneously providing confidence intervals for measurements.

Our method demonstrates robustness against incoherent noise and accommodates variations in sample size and limited beam-time exposures. Crucially, it relies entirely on statistical inference from individual sparse measurements, eliminating the need for sample- or instrument-specific training datasets typically required for machine learning approaches. This innovation significantly enhances the measurement capabilities of CANS for structural studies using SANS.

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Abstract classification - track type:

Applications

Session 6 / 42

PC-CANS - Conceptual Design of a Compact Accelerator Based Neutron Source for Canada

Author: Robert Laxdal[1]

Co-authors: Alexander Gottberg [1]; Dalini Maharaj [2]; Drew Marquardt [3]; Marco Marchetto [1]; Mina Abbaslou [1]; Oliver Kester [1]; Philipp Kolb [1]; Sana Tabbassum [4]

[1] *TRIUMF*

[2] *Forschungszentrum Jülich*

[3] *University of Windsor*

[4] *Purdue*

Corresponding Authors: okester@triumf.ca, gottberg@triumf.ca, lax@triumf.ca, kolb@triumf.ca, drew.marquardt@uwindsor.ca, stabbass@purdue.edu, mabbaslou@triumf.ca, d.maharaj@fz-juelich.de, marco@triumf.ca

In an effort to close the neutron gap in Canada a prototype, compact accelerator-based neutron source for Canada (PC-CANS) is proposed for installation at the University of Windsor. The PC CANS is envisaged to serve two neutron science instruments, a boron neutron capture therapy (BNCT) station and a beamline for fluorine-18 radioisotope production for positive emission tomography. To serve these diverse applications of neutron beams, a linear accelerator solution is selected, that will provide 10 MeV protons with a peak current of 10 mA within a 5% duty cycle. The accelerator is based on an RFQ and DTL with a post-DTL pulsed kicker system to simultaneously deliver macro-pulses to each end-station. The neutron production targets for both neutron science and BNCT will be of Beryllium and engineered to handle the high beam power density. A staged approach is foreseen for ramping the power. Conceptual studies of both the accelerator and the target-moderator-reflector (TMR) will be presented.

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Abstract classification - track type:

Facility Updates

43

The instrumentation of the planned HiCANS at Forschungszentrum Jülich

Authors: Jörg Voigt[1]; Klaus Lieutenant[1]

Co-authors: Eric Mauerhofer [1]; Paul Zakalek [1]; Ullrich Ruecker [1]

[1] *Forschungszentrum Jülich GmbH*

Corresponding Authors: e.mauerhofer@fz-juelich.de, u.ruecker@fz-juelich.de, j.voigt@fz-juelich.de, k.lieutenant@fz-juelich.de, p.zakalek@fz-juelich.de

High-Current Accelerator-driven Neutron Sources (HiCANS) are a promising new type of neutron sources, which have the potential to serve as national neutron sources and thus as an alternative to research reactors. Several countries are currently developing HiCANS facilities. In Germany, the High Brilliance neutron Source (HBS) is described in a Technical Design Report (TDR) 1.
The Forschungszentrum Jülich (FZJ) plans to realize a first HiCANS featuring a proton beam energy of 20 MeV, a peak current of 100 mA and a flexible frequency and duty cycle scheme within the next decade. This will allow to exploit the potential of these innovative neutron sources for a broad application range. The target station will be installed in an existing experimental hall on the FZJ campus and host a suite of 5 instruments. A diffractometer, a small angle scattering machine and a neutron reflectometer address the most demanded scattering applications, while neutron imaging and prompt gamma neutron activation analysis cover the need of user communities such as engineering or cultural heritage research.
References:
1 T. Brückel, T. Gutberlet (Ser. Ed.), Technical Design Report for the High Brilliance Neutron Source, Vol. 1-5, https://doi.org/10.34734/FZJ-2023-03722

Email Address:

Email Address

Presenter if not the submitter of this abstract:

Klaus Lieutenant

Funding Agency:

Abstract classification - track type:

Future of CANS

Poster Session 1 / 44

Numerical Study on the Effect of Scanning Strategy on Beam Uniformity and Target Temperature Field for AB-BNCT

Author: Jinglun Li[None]

Co-authors: Haipeng Li ; Haoquan Su ; Sheng Wang ; Yaocheng Hu ; Yongqi Chen

Corresponding Author: 593159355@qq.com

This paper investigates the beam spot uniformity on a lithium target under different scanning strategies during proton bombardment by using numerical method.In addition, the temperature changes and temperature field distribution on the target surface during proton bombardment were calculated based on the distribution of beam.Revealing that a sawtooth wave motion was revealed to achieves have the best uniformity and results in lower maximum target surface temperatures compared to sinusoidal and triangular wave patterns. These insights contribute to optimizing the beam homogenization for AB-BNCT target systems, potentially improving cooling design and target performance.

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Presenter if not the submitter of this abstract:

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National Natural Science Foundation of China

Abstract classification - track type:

Applications

Session 6 / 45

A Potential Moderator Testing Facility at ISIS

Author: Steven Lilley[1]

Co-authors: Paul Morgan [1]; Alexandra Chrysafi [1]; Steven Gallimore [1]; Steven Jago [1]; Riaan Jansen-van Rensburg [1]

[1] *STFC*

Corresponding Author: steven.lilley@stfc.ac.uk

Moderators are essential parts of neutron sources for neutron scattering experiments for both accelerator and reactor based sources. In accelerator driven sources particularly spallation sources it is much easier and more cost effective to change performance by changing the moderator than by changing the accelerator. The balance of neutron flux, brightness, resolution, and energy distribution can all be changed by modifying the moderators. In large neutron sources it is difficult to regularly change the moderators or perform moderator testing due to the pressure to provide consistent neutrons to the users.
There are a range of moderator performance and reliability aspects that would ideally be tested before installation in a large facility, these include:
• Neutronic performance of different moderator configurations,
• Engineering performance such as cooling performance in solid methane,
• Development of diagnostics such as ortho/para measurement for hydrogen moderators,
• Radiochemistry aspects of moderators particularly for liquid and solid methane to support current ISIS moderators,
• Benchmarking simulations –both neutronics and engineering.
At ISIS we are investigating the potential to use an existing compact accelerator for moderator testing. The Front End test Stand (FETS) has been used to develop ion sources for ISIS and provides a 3 MeV H- ion beam with an average beam current of 6 mA at 10% duty factor. FETS has a pulse chopper which enables the proton pulse to be shaped and chopped to match a short pulse neutron source in pulse length, with a corresponding reduction in protons.
A project has been initiated to investigate adding a neutron target to FETS to create a Moderator Engineering Test Stand (FETS-METS). In order to do this a range of systems are needed including: a lithium target, a reflector, cryogenic systems for the cold moderators, diagnostics and safety systems.
Currently in the concept phase, the project is investigating the potential neutronic performance and engineering feasibility of the facility. In this work we will show some of the concept options for a target, moderator, reflector and diagnostic neutron beam line configuration along with initial

neutronics calculations to estimate the possible performance for comparison against the requirements.

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Presenter if not the submitter of this abstract:

Funding Agency:

Abstract classification - track type:

Instrumentation and Hardware

Poster Session 1 / 46

Study and Beam Experiments of a Compact Accelerator-Based Neutron Source

Author: Su Haoquan[1]

Co-authors: Haipeng Li [1]; Wenlong Pan [1]; Guoqing Kong [1]

[1] *Xi'an Jiaotong University*

Corresponding Authors: lihaipeng@xjtu.edu.cn, suhaoquan@stu.xjtu.edu.cn, guoqing10012022@stu.xjtu.edu.cn, panwenlong@stu.xjtu.edu.cn

This study developed a compact accelerator-based neutron source integrating double Einzel-lens focusing and RFQ acceleration. In the LEBT section, dual electrostatic lenses were employed to focus the beam, achieving a 30 keV, 15 mA pulsed beam output within a length of 0.22 meters, meeting the input requirements of the accelerator. A four-vane RFQ operating at 325 MHz was utilized to accelerate protons from 30 keV to 2.5 MeV over a length of 2.6 meters, achieving a peak beam current of 12 mA and a duty factor of 3%. In the HEBT section, two quadrupole magnets were employed for beam focusing, along with the installation of essential beam diagnostic elements. Beam experiment results demonstrated that the system achieved a 10.6 mA peak proton beam current on the target, with an RFQ transmission efficiency of 93.8% and an effective acceleration efficiency of 87%. The design strategy and experimental results are presented and discussed in this paper.

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Funding Agency:

Abstract classification - track type:

Future of CANS

Poster Session 1 / 47

Feasibility Study of D-D Neutron Generator as a Replacement for Cf-252 Source in Neutron Activation Analysis

Author: Soobin Lim[1]

Co-author: Bong-Ki Jung [1]

[1] *Q-Beam Solution*

Corresponding Authors: lsb9012@qbeamsol.com, bkjung@qbeamsol.com

A neutron generator producing 2.45 MeV neutrons with d-d reaction is fabricated for industrial material identification with neutron activation analysis (NAA). The neutron generator consists of a deuteron plasma source and a Ti-coated Cu target and is expected to produce 108 n/s at maximum operation. The target is supplied with 100 kV bias voltage with 1 mA deuteron at maximum operation. With variation of operating parameters such as applied bias and source voltage, and input deuterium gas flow, the neutron yield from the target is measured with a neutron detector. The neutron detector consists of EJ-301 liquid scintillator, and the yield is calibrated with an MCNP simulation. Finally, material samples from industrial elements such as Fe, Co, and Ni are irradiated by the neutrons to measure the neutron activation peaks via characteristic gamma rays. The feasibility is determined in consideration of measurement time and accuracy for a practical application.

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Presenter if not the submitter of this abstract:

Funding Agency:

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Instrumentation and Hardware

Accelerators / 48

Development of Scalable High Current Accelerator Based Neutron Sources

Author: Holger Podlech[1]

Co-authors: Andreas Lehrach [2]; Chuan Zhang [3]; Julius Storch [1]; Klaus Kuempel [1]; Martin Droba [1]; Oliver Meusel [1]; Paul Zakalek [4]; Sarah Lamprecht [1]; Thomas Gutberlet [4]

[1] *Goethe University Frankfurt*

[2] *Nuclear Physics Institute, FZ Jülich*

[3] *GSI Helmholzzentrum für Schwerionenforschung*

[4] *Jülich Centre for Neutron Science*

Corresponding Authors: kuempel@iap.uni-frankfurt.de, h.podlech@iap.uni-frankfurt.de, lamprecht@iap.uni-frankfurt.de, storch@iap.uni-frankfurt.de, p.zakalek@fz-juelich.de, o.meusel@iap.uni-frankfurt.de, t.gutberlet@fz-juelich.de, droba@iap.uni-frankfurt.de, c.zhang@gsi.de, a.lehrach@fz-juelich.de

Despite the commissioning of the ESS only about half of neutron capacity will be available for research in Europe in the next decade due to the outage of aging reactors. There is an urgent need for a new class of efficient neutron facilities to offer competitive capabilities with neutrons for many research areas compact. High Current Accelerator based Neutron Sources (HiCANS) are currently in development for this purpose.
The basic features of HiCANS are a medium-energy proton accelerator with of tens of MeV and up

to 100 mA beam current, a compact neutron production and moderator unit and an optimized neutron transport system to provide a full suite of high performance, fast, epithermal, thermal and cold neutron instruments.
The goal is to develop state of the art scalable HiCANS facilities based on proton Linacs with a wide range of beam currents (1-100 mA) and energies (2-100 MeV). The accelerator technology is based on the developments for the MYRRHA project aiming for possible high duty factors and high availability. These facilities are able to deliver different pulse lengths with different repetition rates to several target stations simultaneously in the average power range from kW to MW. The current state-of-the-art in this technology is presented.

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Presenter if not the submitter of this abstract:

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Abstract classification - track type:

Future of CANS

Poster Session 1 / 49

A Next Generation RF LINAC as Proton Driver For CANS

Author: Holger Podlech[1]

Co-authors: Andreas Lehrach [2]; Holger Höltermann [3]; Paul Zakalek [4]; Thomas Gutberlet [4]; Ulrich Ratzinger [3]

[1] *Goethe University Frankfurt*

[2] *Nuclear Physics Institute, Forschungszentrum Jülich*

[3] *Bevatech GmbH*

[4] *Jülich Centre for Neutron Science*

Corresponding Authors: a.lehrach@fz-juelich.de, p.zakalek@fz-juelich.de, t.gutberlet@fz-juelich.de, h.podlech@iap.uni-frankfurt.de, ulrich.ratzinger@bevatech.com, holger.hoeltermann@bevatech.com

The use of neutrons is established since decades and essential for industry, medicine, life sciences and research. Classical neutron sources are mainly neutron generators, with low neutron flux, or research reactors and spallation sources, which are large and cost intensive installations. A cost efficient, effective and compact neutron source could bridge the gap existing and offer potential users either a dedicated standalone version for high demands of a single application or a full variable user facility. Such a compact accelerator driven neutron source based on a radio frequency linear accelerator (linac) accelerating 10 - 20 mA of proton current to energies between 8 to 10 MeV can deliver neutron fluxes between 10^9 –10^{13} n/cm^2/s.
A concept for a reliable proton linear accelerator using a combination of high duty cycle H-mode cavities that can be cooled well and 4-rod RFQs suitable for cw operation presents a cost efficient, reliable and well proven linac design for such applications. The neutron target is based on diffusion bonded beryllium as the most suitable choice to be operated for such a neutron source. The linac will have about 15 m in total length including the target station and can be installed and operated for reasonable costs. We will present the current status of such an accelerator-based neutron source and potential perspectives.

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Presenter if not the submitter of this abstract:

Funding Agency:

Abstract classification - track type:

Future of CANS

Poster Session 1 / 50

High Flux Neutron Generators for Critical Civil and Defense Applications (SHINE Technologies)

Author: Martin Wissink[1]

Co-author: Steven Burger [2]

[1] *Phoenix, LLC*

[2] *SHINE Technologies, LLC*

Corresponding Authors: steveburger@shinefusion.com, martinwissink@phoenixwi.com

SHINE Technologies, LLC and its sister company, Phoenix, LLC, have developed and matured through production readiness a suite of high flux, accelerator-based neutron generators to effectively address challenging use cases historically left to nuclear reactors which are less accessible and available. SHINE's deuterium-tritium (DT) system is the world's highest yield accelerator-based system producing predominantly fusion neutrons. SHINE's DT system was originally designed and developed as the driver of the manufacturing process of Molybdenum-99 (Mo-99), a medical radioisotope used worldwide for medical imaging that has traditionally been reliant on nuclear reactors. In 2023, SHINE launched a radiation effect testing service, dubbed FLARE (Fusion Linear Accelerator for Radiation Effects) in Janesville, WI, which employs the same DT gas target neutron source to deliver the highest flux steady-state 14 MeV neutron source for the survivability testing industry of defense and commercial electronics in space and of related diagnostics systems in emerging fusion power pilot plants. In 2020, Phoenix stood up its neutron imaging center in Fitchburg, Wisconsin, after years of design and development of a cyclotron-based Be (p,n) thermal and fast neutron source to address shortfalls in the accessibility of neutron radiography for non-destructive testing of critical aerospace and defense parts for potential manufacturing defects. The development of this inherently scalable approach to neutron generation has demonstrated that privately funded neutron sources are commercially viable, and that we can democratize access to neutrons and potentially significantly increase the user base by bringing neutron production to the open market.

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Presenter if not the submitter of this abstract:

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Abstract classification - track type:

Instrumentation and Hardware

Session 4 / 51

The High-Brilliance Neutron Source Project

Authors: Dalini Maharaj[1]; Doruntin Shabani[2]; El Barbari Monia[2]; Eric Mauerhofer[2]; Holger Podlech[3]; Jingjing Li[4]; Junyang Chen[2]; Jörg Voigt[2]; Klaus Lieutenant[2]; Norberto Schmidt[2]; Paul Zakalek[2]; Theresa Bosserhoff[2]; Thomas Gutberlet[1]; Ulrich Rücker[4]

[1] *Forschungszentrum Jülich*

[2] *Forschungszentrum Jülich GmbH*

[3] *Goethe University Frankfurt*

[4] *JCNS-2, Forschungszentrum Jülich*

Corresponding Authors: p.zakalek@fz-juelich.de, d.shabani@fz-juelich.de, d.maharaj@fz-juelich.de, no.schmidt@fz-juelich.de, j.voigt@fz-juelich.de, ji.li@fz-juelich.de, ju.chen@extern.fz-juelich.de, t.gutberlet@fz-juelich.de, k.lieutenant@fz-juelich.de, t.bosserhoff@fz-juelich.de, h.podlech@iap.uni-frankfurt.de, u.ruecker@fz-juelich.de, m.el.barbari@fz-juelich.de, e.mauerhofer@fz-juelich.de

Accelerator-driven neutron sources provide a cost-efficient and attractive alternative to present neutron sources like fission reactors and spallation sources. With the advent of high-current proton accelerator systems, a novel class of such neutron facilities emerged termed High-Current Accelerator-driven Neutron Sources (HiCANS) with unique properties and possibilities.>

The High Brilliance neutron Source project (HBS) at the Forschungszentrum Jülich develops such a HiCANS facility. It utilizes a 70 MeV and 100 mA pulsed proton linear accelerator providing tailored proton pulses with frequencies of 24 Hz or 96 Hz up to three optimized target stations. These target stations are compact in comparison to spallation neutron sources due to the low energy nuclear reactions releasing neutrons from a high-power tantalum target. It allows for an efficient neutron production, moderation and extraction and, thus allowing competitive neutron instrument performances.

A detailed Technical Design Report (TDR) has been published, describing all relevant components from accelerator, target, moderators to instruments. It shows a potential national neutron source facility with up to 24 instruments for all kinds of applications. A target station prototype was built at a 45 MeV cyclotron and brought into operation with first neutrons December 2022. Experiments performed demonstrated the accessibility and flexibility of this new type of source, and the expected performance could be evaluated.

We will present the current status of the High-Brilliance Neutron Source (HBS) HiCANS project as well as the next steps and milestones for this next generation neutron source.

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Presenter if not the submitter of this abstract:

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Abstract classification - track type:

Future of CANS

Session 5 / 52

The French ICONE Instrument Suite

Author: Xavier Fabreges[1]

Co-authors: Alexis Chennevière [1]; Arnaud Desmedt [1]; Nicolas Pichoff [2]

[1] *Laboratoire Léon Brillouin, CEA/CNRS Saclay, France*

[2] *IRAMIS, CEA/CNRS Saclay, France*

Corresponding Author: xavier.fabreges@cea.fr

Neutron scattering remains an indispensable tool for probing the structure and dynamics of matter. To meet the growing demand for advanced neutron capabilities, the French ICONE project is developing a next-generation neutron source based on a high-current compact accelerator (HiCANS). Now in the Technical Design Report (TDR) phase, ICONE's innovative dual-target station design, with tailored pulse characteristics and both cold and thermal moderator options, will enable high versatility and performance.
The instrument suite is split in two packages, each allocated to a tailored target station. The large-scale structure (SANS, reflectometer) and imaging instruments will make the most of high-flux target with long pulse, low repetition rate and short instruments. On the opposite, inelastic neutron scattering and diffraction instruments are well adapted to a high-resolution target with shorter pulses, higher repetition rate and longer instruments.
In this talk, I will present the current design of the ICONE instrument suite, which is being optimized to cover the broadest possible scientific case. This includes a state-of-the-art SANS instrument with extended Q-range, a high-intensity reflectometer for time-resolved studies, and a suite of inelastic scattering and diffraction instrument offering excellent energy and Q-resolution.
Virtual experiments and simulations indicate that ICONE's instruments will achieve count-rates and resolutions well in the range of the Orphée reactor. These virtual experiments are directly compared to real-life experiments carried out at neutron facilities, providing an immediate benchmark of the facility's capabilities. This comprehensive instrument suite will allow researchers to explore fields ranging from materials science and condensed matter physics to biology and cultural heritage.

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Presenter if not the submitter of this abstract:

Funding Agency:

CEA, CNRS, Frecnh research ministry

Abstract classification - track type:

Instrumentation and Hardware

53

Development of Series Neutron Sources at FDS

Author: Qi Yang[1]

[1] *International Academy of Neutron Science (Chongqing), FDS Consortium*

Corresponding Author: qi.yang@fds.org.cn

Neutron sources are important for the R&D of advanced nuclear energy systems and extended nuclear technology applications. FDS Consortium has developed series neutron sources for different applications, including the Mini Neutron Generator MINEG, Compact Neutron Source CONEG, High Intensity Neutron Source HINEG and Volumetric Neutron Source VNEG.
MINEG, with minimal diameter of 26mm, has characteristics of high neutron yield, long service life, high temperature resistance, and good anti-vibration performance, and the pulse timing can be flexibly set. It has been applied in neutron logging, elements analysis of industrial materials, security inspection, etc.
Small Neutron Generator SNEG is DD/DT neutron source with characteristics of high neutron yield, long-life time, high safety and reliability, compact design, and movable. SNEG has extensive applications in neutron radiography, NAA for elements analysis, detector calibration, irradiation experiments, nuclear physics experiments, etc.

High Intensity Neutron Source (HINEG) comprises of three phases, HINEG-I, HINEG-II, and HINEG-III. HINEG-I, currently operational, is a D-T fusion neutron source with a remarkable yield of 6.4×10^{12} n/s. It has been integrated with the Lead-based Zero Power Reactor (CLEAR-0). Key experiments conducted at HINEG-I include performance assessments of shielding modules, measurements of neutron leakage spectra from lead and lead-bismuth, and irradiation damage evaluations on laser crystals. HINEG-II is a high-voltage electrostatic accelerator-based D-T neutron source with neutron yield over 10^{13} n/s, which is built in Chongqing, China. With development of target technology, ion injecting technology, accelerator technologies, etc., the assembly and commission of HINEG-II has been finished, the facility is open for experiments now.
Besides, a Gas-dynamic Trap (GDT) based Volumetric Fusion Neutron Source VNEG is designed. It can also be used as driver of fusion-fission hybrid system.
FDS offers an open platform for collaboration, inviting global partnerships and joint research initiatives in neutron source and applications.

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Presenter if not the submitter of this abstract:

Qi Yang

Funding Agency:

Abstract classification - track type:

Facility Updates

Session 3 / 54

The University of Birmingham's High-Flux Accelerator-Driven Neutron Facility (HF-ADNeF)

Author: Ben Phoenix[1]

Co-authors: Carl Wheldon [1]; Jack Bishop [1]

[1] *University of Birmingham*

Corresponding Authors: c.wheldon@bham.ac.uk, j.bishop.2@bham.ac.uk, phoenixb@bham.ac.uk

Birmingham's high flux neutron facility utilises a high power electrostatic accelerator to provide currents of over 30 mA, at 2.6 MeV, onto a rotating lithium target. This gives neutron yields of >3x10¹³ neutrons/sec via the 7Li(*p,n*)7Be reaction. This intense and versatile source enables a wide range of research activities including materials damage, medical physics and radiobiology and nuclear physics.

Facility construction began in March 2020 and first neutrons were achieved in December 2023. Experiences of facility construction and commissioning will be presented along with a selection of research activities from the first year of operation. Upcoming work will also be discussed, with a particular focus on Boron Neutron Capture Therapy (BNCT) and on materials for future fusion applications.

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Presenter if not the submitter of this abstract:

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Abstract classification - track type:

Facility Updates

Session 2 / 55

Update on Thermal Scattering Kernel Generation at the European Spallation Source

Authors: José Ignacio Márquez Damián[1]; Douglas Di Julio[1]; Thomas Kittelmann[1]; Shuqi Xu[1]; Günter Muhrer[1]

[1] *European Spallation Source ERIC*

Corresponding Authors: douglas.dijulio@ess.eu, gunter.muhrer@ess.eu, jose.marquez@ess.eu, shuqi.xu@ess.eu, thomas.kittelmann@ess.eu

The Spallation Physics Group at the European Spallation Source (ESS) conducts radiation transport simulations to support the facility's design and licensing processes. These simulations integrate geometric system representations with nuclear data to analyze radiation interactions and produce observables such as dose maps and detector responses. Our work has led to the development of advanced scattering kernels for various materials, including liquid hydrogen, liquid and solid deuterium, superfluid helium and diamond nanoparticles, particularly in the context of the HighNESS project. Moving away from legacy tools like GASKET and NJOY, the team now emphasizes the use of open-source tools, such as NCrystal, to generate high-precision nuclear data for neutron sources and instruments. This approach combines molecular modeling techniques, novel data formats, and Monte Carlo code modifications to enhance simulation capabilities. These advancements, developed in close collaboration with the ESS Data Management Center, contribute to the continuous evolution of neutron transport simulations and are shared with the broader scientific community through open-source platforms and nuclear data libraries.
Within this framework we will present the recent developments in cold neutron moderator scattering kernel generation, and contributions to the evaluated nuclear data libraries. In particular, we will present the case of solid methane for which we re-implemented the Granada model using new experimental data and enhanced it by introducing spin correlation effects and improved angular distributions.

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Presenter if not the submitter of this abstract:

Funding Agency:

Abstract classification - track type:

Cold Moderators and Beyond

Session 1 / 56

Ultra Cold Neutrons and (Some of) Their Applications in Fundamental Physics

Author: Richard Wagner[1]

[1] *Laboratoire Léon Brillouin, CEA Saclay*

Corresponding Author: richard.wagner@cea.fr

Ultra-cold neutrons (UCN) are the slowest class of neutrons with typical energies in the neV range. They show the unique property that they are reflected at any angle from materials with sufficiently high optical potential, so that it becomes possible to confine and store them in material traps. The storage time can reach several hundred seconds and is theoretically limited by the free neutron's lifetime.
As a result of the long holding times UCN are extremely sensitive to small effects. This allows them to be used as probes to investigate fundamental physical phenomena, such as the understanding of the origin of asymmetry of matter and antimatter in the observed universe or search for signatures of dark matter particles.
Examples of experiments that use UCN are, to name just a few, precision measurements to verify a non-vanishing permanent neutron electric dipole moment (EDM), bottle storing experiments to determine the neutron's lifetime and the preparation and study of gravitational eigenstates above a flat mirror surface.

The talk will give a short description of the aforementioned UCN experiments and discuss the questions they aim to answer.

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Presenter if not the submitter of this abstract:

Funding Agency:

Abstract classification - track type:

Physics

Poster Session 1 / 57

Industry-Grade Control Systems for Tomorrow's CANS

Authors: Nik Razorsek[1]; Rok Hrovatin[2]

[1] *Cosylab*

[2] *COSYLAB*

Corresponding Authors: rok.hrovatin@cosylab.com, nik.razorsek@cosylab.com

Particle accelerator systems are becoming more complex with each new installation, yet reliability remains a fundamental requirement for both industrial and research installations. Ensuring that beams are delivered on time and within specified parameters is essential. While the combination of complexity and high reliability may seem challenging, this can be addressed effectively through systematic engineering of the control system. A well-engineered control system not only ensures reliability but can also enhance the overall performance of the entire accelerator.

Cosylab specializes in providing engineering and turnkey software solutions tailored to sophisticated systems, among which are also compact accelerator-based neutron sources (CANS). With over 20 years of experience and hundreds of successfully delivered projects, we have built a strong reputation in the industry, and our commitment to quality is demonstrated by our ISO certifications and a global presence with subsidiaries in China, Japan, Switzerland, the United States, and Slovenia.

What distinguishes Cosylab is our ability to deliver complex projects that require deep domain expertise and a solid understanding of physical operational principles. Our services span from the development of turnkey control systems to systems engineering, architecture, and multi-year project

planning. In addition to control software, we provide custom hardware in small quantities, ensuring that every phase—specification, procurement, development, assembly, delivery, and testing—meets the highest standards.

We develop and integrate subsystems such as timing systems, machine protection systems, interlock systems, slow and fast orbit feedback/feedforward systems and we integrate them into a modern central control system, providing also device list consultancy and validation. This is achieved by a holistic project approach and a keen understanding of each project's unique use cases. Our deep knowledge of accelerator control systems and project management ensures that projects are completed on time and within budget, mitigating risks and lowering the total cost of ownership.

We recognize the significant potential of the CANS domain, both in industry and research, and have already contributed to multiple projects within this area. With a strong technical and project management foundation, we bridge the gap between scientific advancements and industry developments, driving the industrialization of novel CANS systems.

Cosylab is proud to deliver cutting-edge software and engineering solutions to organizations such as ITER, CERN, RPI, SLAC, ESA, FAIR, Varian, Leo Cancer Care, MedAustron, Mevion, Northwestern Memorial Hospital, ProTom, DESY, ALMA, and Massachusetts General Hospital, among others.

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Abstract classification - track type:

Instrumentation and Hardware

Session 6 / 58

Contributions to Measuring the Value of Neutron Sources

Author: Daniel Banks[None]

Corresponding Author: daniel.banks@tvbassociates.ca

Neutron sources produce immense socioeconomic value, and this value must be objectively measured and clearly communicated to the governments that fund them. Yet measuring the impacts of the knowledge that is produced from research is challenging. In addition, they produce other benefits from training highly qualified people for a science and technology workforce or from other missions that are enabled by the same facility, such as production of medical isotopes. This talk will present the contributions of TVB Associates and its collaborators to measuring, predicting or communicating the value of compact neutron sources or research reactor sources in each of three areas: (1) determining the economic impact of knowledge from research using neutrons, (2) developing a business case for leveraging a compact source for isotope production, and (3) extracting meaningful insights from the online career data of former students who used the source during their university education.

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Presenter if not the submitter of this abstract:

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Abstract classification - track type:

Facility Updates

Session 2 / 59

The Role of CANS in the Implementation of Very Cold Neutrons

Author: Erik Iverson[1]

[1] *ORNL*

Corresponding Author: iversoneb@ornl.gov

Very Cold Neutrons represent a natural next step beyond the widely deployed cold neutron sources. As yet, there has been no practical VCN sources demonstrated to make a brighter VCN beam than simply using the low energy tail of a conventional cold moderator. In this talk I will summarize the development efforts and needs leading to practical VCN sources and the unique opportunity for Compact Accelerator-based Neutron Sources in that development.

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US Departement of Energy

Abstract classification - track type:

Cold Moderators and Beyond

Discussion / 60

Discussion: Grand challenges for the realization of a VCN source

Opening remarks / 61

Opening remarks

Place

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Abstract classification - track type: