Working Group on Physics and Disarmament
Arbeitsgruppe Physik und Abrüstung (AGA)

Götz Neuneck
IFSH, Universität Hamburg
Beim Schlump 83, D-20144 Hamburg
neuneck@ifsh.de

Matthias Englert
Öko-Institut e.V.
Rheinstr. 95, D-64289 Darmstadt
m.englert@oeko.de

Christian Alwardt
IFSH, Universität Hamburg
Beim Schlump 83, D-20144 Hamburg
alwardt@ifsh.de

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 Themen wie die nukleare Abrüstung, Verifikation bzw. die Detektion von Nuklearanlagen und Materialien, Raketenabwehr und Zerstörung von Nuklearsprengköpfen, neue militärrelevante Technologien wie Drohnen. Die Fachsitzung wird von der DPG gemeinsam mit dem Forschungsverbund Naturwissenschaft, Abrüstung und internationale Sicherheit FONAS durchgeführt. Die 1998 gegründete Arbeitsgruppe Physik und Abrüstung ist für die Organisation verantwortlich. Die Sitzung soll international vorrangige Themen behandeln, Hintergrundwissen vermitteln und Ergebnisse neuerer Forschung darstellen.

Overview of Invited Talks and Sessions

(Lecture room B 0.014)

Invited Talks

AGA 3.1	Thu	10:00–11:00	B 0.014	**The Long Road: From Eisenhower's 1953 "Atoms for Peace" to the IAEA Low Enriched Uranium Bank in Kazakhstan** — •Tariq Rauf
AGA 3.2	Thu	11:00–12:00	B 0.014	**SILEX Laser Enrichment Technology and Its Proliferation Implications** — •Ryan Snyder
AGA 4.1	Thu	14:00–15:00	B 0.014	**The North Korean Threat from the US Perspective** — •David Wright
AGA 4.2	Thu	15:00–16:00	B 0.014	**To be continued? - Was 2017 the Grand Finale for the North Korean Missile Program?** — •Markus Schiller
AGA 5.1	Thu	16:30–17:30	B 0.014	**Analysen zum Nachweis der nordkoreanischen Nukleartests** — •Jens Ole Ross, Lars Ceranna, Michaela Frei, Peter Gaebler, Nicolai Gestermann, Ilona Grünberg, Gernot Hartmann, Christoph Pilger, Andreas Bollhöfer, Clemens Schlosser, Andreas Barth

Max-von-Laue Lecture

PV XVI	Thu	20:00–21:00	B Audimax	**Max-von-Laue Lecture: Scientific Work in Support of Bans on Nuclear Testing: Lessons for Science Advice** — •Paul G. Richards

Sessions

AGA 1.1–1.3	Wed	15:00–16:30	B 0.014	**Nuclear Safeguards**
AGA 2.1–2.2	Wed	16:30–17:30	B 0.014	**Verification and Conventional Systems**
AGA 3.1–3.3	Thu	10:00–12:30	B 0.014	**Nuclear Nonproliferation**
AGA 4.1–4.2	Thu	14:00–16:00	B 0.014	**North Korean Crisis 1**
AGA 5.1–5.3	Thu	16:30–18:30	B 0.014	**North Korean Crisis 2**
AGA 6	Thu	18:30–19:30	B 0.014	**Annual General Meeting of the Working Group on Physics and Disarmament**
AGA 7.1–7.2	Fri	9:30–10:30	B 0.014	**Nuclear Disarmament Verification**
AGA 8.1–8.2	Fri	10:30–11:30	B 0.014	**Nonproliferation and Research Reactor Conversion**

Annual General Meeting of the Working Group on Physics and Disarmament

Donnerstag 18:30–19:30 Raum B 0.014

- Bericht
- Wahl
- Verschiedenes

AGA 1: Nuclear Safeguards

Time: Wednesday 15:00–16:30 Location: B 0.014

AGA 1.1 Wed 15:00 B 0.014

Study of Neutron Detection Technologies Using ^{6}Li as a Replacement of ^{3}He — Theo Köble, •Charlotte Bornhöft, Olaf Schumann, and Wolfram Berky — Fraunhofer-Institut für Naturwissenschaftlich-Technische Trendanalysen INT, Appelsgarten 2, 53879 Euskirchen

Within the past decade a significant shortage of ^{3}He and correspondingly an enormous increase in cost has occurred. ^{3}He is widely used in neutron detection applications, e.g. by first responders, during on-site inspections, and in other applications where nuclear and radioactive material has to be detected, localized and possibly identified. Therefore replacement materials need to be considered, selected, implemented in a corresponding detector, and thoroughly tested.

One of these promising basic elements is ^{6}Li which is utilized in detector applications such as the scintillation materials CLYC (Cs_2LiYCl_6:Ce), and CLLB ($Cs_2LiLaBr_6$:Ce). These two detector types even offer the possibility of simultaneously measuring neutrons and gamma radiation with good discrimination capability. Within the detection materials neutrons are captured by ^{6}Li, triggering the nuclear reaction ^{6}Li(n,α)^{3}He. The secondary particles then create light pulses in the scintillation crystal which ultimately serve as detection signals. The neutron and gamma radiation result in different pulse shapes which allow the discrimination.

We performed test measurements with both scintillation materials; the results gain information for further use as material in measurement systems in the field of nuclear safety and security.

AGA 1.2 Wed 15:30 B 0.014

Production and Characterisation of Microparticle Reference Materials for Particle Analysis in Nuclear Safeguards — •Stefan Neumeier, Philip Kegler, Martina Klinkenberg, Irmgard Niemeyer, and Dirk Bosbach — Forschungszentrum Jülich GmbH, Institute of Energy and Climate Research * Nuclear Waste Management and Reactor Safety (IEK-6), 52425 Jülich, Germany

The International Atomic Energy Agency (IAEA) implements safeguards measures in order to verify that member states are in compliance with their international legal obligations to use nuclear material and technology only for peaceful purposes. Safeguards measures, inter alia, include analytical measurements of samples taken during inspections at nuclear facilities. While the use of analytical techniques by the IAEA constantly requires quality control and further advancement, particle reference materials are needed for enhancing particle analysis methods in safeguards. This presentation reports on the development of an installation at Forschungszentrum Jülich capable of the production of microparticles, which are intended to be used as source material for certified reference materials. The first part of the presentation addresses the process development and optimization, e.g. influence of precursor chemistry on particle morphology. The second part discusses the particle characterization and analysis by electron microscopy, mass spectrometry and μ-X-ray methods.

AGA 1.3 Wed 16:00 B 0.014

Detection of nuclear reprocessing activities using Kr^{85} — •Pablo Woelk, Markus Kohler, Carsten Sieveke, Simon Hebel, Ergin Simsek, Christoph Becker, Klaus Sengstock, and Gerald Kirchner — Universität Hamburg, Deutschland

An increased concentration of the isotope Kr^{85} in atmospheric air samples combined with atmospheric calculations is an excellent indicator for detecting nuclear reprocessing activities.

For an effective detection, small sample sizes and a high sample throughput rate are necessary. These factors place high demand on the measuring technology.

Our Atom Trap Trace Analysis (ATTA) experiment aims to measure the concentration with a magneto-optical trap. This method allows to capture specific isotopes and is sensitive to the part-per-trillion level.

Established implementations using the ATTA method allow high sensitivity but have a limited sample throughput rate, since the vacuum chambers need to be flushed after each measurement to avoid cross contamination due to the RF-driven excitation into the metastable state. Here, however, we are producing metastable Kr all-optically, avoiding cross contamination.

Our experiment includes the entire measuring chain. Besides the actual concentration measurement this includes an in-house developed autonomous air sampling as well as automated sample preparation.

AGA 2: Verification and Conventional Systems

Time: Wednesday 16:30–17:30 Location: B 0.014

AGA 2.1 Wed 16:30 B 0.014

Seismic Modelling of Tracked-Vehicle Signals for Monitoring and Verification — •Mathias Pilch and Jürgen Altmann — Experimentelle Physik III, TU Dortmund

To understand the characteristics of seismic signals measured with passes of tracked vehicles we numerically modelled the responses of a layered soil at various distances to a vertical force pulse. The soil properties were chosen similar to the ones found at the measurement site. The pulse amplitude and shape followed the force time function measured under the track elements. Because of different wave types and of reflection at the layer boundaries, the signal shape varies with distance. During a vehicle pass the road wheels roll over the tracks (with different left-right offset), each producing one force pulse at each element. At a sensor site the one-pulse signals for the corresponding slant distances are superposed, shifted by the respective excitation times. As the vehicle moves, the times and distances vary. The sum signals and their spectra show qualitative agreement with the ones from the measurements. Differences are: the theoretical signals are much simpler and weaker, and higher frequencies seem to be damped much less at larger distance. Due to the large variability seismic vehicle-type recognition seems much more difficult than acoustic.

AGA 2.2 Wed 17:00 B 0.014

Technologien für autonome Waffensysteme - Stand und Perspektiven — •Jürgen Altmann — Exp. Physik III, TU Dortmund

Nach unbemannten, ferngesteuerten Kampffahrzeugen werden in militärischer Forschung und Entwicklung (FuE) autonome Waffensysteme (AWS) vorbereitet. Der Übergang von einem Menschen "in der Entscheidungsschleife" zu "auf der Schleife" und schließlich "außerhalb der Schleife" könnte sich gleitend vollziehen, beginnend mit übersichtlichen Szenarien etwa auf hoher See. Erheblich problematischer würden langreichweitige Flugkörper oder "bummelnde" Kampfdrohnen, die Ziele über längere Zeit suchen, erkennen und bekämpfen würden. Kleine Schwärme größerer Kampffahrzeuge oder größere mit einer großen Anzahl kleiner Einheiten versprechen wirksame Angriffe von vielen Seiten, Arbeiten zur Schwarmabwehr haben begonnen. Einhaltung des Kriegsvölkerrechts bei AWS würde Situationsbeurteilung auf dem Niveau eines menschlichen Befehlshabers erfordern, was "künstliche Intelligenz" in komplexen Szenarien wahrscheinlich Jahrzehnte lang nicht erreichen können wird. Für Kampf gegen einen etwa ebenbürtigen Gegner in der Luft, am Boden und auf dem Wasser gibt es aus v.a. aus Zeitgründen starke Motive für autonomen Waffeneinsatz. Das gilt ebenso für Schwärme, die sich gegenseitig bedrohen. Bei FuE ist schon jetzt ein Wettrüsten zu beobachten. Die Einführung von AWS wird wahrscheinlich die militärische Situation zwischen potentiellen Gegnern erheblich destabilisieren; eine besondere Gefahr stellt die Wechselwirkung zwischen zwei sich gegenseitig belauernden AWS-Systemen in einer schweren Krise dar, die nie erprobt werden könnte.

AGA 3: Nuclear Nonproliferation

Time: Thursday 10:00–12:30 Location: B 0.014

Invited Talk AGA 3.1 Thu 10:00 B 0.014

The Long Road: From Eisenhower's 1953 "Atoms for Peace" to the IAEA Low Enriched Uranium Bank in Kazakhstan — •Tariq Rauf — Vienna

On 8th December 1953, US President Eisenhower in his "Atoms for Peace" speech at the UN called on States to make joint contributions from their stockpiles of natural uranium and fissionable materials to an International Atomic Energy Agency [IAEA]"[to] provide special safe conditions under which such a bank of fissionable material" would be allocated to "provide abundant electrical energy in the power-starved areas of the world." A half century later, in 2003, IAEA Director-General ElBaradei called for a new approach to the sensitive parts of the nuclear fuel cycle "uranium enrichment and plutonium separation" that would assure supplies of low enriched uranium (LEU) for civilian uses and preserve States" nuclear fuel cycle options while minimizing the establishment of additional enrichment and reprocessing capabilities. On 29 August 2017, the storage facility for the IAEA LEU Bank was inaugurated at the Ulba Metallurgical Plant in Kazakhstan. This presentation will describe the evolution and development of the IAEA LEU Bank

Invited Talk AGA 3.2 Thu 11:00 B 0.014

SILEX Laser Enrichment Technology and Its Proliferation Implications — •Ryan Snyder — United Nations Institute for Disarmament Research, Geneva, Switzerland

Efforts to develop a commercially viable laser-based process for uranium enrichment have been ongoing since the discovery of the laser in 1960. After limited success with various atomic and molecular laser isotope separation techniques, a new process that relies on the concept of condensation repression may yet prove commercially successful. One example of this technique is the SILEX (Separation of Isotopes by Laser Excitation) process being developed by the Global Laser Enrichment (GLE) project, which can enrich uranium to weapon-grade levels using less space and energy than almost all centrifuge designs. Research programs worldwide are also developing laser systems capable of enriching uranium using this concept. The basic dynamics of the SILEX process will be presented here, along with physical space constraints and energy efficiency estimates for clandestine nuclear weapons production. The proliferation implications of successful commercial demonstration and continued worldwide development of relevant laser systems will also be discussed.

AGA 3.3 Thu 12:00 B 0.014

The Composition of the British Plutonium Stockpile — •Christopher Fichtlscherer — IANUS, TU Darmstadt, Darmstadt, Germany — ISR, BOKU, Vienna, Austria

The UK has the largest stockpile of civil plutonium worldwide. Different options on how to manage this stockpile are discussed, among others the use as MOX fuel in either fast or thermal reactors. When reusing the plutonium as fuel, the isotopic composition of the plutonium has a major impact on reactor operation, it influences safety parameters such as the reactivity coefficients but also the possible burn-up and the dose rate emerging from the spent fuel elements - an important factor when assessing the disposition of fissile material using a radiation barrier. The information on the composition of the plutonium is, however, scarce. By using the operation times and characteristics of all AGR and Magnox reactors in the UK, we try to make a useful estimation of the composition of the British civil stockpile. Since the half-life of e.g. plutonium-241 is only 14 years, different points in time also lying in the future are considered.

AGA 4: North Korean Crisis 1

Time: Thursday 14:00–16:00 Location: B 0.014

Invited Talk AGA 4.1 Thu 14:00 B 0.014

The North Korean Threat from the US Perspective — •David Wright — Union of Concerned Scientists

After developing its missile program for several decades, North Korea has made surprisingly rapid progress in the last two years. This talk will describe what we know about North Korea's program and what additional steps it needs to develop*and demonstrate*the capability to deliver a nuclear weapon to US territory. In particular, the talk will look at issues related to the development of a successful reentry vehicle to shield the warhead from the heat and stresses of passing through the atmosphere. It will also discuss the US debate over how to respond to North Korea's program, including the role of sanctions, diplomacy, and military options. Finally, it will look at the effect the growing North Korean missile threat is having on US plans to develop and deploy ballistic missile defenses.

Invited Talk AGA 4.2 Thu 15:00 B 0.014

To be continued? - Was 2017 the Grand Finale for the North Korean Missile Program? — •Markus Schiller — ST Analytics GmbH, München, Germany

In 2017, North Korea was attributed of having launched a total of 6 different new guided ballistic missile types - a record that would have seemed impossible just a few years ago, and which might seem out of reach for even most industrialized countries today. The fireworks had a highlight with the launch of North Koreas first ICBM, the Hwasong-14, in July, and culminated with the launch of the large Hwasong-15 ICBM in late November.

This presentation tries to illuminate the ratio behind and the systematics of the program, to shed light on some inconsistencies, to give an idea of what the new missiles are capable of, and to understand if that was the grand finale, or if the program will hold its pace over the coming years.

AGA 5: North Korean Crisis 2

Time: Thursday 16:30–18:30 Location: B 0.014

Invited Talk AGA 5.1 Thu 16:30 B 0.014

Analysen zum Nachweis der nordkoreanischen Nukleartests — •Jens Ole Ross[1], Lars Ceranna[1], Michaela Frei[1], Peter Gaebler[1], Nicolai Gestermann[1], Ilona Grünberg[1], Gernot Hartmann[1], Christoph Pilger[1], Andreas Bollhöfer[2], Clemens Schlosser[2] und Andreas Barth[3] — [1]BGR, Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover — [2]BfS, Bundesamt für Strahlenschutz, Freiburg — [3]KIT, Karlsruher Institut für Technologie, Geophysikalisches Institut, Karlsruhe

Das internationale Überwachungsnetz für den umfassenden Kernwaffenteststoppvertrag (CTBT) registriert seismische und hydroakustische Wellen sowie Infraschall zur Detektion und Lokalisierung von Explosionen. Hochempfindliche Radionuklidstationen dienen der Messung von Spuren radioaktiver Spaltprodukte in der Atmosphäre. Numerische Modelle der atmosphärischen Ausbreitung helfen die örtlich-zeitliche Konsistenz von Radionuklidmessungen mit möglichen Explosionsquellen zu bewerten. Die fünf nordkoreanischen Nuklearexplosionen von 2006 bis 2016 zeigten eine steigende Sprengkraft von unter einer bis ca. 25 kt TNT äquivalent. Nach den Tests 2006 und 2013 gelang durch atmosphärische Messung von Xenon in spezifischen Isotopenverhältnissen der Nachweis des nuklearen Ursprungs der Explosion. Mittels Satelliten gestützter Radarinterferometrie wurden 2016 Bodenabsenkungen festgestellt. Die Explosion vom 3.9.2017 war um ein Vielfaches stärker und es wurden mehrere Nachbeben registriert. Am Beispiel von 2017 wird die Bandbreite der am Nationalen Datenzentrum für das CTBT-Monitoring eingesetzten Methoden demonstriert.

AGA 5.2 Thu 17:30 B 0.014

Disarming North Korea with physics: How can verification help resolve the nuclear crisis? — •Malte Göttsche — AICES Graduate School, RWTH Aachen, Germany

How to stop Kim Jong Un's nuclear path? Despite de-escalation hardly being in sight, concepts must be ready. Should the complete denuclearization be required for political and economic guarantees, or at first only a freeze of the nuclear programme? Either approach raises scientific challenges: How could inspectors verify North Korean compliance? Two key issues are quantifying how much fissile material was produced in the past to assess how many weapons could be built and must be dismantled, and determining the present non-production (under a freeze).

This talk introduces the North Korean fissile material production programme and inspections carried out in the past, as well as concepts for novel methods to quantify past production. This includes measurements in shut-down reactors to determine the neutron fluence and to distinguish past plutonium from tritium production, measurements of the isotopics and mass of radioactive waste, and analyzing operational records coupled with fuel cycle simulations. Beyond North Korea, such methods will be needed to verify global nuclear disarmament.

AGA 5.3 Thu 18:00 B 0.014

How many nuclear weapons does North Korea have? - Fissile material production estimates — •Matthias Englert — Institute for Applied Ecology - Öko-Institut e.V., Rheinstr. 95, 64295 Darmstadt

The question of how many weapons could North Korea possibly have depends on the amount of plutonium or highly enriched uranium North Korea has produced already and how much is used in one nuclear device. Much about its nuclear program is shrouded in secrecy and little reliable information is available, especially since the IAEA and international experts lost access to the fissile material production plants. This talk will give a summary of North Korean fissile material production capabilities based on estimates in the open literature and own calculations. Some detail is available about the plutonium production at the 5 MWe gas graphite reactor and the reprocessing plant at the Radiochemical Laboratory at Yongbyon.

After roughly 35 kg plutonium was produced in the 1990s and early 200s the reactor was restarted in 2013 but operated only intermittendly. North Korea also builds an experimental light water reactor with 100 MWth. In 2010 North Korea also revealed the existence of an uranium enrichment program and a seemingly operating 2000-centrifuge enrichment plant to US scientists. Estimating the separative work of the centrifuges based on information about technology transfers to and from North Korea it is possible to calculate a hypothetical production rate for Highly Enriched Uranium (HEU). However, such estimates are highly uncertain as it is not known if a second plant exists and since when the revealed plant is operating and at which capacity level. Additionally, estimating uranium enrichment production rates does depend heavily on the assumption about the enrichment and depletion level, the cascade scheme, on the amount of raw material available and on the timescale. Together with the uncertainties about the North Korean weapon design and the amount of fissile material used per weapon, estimates vary considerably from 10 up to 60 nuclear weapons in the North Korean arsenal. Some consideration will be also given to the availability of other nuclear weapon relevant materials such as tritium, lithium-6, and deuterium.

AGA 6: Annual General Meeting of the Working Group on Physics and Disarmament

Time: Thursday 18:30–19:30 Location: B 0.014

Duration 60 min.

AGA 7: Nuclear Disarmament Verification

Time: Friday 9:30–10:30 Location: B 0.014

AGA 7.1 Fri 9:30 B 0.014

The Nuclear Disarmament Verification Challenges: Scenarios, Procedures, Technologies — •Götz Neuneck — IFSH, Hamburg

Until now, nuclear disarmament only occurred unilaterally (South-Africa, Irak) or in a bilateral constellation between the U.S. and Russia within the START- and INF-process. Mainly, the reduction or destruction of the delivery systems has been verified by national technical means or inspections, not the dismantlement of nuclear warheads itself. Additionally, the IAEA, but also other verification agencies and institutionshave gathered much procedural and technological expertise in verifying the presence or absence of nuclear materials for military purposes. Internationally, there are two main efforts to advance the nuclear disarmament process, which is blocked politically. The "International Partnership for Disarmament Verification" (IPNDV) is a 25 state endeavour inter alia to provide a strong analytic contribution to build the needed tool kit of nuclear disarmament concepts and capabilities. At the same time the Treaty on the Prohibition of Nuclear Weapons (not yet in Force) is established as the first legally binding international agreement to comprehensively prohibit nuclear weapons, with the goal of leading towards their total elimination. Art. 3/4 are advocating "to remove and destroy nuclear weapons" by "verifiable, time-bound, transparent and irreversible destruction". The talk articulates the results, experiences, principles and technologies of the international efforts to develop nuclear disarmament verifications and attempts to identify the criteria, common ground and gaps of the different approaches.

AGA 7.2 Fri 10:00 B 0.014

Nukleare Abrüstungsverifikation: Technische Herausforderungen und Lösungsansätze — •Simon Hebel und Gerald Kirchner — Universität Hamburg, Zentrum für Naturwissenschaft und Friedensforschung

Die Existenz zuverlässiger und erprobter Verifikationsinstrumente stellt eine der wichtigen Anforderungen für erfolgversprechende nukleare Abrüstungsverhandlungen dar. Für diese Aufgabe geeignete technische Verfahren befinden sich teils in der Entwicklung, teils bedürfen sie noch umfangreicher Erprobung, um ihre Zuverlässigkeit und Grenzen quantifizieren zu können. Zentrale Anforderungen werden die Authentifizierung nuklearer Sprengköpfe oder deren spaltbarer Komponenten sowie der Explosivstoffe, die lückenlose Überwachung der sensitiven Materialien und die Entwicklung geeigneter Informationsbarrieren sein, damit bei Inspektionen keine sensitiven Informationen proliferiert werden.

In diesem Vortrag wird ein Überblick gegeben über den aktuellen Entwicklungsstand potentiell geeigneter Messverfahren, ihren Entwicklungsstand und mögliche Einsatzgebiete. Ihre Grenzen und erforderliche Forschungsprioritäten werden hervorgehoben.

AGA 8: Nonproliferation and Research Reactor Conversion

Time: Friday 10:30–11:30 Location: B 0.014

AGA 8.1 Fri 10:30 B 0.014

The German Research Reactor FRM-II and the Use of High Enriched Uranium (HEU) Fuel — •Friederike Friess — Institut für Sicherheits- und Risikowissenschaften, BOKU Wien

The design of the research reactor FRM-II in Munich took place when the norm against using highly enriched uranium (HEU) as fuel for research reactors was already widely accepted. Yet, the FRM-II went critical in 2004 using HEU. The operating license, however, included the requirement to convert the FRM-II to low enriched uranium (LEU) fuel until the end of 2010. This deadline has been extended to 2018. This conversion deadline will not be met either. The operation of a research reactor using HEU does not only undermine international non-proliferation policy, it also bears several problems such as the fuel supply and the spent fuel management.

The FRM-II influenced several recent developments such as Russia's renewed efforts to enrich to HEU and the change in German nuclear legislation in 2017.

AGA 8.2 Fri 11:00 B 0.014

Conversion Options for the FRM-II - an overview of results of neutronic calculations — Christoph Pistner and •Matthias Englert — Institute for Applied Ecology - Öko-Institut e.V., Rheinstr. 95, 64295 Darmstadt

Minimization of the civil use of highly enriched uranium (HEU) is one of the cornerstones of international nonproliferation efforts to prevent access to fissile material suitable to build nuclear weapons. The conversion of the fuel of research reactors from the use of HEU to the use of low-enriched uranium is at the heart of this effort, as the annual demand for HEU for research reactors is highest compared to other civilian applications. Since the 1980s, a norm existed not to commission any new research reactors with a design based on HEU fuel. The only exception is the research reactor Munich II (FRM-II) which went critical in 2004, and today is one of the seven HEU reactors worldwide, which account for about 80% of the civilian HEU demand worldwide. To convert existing reactors, programs for the development of high-density uranium silicide fuels were set up in the 1980s and were qualified for use in reactors up to a density of 4.8 g/cm3. In the following decades, all German research reactors were converted with this new fuel or shut down. For the reactor core design of the FRM-II, however, instead of using it at a 20% LEU enrichment, these new uranium-silicide fuels developed for the HEU-LEU conversion have been highly enriched again for the FRM-II core. The extremely compact design of the fuel element, made possible by the new uranium silicide fuel, has made the conversion of the reactor into a demanding task ever since. However, the proliferation risks were finally acknowledged and while the reactor initially started operation with HEU, a legal obligation exists to convert the reactor to lower enrichment. The new hope for conversion is on the development of new uranium-molybdenum (UMo) alloys with which fuels of even higher density could be obtained. We present an overview of the current status of the conversion possibilities for the FRM-II, especially with regard to neutron-physical simulations and possible changes in the core geometry.