

Arbeitsgruppe Physik und Abrüstung (AGA)

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Zur Abrüstung, der Verhinderung der Verbreitung von Massenvernichtungsmitteln und der Beurteilung neuer Waffentechnologien sind naturwissenschaftliche Untersuchungen unverzichtbar. Auch bei der Verifikation von Rüstungskontrollabkommen werden neue Techniken und Verfahren benötigt und eingesetzt. Schwerpunkte in diesem Jahr bilden einerseits Themen wie die Weiterverbreitung von waffenfähigen Materialien und die Modernisierung von Nuklearwaffen und die Proliferationsresistenz, andererseits neue Rüstungstechnologien, die Raketenabwehr, Weltraumsicherheit und die CTBT-Verifikation bzw. die Detektion von Nuklearanlagen und Materialien.

Die Fachsitzung wird zum vierzehnten Mal von der DPG gemeinsam mit dem Forschungsverbund Naturwissenschaft, Abrüstung und internationale Sicherheit FONAS durchgeführt. Der 1998 gegründete Arbeitskreis Physik und Abrüstung ist für die Organisation verantwortlich. Die Sitzung soll international vorrangige Themen behandeln, Hintergrundwissen vermitteln und Ergebnisse neuerer Forschung darstellen.

Überblick Hauptvorträge und Sitzungen

(Hörsaal VMP 9 HS)

Hauptvorträge

AGA 1.1	Mi	14:00–15:00	VMP 9 HS	From Data Acquisition via a Common Operational Picture to Space Situational Awareness — ●GUIDO BARTSCH
AGA 2.1	Mi	16:30–17:30	VMP 9 HS	Missile Defense in and for Europe: Immature Technology and Counterproductive Reactions — ●GÖTZ NEUNECK
AGA 3.1	Do	10:30–11:30	VMP 9 HS	The Increasing Militarisation of Universities in the UK and Elsewhere — ●STUART PARKINSON, CHRIS LANGLEY
AGA 4.1	Do	14:00–15:00	VMP 9 HS	Expanding global nuclear energy supply without increasing the risks of nuclear proliferation — ●STEVE FETTER
AGA 4.4	Do	16:30–17:30	VMP 9 HS	On the Challenges of Containing the Spread of Gas Centrifuge Enrichment Plants — ●HOUSTON WOOD

Sitzungen

AGA 1.1–1.3	Mi	14:00–16:00	VMP 9 HS	Verification, Space Surveillance and Early Warning
AGA 2.1–2.4	Mi	16:30–19:00	VMP 9 HS	Missile Defense and Threat Analysis
AGA 3.1–3.4	Do	10:30–13:00	VMP 9 HS	Military-relevant R&D and New Technologies
AGA 4.1–4.7	Do	14:00–19:00	VMP 9 HS	Fissile Material and Proliferation Resistance
AGA 5.1–5.6	Fr	10:30–13:30	VMP 9 HS	Verification and Detection

Mitgliederversammlung der Arbeitsgruppe Physik und Abrüstung

Mittwoch 19:00–20:00 VMP 9 HS

- Bericht der Sprecher
- Wahl der Sprecher
- Kandidaturempfehlung für Wahl zum Vorstandsrat
- Verschiedenes

AGA 1: Verification, Space Surveillance and Early Warning

Zeit: Mittwoch 14:00–16:00

Raum: VMP 9 HS

Hauptvortrag AGA 1.1 Mi 14:00 VMP 9 HS
From Data Acquisition via a Common Operational Picture to Space Situational Awareness — ●GUIDO BARTSCH — FGAN-FHR, Dept. Radar Techniques for Space Reconnaissance (RWA), Neuenahrer Straße 20, D-53343 Wachtberg-Werthhoven

A widely spread misunderstanding concerning the formation of Space Situational Awareness (SSA) is that its indispensable prerequisite, a common space situational picture, is already available after gathering data from different sensor and non-sensor sources. Even though assumed valuable data may already be available at this point, additional steps have to be performed.

Endsley stated in his theory of situation awareness in dynamic systems [1] that one needs three steps to form Situational Awareness (SA): Perception, comprehension, and projection. These three steps can be adopted to the process forming Space Situational Awareness (SSA). An example which underpins this statement is e.g. the analysis of potential threats which come from foreign space objects. One typical question in this context is: Has any of the foreign objects non-peaceful capabilities and will they likely be applied against me? To answer this question, one needs much more than just images of these space objects: One important follow-up process is the image analysis or, to be more precise, the space object's capability analysis based on space object imaging. Together with the outcome of additional processes, e.g. the analysis of abnormality (behavioural analysis) and the assessment of the political circumstances, one can develop a situational picture to support the formation of space situational awareness. This talk will give a survey on the SSA needs, methods as well as a review about existing and planned subsystems.

[1] M. R. Endsley, "Toward a Theory of Situation Awareness in Dynamic Systems", *Human Factors*, Vol. 37, No. 1, 1995, pp. 32-64.

AGA 1.2 Mi 15:00 VMP 9 HS
Verifikation der Rüstungskontrolle im Weltraum — ●JÜRGEN SCHEFFRAN — University of Illinois at Urbana-Champaign, USA

Nach dem Ende der Bush-Administration bestehen neue Chancen, dass die Rüstungskontrolle im Weltraum ernsthaft angegangen wird. Das Spektrum der Optionen reicht von Verkehrsregeln für den Weltraum bis zu einem vollständigen Verbot von Weltraumwaffen, eingebettet in ein umfassendes kooperatives Sicherheitsregime für den Weltraum. Eine der Schlüsselfragen ist die Verifikation eines möglichen Weltraum-Rüstungskontrollabkommens. Um eine ausreichende Überprüfung sicherzustellen, sind Prinzipien, Regeln und Verifikationsmittel bereit-

zustellen, die das Destruktivpotenzial von weltraumbezogenen Systemen eingrenzen und das Risiko bewaffneter Einsätze begrenzen. Hierzu ist eine Analyse der Multi-Funktionsfähigkeit und Doppelverwendbarkeit von Weltraumobjekten ebenso erforderlich wie der für Weltraum-einsätze nutzbaren Trägersysteme. Besondere Problembereiche sind die Miniaturisierung, das Manövrierpotenzial und die Verwundbarkeit von Satelliten, die Entwicklung von Raketenabwehrsystemen, das Destruktivpotential von Lasersystemen und die Ähnlichkeit von ballistischen Raketen und Weltraum-Trägerraketen. Aus möglichen Abgrenzungen ergeben sich Anforderungen an die Verifikation und dafür erforderliche Mittel, insbesondere für Satellitenbeobachtung, Weltraum-Tracking-Systeme und Inspektionen von weltraumrelevanten Anlagen. Dies ist eine Voraussetzung für eine vorbeugende Rüstungskontrolle im Weltraum, die Risiken, Kosten und Effizienz von Abkommen in den Kontext sicherheitspolitischer Bewertungen setzt.

AGA 1.3 Mi 15:30 VMP 9 HS
Constellations of a possible European Missile Early Warning System — ●MARCEL DICKOW¹ and GEOFFREY FORDEN² — ¹Institut für Friedensforschung u. Sicherheitspolitik (IFSH), Hamburg, Germany — ²Science, Technology and Global Security Working Group, Massachusetts Institute of Technology, USA

Missile early warning systems played (and still play) an important role in the concept of nuclear deterrence during the cold war. Providing intelligence and surveillance data space-based sensors guaranteed capabilities of both parties to initiate a retaliation strike before own ICBMs would have been destroyed. Together with submarine second strike capability missile early warning was a major security asset both parties agreed on to be necessary for political stabilization.

As the now Russian system struggles with financial obstacles the U.S. system components have been partly integrated into the Space Surveillance Network (SSN) providing not only reconnaissance but Space Situational Awareness (SSA) data for civil and military purposes. A European Missile Early Warning System with global coverage is not a topic in national or EU space policies. However ESA and the European Defence Agency (EDA) drive SSA programs and the European space industry recently proposed missile early warning systems, mostly to spur on discussion.

The talk investigates possible constellation for these systems using visible and infrared surveillance, presents deliberations on coverage, detection times and probabilities and pulls together political implications for European policies and international security.

AGA 2: Missile Defense and Threat Analysis

Zeit: Mittwoch 16:30–19:00

Raum: VMP 9 HS

Hauptvortrag AGA 2.1 Mi 16:30 VMP 9 HS
Missile Defense in and for Europe: Inmature Technology and Counterproductive Reactions — ●GÖTZ NEUNECK — IFSH, Beim Schlump 83; 20144 Hamburg

Political statements are concluding that ballistic missile defense is "technically feasible". They are also recognizing that a "substantial contribution to the protection of Allies from long-range ballistic missiles to be provided by the planned deployment of European-based United States missile defence assets". On the other hand, the Russian government claims that such a system undermines strategic stability. A technical analysis shows that the planned Ground-based Midcourse Ballistic Missile Defense system in Europe has very limited defense capabilities. It is clear that the GMD system cannot match countermeasures (such as decoys, warhead replica balloons etc.) thus creating an illusionary protection. The talk explains the short-term as well as long-term consequences in the light of future disarmament and non-proliferation.

AGA 2.2 Mi 17:30 VMP 9 HS
Consistency - the decisive factor for realistic threat assessment — ●ROBERT SCHMUCKER and MARKUS SCHILLER — Schmucker Technologie, 80469 München, Klenzestr. 14

Disarmament and verification are closely linked to threat situation

analysis. The assumed threat potential of a country should be based on the two factors "intention" and "capability", where capability can be derived by an engineering approach with technical and physical analysis methods.

Usual threat analysis concentrates on single topics without regarding other assessments and facts. If all the independent assessments are connected, a big picture is created that is often contradictory in many ways, which means that some assessments must be wrong.

A sense of consistency must be established in the community of analysts to become aware of this problem and to critically question some of the established truths. The lecture gives comprehensible examples of inconsistencies concerning various countries of interest (Syria, Iran, North Korea, Pakistan,...) that might contribute to establish this requested sense of consistency.

AGA 2.3 Mi 18:00 VMP 9 HS
Modelling of Missile Trajectories and their Application — ●HANS CHRISTIAN GILS — Institut für Friedensforschung und Sicherheitspolitik an der Universität Hamburg (IFSH)

A detailed model for the simulation of flight trajectories of different kinds of ballistic missiles is introduced. The model includes the Earth's shape and rotation as well as atmospheric aspects and missile characteristics. It can further be used to calculate a missile's maximum range

and its possible trajectories to a target point on Earth. For a given trajectory of an approaching missile, the feasibility of an interception in space can be determined. The missile's coordinates during the flight are saved and can be visualized in a virtual-globe program. The model allows the investigation of various scenarios, taking into account existent and prospective ballistic missile threats and defense systems. The results of some scenarios will be presented in the talk.

AGA 2.4 Mi 18:30 VMP 9 HS

Gefahren-Szenarien der Freisetzung von Plutonium durch einen erfolgten Abschuss mit einem Raketenabwehrsystem — ●WIEBKE PLENKERS und MARTIN KALINOWSKI — Carl Friedrich von Weizsäcker-Zentrum für Naturwissenschaft und Friedensforschung (ZNF), Universität Hamburg

Besonders seit die USA im Jahre 2002 den ABM-Vertrag kündigten und ihr Ballistic Missile Defense System neu verstärkten mit dem Ziel,

die USA von aller Art Raketen zu beschützen, gibt es erneut kontroverse Diskussionen über den Sinn von Raketenabwehrsystemen, sowie die Wahrscheinlichkeit künftiger nuklearer Bedrohungen.

Um mögliche Gefahren für die Zivilbevölkerung bei Raketenabwehr aufzuzeigen, wurden am ZNF verschiedene Szenarien eines versuchten Abschusses einer Trägerrakete mit nuklearem Sprengkopf untersucht. Der Schwerpunkt lag auf einer Folgenabschätzung der nuklearen Strahlung bei Freisetzung und Verteilung von Plutonium in der Atmosphäre. Ebenso wurden Risiken bei verschiedenen Flugphasen bedacht, darunter besonders der willkürliche Herabsturz ("shortfall") des Gefechtskopfes.

Die Analyse basierte auf eine umfangreiche Literaturrecherche der bisherigen Forschung zu Raketenabwehrsystemen, der Sicherheit von nuklearen Sprengköpfen und der Strahlengefahren von Plutonium. Die Arbeit wurde im Rahmen einer studentischen Hilfskraft durchgeführt.

AGA 3: Military-relevant R&D and New Technologies

Zeit: Donnerstag 10:30–13:00

Raum: VMP 9 HS

Hauptvortrag

AGA 3.1 Do 10:30 VMP 9 HS

The Increasing Militarisation of Universities in the UK and Elsewhere — ●STUART PARKINSON and CHRIS LANGLEY — Scientists for Global Responsibility, Folkestone, Kent, UK

Two important trends have contributed to a growth of military involvement in universities in recent years, especially in countries such as the USA and UK. The first is the so-called 'War on Terror' led by the US government, which has stimulated a major increase in the number of programmes addressing research and development with military objectives. The second is the growth in the commercialisation of universities, which involves greater collaboration with industry and the restructuring of the universities to behave more like businesses.

This presentation will focus mainly on developments in the UK over the last 5-10 years - especially the expansion of military-university 'partnerships' and the ethical concerns that they raise. It will also include some discussion about the situation in the USA and Europe. It will be based mainly on the research carried out by the UK organisation, Scientists for Global Responsibility (SGR).

AGA 3.2 Do 11:30 VMP 9 HS

Unmanned Military Systems: Preventive Arms Control Needed — ●JÜRGEN ALTMANN — Experimentelle Physik III, TU Dortmund, 44221 Dortmund

Unmanned vehicles find increasing military interest. About 50 countries produce or develop unmanned aerial vehicles, 20 export them. Providing them with weapons is underway in the USA; further countries developing unmanned combat air vehicles are France, Germany, Russia and the UK. In particular the US military are pushing for an integrated approach for air, ground, water-surface and underwater vehicles, the outlook extends to 2032. Arms-control treaties have only marginal effect up to now. Export controls are in effect for ballistic missiles, cruise missiles and UAVs - however these controls pose no limits on the strongest military powers. Various problems raise concerns about peace and international stability, the international law of warfare or the security of societies: proliferation to crisis regions, killing by remote control - or even by autonomous machine decision -, and the possible use for terrorist attacks. Preventive arms control is advisable; ideas will be presented.

AGA 3.3 Do 12:00 VMP 9 HS

New developments in laser technology and the assessment of their implications for international politics — ●JAN STUPL¹, CLAUS EMMELMANN², GÖTZ NEUNECK³, and HARTWIG SPITZER⁴ — ¹Center for International Security and Cooperation (CISAC), Stanford University — ²Institut für Laser- und Anlagensystemtechnik (iLAS), TU-Harburg — ³Institut für Friedensforschung und Sicherheitspolitik an der Universität Hamburg (IFSH) — ⁴Institut für Experimentalphysik, Universität Hamburg

Recent developments in laser technology, like the advent of high power fibre lasers and chemical lasers, open up new possible weapon applications for laser technology. This has implications for international politics. In order to assess these implications, a science-based understanding of the technical capabilities is a prerequisite.

In its first part, this paper will introduce recent developments in laser technology. The second part will present a method which was developed to assess possible laser applications and their consequences. This method includes the beam propagation including atmospheric effects, the calculation of temperature fields in radiated objects and the calculation of the induced thermal stress field. The last part of the talk will present the application of the devised method using case studies in the realm of international security.

AGA 3.4 Do 12:30 VMP 9 HS

Digitale Luftbildkameras für den Open Skies-Vertrag — ●HARTWIG SPITZER — Institut für Experimentalphysik, Universität Hamburg

Der Open Skies-Vertrag öffnet den Luftraum von Nordamerika, Russland und großen Teilen Europas für kooperative Beobachtungsflüge. Zur Zeit werden ausschließlich photographische Kameras mit einer Bodenauflösung von 30 cm eingesetzt. Der Vertrag erlaubt aber auch die Verwendung anderer Sensoren, insbesondere Wärmebildsensoren und künftig wahrscheinlich auch digitale Luftbildkameras mit vier Farbkanälen. Zur Überprüfung, ob die vertraglich vereinbarte Auflösung eingehalten wurde, sind aufwändige Prüfverfahren entwickelt worden. Im Vortrag wird über diese "Zertifizierungsverfahren" berichtet. Anschliessend werden Rückschlüsse, die aus den Bildern gezogen werden können, und politische Perspektiven des Vertrages diskutiert.

AGA 4: Fissile Material and Proliferation Resistance

Zeit: Donnerstag 14:00–19:00

Raum: VMP 9 HS

Hauptvortrag

AGA 4.1 Do 14:00 VMP 9 HS

Expanding global nuclear energy supply without increasing the risks of nuclear proliferation — ●STEVE FETTER — School of Public Policy, University of Maryland, College Park, USA

To avoid potentially catastrophic changes in the Earth's climate, world energy supply must shift over the next several decades toward carbon-free sources. Nuclear energy has particular promise for rapid and large-scale expansion worldwide, if a corresponding expansion in the risks of

nuclear proliferation could be avoided. In recent years, attention has focused on limiting the spread of enrichment and reprocessing through a combination of export controls, voluntary agreements and incentives, and multinational ownership or international control. Iran and North Korea have demonstrated the limitations of export controls, due both to the diffusion of knowledge and technology and the willingness of individuals to engage in illegal trade for profit. Incentives has focused on the guaranteed supply of fresh fuel, but the the guaranteed take-back

of spent fuel would be a far more powerful incentive for forego enrichment and reprocessing. Multinational ownership and international control are more promising long-term solutions, if they can be made binding on all states. A promising technological approach is the development of small, sealed-core reactors with long life-time cores. Such reactors would eliminate the need for any fresh fuel manufacture or spent-fuel handling by recipient states. Because small reactors could be economically competitive only if they were mass produced by a few suppliers, they hold the potential of centralizing enrichment and reprocessing in a few states.

AGA 4.2 Do 15:00 VMP 9 HS

Neutronics Calculations to Assess and Strengthen the Proliferation Resistance of Nuclear Technologies — ●MATTHIAS ENGLERT and WOLFGANG LIEBERT — IANUS, TU-Darmstadt, Hochschulstr. 4a, 64289 Darmstadt

Ambivalent nuclear technologies use or have a potential to produce nuclear weapon relevant material like highly enriched uranium, U233, plutonium and tritium. Three different cases for such technologies representing current, cutting edge and future technologies are assessed with regard to their proliferation potential and a focus on measures to strengthen their proliferations resistance. The assessment is carried out with the help of neutronics simulations. First we present results for the conversion of high flux research reactors to the use of low enriched uranium with the new simulation package developed in our group. Secondly the potential of spallation neutron sources to produce U233, plutonium and tritium is assessed. Thirdly we briefly discuss the proliferation potential of the future use of fusion power plants. Finally the analysis of the three technologies is compared to explicate on this exemplary basis general criteria for the proliferation resistant use of nuclear technologies.

AGA 4.3 Do 15:30 VMP 9 HS

Radiative aspects in coupled nuclear fission-fusion processes — ●JENS FIEDLER and PETER HAFNER — Fraunhofer Institut Naturwissenschaftlich-Technische Trendanalysen, Euskirchen, Germany

Boosting of fission processes using fusion neutrons is a well-known technique in developing compact nuclear fission devices. The Fraunhofer Institute for Technological Trend Analysis (INT) operates a coupled hydrodynamic-neutron transport program system, which also incorporates radiative processes. This program system allows studying the physics of interactions between fission and fusion processes. At high temperatures a significant amount of energy is governed by radiation. Radiation and the encapsulated material generally affect each other. The description of such a model requires the solution of the radiation transport equation, which is a complex task. Calculations performed in this work take radiation processes into account by a radiation heat conduction formulation. Besides presenting the basic concept of fission-fusion devices, first results from coupled fission-fusion calculations are given in this presentation.

30 min break

AGA 4.4 Do 16:30 VMP 9 HS

Hauptvortrag On the Challenges of Containing the Spread of Gas Centrifuge Enrichment Plants — ●HOUSTON WOOD — Mechanical & Aerospace Engineering University of Virginia Charlottesville, Virginia 22904

Since the end of the Cold War, a number of non-nuclear weapon states have pursued enrichment of uranium by gas centrifuges. At the moment, the most challenging case is that of Iran, who has continued to build their gas centrifuge plant. Iran contends they only want to make enriched fuel for nuclear reactors, but the line between civil and military enrichment activities is very thin. The IAEA and Western countries are trying to find ways to assure that Iran does not produce uranium enriched to weapons grade levels. In this talk, I will describe gas centrifuges and cascades of gas centrifuges, and I will discuss the challenges of safeguarding enrichment plants. I will also discuss possi-

bilities for thickening the thin line. These efforts are of utmost importance, not only for Iran, but for other nations that may want to pursue the nuclear fuel cycle in the future.

AGA 4.5 Do 17:30 VMP 9 HS

Proliferation risks of highly enriched uranium used for medical isotope production — ●MARTIN B. KALINOWSKI — ZNF, Universität Hamburg

The use of highly enriched uranium (HEU) for medical isotope production is of concern for proliferation. The used target material is still of proliferation concern since only about 2% of the HEU is consumed, the irradiation time is in the range of two to ten days and part of the radioactivity is removed by chemical separation. As a result, after some cooling time the radiation barrier is not very high. While the global demand of HEU for research reactors is declining from more than 1,500 kg per year in 1978 to projected 500 kg/y in a few years, the use of HEU for medical isotope production is increasing and likely hitting an annual consumption level of 100 kg soon. Since molybdenum-99 is the most widely used medical isotope, the amount of irradiated HEU can be estimated from its consumption rate.

AGA 4.6 Do 18:00 VMP 9 HS

Abschätzung des Proliferationspotentials eines Fusionsreaktors: mögliche Pu-239 Produktion und Bestimmung des Isotopenvektors — ●FABIO BALLONI — TU Darmstadt Deutschland

Tokamak-Fusionsreaktoren, die auf einem Deuterium-Tritium Brennstoffzyklus basieren, müssen so konzeptioniert sein, daß die erforderlichen Tritiummengen im Reaktorsystem selbst produziert werden können. Dazu wird als Edukt Lithium-6 in die modular aufgebauten Reaktorwände eingespeist, um so über Neutroneneinfänge das benötigte Tritium zu erhalten. Das Design dieser Module, die sog. Blankets, erlaubt es, auch andere Brutstoffe im Reaktor zu platzieren, bspw. Uran. Dies würde die Produktion von Plutonium-239 ermöglichen. Um das Proliferationspotential einer solchen Konfiguration abzuschätzen, wurde die Fusionsneutronik mit dem Monte Carlo Code MCnPx simuliert. Dazu wurde ein maßstabsgetreues, 3D Modell einer kommerziellen Fusionsreaktor-konzeption PPCS-A, veröffentlicht 2006 durch die European Fusion Development Agency (EFDA), erstellt. Darüberhinaus wurde durch die Abbrandroutine MCMATH die Isotopenverteilung des produzierten Plutoniums berechnet. Im Vortrag werden Ergebnisse dieser Simulationen vorgestellt und diskutiert. Außerdem wird auch auf eine mögliche Verwendung des Fusionsreaktors in einem Fusion-Fissions-Hybrid Satellitensystem eingegangen.

AGA 4.7 Do 18:30 VMP 9 HS

Proliferation Risk of Plutonium Fuels: Burnup Calculations, with Particular Regard to Pu238 Fractions — ●MORITZ KÜTT¹, MATTHIAS ENGLERT¹, WOLFGANG LIEBERT¹, and CHRISTOPH PISTNER² — ¹IANUS, TU-Darmstadt, Hochschulstr. 4a, 64289 Darmstadt — ²Öko-Insitut e.V., Rheinstraße 95, 64295 Darmstadt

One solution, besides elimination or immobilization, to address the proliferation risk associated with existing plutonium stockpiles can be the use as fuel for energy production in light water reactors. To make plutonium fuel more proliferation resistant it is favorable to have a high percentage of Pu238 in the spent fuel which increases the heat development and the neutron rate of the plutonium significantly and makes it less usable for the construction of nuclear weapons. Different fuels were proposed to reach this goal and increase the Pu238 build up. Among them pure uranium or MOX fuels with a small percentage of U236 or plutonium in Inert Matrix Fuels (IMF) with or without additional minor actinides. To investigate the Pu238 buildup capability of these fuels, burnup calculations were performed with an improved version of the coupled neutronic and burnup code MCMATH. We present and compare the results for these fuel types with regard to the amount of Pu238 produced and proliferation relevant factors like the heat and neutron rate and the critical mass of plutonium generated after burn-up. The comparison shows that IMF fuels are favorable with regard to their proliferation resistance compared to MOX/pure uranium fuels.

AGA 5: Verification and Detection

Zeit: Freitag 10:30–13:30

Raum: VMP 9 HS

AGA 5.1 Fr 10:30 VMP 9 HS

Detectability of unreported nuclear reprocessing analysed by atmospheric krypton-85 modelling — ●OLE ROSS^{1,4}, ROBERT ANNEWANDTER¹, JOHANN FEICHTER², SEBASTIAN RAST², K. HEINKE SCHLÜNZEN³, and MARTIN B. KALINOWSKI¹ — ¹Carl Friedrich v. Weizsäcker Centre for Science and Peace Research, University of Hamburg — ²Max Planck Institute for Meteorology, Hamburg — ³Meteorological Institute, University of Hamburg — ⁴International Max Planck Research School on Earth System Modelling

As project within the German support programme to IAEA Safeguards the detectability of additional ⁸⁵Kr sources using atmospheric transport modelling was investigated. ⁸⁵Kr is released into the air during reprocessing of spent nuclear fuel rods. Therefore it can possibly be used as indicator for the detection of undeclared plutonium separation. First, the global ⁸⁵Kr background produced by known reprocessing facilities from 1971 until 2006 was simulated with the atmospheric general circulation model ECHAM5. Based on the background study, the detection sensitivity to a set of arbitrarily specified source locations is analysed with a lagrangian particle dispersion model. This, in combination with the location specific background variability simulated by the global model, is giving first benchmarks on the capability of using ⁸⁵Kr for IAEA Safeguards on the NPT based on the Additional Protocol and its possible contribution for the verification of a future Fissile Material Cut-off Treaty.

AGA 5.2 Fr 11:00 VMP 9 HS

Kr-85 signatures for various plutonium production schemes — ●PAUL STANOSZEK — Carl Friedrich von Weizsäcker-Centre for Science and Peace research

Kr-85 is considered to be the best atmospheric indicator of unreported weapon-grade material production. This fact is based on the half-life of 10.76 years of Kr-85 and its chemical inactivity, which makes it even detectable after extended periods of cooling time. Kr-85 is produced as fission product during nuclear reactor operation and remains in the fuel until reprocessing starts. In order to determine the detectability of plutonium production the Kr-85 source term has to be assessed. The important issue of this presentation is the question on the minimum signal that an inspector can expect under the assumption that a proliferator minimizes his Kr-85 generation in order to circumvent a Kr-85 detection. A further assumption is that for nuclear weapon production a burn-up of typically around 2 MWd/kg is used. In addition, if clandestine plutonium production takes place, the source term might be used to estimate the amount of separated plutonium. The methodology of this study is based on a linkage between MCNPX and MATLAB. All results for actinide concentrations and Kr-85 are evaluated for different enrichments of U-235 and compared to known literature data. The Kr-85 source term per kilogram plutonium depends on the enrichments. As a result the lowest Kr-85 source term is found for depleted uranium.

AGA 5.3 Fr 11:30 VMP 9 HS

Detectability of Krypton-85 Sources — ●ROBERT ANNEWANDTER and OLE ROSS — C.F.v.Weizsäcker-Centre for Science and Peace Research, Hamburg, Germany

The lagrangian particle dispersion model HYSPLIT was used to determine the detectability of globally distributed krypton-85 sources regarding the variability of its background concentration calculated by Ole Ross with ECHAM 5.

Results on minimal detectable releases and their distance to source will be presented.

This work is part of a project showing Krypton-85 tracers applicable for remote monitoring purposes of nuclear facilities based on the Additional Protocol of the Non-Proliferation Treaty.

AGA 5.4 Fr 12:00 VMP 9 HS

Bestimmung des Detektionsvermögens des IMS Infrasschallnetzwerks — ●LARS CERANNA — Bundesanstalt für Geowissenschaft-

ten und Rohstoffe, Hannover

Basierend auf der Auswertung der verfügbaren Detektionslisten aller Infrasschallstationen des Internationalen Monitorsystems (IMS) zur Verifikation des Comprehensive Nuclear-Test-Ban Treaty (CTBT) konnten eindeutig die vorherrschenden stratosphärischen Winde als bestimmender Faktor für die Registrierung kohärenter Signale identifiziert werden. An nahezu allen Stationen werden mehr als 85 % aller Detektionen im Frequenzbereich zwischen 0.2 und 2 Hz dem stratosphärischen Wellenleiter zugeordnet. Dabei zeigt sich deutlich die saisonale Variation zwischen vorherrschenden westlichen und östlichen Richtungen.

Diese Beobachtungen des zeitlich veränderlichen Detektionsvermögens des IMS Infrasschallnetzwerks lassen sich auch mit synthetischen Vorhersagen vergleichen. Zur Modellierung werden aktuelle Wind- und Temperaturprofile verwendet sowie stationsabhängige Relationen für das lokale Windrauschen. Insgesamt lässt sich das Detektionsvermögen zwischen 0.2 und 2 Hz für atmosphärische Explosionen an Hand der Simulationen mit einer Stärke von etwa 500 t TNT-Äquivalent zu jeder Jahreszeit abschätzen, wobei mindestens zwei Infrasschallarrays Signale registrieren. Diese Abschätzung kann wiederum mit Hilfe so genannter ground-truth Ereignisse verifiziert werden.

AGA 5.5 Fr 12:30 VMP 9 HS

Testing of portal monitor methods to discover illicit trafficking of anthropogenic radioactivity in operational field use — ●ALEXANDER RAMSEGER ET AL. — Carl Friedrich von Weizsäcker Centre for Science and Peace Research

The goal of this project is the detection of illicit trafficking radioactive substances. These substances have a high risk potential in their intentional or careless use.

The detection systems used up to now are not sensitive enough to discover all relevant nuclides (false negative) and have a high false alarm rate (false positive). By an improved gamma spectrometric analysis as well as an active detection with neutron radiation, the false alarm rate could be minimised and the amount of detected substances increased. The first step is to determine the improvement potential regarding measurement methods and analytical algorithms. The most promising methods and algorithms should be developed and then tested.

At the Hamburg harbour first measurements were conducted to compare gamma spectrometric detectors with an already installed portal monitor system for gamma rate measurements of containers. The average distance of the detectors (portal monitor as well as gamma spectrometric detectors) to the containers depended on the traffic lane of the lorry carrying the container through the portal monitor but was in average about 2 meters.

The results of these measurements, which are presented in this talk, are a first basis for further search of improvements.

AGA 5.6 Fr 13:00 VMP 9 HS

Erkennung und Unterdrückung von Störsignal-Linien in akustischen und seismischen Spektren — FELIX GORSCHLÜTER und ●JÜRGEN ALTMANN — Experimentelle Physik III, TU Dortmund, 44221 Dortmund

Zur Nah-Ortung der Kaverne einer unterirdischen Kernwaffenexplosion (im Rahmen der Teststopp-Überwachung) müssen schwache seismische Signale nachgewiesen werden, die von periodischen Quellen überlagert sein können (Motoren, Industrie). Zur Abtrennung suchen wir in den komplexen Fourier-Spektren die daher stammenden Linien. Aus den stärksten drei Werten werden die Parameter Frequenz, Phase und Amplitude mittels nicht-linearer Anpassung ermittelt. Für alle Linien wird nacheinander das dazugehörige Ein-Linien-Spektrum abgezogen. Die Leistungsfähigkeit beim Finden schwacher, nicht-periodischer Ereignisse wird mit synthetischen Spektren in Abhängigkeit vom Rauschen ermittelt. Wir überprüfen die Trennfähigkeit an akustischen und seismischen Messungen von Hubschraubern.