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IAEA Activities in Support of Development and Utilization of Neutron Sources

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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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[6] INTERNATIONAL ATOMIC ENERGY AGENCY, Strategic Planning for Research Reactors, IAEA Nuclear Energy Series No. NG-T-3.16, IAEA, Vienna (2017); https://www.iaea.org/publications/10988/strategic-planning-for-research-reactors.
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