AGA 2: New Verification Concepts and Forensics

Time: Wednesday 14:45–16:25 Location: HSZ/0004

AGA 2.1 Wed 14:45 HSZ/0004

First Steps Towards a Muon Bunker Telescope to Verify the Absence of Nuclear Weapons — •Alexandra Datz[1] and Moritz Kütt[1,2] — [1]Institute for Peace Research and Security Policy at the University of Hamburg — [2]Program on Science and Security, Princeton University

Measurement approaches to verify the absence (or presence) of fissile materials are currently under intensive investigation. Through such measurements, one can demonstrate the absence of nuclear weapons. Previous measurements relied on particles emitted by the nuclear weapons themselves, photons and neutrons. We propose a new approach, using cosmic-ray-induced muons (muography), and a single detector to find hidden fissile material in potential nuclear weapon deployment sites (e.g. bunkers). Our contribution will present the possible framework for the application of this method to find hidden significant quantities of plutonium or highly-enriched uranium. Additionally, we show simulation results illustrating necessary detector properties and measurement times for a practical application.

AGA 2.2 Wed 15:05 HSZ/0004

Nuclear verification research – an integrated interdisciplinary approach — •Sophie Kretzschmar and Malte Göttsche — RWTH Aachen University

Verification is a key element for nuclear arms control. In today's global situation, it faces grave pressure: Increasing geopolitical change, rapid technological developments, and growing mistrust between states pose significant challenges to present and future verification regimes. The BMBF project *VeSPoTec – Verification in a complex and unpredictable world: social, political and technical processes* brings together researchers from physics, political sciences, and sociology to study verification in an interdisciplinary manner. This talk will introduce the project and demonstrate our integrated interdisciplinary approach on an example application case: verifying fissile material declarations using nuclear archaeology. On the technical side, questions remain on how to reduce uncertainties. For practical application, however, equally important questions persist that address a broader perspective: How can confidence be built when uncertainties remain? This talk will present first results on how social, political, and technical factors impact the success or failure of verification and discuss future challenges and potential solutions.

20 min. break

AGA 2.3 Wed 15:45 HSZ/0004

Anti-neutrino detector concepts for safeguarding spent nuclear fuel repositories — •Yan-Jie Schnellbach[1,2], Thomas Radermacher[1,2], Irmgard Niemeyer[3], Stefan Roth[1], and Malte Göttsche[2] — [1]RWTH Aachen University - Nuclear Verification and Disarmament, Aachen, Germany — [2]RWTH Aachen University - Physics Institute III B, Aachen, Germany — [3]Forschungszentrum Jülich, Jülich, Germany

Spent nuclear fuel (SNF) is an inevitable by-product of nuclear power generation and requires safeguarding, whether in interim storage or deep geological repositories. Anti-neutrino emissions from the ongoing beta decay of fission fragments could provide a complementary monitoring channel, as anti-neutrinos pass through shielding and geology unhindered and can be detected using inverse beta decay (IBD). This study investigates a novel anti-neutrino detection concept using a liquid organic (LOr) time projection chamber (TPC), combining scalability and particle reconstruction of TPCs with the hydrogen target atoms provided by organic compounds. Geant4-based simulations and electron drift modelling are used to study IBD event reconstruction in a container-sized concept detector for interim storage. The concept detector's expected signal rate, sensitivity and directionality are estimated for a representative example repository with varying deployment scenarios. The results are compared to other state-of-the-art anti-neutrino detection technologies proposed for monitoring. This ongoing comparison study will determine the feasibility anti-neutrino detection as complementary safeguards for SNF repositories.

AGA 2.4 Wed 16:05 HSZ/0004

Forensic Measurements for Nuclear Archaeology - A New Approach — •Lukas Rademacher and Malte Göttsche — Nuclear Verification and Disarmament, RWTH Aachen University

Nuclear archaeology is a field of study aiming to reconstruct the production and removal history of weapons-usable fissile materials and thus create estimates of existing stockpiles. A central method of nuclear archaeology is the deduction of a shut-down reactor's lifetime plutonium production using samples taken from within its core. Specific isotopic ratios are measured to assess neutron fluence and thus estimate plutonium production.

We will present a new approach aiming to strengthen the potential of the method by analyzing a larger set of measured isotopic ratios. This allows for the reconstruction of operational histories of the considered reactor in more detail, therefore also improving production estimates. The analysis required for this is however much more complex, so we developed a suitable procedure using mathematical and computational methods that we will present in the form of a first feasibility study.

This new analysis methodology can be used for various applications ranging from crosschecking fissile material declarations for international confidence building, to a combination with specially designed and installed reactor monitor tags to contribute to the verification of the proposed Fissile Material Cutoff Treaty, to reassessing potentially highly uncertain early plutonium production estimates on a purely national basis.