FONAS.org

Forschungsverbund Naturwissenschaft, Abrüstung und internationale Sicherheit

Research Association Science, Disarmament and International Security

Nuclear Weapons - Armament of Space - Weapons of Mass Destruction - Chemical and Biological Weapons - Concepts for a Nuclear Weapon free world - Nanotechnology and new Weapon Systems - Detection of clandestine Fissile Material production - Technology assessment of an international fusion research and technologies - Verification of conventional Disarmament in Europe - Weapons of Mass Destruction and Terrorism - Modeling of Conf eration-Cl hange and curity - -lethal" we s - Non-Prolif Missile Defe eapo Confli Coope n - Wea Mass D mate char nd Security - ethal" W ons rolife - Nucl ons - M Defen ser Wea Nuclear We - Armam S eapo f Mass n - Che nd Biological Wea ts f uclear Wea ee no ology ew pon Syst ion of clan M productio ec gy ent r inte nal fusion and tech es - Verificati conventio arr nt in We strui and Ter n - Mod of Conflict and rati te c e and y - lethal W ns -Prol n - Miss fense - Laser We g of C

Editorial

This is the ninth edition of the FONAS Newsletter and the first one in the English language.

FONAS, which means *Forschungsverbund Abrüstung, Naturwissenschaft und internationale Sicherheit* (FONAS) or *Research Association Science, Disarmament and International Security*, is a scientific association that aims to promote the scientific work on questions of disarmament, international security and peace by applying mathematical, scientific and technical methods.

Launched at the *Center for Physics* in Bad Honnef on March 21st, 1996, FONAS currently has 71 members who are natural scientists, mainly physicists and mathematicians.

During the past twelve years FONAS and its members have worked on a broad spectrum of subjects to do with disarmament, arms control, nonproliferation of weapons of mass destruction and verification of international treaties. The scientific results have been published in numerous scientific journals. Furthermore, at the universities of Bochum, Darmstadt and Hamburg, 15 dissertations and more than 20 diploma theses have been completed. Many studies have been written on issues of immediate policy relevance. Today FONAS represents a remarkable scientific network whose expertise is not only regularly asked for by media but also by members of the German Parliament.

With this edition FONAS strives to communicate its results of natural scientific peace research and security in a wider European community and to intensify networking among natural scientists working on questions of arms control and disarmament beyond Germany. Accordingly, the first article introduces the network FONAS and gives a survey of its history, issues of research and previous achievements.

Then an excerpt of an article follows, written by *Jürgen Scheffran,* on the complexity of security after the end of the Cold War, when complexity became a new paradigm of the international security debate. Today not only the military arsenals are relevant for security, but also economic and technological as well as social and ecological factors.

Afterwards *Fabio Balloni, Matthias Englert, and Wolfgang Liebert* of the *Interdisciplinary Research Group Science, Technology and Security (IANUS*) at the *Technical University of Darmstadt* present first results of a project dealing with the proliferation risks of future tokamak-based fusion reactors..

After this, some European institutions working on international security issues and peace research are introduced: Science policy on international security issues at the *British Royal Society* by *Martin B. Kalinowski,* the *Carl Friedrich von Weizsäcker-Centre for Science and Peace Research* by *Ole Ross,* the *International Centre for Security Analysis* (ICSA) by *Chris Hobbs* and *The Praxis Centre: For the study of Information and Technology in Peace, Conflict Resolution and Human Rights* by *Dave Webb.*

As usual, reports of conferences, workshops and other meetings follow where FONAS members took part or were involved in the planning and organizing process.

At the end, the annual report (in German) of the FONAS association as well as a list of selected publications of FONAS members are given.

Ulrike Kronfeld-Goharani, April 2009

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Science and Peace Research: The Forschungsverbund Naturwissenschaft, Abrüstung und internationale Sicherheit (FONAS)

Ulrike Kronfeld-Goharani

The *Forschungsverbund Abrüstung, Naturwissenschaft und internationale Sicherheit* (FONAS) was founded on 21 March, 1996 at the *Physikzentrum Bad Honnef* which is run by the *German Physical Society* (DPG). The aim of FONAS is to promote the scientific work on questions of disarmament, international security and peace by applying mathematical, scientific and technological methods. FONAS is a professional association that strives to communicate results of natural scientific peace research and security policy.

History of FONAS

In Germany the idea what we call today *natural scientific peace research* was firstly introduced by *Carl Friedrich von Weizsäcker*, who was among the founding members of the *Vereinigung Deutscher Wissenschaftler* (VDW, Federation of German Scientists) in the sixties. At this time, the study *Kriegsfolgen und Kriegsverhütung (Consequences and Prevention of War)* elaborated by an interdisciplinary team led by Weizsäcker attracted great public attention. In 1970 under the direction of von Weizsäcker the *Max-Planck-Institut zur Erforschung der Lebensbedingungen der technisch-wissenschaftlichen Welt(Investigating the living conditions in the scientific-technological world)* was established in Starnberg, where some of this kind of research was continued.

In the late 1970s and early 1980s there was a security-policy debate related to the planned deployment of intermediate-range missiles in Western European countries, the emerging peace movement and the question of the responsibility of scientists. Against this background 1984 the German *Volkswagen-Stiftung* started a small scholarship programme. Its objective was to draw in natural scientific and economic research skills into security and peace research, that was dominated since the 1970ies by political scientists. Due to this successful programme, the Volkswagen-Stiftung set up a comprehensive interdisciplinary focal programme titled *Research and Education in the Context of Security Policy.* With a start-up fund of over 7,7 million DM, research groups were established in Berlin, Bochum, Darmstadt, Hamburg and Munich (Fig. 1).

From the very beginning the German working groups were in touch with US researchers working on questions of disarmament and arms control. In the USA scientific research groups engaging in this research field existed at MIT and the universities of Princeton and Stanford. Natural scientists such as *W. Panofsky, S. Drell, V. Weisskopf* and others provided important contributions to the concept of "arms control". Today diverse research groups in the USA, at specially installed research units, work on disarmament and proliferation analysis in the context of specific security relevant questions. *Frank von Hippel* (Princeton) described the concept of scientific analytic expertise in the public-interest as follows:

> *"The growing public awareness of the dangerous consequences of leaving the exploitation of technology under the effective control of special industrial and governmental interests has led to a readiness within the scientific community to undertake a serious commitment to what we will term 'public-interest science'"*.

Contacts to US scientists such as *Frank von Hippel, John Holdren, Richard Garwin* and *Ted Postol* gave important motivation for the German working groups. Travels to the USA and invitations to the *International Summer Symposium on Science and World Affairs*, organized by the *Union of Concerned Scientists* (*David Wright, George Lewis, Lisbeth Gronlund*) and MIT, provided an opportunity to meet younger scientists not only from the USA, but also from Russia, Pakistan, China and India. Invitations to workshops and conferences of the *Pugwash Conferences on Science and World Affairs,* honored with the Nobel Peace Prize in 1995, opened the possibility to discuss research results in a broader international context with senior scientists and political professionals.

Fig. 1: Interdisciplinary working groups supported by the Volkswagen-Stiftung

1988 – Technical University of Darmstadt: *Interdisziplinäre Arbeitsgruppe Naturwissenschaft, Technik und Sicherheit (IANUS)*

1988 – Ruhr-Universität Bochum: *Bochumer Verifikationsprojekt (BVP)*

1988 – University of Hamburg: *Arbeitsgruppe Naturwissenschaft und Internationale Sicherheit (CENSIS)*

1989 – University of the German Federal Armed Forces in Munich *Institut für Angewandte Systemforschung und Operations Research*

1991 – Max-Delbrück-Centrum, Berlin: *Arbeitsgemeinschaft Bioethische Forschung*

Fig. 2: German research institutions funded by the federal government with partial work on disarmament issues

- Wehrtechnische Dienststelle der Bundeswehr in Munster (detection and destruction of chemical weapons);
- Institut für naturwissenschaftlich-technische Trendanalysen (INT), Euskirchen (detection of nuclear material);
- Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover (acoustic and seismic detection of nuclear explosions);
- Bundesanstalt für Strahlenschutz, Institut für Atmosphärische Radioaktivität, Freiburg (detection of atmospheric nuclear explosions by radioisotope measurements).

In the past years the German research groups for disarmament and arms control have improved their contacts to other German institutes and people working within the scope of disarmament research. To an increasing extent, the German groups have organized workshops, conferences and public expert discussions. Fig. 2 gives an overview of German institutions, partly funded by the Ministry of Defense or the Ministry of Environmental Affairs, that engage – at least to some extent – in disarmament aspects under scientific-technical auspieces. However, only a part of them work on public, not military-classified science. A combination of research and teaching takes place at the universities of Darmstadt, Dortmund and Hamburg.

During the last twelve years a remarkable network working on questions of disarmament and arms control together with colleagues and partners from social science, political science and international law has arisen in Germany. The idea of FONAS to enhance the contribution from the natural sciences has proven successful. FONAS maintains an internet website (www. fonas.org) that provides information on FONAS members, projects, publications and events.

Since 1995, FONAS groups have organized expert meetings on the subject *Armament and Verification* at the annual meetings of the German Physical Society (DPG). In 1998, the board of the DPG established the Working Group *Physik und Abrüstung* (AGA – Physics and Disarmament) to foster and improve physics-related work on questions of disarmament, international security and peace and to better educate the physics community on these issues. Thus FONAS is connected to an important professional society.

Fig. 3: Selection of FONAS Projects

Verification of conventional disarmament in Europe (Hamburg)

New technical means of verification of arms reductions (Bochum)

Verification of conversion agreements using on-site sensors (Bochum/Duisburg)

UN peacekeeping monitoring with sensors (Dortmund/Bochum)

Impacts of new technologies on conventional armament/preventive arms control (Hamburg)

Missile proliferation (Hamburg)

Proliferation of nuclear weapons and missiles in South Asia (Hamburg)

Proliferation risks of modern nuclear technologies (Darmstadt)

Inertial confinement fusion and 3rd –generation nuclear weapons (Darmstadt)

Development of biological and toxin weapons and biotechnological research (Darmstadt)

Strategic stability and modeling exchanges of nuclear strikes (Hamburg)

Modeling of conventional stability and disarmament (Hamburg)

Mathematical modeling of systems of collective security (Hamburg)

Mathematical analysis of distribution of power in existing and future security systems (Hamburg)

Game theoretical models for disarmament (Darmstadt)

Modeling of conflict and co-operation (Darmstadt)

Acoustic-seismic detection of heavy military vehicles (Bochum)

Concepts for a nuclear-weapon free world (Darmstadt)

Hazards from toxic gas in the Baltic Sea (Kiel)

Suitability of plutonium separated from commercial reactor fuel elements for nuclear bomb production (Darmstadt)

Technology assessment of fusion research and technologies (Darmstadt)

Impact assessment of an international tritium control (Darmstadt)

The Biological and Toxin Weapons Convention (Darmstadt)

Eliminating strategies for weapon-grade plutonium (Darmstadt

Ambivalence of research and technology and preventive arms control (Darmstadt)

What has been achieved?

During the past twenty years, FONAS and its members have worked on a broad spectrum of topics related to disarmament, arms control, nonproliferation of weapons of mass destruction and verification of international treaties (Fig. 3). The scientific results have been published in numerous scientific journals, books, and research papers. Furthermore at the universities of Bochum, Darmstadt and Hamburg 15 doctoral dissertations and more than 20 diploma theses have been completed.

Research projects have studied micro-systems and nanotechnology, proliferation resistance, plutonium disposal, missile defense and the armament of space. Significant impulses for preventive arms control and its methodology have been worked out as well as precise technical expert opinions on new disarmament-relevant technologies, e.g. nuclear fusion, detection of landmines, “non-lethal” weapons or remote sensing. Research findings were integrated in comprehensive reports of the Office of Technology Assessment at the German Parliament (TAB). FONAS members took part in delegations and acted as advisors in negotiations and review conferences of the *Comprehensive Test Ban Treaty* (CTBT), the *Non-Proliferation Treaty* (NPT), the *Biological and Toxin Weapons Convention* (BTWC) and the *Open Skies Treaty*. In addition, reviews were done on the new German research reactor FRM-II and international scientific developments. Today the expertise of FONAS members is regularly asked for by the media.

From the beginning FONAS made an effort not only to publish its scientific results but also to discuss them in public. For this purpose FONAS has organized 16 expert talks in Berlin, the first in Bonn in 1996. The first FONAS expert talk on anti ballistic missile defense with the US scientists *Richard Garwin* and *Ted Postol* in Berlin, 22 March 2000 was exceptionally successful.

Fonas Meeting 2005 in Osnabrück

The publication of a research memorandum on 23 June 1998 was another important outcome that supported, among other things, the long process to establish an endowed professorship for the natural-scientific peace research. In spring 2004 the *German Foundation for Peace Research* (DSF) granted such a professorship to the University of Hamburg and provided funding of €1.25 million over five years. On 1 March 2006 FONAS member Prof. Dr. Martin B. Kalinowski, took up the endowed professorship and became the head of the *Carl Friedrich von Weizsäcker Center for Science and Peace Research.* Although the Council of the DSF had at first been skeptical, FONAS succeeded in convincing the Council of the importance of its research during a DSF workshop in Berlin on 19 February 2002. Besides the founding of the DSF by the *Federal Government of Germany* in 2001, with the support of FONAS members, the professorship might be the greatest and hopefully long-lasting success. A second professorship will be established this year at the Technical University Darmstadt, sponsored by the DSF again together with the Berghof-Stiftung.

Another highlight was the award of the Göttinger Friedenspreis to the IANUS group on 9 March 2000.

Over the past years the German technical arms control community has achieved a more international level. Three colleagues who worked in FONAS projects earlier now have temporary positions at the universities of Princeton, Harvard and Illinois (Urbana-Champaign) in the USA.

The internal discussion of our research projects takes place during annual meetings on the premises of the DSF in Osnabrück or the DPG in Bad Honnef. These meetings are important for younger scientists and the internal communication of FONAS. Furthermore expert conferences are held, frequently organized together with other organizations, e.g. the conference *Information Technology and Armament*.

Problems with Implementation

Already in 1996, on the occasion of the 2nd expert discussion in Bonn, FONAS specified a number of issues that are still waiting to be worked out: tens of thousand deployed nuclear weapons, the ongoing dynamic arms race in high-tech weapons, the peril of the use of weapons of mass destruction by sub-state actors, the interrelationship of security, underdevelopment, environmental hazards and human rights. Regrettably, we and many others still have not been successful in fundamentally changing the reality, because the list of relevant subjects to be treated has grown and the political will is rather weak. Examples are the nuclear test of North Korea, the nuclear ambitions of Iran and other states, the selective non-proliferation policy of the West, the threat of space weapons and the renaissance of nuclear weapons. Even though the root cause of this situation lies in policy, scientists also have responsibilities. We hope that policy and science realize the importance of a small scientific community such as FONAS. Compared to hundreds of thousands of scientists and engineers working for armament and war, the work of FONAS is only a drop in the ocean, but a community of resolute scientists can achieve quite a lot. The role of Pugwash and other organizations in the ending of the Cold War is an encouraging example.

The future problems and hazards such as the safeguarding and destruction of nuclear materials, the prevention of high-tech arms races and the use of these weapons in wars, the improvement of verification methods and coping with the ambivalence of nuclear energy are immense. In this context the following questions are of relevance for the future work of FONAS:

- How can we help so that policy is responsive to the dangerous tendencies not too late and frantically but preventively and following sensible long-term global goals going beyond national interests?
- Is the existing structural framework still adequate for our work?
- How can we avoid the structurally excessive demands of our small research community?
- How can we better combine scientific analysis with considerations on the political context, and a capacity to act?

Normally, FONAS members pursue a problem-oriented agenda. Natural scientific and technical factors of relevant problems are the focus. Specific issues are treated in connection with political and social questions and can thus contribute to problem solving. From here, basic and application-oriented results can be generated. Regrettably this interdisciplinary approach often causes problems. Still working in the traditional disciplines is ranked higher than an interdisciplinary approach and global or rather societal relevance of research results.

Issues of Research

In the following some examples of specific issues that are particularly relevant to the work of FONAS are given. Firstly, the nano-bio-info-cogno convergence should be mentioned. For some strong actors such as the USA, the point is the “improvement of human performance”. One

goal of this research approach is also generating an enhanced and diversely networked warrior for the 21st century. This development has to be critically analyzed. The broad field of nanotechnology research plays a role in military-technology improvements. These developments must be studied further.

The considerable development in the range of laser technology does not have only pleasant and welcome aspects. A new category of weapons is planned, especially for applications in outer space. Whether such technological projects make sense has to be examined scientifically and conceptually.

The threat of the use of biological weapons is increasing again worldwide. With the aid of gene-technology methods, the bioengineering revolution is going on and opening new possibilities to enhance the efficiency of biological agents, thus increasing the hazard to be expected in future. Another example is the research on so-called bio-regulators that can cause effects comparable to those of biological weapons.

The "conquest" of low-earth space that is already remarkably burdened by military interests and technology is to be steered into a peaceful direction. According to the will of the USA, outer space is to be armed also with offensive weapons. In this context a multitude of questions according to planned or possible weapons technology exists. The line of approach has to be analyzed and its global consequences are to be estimated including the debate about the deployment of an anti-ballistic missile system.

In the area of nuclear weapons a re-conceptualization concerning non-proliferation, disarmament and arms control is pending as developments in North Korea and Iran, in the nuclear weapon states, and in the growing number of nuclear capable states show. Since the end of the Cold War, the world is undergoing a profound change: Currently there are nine states that have successfully detonated nuclear weapons and they do improve their arsenals constantly. Additionally, a growing minority of states has actual access to sensitive nuclear technologies and materials. Other states operate civilian nuclear technologies under safeguards that are still too weak and ineffective. It seems that the attempt to get the existing non-proliferation regime, which is a conflicting and unfair concept, globally accepted and stabilized is unreasonable and counterproductive.

In general, the technological factors and development tendencies with relevance to international security and the design of live together peacefully have increased. From a large number of possible fields of work, at least two are to be suggested in few words. The topic of energy having strong technologically-oriented components will have a high importance in the next decades.

The second example: Currently decisions have been taken to strengthen security research in Europe as well as in Germany. Among other basic questions (e.g. concerning the dual-use problem) specific input of our research community could make sense.

This incomplete list of examples gives an impression of the amount of issues waiting to be followed up or worked on by FONAS members. All questions are of the utmost urgency concerning global challenges and problems of securing the future. With its work, FONAS is trying to close the gap between special branches of science and peace research. Public discussion requires an input based on scientific facts and its interpretation. Independency is a precondition for expert advice to policy and the public.

The Complexity of Security

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The emerging complexity-security paradigm

With the end of the Cold War, complexity became a new paradigm of the international security debate. The decade of the 1980s established complexity and chaos as concepts in the natural sciences. It ended with the demise of the structurally simple bilateral East-West conflict. In 1989, seemingly minor events accumulated to chaos-like changes of historic and global dimensions, following a path that nobody expected or predicted. What was set into motion by *Mikhail Gorbachev* to reform the Soviet Union, escaped his control and finally turned into a wave that removed him from power. When the global socialist system disappeared, the world that emerged from the ashes was more complex than before.

In the new emerging world order not only the military arsenals are relevant for security, but also economic and technological as well as social and ecological factors, on global and regional levels. The Cold War was followed by a period of disorder and a transformation towards a globalized international system that continues to be unstable. The hostile relationship between the former superpowers USA and USSR was replaced by a more cooperative relationship involving political dialogue, crisis management and verification. Progress in the field of nuclear and conventional disarmament was codified by arms control agreements, including the *Strategic Arms Reduction Treaties* (START), the *Chemical Weapons Convention* (CWC), the *Comprehensive Test Ban Treaty* (CTBT), and the *Treaty on Conventional Forces in Europe* (CFE). Although Cold War deterrence became obsolete, it was never completely abandoned, nor were the nuclear arsenals themselves.

The positive consequences of the abandoned East-West conflict were increasingly challenged by countering trends. The unipolar dominance of the United States and the quest for supremacy provoked opposition from Russia and China and attracted criticism from

European allies, most notable in the Iraq war of 2003 and its aftermath. Nuclear and missile proliferation continued, new arms races emerged including outer space. Conflicts in the Balkans, in Africa and in other parts of the world cost numerous lives and provoked military interventions by the US, NATO and the United Nations. Environmental degradation, poverty and hunger affected the living conditions in many parts of the world. Terrorism provided a justification to keep the cycles of hatred and violence alive.

Today the international security landscape is fractured and complex. Decision processes and conflicts in the international system are determined by a variety of actors and factors which mutually influence each other. While the concentration of power and the formation of cooperative structures can reduce complexity, the increasing influence of subnational and transnational actors has rather the opposite effect. Everything is connected to everything and small changes in one part of the world could have significant impacts on other parts. How small differences can matter was demonstrated by the 2000 Presidential election in the United States when a few individual votes made a difference that changed the course of history. The 9/11 terror attacks involved only a small group of individuals and the decision to invade Iraq against world opinion and the majority of the UN Security Council was taken by a small groups of politicians in the US administration (McGoldrick 2004). More "tipping points" may come in the future, in particular when considering the risks of climate change which could turn into severe security threats (Lenton et al. 2008, Scheffran 2008). Tipping points involve three notions (Urry 2002): "that events and phenomena are contagious, that little causes can have big effects, and that changes can happen in a non-linear way but dramatically at a moment when the system switches." Complexity theory may help to understand how the complex trends of our times could affect and be affected by security risks.

The technological arms race

Throughout history, science and technology have contributed to warfare by inventing new weapons and making them more effective and destructive (Scheffran 2005). The physical sciences provided instruments to concentrate energy and force over larger spatial and shorter time dimensions, with increasing accuracy. A symbol is the nuclear-armed intercontinental ballistic missile, which can obliterate any point on the planet within half an hour. With this ever-growing destructiveness, science and technology have tremendously increased the complexity of warfare and provided the means for an all-encompassing total war.

The technological arms race contributes to innovations of weapons systems and force structures to fight wars at any time and place. Modernization no longer only affects the weapons systems and their components (warheads, delivery systems, command and control), but also the socio-economic infrastructure and life-cycle within which weapon systems are embedded, designed, developed, tested, deployed, used and removed. Scientific innovation and competition perpetuate the arms race and undermine political solutions. Scientists explore new military applications of technological innovations and tend to justify their inventions by new threats. The battlefield becomes a testing ground for new weapons, the war altogether a scientific experiment.

With the advent of nuclear weapons, the security landscape was fundamentally changed. For the first time mankind was able to destroy itself. Although the existing nuclear arsenals of the Cold War have been reduced, they still amount to tens of thousands of nuclear weapons and they are being modernized. The nuclear club has increased in the past decade, and more countries may acquire nuclear weapons as long as the existing arsenals are not abolished. The proliferation of nuclear weapons and delivery systems continues and is a major threat not only in the Middle East where the crisis of Iran's nuclear programme continues, but also in the duel between India and Pakistan in South Asia or North Korea's nuclear and missile programmes.

Throughout military history, the offense–defense competition has been a major driver of the arms race. Offenses increased the potential damage to opponents while defenses tried to limit it. With the advent of nuclear-armed ballistic missiles, any attempt to protect against this immense threat by defensive measures remained economically and technically unfeasible, despite enormous costs and efforts in missile defense programmes such as the *Strategic Defense Initiative* or the current US *Missile Defense* programme. The attempts to build a missile shield have been driving the arms race und undermining strategic stability (Scheffran 1989). Despite considerable political efforts and expenditures of more than a hundred billion dollars spent on missile defense, so far all attempts to overcome the vulnerability caused by nuclear-armed missiles have failed (Wright/Gronlund 2008). One of the reasons is the speed of long-range ballistic missiles which make interception a daunting task, further complicated by countermeasures an attacker could apply to undermine the effectiveness of missile defense. On the contrary, by making outer space a battleground for missile defense projects, vulnerability could rather increase and complicate international security, as recent anti-satellite tests in China and the United States have demonstrated.

The so-called *Revolution in Military Affairs* is driving the transformation of US armed forces and comprises almost the complete high-tech sector, including nanotechnology, biotechnology and genetic engineering, computer and communication systems, artificial intelligence, sensors, nuclear and space technology, lasers and material sciences (Neuneck 2008). Technology shapes warfare toward "intelligent" weapons, guided missiles, electronic warfare, cyber warfare, and biological warfare. On micro and nano scales, physics, chemistry, and biology are merging into nanotechnology which opens new and quite complex dimensions of warfare (Altmann 2008). Advances in the biosciences open new avenues for biological warfare, making global bio-security a challenging problem of bio-complexity that involves multifaceted processes such as interactions between humans and nonhuman biota,

anthropogenic environmental and ecological factors, and socioeconomic and political pressures (Wilson 2008).

Science and technology play a key role in the global command, control, communication and intelligence (C3I) systems that control the components of the military infrastructure of a country and observe the activities of potential adversaries. C3I serves as a backbone of the military and as a force multiplier (Reppy 2006). It is the network of networks to control military operations and provides the medium for information warfare and cyber security.

These developments increase the technical performance of weapon systems, such as the global physical expansion of weapon use through transportation and communication systems, shortening of decision times, improvement of accuracy, damage limitation in weapons use, growth of information flows, and automatization of warfare.

Although the dichotomy between civilian and military technology was more distinct during the East-West conflict, the boundaries eroded after the end of the Cold War. In the past, the military was often thought to be a pacemaker in many fields of high-tech development, even though the spin-offs remained less than expected. Scarce resources and lack of public acceptance, combined with converging demand profiles, supported the dual-use of civil and military technologies, exploiting the ambivalence of science. Dual-use refers here to those technologies that have actual or potential military and civilian applications. The strategy of "commercial-off-the-shelf" (COTS) development puts more emphasis on spin-in; taking advantage of economies of scale, a technology developed in the civilian-commercial sector is used for military purposes. Modern semiconductor, nuclear, laser, bio, computer, and communication technologies, to name a few, are employed not only in the manufacture of civilian products but also in the production of weapons.

The overlap between civil and military technologies poses severe challenges to the control of new weapon systems, which are seen as detrimental to international security. Countries that either want to keep their advantage in military technologies or want to prevent negative impacts on their own security, are more ready to control their export of "sensitive" technologies to "critical" countries. Major suppliers have agreed that certain technologies which are clearly devoted to the development and production of weapons of mass destruction (nuclear, chemical, or biological) and related dual-use items, including delivery systems, should be subjected to strict export controls.

According to Reppy (2006), the "military utility of dual-use technology is greater than ever, and the need for a policy to control diffusion of the relevant technology remains a pressing security concern". In the long run, export controls cannot prevent proliferation of the supply-side alone and need to be accompanied by preventive arms control that also restrains weapons technology on the demand side (Altmann et al. 1999). The consequence would be a more streamlined approach toward technology control that restrains the most dangerous technologies and seeks international cooperation in other fields of dual-use. Verifying agreements can apply advanced sensor technology. One of the most developed systems is the verification of the *Comprehensive Test Ban Treaty* for nuclear weapons that combines seismology, hydro-acoustics, infrasound, and radionuclide monitoring (Kalinowski et al. 2008).

Notes

[1]This is a slightly modified excerpt of: J. Scheffran, The complexity of security, Introduction to: J. Scheffran (ed.), "Security and Complexity", Special Issue of "Complexity", 14(1) 2008, 13-21.

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Security and Complexity

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Guest editor: Jürgen Scheffran

Götz Neuneck, The revolution in military affairs- Its driving forces, elements, and complexity

The current concept of a ''revolution in military affairs'' (RMA) mainly characterizes the transformation of the US military to smaller, more lethal forces. It is driven by structural changes in the international system, the high investment in R&D and military expenditures by the US government, the dramatic advancements in information and communication technologies, and the integration of these military, doctrinal, and technological factors into new military structures and tactics. This current revolution in American affairs has been a capital-intensive evolution, and while these innovations have lead to tactical victories over opposing forces on the battlefield, it is not yet clear that they have contributed to stability in the larger strategic context. Indeed, even the tactical advantages are eroding as potential and existing opponents retool their own military doctrines. The strategic response runs the length of technological spectrum, from the development of countermeasures such as in the proliferation of WMD to the development of effective low-tech warfare strategies and tactics like IEDs detonated by cell phone. The proliferation of conventional weapons combined with the adaptation of new asymmetric tactics offer a particularly grim forecast of the future. The Iraq War demonstrates that the fog of war is not overcome, nor are wars fought with precision-guided munitions necessarily ''clean.'' In short, the sophisticated weapons and communications platforms of RMA are no panacea for the ills of the modern world. The key task for the globalized world is first and foremost to develop strategies to win the ''hearts and minds'' of people in zones of violent conflict. The inclusion of civil society is a basic element, and armed forces should seek the dialogue with the civil society before it comes to war. Moreover, efforts must be redoubled to develop new methods for effective arms control.

Jürgen Altmann, Military uses of nanotechnology – Too much complexity for international security

Nanotechnology, converging with other advanced technologies, will bring benefits and risks. Particular dangers can arise from military uses. Weapons and other systems that are autonomous and/or small, cheap, and numerous will greatly increase complexity. Proceeding from criteria of preventive arms control, several potential military applications should be limited preventively. Here the USA plays a key role. In the future, verification of compliance would have to be very intrusive, with inspection rights and criminal prosecution within states. Would this be compatible with nation states maintaining armed forces for their security? Or does mastering the complexity brought about by the new technologies require changes in the international system?

Brenda Wilson, Global biosecurity in a complex, dynamic world

Biosecurity is emerging as a major global health priority for which innovative and unprecedented solutions are needed. Biosecurity is a challenging biocomplexity problem involving multifaceted processes such as interactions between humans and nonhuman biota, anthropogenic environmental and ecological factors, and socioeconomic and political pressures. Key to an effective biosecurity strategy will be fundamental understanding of evolutionary, anthropogenic and environmental driving forces at play in transmission and perpetuation of infectious diseases. Biosecurity solutions will depend on increased support of basic biomedical research and public education, enhanced healthcare preparedness, alternative strategies for ensuring safety, and improved interagency cooperation regarding global health policy.

Martin Kalinowski et al., The complexity of CTBT verification. Taking noble gas monitoring as an example

Verification of the *Comprehensive Nuclear-Test-Ban Treaty* is a complex undertaking. A monitoring system comprising of a global network of 321 seismic, hydroacoustic, infrasound and radionuclide stations is used to detect signals that could indicate a possible nuclear explosion. This system daily sends more than 10 GB of raw data to the Vienna based International Data Centre for further processing and analysis to answer a simple question: have any indications for a possible nuclear explosion been sensed? We will focus on the 40 stations in charge for global radioxenon monitoring and discuss the complexity of solving the nuclear source attribution problem.

Michael Findley, Agents and conflict-adaptation and the dynamics of war

Civil wars pose one of the most challenging threats to peace in the post-WWII era. The successful resolution of ongoing civil wars is particularly difficult. Parties opposing peace successfully subverted negotiated agreements in contexts as diverse as Rwanda, Northern Ireland, and Bosnia. Despite growing attention to civil wars in the empirical literature, little formal-theoretic work addresses the dynamics of civil wars. Empirical work demonstrates that the resolution of civil wars is both complex and uncertain: civil war combatants are heterogeneous in their traits, incompletely informed, and thus, limitedly rational, capable of learning from history and adapting their behavior—all hallmarks of a complex adaptive system. I employ an agent-based model, therefore, to capture these characteristics and address the conditions affecting the dynamics and evolution of civil wars. In particular, I focus on the evolutionary context of civil wars including learning and adaption and find that civil wars with adaptive combatants exhibit vastly different behavior than those without adaptive agents.

Ravi Bhavnani et al., Simulating closed regimes with agent based models

This article describes efforts to develop an exploratory agent-based model as a tool for studying decision

making in political regimes such as Iraq, North Korea, and Syria. Our hybrid of the landscape metaphor and the rule-based system approach captures the trade-offs leaders face in balancing components of a utility function, plus risk profiles that allow departures from conventional utility maximization. Two simple experiments concerning succession demonstrate the surprising compromises both leaders and elites are willing to make, as well as the instability of these bargains.

Without abstracts:

- *Jürgen Scheffran, The Complexity of Security*
- *Alwin Saperstein, Mathematical modeling of the interaction between terrorism and counter-terrorism and its policy implications*

Proliferation Risks of a Future Fusion Reactor – Possible Plutonium Production

Fabio Balloni, Matthias Englert, Wolfgang Liebert

Abstract

Actually there are several new technological ideas to solve the global energy problem. One is the utilization of fusion power related to the nuclear fusion of the hydrogen isotopes deuterium (D) and tritium (T). Current tokamak-based D-T fusion reactor concepts have to produce the needed T-fuel in the reactor itself inside the so-called blankets which surround the reactor chamber. It is planned to breed T from lithium using the high neutron flux produced in the plasma of the reactor chamber. To assess the proliferation potential of fusion reactors it is important to address not only the T-production and handling but also the possibility to produce weapon-usable fissile material like plutonium within the reactor blankets by partially exchanging the breeding material lithium with a fertile material like e.g. uranium.

Recently, the European Fusion Development Agency (EFDA) has published its Power Plant Conceptual Study (PPCS) which describes four promising fusion reactor designs to be realized in the future. The study provides sufficient technical information for a detailed analysis of the possible proliferation path mentioned above. For that purpose we have set up a three-dimensional reactor model of the PPCS A reactor concept in the Neutron Transport Code MCNPX [1]. In our calculations we have assumed that the lead-lithium alloy in the blankets will be partly exchanged by uranium (range: 0.1 – 1.0 vol. %). This allows to roughly but quantitatively asses different, possible proliferation scenarios, where plutonium-239 could be produced in a commercial power plant as it is conceptualized today.

I. Introduction

In January 2006, *EFDA* published a conceptual study describing four different future commercial fusion reactors PPCS A-D, that are planned as toroidal-shaped tokamak reactors [2]. While reactor concept A relies mostly on materials and technologies already available for fission reactors, concept B, C, and D need increasingly more development efforts and time, but will be much more efficient.. Accordingly, the reactor concept PPCS A could be the first fusion reactor working as a commercial power plant at the mid of the century. The entire concept will also be based on the knowledge and results that are hoped to be gained during the lifetime of the International Thermonuclear Experimental Reactor (ITER) currently under construction in Cadarache (France). The PPCS A model is based, like all the other models (B-D), on the fusion of deuterium and tritium:

$$^{2}H + {}^{3}H \rightarrow {}^{4}He + n + 17.58\ MeV \qquad (1)$$

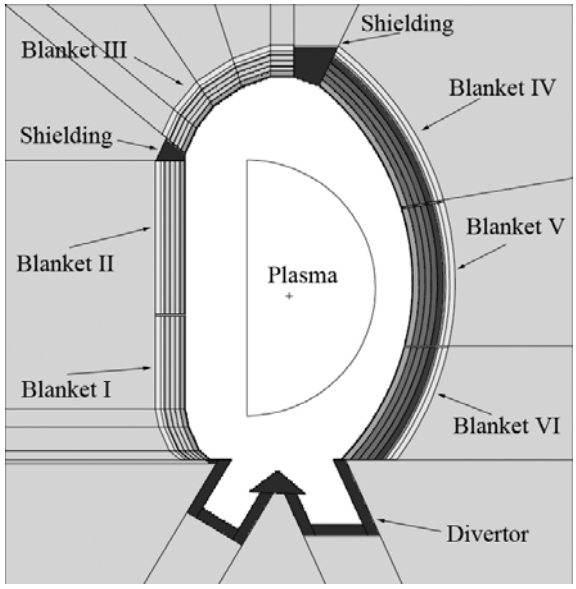

Fig. 1: Cut through the toroidal-shaped fusion reactor model PPCS A modeled in MCNPX.

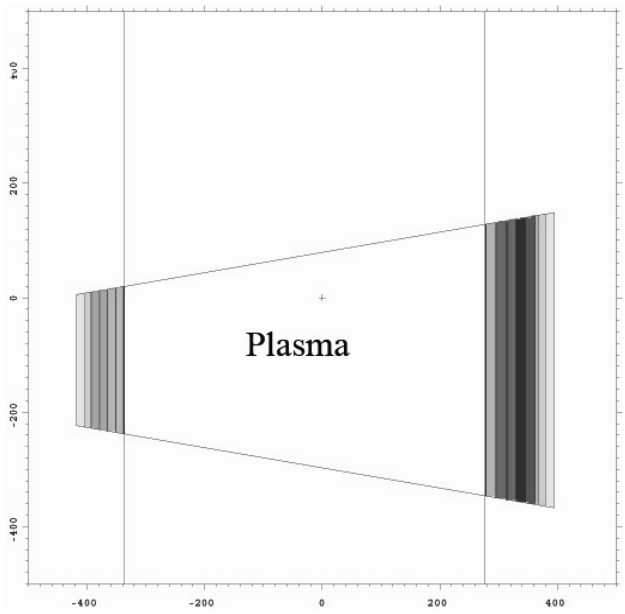

Fig. 2: Top view of one 20° torus segment.

About 80% of the produced energy is transported by the high-energetic fast neutrons (14.1 MeV). One unit is planned for an electric power of 1500 MW corresponding to 5500 MW fusion power [2].

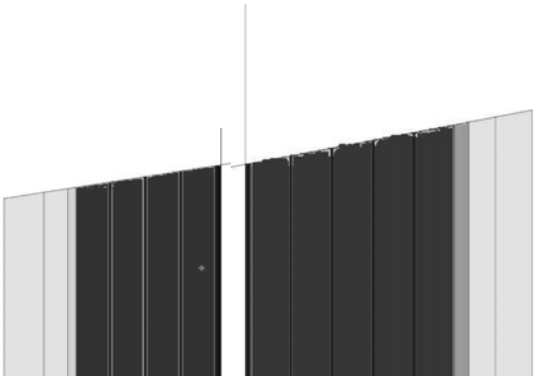

Fig. 3: Enlarged inboard (thickness 12.6 cm each) and outboard (thickness 15 cm each) breeding segments (dark grey) together with shielding segments (light grey) in poloidal view.

Whereas deuterium can be extracted from water, the annual T need of roughly 200 kg to feed the D-T plasma must be bred from lithium-6 in the reactor blankets, an amount which could not be produced effectively in other nuclear facilities like heavy water reactors. The blankets have to be easily removable with remote handling for maintenance and to replace embrittled and activated material (about every two years). The breeding material is lithium (enriched to 90 at% Li-6) in a liquid lead-lithium alloy (Pb-17Li) which will be continuously pumped through the blankets of the fusion reactor during operation. The blankets are cooled by light water to temperatures below 670K. The number of cooling tubes in the blankets decreases with distance to the first wall of the reactor chamber, as less energy is deposited. The tubes, like other structural material, will be made out of a low-activation steel (e.g. EUROFER 97 [3]), which is still under development.

II. Reactor Model

For the neutron transport calculations in the reactor chamber and the blankets the Monte Carlo n-Particle Transport Code MCNPX in Version 2.6.c [4] has been used. With the MCNPX code it is possible to model the 3-dimensional full-scale geometry of the PPCS A reactor concept. For our purposes it was sufficient to code a 20° segment of the full 360° tokamak torus, (figs. 1 and 2) with reflecting walls, thus simulating the contribution from neighboring segments to the neutron population of the 20° segment under consideration.

In the model the breeding blankets containing liquid Pb-17Li are placed in six different blanket modules (cf. Fig. 1 and 2), three on the inboard side of the reactor i.e. close to the axial center of the torus (blankets I-III), and three on the outboard side (blankets IV-VI). The inboard blankets I-III contain four breeding segments each, the outboard blankets IV-VI five (fig. 3).

Our MCNPX model is based on the model described in [5] and on design information taken from the public domain [2], [5]. Like in [5] the MCNPX model does not contain the complex internal structure of the breeding blankets (cooling tubes, steel structures). Instead each blankets is filled with a homogeneous mixture of materials (H_2O, Pb-17Li, EUROFER) as described in [5]. The shielding and the divertor complete the entire reactor structure.

Source Definition

The neutron source zone in the model is defined as one single cell bounded by elliptical and circular tori:

$$R = R_0 + a\cos(\theta - \varepsilon \sin\theta) + \delta\,[1 - (a/A)^2\,] \qquad (2)$$

$$z = k \cdot a \sin\theta, \qquad (3)$$

where R_0 is the tokamak major radius, A the maximal plasma radius, a the reduced plasma radius, k the plasma elongation, ε the triangularity, δ the maximum radial plasma shift and θ the poloidal angle. The source neutrons are assumed to be emitted isotropically with a Muir velocity Gaussian fusion energy spectrum as

$$p(E) = C \exp\{-[(E^{1/2} - b^{1/2})/a]^2\} \qquad (4)$$

where a is the width in $MeV^{1/2}$, and b is the energy in MeV corresponding to the average speed. The width here is defined as the change in velocity above the average velocity $b^{1/2}$, where the value of the exponential is equal to e^{-1} [4]. The Muir Gaussian source distribution is included in the MCNP Code. Compared to a more realistic source model, that has to be separately implemented in MCNPX, results from the used source model differ from 0.1 % to 8.2 %. Given an alpha rate of 23% and due to the fact that the virgin neutrons have an energy of 14.1 MeV before reaching the first wall, the neutron rate $\acute{N}_n$ for the total fusion power of 5500 MW is ([5] and eq.1)

$$\acute{N}_n = 1.88 \cdot 10^{21}\ \ [n/s] \qquad (5)$$

This provides a neutron flux density of roughly 10^{15} neutrons per $cm^2 s^1$ on the first wall and in consequence a harder neutron spectrum in all blanket segments than in typical light water reactors.

Model Comparison

Overall the geometric structure fits adequately to the dimensions given in [5] yielding a maximum of 10% difference in blanket volumes and first wall surface areas comparing both models.

The comparison of the average neutron wall loading, neutron flux and loaded power in the blankets differs maximal 5%.

Summing the tritium production in all blankets of a 20° segment in the MCNPX model we calculated an annual production rate of 18.06 kg/y and a tritium production multiplication of 1.095. In [5] a 3.5 % lower multiplication of 1.06 is given.

III. Plutonium Production Potential

As the structure of the blankets is optimized for neutron capture to produce the needed tritium fuel of the reactor from lithium, it has to be considered that instead of

lithium the uranium isotope U-238 could be inserted into the breeding blankets. If the fertile U-238 captures a neutron the fissionable and nuclear weapon usable plutonium isotope Pu-239 will be produced after a short decay chain:

$$^{238}U \rightarrow^{(n,\gamma)} \rightarrow ^{239}U \rightarrow ^{\beta-,23.5min} \rightarrow ^{239}Np$$

$$^{239}Np \rightarrow ^{\beta-,2.355d} \rightarrow ^{239}Pu \quad (6)$$

Limiting factors

In principle, the entire breeding material could be substituted by uranium to maximize the production. However a possible plutonium production is limited by the following parameters:

1. Blanket heating: Instead of capturing a neutron it is possible that U-238 or other uranium isotopes like U-235 fission and produce a lot of energy and increasing the heating of the blanket. The mass of U-238 inserted into a blanket is limited by the maximum heat that can be transported from that specific area, and by the maximum temperature before losing structural integrity.

2. Tritium production: For any replacement of the Pb-17Li alloy by U-238 it must be secured, that there is still a sufficient amount of tritium in the production cycle to fuel the reactor. Otherwise the reactor fuel must be produced by another similar facility, and a large amount of tritium has to be transported. We consider it more realistic if the tritium production remains assured, even with a possible plutonium production occupying some tritium production capacity.

In our simulations we used a fraction of 0.1%, 0.5%, 1% and 10% to replace the Pb-17Li alloy in the blankets with three different isotopic compositions: pure U-238 as reference case, natural uranium and Low Enriched Uranium (LEU) with an enrichment of 3.75% U-235, which is typical for nuclear reactor fuel.

The result shows, that the maximum exchangeable fraction is about 1%. In this case only LEU can reach a nominal undisturbed tritium production multiplication factor of 1.095 of produced and needed tritium[2] (fig. 4). It is evident that the increased abundance of U-235 causes a larger neutron population by fission increasing the number of Li-6 captures producing T.

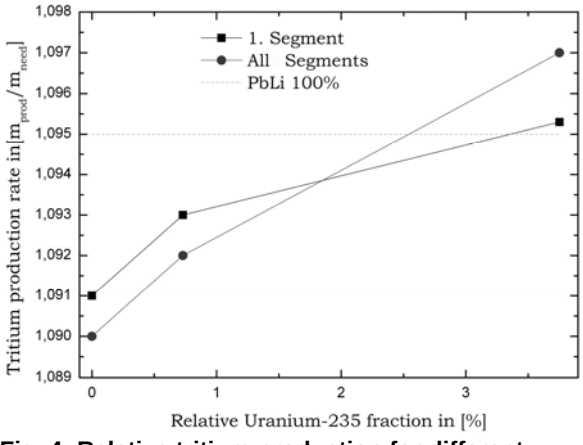

Fig. 4: Relative tritium production for different enrichment levels of the inserted Uranium (Uranium fractions 1 %).

Annual Pu-239 production rates

Assuming (unrealistically) a continuous operation of the reactor, the annual Pu-239 production rates were calculated from the macroscopic capture cross-section for U-238 given by MCNPX.

Tab. 1 shows the amount of produced Pu-239 for three volume fractions of natural uranium or LEU in the blankets. Exchanging one vol. % of Pb-17Li by uranium, the produced quantity of roughly 65 kg Pu-239 per year even for the 20° segment is still large enough to obtain enough plutonium for a significant number of bombs[1]. Decreasing the uranium fraction inside the blankets to 0.5% or even 0.1% it is still possible to breed 38 kg or 9 kg Pu-239 per year respectively, still enough to build several or at least one nuclear bomb per year. Theoretically, a PPCS-A fusion reactor could produce plutonium in the range of a tonne per year.

We have not yet calculated the isotopic vector of the produced plutonium, since a somewhat complicated burn-up calculation would be needed for that purpose.

	Natural Uranium		LEU (U-235 at 3.75 %)	
%	20° [kg]	Total [kg]	20° [kg]	Total [kg]
0.1	9.04	162.18	9.1	163.8
0.5	37.91	682.38	38.5	693
1.0	64.87	1167.66	65.32	1175.76

Tab. 1: Total Pu-239 production capacity per year (assuming continuous reactor operation) for 0,1 %, 0,5% and 1% of natural uranium or LEU replacing Pb-17Li in PPCS A for a 20° segment and for the total tokamak.

However, we expect that it would be nearly pure Pu-239 due to the high energetic neutron spectrum even in the blanket segments with largest distance to the first wall.

IV. Relative Overheating

Considering the complex structure of the cooling system it must be also clear, that the additional energy production in the blankets, which can be cooled without major changes in the reactor layout, is limited. To estimate the additional energy by fission the total deposited energy for each breeding blanket was calculated and compared with the nominal reactor configuration.

Due to the results for the tritium production deficiency figure 5 and 6 only show the heating for 0.1%, 0.5% and 1% fractions of natural uranium and LEU replacing Pb-17Li in the first breeding segment of blanket II and V respectively (obviously the maximum energy is discharged into the first segment next to the plasma). According to [2] those blankets contain the highest number of cooling tubes that decrease with distance to the *first wall*. Starting with 0.1% fraction the relative overheating comparing to pure PbLi is 3% to 6% for natural uranium and LEU. Increasing the fraction of uranium increases the deposited energy. The relative

overheating is about 20% and 40% for 0.5% and 1% uranium replacing Pb-17Li respectively.

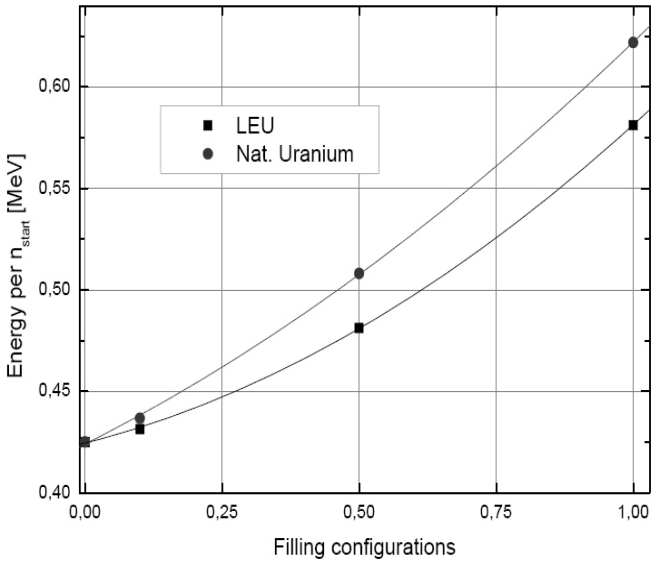

Fig. 5: Loaded neutron energy in inboard Blanket II (first segment) for different uranium fractions.

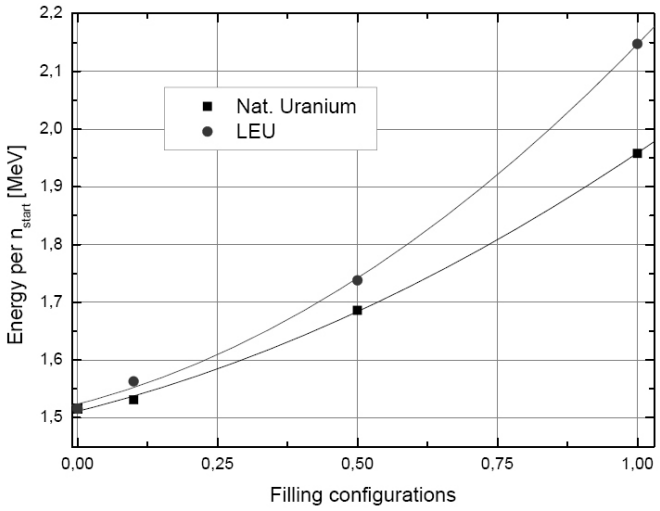

Fig. 6: Loaded neutron energy in outboard Blanket V (first segment) for different uranium fractions.

V. Conclusion

A fusion reactor based on the model concept PPCS A is theoretically able to produce plutonium in significant amounts. Due to the results the difference between used natural and low enriched Uranium is negligible for small inserted uranium fractions. Nevertheless, hence the fission cross section of U-235 is higher than the natural uranium one, the generated fission neutrons provide a small additional contribution to the plutonium production rate. For a use of uranium in all blankets of the reactor 20°-cutout the produced plutonium amount is in the order of 9 kg for a natural or low enriched uranium fraction of 0.1%, 37 kg for a 0.5% fraction and 65 kg for 1.0%. If all blankets in the total reactor would be used for plutonium production, those numbers have to be multiplied by factor 18. Probably, the produced plutonium will be nearly pure Pu-239, due to the hard neutron spectrum in all blankets.

The diversion of fusion neutrons for plutonium production does not hinder the continuous operation of the reactor as long as enough tritium is bred from lithium. This is the case, if only up to 1 % of Pb-17Li inside the blankets is exchanged by uranium. The heating of the blanket will be raised due to the uranium fillings. For smaller amounts of uranium (below 1%) this might be acceptable. However, there will be a technical limit depending on the design of the cooling system.

Another limiting factor might be, that one has to consider that the Pb-17Li alloy is liquid at the reactor`s operating temperature, whereas inserted uranium is not. Therefore, in a realistic scenario appropriate redesign of the blanket structure is necessary.

Future work has to include: consideration and calculation of specific and realistic proliferation relevant production scenarios at different places inside the blanket modules; calculation of the isotopic vector of produced plutonium. Furthermore, it has to be considered how and to what extent safeguard measures could be introduced or measures could be invented, which lead to a more proliferation resistant shaping of fusion reactors.

These questions will be addressed in an interdisciplinary research project at Technical University of Darmstadt (IANUS), which has been started recently together with political scientists.

Notes

[1] The International Atomic Energy Agency considers a mass of 8 kg Pu-239 a "significant quantity" to build a nuclear weapon.

[2] Note, that these values are only counted in the 20° segment. Due to that in the rest of the modules more Tritium is produced than needed, the waste can be used to balance the deficiency of the modules that contain uranium.

References

[1] Balloni, F.: Neutronenphysikalische Simulationsrechnung zur Analyse der Proliferationsrisiken bei Fusionsreaktoren (Neutron Physics Simulation Calculations to Analyse Proliferations Risks of Fusion Reactors. Diploma Thesis, IANUS, TU Darmstadt, April 2008).

[2] Maisonnier D.; .et al.: A Conceptual Study of Commercial Fusions Power Plants. EFDA, April, 2005 (published in Jan. 2006).

[3] Fischer, U. et al.: Application of the IEAF-2001 activation data library to activation analyses of the IFMIF high flux test module. Journal of Nuclear Materials, 2002.

[4] Denise B. Pelowitz (Editor): MCNPX Users Manual Version 2.6.0, April 2008, LA-CP-07-1473.

[5] Chen, Y. et al.: The EU Power Plant Conceptual Study - Neutronic Design Analyses for Near Term and Advanced Reactor Models, FZKA 6763, 2003.

[6] Chen, Y.; Wu, Y.: Effect of Fusion Neutron Source Numerical Models on Neutron Wall loading, in a D-D Tokamak Device. Plasma Science and Technology Vol. 5, February, 2003.

Science Policy on International Security Issues at the Royal Society

Martin B. Kalinowski

1. Science Policy

The science policy team of the British Royal Society has sections on energy, environment, bioscience and health, emerging technologies and on international security. The Royal Society is well placed to tackle related policy issues as these often cover a wide range of scientific disciplines. The Society considers it important to provide independent, objective scientific advice. The Royal Society describes its scientific policy work as follows:

> "Composite of scientific imagery the Society has a long-standing history of providing independent advice on science issues. We are able to provide this advice by drawing on our Fellowship, which consists of around 1400 of the best scientists of our time. The Fellowship has a wealth of scientific knowledge and experience, from every area of science, making our advice independent and unique. We also work with the Society's research fellows, and experts from both academia and industry.
>
> Our advice is aimed at those who determine policy on issues with a scientific aspect, such as Government ministers, MPs, MEPs and civil servants. In addition to this, we aim to inform the public debate around these issues.
>
> Our policy work comes in a variety of forms, such as workshops, seminars, briefing meetings, summaries, statements, major reports or consultations (which we both issue and respond to). Although the outputs vary, the end goal is the same to provide independent advice, based on the best scientific evidence available, to those determining policy.
>
> We aim to make our work as timely as possible, to feed into the correct processes and decision making framework. We strive to disseminate our recommendations as widely as possible, to those who are making policy decisions or influencing policy makers.
>
> Science Policy at the Society has developed and expanded in many ways in recent years. Currently we focus our policy activities in the following areas:
>
> - Biosciences and health
> - Climate change, energy and environment
> - Innovation and science base
> - International security
> - New and emerging technologies"

2. International Security

The Royal Society investigates scientific and technological aspects of many areas of international security. These cover a wide range including the prevention of nuclear weapons proliferation, minimising the impact of incidents involving chemical or biological substances and understanding and mitigating the impacts of climate change.

A recent product is the workshop report on technologies for detecting the illicit trafficking of nuclear and radiological materials. In 1998 a report was issued on options for managing the increasing stockpile of UK's separated plutonium from the reprocessing of spent fuel. Since no action had been taken for almost 10 years, the Royal Society published an update in September 2007.

In the years preceding 2007, the Royal Society focused on minimising the risks of advances in life sciences being misused, the hazards related to chemical and biological substances as well as those arising from depleted uranium. These are described as follows:

> "This included co-hosting a workshop with the Welcome Trust entitled 'Do no harm: reducing the potential for the misuse of life science research' (October 2004; report published December 2004). The Society's work in this area fed into the preparation for the Meeting of Experts of the Biological Weapons Convention (BWC) in Geneva in June 2005. The meeting focused on codes of conducts for life sciences and was chaired by the UK Government. The Society has published its views on codes of conduct and presenting these to delegates at the BWC Meeting of Experts.
>
> Other major studies initiated by SAIS in recent years include *"Making the UK safer: detecting and decontaminating chemical and biological agents"* (April 2004). This report made recommendations aimed at enhancing the UK's capability for dealing with the deliberate or accidental release of biological and chemical agents.
>
> The Society has also published two reports on the health hazards of depleted uranium (Part 1, May 2001; Part 2, March 2002). The chair of the working group, a former member of SAIS, is a member of the Ministry of Defence (MOD) Depleted Uranium Oversight Board – an independent group established by the MoD."

3. The SAIS Committee

Much of the work described above was performed by the Royal Society's standing committee on Scientific Aspects of International Security (SAIS), set up in 1988. Its goal is to provide independent, objective scientific advice on issues of international security.

The terms of reference of the committee are:

> "SAIS will consider the scientific and technical aspects of international security such as arms control, non-proliferation, countering terrorism and reducing the risk of the misuse of scientific research. Its principal roles are to prioritise issues in this area that the Society can

act on; proactively and reactively undertake studies, prepare advice and report to Council; maintain contact with scientists nationally and internationally; and provide briefings for Fellows."

The mode of operation of the SAIS is described as follows:

"SAIS meets bi-annually and advises on the direction of the Society's international security work. SAIS initiates projects which are often taken on by working groups, established for the duration of the particular project. SAIS members may be involved in the working group, but do not usually make up the majority of the group.

A number of SAIS members are involved with on going meetings with the Foreign and Commonwealth Office and the Ministry of Defence. Members of working groups of projects decided upon by SAIS have also met with the Cabinet Office, Home Office and the Office of Science and Technology on several occasions."

In 2006 the SAIS members were:

Professor Roderick Flower FRS (Chair), Wellcome Trust Principal Research Fellow and Professor of Biochemical Pharmacology, Queen Mary, University of London

Professor Mark Bradley, Professor of Combinatorial Chemistry, University of Edinburgh

Professor Raymond Dixon FRS, Research Group Leader, John Innes Centre

Professor Laurence Eaves FRS CBE, Lancashire-Spencer Professor of Physics, University of Nottingham

Professor John Finney, Quain Professor of Physics, University College London

Professor Stephen Furber FRS, Professor of Computer Engineering, University of Manchester

Professor William Gelletly OBE, Distinguished Professor of Physics & Head of Department, University of Surrey

Professor Peter Goodfellow FRS, Senior Vice President, Discovery Research, GlaxoSmithKline

Professor Alastair Hay OBE, Professor of Environmental Toxicology, University of Leeds

Dr Sarah Heath, Senior Lecturer Inorganic Chemistry, University of Manchester

Dr Jim McQuaid, former Chief Scientist, UK Health and Safety Executive

Professor Geoffrey Smith FRS, Professor of Virology, Imperial College London

Two of the members are retired and replaced each year.

4. Statements and reports

All of the documents listed below are available online at http://www.royalsoc.ac.uk/page.asp?id=2562:

Detecting nuclear and radiological materials (6 March 2008)

Strategy options for the UK's separated plutonium (21 Sep. 2007)

Letter to Secretary of State for Trade and Industry on the management of separated plutonium (22 May 2007)

Submission to the Quadripartite Committee's review of export control legislation (29 March 2007)

Submission to House of Lords S&T Select Committee inquiry on radioactive waste management (27 Feb. 2007)

Letter to Defra Chief Scientific Advisor about radioactive waste management policy (15 Feb. 2007)

Report of the international workshop on science and technology developments relevant to the BTWC (16 Nov. 2006)

Key points statement on scientific and technological developments relevant to the Biological & Toxin Weapons Convention (27 Sep. 2006)

Royal Society response to the Committee on radioactive Waste Management's draft recommendations (28 July 2006)

Royal Society response to CoRWM consultation on scores from specialist workshops (1 Feb. 2007)

The long term management of radioactive waste: the work of the Committee on Radioactive Waste (CoRWM) (9 Jan 2007)

Royal Society response to the Council for Science and Technology's consultation on a universal code (5 Jan. 2006)

InterAcademy Panel statement on biosecurity (Dec. 2005)

The roles of codes of conduct in preventing the misuse of scientific research (June 2005)

Issues for discussion at the 2005 Meeting of Experts of the Biological Weapons Convention (June 2005)

Response to Defra consultation on the Government Decontamination Service (May 2005)

Do no harm: reducing the potential for the misuse of life science research (Dec. 2004)

Royal Society work towards 2005 Annual Meeting of the Biological Weapons Convention (Dec. 2004)

Making the UK safer: detecting and decontaminating chemical and biological agents (April 2004)

Paper on the individual and collective roles scientists can play in strengthening international treaties (April 2004)

Response to the House of Lords Science & Technology committee inquiry into science and international agreements (Jan. 2004)

Response to the House of Commons Science & Technology select committee inquiry into the scientific response to terrorism (Feb. 2003)

Response to UK Foreign & Commonwealth Office Green Paper on strengthening the Biological Weapons Convention (Nov. 2002)

Joint statement from the Presidents of the US National Academy of Sciences & the Royal Society, Bruce Alberts & Lord May, 'Scientist support for Biological Weapons Controls' (Nov. 2002)

The health hazards of depleted uranium munitions Part II (March 2002)

Royal Society Foreign Secretary Sir Brian Heaps editorial in Science, 'Scientists against biological weapons' (Nov. 2001)

The health hazards of depleted uranium munitions Part I (May 2001)

Measures for controlling the threat from biological weapons (July 2000)

Management of separated plutonium (Feb. 1998)

Scientific aspects of control of biological weapons (July 1994)

5. Further information and contact data

The primary sources used for this brief description are http://royalsociety.org/policy and http://www.sussex.ac.uk/Units/spru/hsp/Papers/Seminar%203/Green2.pdf. More information can be found in the Science Policy brochure at http://royalsociety.org/downloaddoc.asp?id=5301.

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"Physics of Societal Issues. Calculations on National Security, Environment, and Energy"

David Hafemeister, Springer-Verlag, New York 2007

Review by Götz Neuneck
(An abbreviated version was printed in the March edition of „Physik Journal")

Books which deal with "Physics and Society" are quickly laid aside by physicists with the argument, that this is only "politics". Hafemeister's 500 page English book with the title: "Physics of Societal Issues: Calculations on National Security, Environment, and Energy", shows that basic formulas can make a contribution in understanding key problems. This compendium with equations, figures and charts deals within three separate sections with "societal issues from the 'National Security', environment and energy". Hafemeister succeeds in pervading central social questions by the use of physical formulas.

In 16 chapters, fundamental problems such as nuclear disarmament, car emissions and energy transfer in solar-houses, are dealt with mostly simple "back of the envelope" calculations. If you want to know precisely the effect of nuclear weapons, how GPS and laser weapons work or how verification is carried out, the first part of the book is the right place. In the environmental part, mechanisms of air and water pollution as well as the threats of radioactive and electromagnetic radiation and the climate change are the main topics.

In the energy part, the main focus is on the global energy situation, improvement of the energy efficiency and the potential of renewable energies. Each chapter is complemented by recommended literature and exercises. The book is rounded off with an extensive annex for the two subjects *nuclear weapons* and *energy/environment*. Mathematical requisite is thorough knowledge of natural scientific basic studies. Hence the book is for tutors, who hold courses concerning the mentioned problems or for scientists, especially engineers, who are interested in these subjects and who want to understand science beyond "non-linear" societal problems.

This book should neither be missing in libraries nor on literature lists which deal with these problems. On the other hand, an understanding of motives, conflicts and interests is necessary in order to comprehend the subjects; understandably the book cannot provide this. On the basis of the comprehensive content the high price of € 150.00 is justified, however the quality of some figures is insufficient.

The Carl Friedrich von Weizsäcker Centre for Science and Peace Research

Ole Roß

Three years after its establishment, the Centre of Science and Peace Research is a well known interdisciplinary institution of the University of Hamburg.

The research projects of the group for nuclear arms control around *Martin Kalinowski* concentrate on technical verification improvements. But also a dialogue project for decision makers of nuclear weapon states is within the scope.

The research group for biological arms control lead by Iris Hunger deals with export monitoring and Confidence Building Measures. At the University Hospital, projects investigating societies after war concerning medical and psychological aspects are performed. Although there is a focus on natural science, all faculties of the University participated in the foundation process of the centre, which is funded by the German Foundation for Peace Research for the first five years. After that, the university will continue the financing.

As Martin Kalinowski used to work at the Technical Secretariat of the Preparatory Commission of the *Comprehensive Test-Ban Treaty Organisation* (CTBTO), projects to support this institution deal with civilian background concentrations of certain xenon isotopes used for the verification of nuclear test explosions.

One of the main physics projects of the centre is to develop an *Atom Trap Trace Analysis* (ATTA) for krypton-85, a radioactive noble gas which can be used to detect clandestine plutonium production. The ATTA team started to instrument its own laboratory at the end of 2007.

For implementing krypton-85 sampling in the verification regime of the *Non Proliferation Treaty*, atmospheric transport modeling studies are performed for the IAEA in collaboration with the Max Planck Institute for Meteorology and the *Meteorological Institute* of the University of Hamburg.

Furthermore, a noble gas sampling station is operated in Hamburg at the centre in cooperation with the *German Federal Office for Radiation Protection* to reach a better regional coverage with measurement stations.

For international networking, the independent group of experts for the detection of nuclear weapon usable material (iGSE) was founded and three workshops were organized in 2008.

Furthermore an association of scientists in Hamburg is establishing an interdisciplinary research group on treaty verification technologies.

The centre is very active in teaching. Martin Kalinowski gives lectures at the physics department on technical aspects of verification and arms control and more general lectures in “Natural Science and Peace Research” for the whole University and the interested public. The first series of the “Carl Friedrich von Weizsäcker Peace Lectures” with invited speakers was very well attended.

At the centre, six diploma students have already successfully graduated in physics and four more are on their way. Eight post graduate students are working on their doctoral projects in five different disciplines.

Carl Friedrich von Weizsäcker Centre for Science and Peace Research, University of Hamburg
Beim Schlump 83, 20144 Hamburg, www.znf.uni-hamburg.de

Professor:	Prof. Dr. Martin Kalinowski
Research associate:	Dr. Iris Hunger
PhD students	Heiner Daerr, Markus Kohler, Alexander Ramseger, Robert Annewandter (Physics), Ole Roß (Meteorology), Gunnar Jeremias, Nicolas Isla (Political science), Anna Zmorzynska (Biochemistry)
Diploma students:	Hauke Gravenkamp, Franziska Herrmann, Franziska Klingberg, Britta Riechmann
Assistant:	Beatrice Mittelstädt
Diploma Alumni:	Jörg Reckers, Christian Alwardt, Robert Annewandter, Simon Hebel, Enno Peters, Paul Stanoszeck

For running the centre and for many smaller projects, up to 20 student assistants are essential. They not only help the centre, but also get opportunities for themselves to get into scientific working, visit conferences and if possible, publish their own results.

For the optional module “Science and Peace Research” of the physics curriculum, there are regular examinations held at the centre. There is also support in teaching for the *Masters Programme in Peace and Security Studies* (MPS) offered by the *Institute for Peace Research and Security Policy* (IFSH), which is located in the same building since summer 2007. Beside the lectures, three MPS theses are already supervised by Martin Kalinowski.

The new “cluster of excellence” named *Climate integrated system analysis and prediction* (CliSAP) at the University of Hamburg, has a very comprehensive and highly interdisciplinary approach. On the so called “Climate Campus” the *Centre for Science and Peace Research* participates with projects on security aspects of climate change (e.g. resource conflicts) as well as projects accompanying climate change mitigation – like CO_2 sequestration and storage or expanding the future role of nuclear energy and connected proliferation concerns.

The International Centre for Security Analysis (ICSA)

Chris Hobbs

ICSA summary

The *International Centre for Security Analysis* (ICSA) is a research group within the *Department of War Studies at King's College* London, United Kingdom. ICSA carries out work and runs a number of contract research projects, from the United Kingdom (UK) government and the UK *Economic and Social Research Council*, in the fields of nuclear non-proliferation and open source research methodologies, with a particular focus on the identification of grey literature and information management. ICSA have also carried out work in the field of open source intelligence (OSINT) for private sector clients, such as the *Olive Group*, a leading global integrated risk management company. The centre employs a multidisciplinary team of more than fifteen part time researchers and interns, led by *Joanna Kidd*, a historian by background and supported by *Dr Chris Hobbs*, a physicist by training. In addition to their research tasks, they also lecture on a number of MA (Masters) courses within the wider *War Studies Department*. Dr Hobbs coordinates an MA module on the 'Science of Security' which provides students with a grounding in the science behind key security issues such as WMD proliferation, missile defence and space security. In September 2009 ICSA plan to offer a module on OSINT and security as pathway on the War Studies' MA Intelligence and International Security Programme. Dr. Hobbs and Miss Kidd have also carried out a number of one day training workshops in advanced internet research methods for researchers from government, academia and the private sector.

Bios

Joanna Kidd is the Director of ICSA and has been a Research Associate and subsequently Fellow at the Department of War Studies at KCL since March 2003. She is a Special Advisor on strategic export controls for the *House of Commons' Quadripartite Committee*; a member of the *Project on Nuclear Issues* (PONI) and an Associate of the *KCL Centre for Science and Security*. Prior to joining KCL, she worked as a Defence Analyst at the *International Institute for Strategic Studies* in London from 1999-2003 and was a surface warfare officer in the UK Royal Navy from 1994-1998.

Dr Christopher Hobbs is the Deputy Director of ICSA and has been a Research Associate at the *Department of War Studies* at KCL since February 2006. He is the course co-ordinator of the War Studies Department's MA module on 'The Science of Security'. From 2003-2005 he was employed part time as a scientific consultant to ICSA. He gained a PhD in Physics ('Ab initio studies into the nanoscale manipulation of molecules on reactive surfaces') in 2006 from the University of London and an MPhys from the University of Oxford in 2002. In addition, he is a member of PONI and the International Institute for Strategic Studies (IIS) and an Associate of the KCL Centre for Science and Security.

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The Praxis Centre: For the Study of Information and Technology in Peace, Conflict Resolution and Human Rights

Dave Webb

The *Praxis Centre* is composed of a multidisciplinary research group with common interests in peace, conflict resolution and human rights issues. The Centre aims to investigate the effects of technology in the context of peace and conflict studies. The work involves research in the development and implementation of a range of technologies, and the effects that they have on security and society, on international relations and the functioning of communities and organisations within society.

In particular, we examine the implications of the use of technology as a form of social and political control, its impact on privacy, data protection and civil liberties and the consequential effects on civil society, democracy and governance. In addition, we are interested in the extent of the military's technical influence on science, society and world affairs – from surveillance and "non-lethal" weapons technologies to nuclear arms and the militarization of space.

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Conference Proceedings

Research Development in Palestinian Universities

International Conference and 7th Session of the General Assembly of PEACE, UNESCO, Paris, 4–5 Nov. 2007

The *International Conference*, organised by the PEACE Programme (Palestinian European Academic Cooperation in Education), was attended by over 70 participants – rectors, vice rectors, senior level academics, directors of international relations offices and students – from 37 higher education and research institutions in Europe and the USA. All Palestinian universities in the West Bank were represented by their presidents and other faculty members. The former vice president of Gaza Islamic University represented his university: the presidents of the three Palestinian universities in Gaza could not attend because they were not issued exit permits. The Conference expressed its strong protest against this violation of the right to travel imposed on Palestinian academics and appealed to the international community to help put an end to all measures taken by the Israeli government in disregard of human rights and of the right to education and of academic freedom.

Ms. *Louisa Morgantini*, Vice President of the European Parliament, Mr. *Marcio Barbosa*, Deputy Director General of UNESCO, and Mr. *Georges Haddad*, Director of *UNESCO's Division of Higher Education*, attended and addressed the Conference. The debates of the Conference were organized into two panels, devoted to *Priorities for the Development of Research at Palestinian Universities* and to *International Research Co-operation for the Palestinian Universities*, respectively. The contributions of the panellists and the final report are available on the PEACE website (*www.peace-programme.org*).

In particular, Professor *Henry Jaqaman*, UNESCO Chair in Mathematics and Theoretical Physics, Birzeit University, presented the project to establish a *Centre of Excellence in Mathematics and Theoretical Physics*. He pointed out that the Centre will serve as "a focal point for research, training, knowledge sharing and technology transfer and enhance the quality of mathematics and physics teaching and research at Palestinian universities and in the region". Details of this project are available at *www.physik.uni-augsburg.de/ifk/ecce* (see also FONAS Newsletter, July 2007, p. 15).

Ulrich Eckern

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Disarmament in the Deutsche Physikalische Gesellschaft (DPG)

The three groups which grew into FONAS (*Research Association Science, Disarmament, and International Security*) had links to the *Deutsche Physikalische Gesellschaft* DPG (the learned society of physicists in Germany) from their beginnings in the late 1980s, and FONAS was founded in 1996 in the Physics Centre of the DPG.[1] The DPG has some tradition concerning disarmament – in 1957 eighteen leading German nuclear scientists signed a letter opposing a nuclear-armed Federal Republic of Germany. Much later, the DPG spoke out in favour of the comprehensive nuclear test ban and founded a corresponding commission. From 1995 on, physicists from the FONAS community organised topical sessions on Disarmament and Verification at the DPG Annual Meetings. In 1998, DPG founded its *Working Group on Physics and Disarmament* (now AGA, *Arbeitsgruppe Physik und Abrüstung*)[2] that from then on co-organised the sessions together with FONAS. Among the main topics are: test ban, verification technology, nuclear disarmament and non-proliferation, missile defense, mine detection, military-technology assessment. The goals are to provide information on actual problems of physics and disarmament, to present the results of recent research, and to provide a forum for the presentation of industry/government work that is normally not published. Often, main lectures are given by invited speakers from foreign countries, such as the USA, India and Russia. Our audience varies between 20 and 250 physicists, i.e., we reach 5 to 10 % of the attendees at the Annual Meetings. The list below shows a selection of talks of 2008. The present AGA speaker is *Götz Neuneck* (Hamburg), deputy speakers are *Jürgen Altmann* (Dortmund) and *Matthias Englert* (Darmstadt). Within DPG, the Working Group on Physics and Disarmament is well respected and from time to time one of our speakers gives an invited talk to the conference plenary.

Selected talks at the AGA sessions at the 2008 Annual Meeting of DPG:

- Nuclear safeguards for future fusion reactors
- Beryllium – a Proliferation Problem?
- Optimisation from Reactor Core to Experiment – Use of Monte Carlo Codes for Conversion of High-Flux Neutron Sources from HEU to LEU
- Uninhabited Combat Vehicles – the Next Arms Race?
- Experiences as an Observer of the CTBT On-Site-Inspection Exercise DE07 in Chernobyl
- Iran and Missile Defence – A Realistic Assessment
- The Consequences of the Chinese Anti-Satellite Test on the Space-Debris Environment
- Fissile Material Implications of the US-India Nuclear Deal

Plenary talk:

The US Missile Defense and Its European Components-Implications for European Security (T. Postol, USA)

Jürgen Altmann

Notes

[1] www.fonas.org
[2] www.dpg-physik.de/gliederung/ak/aka/index.html

20th Summer Symposium of the Union of Concerned Scientists

Following the invitation by the *Union of Concerned Scientists* (UCS) *Simon Hebel, Ole Roß, Christian Alwardt, Fabio Balloni* and *Moritz Kütt* participated from 23 July till 2 August 2008 in the 20th *Summer Symposium on Science and World Affairs* in Boston.

This year's meeting started with a one-day conference with international experts on questions of the "Global Security and World Affairs" at the *Massachusetts Institute of Technology* (MIT).

The Summer Symposium was well attended with 35 international participants from 12 nations. Along with the USA and China, Germany had one of the largest delegations with 6 participants, thereof 5 FONAS members. The keynote and aim of this Summer Symposium, which takes place since 1989, is to enhance the international exchange of ideas on questions of arms control and international security between senior scientists as well as young academics.

This year the key issues were nuclear proliferation, arms control and security in space. Other topics were the planned European antimissile defense and the problem of "global warming".

Simon Hebel presented the results of his diploma thesis on genesis and equilibrium of natural lithospheric radioxenon and its influence on CTBT-compliant subsurface noble gas samples.

Ole Roß talked about his results on atmospheric krypton-85 transport modeling. Krypton-85 can act as an indicator for detection of clandestine plutonium production.

During his lecture, Christian Alwardt introduced the present European efforts concerning the establishment of its own *Space Situational Awareness System.*

In addition to the lectures in the evenings and on two free days there was enough time for discussions with the participants and to explore Boston. In connection with the *Summer Symposium* some participants made a tour to New York in order to – among other things – visit the United Nations.

FONAS Annual Meetings in Osnabrück 2007/08

From 16-18 October 2007 the FONAS annual meeting took place in the rooms of the *German Foundation for Peace Research* (DSF) in Osnabrück, Germany. Eighteen participants, mainly physicists, attended the conference.

After the address of welcome by Dr. *Wolfgang Liebert*, chairman of FONAS, and Dr. *Thomas Held*, director of the DSF, the first talk began. *Christian Alwardt, Markus Kohler* and *Matthias Tuma* from the *Carl Friedrich von Weízsäcker Centre for Science and Peace Research* (ZNF), Hamburg, gave accounts of their work on measuring and calculating the global dissemination of krypton-85. As this radioisotope is only produced along with plutonium, it can be used as an indicator for plutonium separation. Reason to this project under the supervision of Prof. Dr. *Martin B. Kalinowski*, head of the ZNF, gave the Additional Protocol (1997) of the *Nonproliferation Treaty* (NPT), which is designed to strengthen existing IAEA safeguards.

The main source of the atmospheric krypton-85 are reprocessing plants for spent nuclear fuel. Measurements of this radioisotope, whose emissions have increased since 1945, serve as an instrument to search for unknown nuclear sources. For ultratrace analysis the *Atomic Trace Trap Analysis* (ATTA) method is being developed in Hamburg.

The quality of disarmament treaties significantly depends on the verification of their implementation. In this context two students of the University of Dortmund presented first results of their diploma theses. *Felix Gorschlüter* introduced a measurement and identification procedure of seismic periodical interference signals. *Christoph Weber* showed infrasound measurements near to the ground to locate an acoustic source.

FONAS Annual Meeting 2007 in Osnabrück

Dr. *Jürgen Altmann* from the *Bochum Verification Project* (BVP) introduced a project on *"Status and Trends of the Military Use of Unmanned Platforms",* funded by the *Office of Technology Assessment at the German Parliament* (TAB). As examples he presented the two unmanned aerial vehicles (UAV) "Global Hawk" and "Predator" and discussed the problems arising from the growing role of these systems in the modernisation and transformation of forces, especially the U.S. forces.

On Wednesday morning, 17 October, Dr. *Wolfgang Liebert* and *Matthias Englert*, both from the "Interdisziplinäre Arbeitsgruppe Naturwissenschaft, Technik und Sicherheit

(IANUS) at the Technical University of Darmstadt, talked about gas ultracentrifuges technology for uranium enrichment. Centrifuges are much faster and more effective than other enrichment technologies, but they could also rapidly be re-configured to produce weapon-usable HEU instead of low enriched reactor fuel. Even more, small facilities are practically not detectable from outside, so it is a proliferation prone technology. Cascade calculations were presented clearly showing the dramatic proliferation potential even of small facilities. Currently, new centrifuge facilities (or the enlargement of existing ones) are not only constructed in Iran, but also in Brazil, France, Germany, UK and USA. In 2005 Mohamed El Baradei, head of the IAEA, called for a moratorium for new enrichment facilities to allow time for finding new international arrangements for the use of such dangerous dual-use technologies.

The next speaker, *Fabio Balloni* (Darmstadt), told about the proliferation risks of fusion reactors. At present the *"International Thermonuclear Experimental Reactor"* (ITER), which is built in Cadarache, France, is an international project for energy generation by the fusion of hydrogen atoms. A tokamak-based nuclear fusion reactor might cause less problematic radioactive waste than nuclear-fission power plants. However, there are hazards related to tritium as major fuel component, which is also used in nuclear weapons. Another concern is the possible production of fissionable materials like plutonium inside the facility. Fabio presented a quantitative analysis of such a scenario (cf. article in this issue).

Giorgio Francheschini from the *Peace Research Institute Frankfurt* (PRIF) presented the initial results of a study on nuclear weapons research and modernisation without nuclear testing. Since the conclusion of the *Comprehensive Test Ban Treaty* in 1996, nuclear testing is forbidden. This fact interferes with the endeavour of leading nuclear weapon states to restructure and modernize their nuclear arsenals. With the launch of programmes such as the *Science Based Stockpile Stewardship* (SBSS) the leading nuclear powers strive to advance weapon science. One immediate goal was to test the safety and reliability of nuclear arsenals. First results of a U.S. study on ageing effects of Plutonium indicated that the nuclear warheads currently stockpiled in the USA can be safely maintained for approximately a century.

Technical facts and political settings of missile defense were the topics of Prof. Dr. *Götz Neuneck,* head of the *Interdisciplinary Research Group on Disarmament, Arms Control and Risk Technologies* (IFAR^2) at the *Institute for Peace Research and Security Policy at the University of Hamburg* (IFSH). Concern about Iran and North Korea's ballistic missile programmes is the driving force of the U.S. plan to establish a long-range antimissile basis with components in Poland and the Czech Republic. Regardless of several technical problems concerning the planned missile tracking radar and 10 long-range ballistic missile interceptors, the negotiations between the U.S. and the Polish government are on-going. Meanwhile Russia sees itself as the target and vigorously objects to the project. In the long run, the research and development of missile defense systems may cause a new arms race.

Prof. Dr. Götz Neuneck, FONAS Annual Meeting 2008 in Osnabrück

Jan Stupl, also from the IFAR^2 group, reported on the applications of the *Airborne Laser* (ABL) to locate and track enemy missiles in the boost phase of their flight and to destroy them. Though the idea of missile defense by laser is not new, there are still technical problems to overcome. For example, in some tests the laser could destroy the missile but not the warhead.

The last speaker of the day, Dr. *Ulrike Kronfeld-Goharani* from the *Working Group Peace Research* at the University of Kiel, gave an overview of the status of the disarmament of chemical weapons. Ten years after the entry into force of the *Chemical Weapons Convention* (CWC), more than a third of the 71,330 tons of declared CW – the largest amount from Russia and the USA – have been destroyed. As she pointed out, the main difficulties of the CW destruction are the technical complexity of the used incineration and neutralisation methods, the required timeframe and the increasing costs of security measures and outreach programmes.

In the afternoon, there was a discussion about thematic FONAS workshops and the general meeting of FONAS members took place.

On Thursday, Dr. *Peter Carl* from the *Leibniz Institute of Freshwater Ecology and Inland Fisheries*, Berlin, gave a lecture on the response of the hydrological cycle of the atmosphere caused by anthropogenic civil or military effects.

At the beginning of the 1980s there were some scientific works discussing the possible environmental consequences of a nuclear war. Large amounts of smoke and dust and their effects on atmospheric radiation were described by the term "nuclear winter". Research on this issue ended in the late eighties. Since then, new findings on the effects of vast emissions of particulate matter into the atmosphere have given rise to new model calculations to estimate the consequences of a nuclear war on the hydrological cycle and the climate system.

Programm der FONAS-Herbsttagung 2008

Montag, 29. September bis Mittwoch, 1. Okt. 2008

in der Geschäftsstelle der Deutschen Stiftung Friedensforschung (DSF)
Am Ledenhof 3-5, 49074 Osnabrück

Montag, 29.9.08, 14.00 – 18.00

14:00 Begrüßung durch den FONAS Vorsitzenden Wolfgang Liebert und den DSF-Geschäftsführer Thomas Held

14:10 *Felix Gorschlüter (Dortmund):* Erkennung und Unterdrückung periodischer, seismische Störsignale

Simon Hebel (Hamburg): Auswirkung natürlicher, lithospärischer Spaltgase auf die Radioxenonmessungen bei Vorortinspektionen im Rahmen der Verifikation des CTBT

Hauke Gravenkamp/Heiner Daerr (Hamburg): Status des ATTA-Experiments zur Ultraspurenanalyse von Krypton-85

Paul Stanoszek (Hamburg): Krypton-85 Quellterm für verschiedene Plutoniumszenarios

16:20 Kaffeepause

16.50 *Ole Roß* (Hamburg): Modellierung des globalen Kr-85 Hintergrunds in der Atmosphäre und dessen Einfluss auf die mögliche Aufdeckung heimlicher Plutoniumabtrennung

Manuela Meppen (Hamburg): DBP Emissionen von Wiederaufarbeitungsanlagen

Alexander Ramseger (Hamburg): Entwicklung und Testen neuer Methoden zum Entdecken anthropogener radioaktiver Strahlung im operationellen Feldeinsatz

Hans Christian Gils (Hamburg): Simulation von Raketentrajektorien und Interzeption

Christian Alwardt (Hamburg) Space Situational Awareness – Die Europäischen Bemühungen

Dienstag, 30.9.08, 9.00 – 19.00

09:00 *Jürgen Altmann (Dortmund):* Unbenannte militärische Systeme - Ergebnisse des TAB-Projekts

Diskussion über mögliche neue FONAS-Schwerpunktthemen:

- Asymmetrische Kriegführung und naturwissenschaftliche Abrüstungsforschung (Input Altmann/Neuneck)
- Sicherheitsforschung (Input Kalinowski)
- Ressourcen- und Energiekonflikte (Input Liebert)

10:40 Kaffeepause

Götz Neuneck (Hamburg): Der Streit um das iranische Atomprogramm und die Debatte über die Raketenabwehr

Matthias Englert (Darmstadt): Forschungsreaktor München II – Aktuelle Rechnungen zur Konversion von HEU- auf LEU-Brennstoffe

13:00 – 14.30 Mittagspause / gemeinsames Mittagessen

14:30 *Fabio Balloni (Darmstadt):* Neutronenphysikalische Simulationsrechnungen zu Proliferationsrisiken bei Fusionsreaktoren: mögliche Plutoniumproduktion

Moritz Kütt (Darmstadt): Vergleichsrechnungen zum Aufbau von Plutonium-238 in inerten (uranfreien) und anderen Brennstoffen

16:00 Kaffeepause

16:30 FONAS-Mitgliederversammlung (inkl. Planung von FONAS-Aktivitäten)

Mittwoch, 1.10.09, 9.00 – 13.00

09:00 *Martin Kalinowski (Hamburg):* Klimawandel und Kernenergie

Robert Annewandter (Hamburg): Identifikation der Ausgasungsmöglichkeiten von CO2-Lagerstätten durch numerische Modellierung

Christoph Pistner (Darmstadt): Kernenergie und Terrorismus – Folgen eines gezielten Flugzeugabsturzes auf ein KKW

10:30 Kaffeepause

11:00 *Ulrike Kronfeld (Kiel):* Störfälle in zivilen Atomanlagen

Jörg Reckers (Braunschweig): Der Umgang mit dem Risiko am Beispiel probabilistischer Sicherheitsanalysen von Kernkraftwerken

Wolfgang Liebert (Darmstadt): Nukleare Renaissance – Realistisch oder unglaubwürdig

Allgemeine Diskussion zur Zukunft der Kernenergie

13.00 Ende der FONAS-Jahrestagung

Afterwards, Dr. Götz Neuneck mentioned the German physicist and philosopher *Carl Friedrich von Weizsäcker*, who died on 28 April 2007. Von Weizsäcker, born on 28 June 1912 in Kiel, is the German pioneer of science and peace research. The new professorship and the "Zentrum für Naturwissenschaft und Friedensfor-

schung" (ZNF) has been named in commemoration of his achievements. It is financed by the *German Foundation for Peace Research*. From 1957-1970 he was professor for philosophy at the University of Hamburg, where he held lectures on natural philosophy, ethics and the social responsibility of scientists. In 1957 he was the initiator of the "Göttingen Declaration" in which eighteen leading German nuclear scientists called for the abdication of all types of nuclear weapons for Germany and declared not to work on the "production, the testing and use of nuclear weapons".

1959 von Weizsäcker was among the founding members of the *Vereinigung Deutscher Wissenschaftler* (VDW, Federation of German Scientists). From 1970-1980 he was the director of the *Max Planck Institute for Investigating the Living Conditions of the Scientific-technological World* in Starnberg near Munich, where scientists worked on problems such as arms control, peace research, economy and resources, environmental affairs etc. Especially, a study on the consequences of nuclear war and how to prevent it, published in 1971, was widely discussed in the German public.

Carl Friedrich von Weizsäcker, who received numerous awards, was one of the leading intellectuals in Germany and can be seen as one of the founding fathers of German Peace and Conflict Research. More information and an obituary by Götz Neuneck and Martin Kalinowski can be read at http://www.znf.uni-hamburg.de/CFvW.html.

As usual, the conference ended with a discussion about present and future FONAS activities.

Ulrike Kronfeld-Goharani

Teaching ethics and peace to science and engineering students. An international workshop at University of Hamburg 15-17 October 2008

The natural and engineering sciences produce knowledge and technology which can be abused or used for the better. Students of science and engineering are often unaware of related dilemmas which they will face in their future careers. The new bachelor and master programmes of the Bologna process offer some opportunities to address such issues in dedicated teaching units. Initiatives for establishing ethics and peace education at universities have been promoted by various national and international organizations (like UNESCO, the UN Committee for disarmament education, the International Peace Research Association, the European Association for Engineering Education (SEFI) etc.).

However, it depends largely on the local leadership, expertise and resource to put such intentions into practice. Every case is a story of its own.

The workshop was organized by the Universities of Hamburg and Copenhagen in cooperation with the *Institut für Friedensforschung und Sicherheitspolitik* (IFSH), *International Network of Engineers and Scientists* (INES), *International Network of Engineers and Scientists' Projects on Ethics* (INESPE) and FONAS. The organizers have initiated peace and ethics teaching for science students at their universities. They invited colleagues and experts with practical experience to come to Hamburg for this three day workshop to share experience and exchange insight and inspiration for future work. The workshop was a platform for networking and establishment of cooperation, like joint development of teaching approaches and exchange of teaching material. We had 21 speakers and 17 additional participants.

The brochure "Ethics and Peace – How to prepare students for the responsible use of science and engineering" summarizes the results of the workshop. It can be downloaded on the following webpage that offers further information on the workshop and the topic: www.znf.uni-hamburg.de/ethics-and-peace.html.

Martin B. Kalinowski

Excerpts of the brochure "Teaching Ethics and Peace"

The participants of the workshop "Teaching ethics and peace to science and engineering students" in Hamburg agreed on the following conclusions and recommendations.

Conclusions

1. Responsible use of science and engineering is essential.

Universities have an obligation to prepare students for responsible conduct and use of science and engineering in society.

2. All students must be reached.

Hence the respective educational modules must be compulsory both at the bachelor and the master level.

3. Natural and engineering faculties lag behind.

While many universities offer courses on medical ethics, respective teaching units in the natural and engineering faculties are only slowly being introduced.

4. Different approaches exist.

The pioneering programs the workshop focused on show a considerable diversity in scope and character ranging from optional courses through minor courses to a compulsory Studium Generale for all students.

5. Bologna is an opportunity.

The Bologna process is an opportunity to introduce new educational elements to prepare students for ethical and social responsibility. However, mechanisms that guide and safeguard the actual inclusion of such necessary elements are lacking.

6. Accreditation bodies support teaching responsibility.

Accreditation bodies have formulated criteria for learning outcomes that relate to ethical and social responsibility. These criteria imply and support the need to introduce the educational elements referred to above.

7. External funding decisions or guidelines are important.

External funding decisions or guidelines of governing bodies which triggered or mandated the introduction of

such courses have been decisive factors in several successful cases (Denmark, Finland, some Dutch universities).

8. A nucleus of motivated and competent staff is essential.

The presence of a core of motivated and competent staff in each school and department is a necessary precondition for developing and providing adequate educational forms and contents.

9. Staff nuclei have to be augmented.

This can be achieved by allocating and training additional staff. The actual funding situation regarding this teaching is often inadequate.

10. Active learning forms are important.

They relate the learning process to real life situations. Successful programs have made good use of role plays, case studies, projects and community work. The aims of these learning forms need to be made explicit and they should be linked to appropriate theoretical and empirical input.

11. Need for teaching material.

There is a great need for the development of suitable teaching material in print and web form. This should be nationally and internationally available at low cost.

12. Going beyond the individualistic approach.

The individualistic approach to teaching ethics and peace to science and engineering students which puts the ethical responsibility solely on the individual should be augmented to include a critical analysis of the broader context in which they will do their work (organizations and their cultures, laws, political decision-making, economic and social pressures). Without this attention for "critical analysis of the context," courses on ethics for scientists and engineers may end up having a negative impact, by merely making students shrug their shoulders and turn to "business as usual."

How to prepare students for a responsible use of science and engineering

The implementation of teaching modules on a responsible use of science and engineering does not happen on its own. The following recommendations might be of help.

Recommendations

1. Make use of the Bologna process!

University leaders Europe-wide are asked to make determined use of the Bologna process in order to introduce teaching on science, engineering and social responsibility. Accreditation criteria require preparing students for professional and social responsibility. University leadership is needed to see to the proper installation of such teaching into curricula.

2. Provide external funding and guidelines!

Experience shows that external funding decisions and/or governmental guidelines can be crucial to start the process. This has been successfully illustrated e.g. in Denmark, at some Dutch universities and at the University of Hamburg.

3. Make it compulsory!

All students of science and engineering need to be reached. Hence the teaching elements have to be compulsory.

4. Motivate teaching staff!

Motivated teaching staff is a prerequisite. Existing cores of such staff need to be augmented by allocating and training additional staff proportionate to the teaching task.

5. Use active learning forms!

Active learning forms like project work and role plays are instrumental, especially for interdisciplinary problems. Existing staff should be encouraged and supported in introducing such elements. Theoretical understanding has to be complemented with case studies and real life situations .

6. Enhance the attractiveness for your students!

There are strong reasons to expect that universities will enhance their attractiveness and success by preparing their students for a responsible conduct and use of science and engineering in society. Good Luck!

Yes, we can – A World Without Nuclear Weapons. Conference Report from the XXII ISODARCO Winter School

After a number of conferences dedicated to the challenges posed by international terrorism, the 22nd ISODARCO Winter Course, which took place in Andalo (Italy) from 11 to 18 January 2009, returned to one of the core subjects of its founding fathers: nuclear disarmament.

ISODARCO was founded in 1966 by two Italian physicists as an *International School on Disarmament and Research on Conflicts* and hosted a considerable number of workshops, conferences and summer and winter schools on a variety of subjects within the realm of peace and conflict studies. Among its numerous activities, ISODARCO is best known to the arms control community for its annual Winter School, which has been taking place regularly since 1966 in the beautiful mountain resort of Andalo in the Italian Alps. Even this year, ISODARCO's director of the School, the Italian physics professor *Carlo Schaerf*, was able to attract two eminent course directors and a number of renowned scholars of nuclear arms control and disarmament from all over the world to Andalo.

"Nuclear Futures: What Would Nuclear Disarmament Look Like?" was the title of this year's Winter School, clearly referring to the new discussion of the vision to eliminate all nuclear weapons worldwide, triggered by the famous op-ed in the Wall Street Journal ("A World Without Nuclear Weapons" by *George Shultz, William Perry, Henry Kissinger and Sam Nunn*) four years ago. For a comprehensive discussion about this vision the course directors of this year's Winter Course,

Catherine M. Kelleher (Brown University) and *Judith Reppy* (Cornell University), designed a dense program focussing on this complex topic from several angles. As a result, nuclear disarmament was discussed in light of changing power relations in the international system, shifting strategic balances through deployment of ballistic missile defence systems, emergence of new influential sub-state actors interested in nuclear weapons (i.e. nuclear terrorists), technical challenges for sustaining a nuclear weapon free world, regional perspectives for eliminating nuclear weapons and theoretical insights on the motivation of a state to embark on a nuclear weapon program – or to abstain from it.

The agenda of the five-day course consequently was packed with intriguing lectures accompanied by interesting and open debates, where especially junior scientists were encouraged to engage the (usually senior) lecturers after their presentation. Between the morning session and the afternoon sessions there was plenty of time for discussion, but also for enjoying the snow and the sun in Andalo. The ski-slope was closed to the course venue and it was not unusual to meet course participants somewhere on the slopes around noon, skiing, hiking or just enjoying the sun. But it was not unusual either to find a "coalition of the willing" in the course room setting up an ad-hoc session and discussing additional aspects of nuclear disarmament, which did not make it into the official program. This held even for the evening program, as some participants offered to share some very interesting documentaries on the course subject and transformed the conference room into a little after-dinner cinema for some evenings.

In the opening lecture *David Holloway* from the *Centre for International Security and Cooperation* (CISAC) of Stanford University traced the discussion since the op-ed of the "Gang of Four" (Shultz et al.) and gave a historical overview on the attempts (and failures) to eliminate nuclear weapons since the inception of the nuclear age. He highlighted the challenges a "Zero-Nuclear-Weapons" (ZNW) campaign might encounter, but gave a moderately optimistic outlook on its chances to succeed. His colleague *Lynn Eden*, co-director of CISAC, focused on a number of existing stumbling blocks on the road towards a ZNW world, especially in terms of bureaucratic inertia to change nuclear postures, doctrines and deployments. As a matter of fact, there is a frightening continuity in US nuclear war planning and few things appear to have changed since the end of the Cold War, especially with respect to the alert status of US nuclear forces and (probably) their role within a major war. The degree of continuity in war planning could nevertheless not be determined exactly, as critical details on past and current nuclear postures remain classified.

A good share of the presentations dealt with regional aspects of nuclear arms control and thus of the likelihood of an existing nuclear weapon state joining the ZNW vision. There was moderate optimism the US could take important steps in this direction, especially in light of some encouraging declarations of the Obama team during the presidential campaign (*Peter Dombrowski*, Naval War College).

The perspectives whether Russia would actively work on a ZNW vision were clearly linked to the progress on a number of unresolved questions in the relationship between Moscow and the West (*Alexei Arbatov*, Carnegie Moscow). The most pressing issue was definitely the US missile defence program in Poland and Czech Republic and the associated Russian countermeasures, which could jeopardize the whole European security architecture (*Götz Neuneck*, IFSH) and severely damage NATO-Russia relationships.

This relationship is already under quite heavy strain due to NATO enlargement and NATO's continued deployment of tactical nuclear weapons in a number of European non-nuclear weapon states (*Marco de Andreis*, *Fondazione Ugo la Malfa*, and *Jeffrey Lewis*, Arms Control Wonk). There was widespread consensus among the participants that this practice should be terminated by NATO and accompanied by a solemn declaration that all remaining NATO tactical nuclear weapons (TNW) on European soil would be removed and repatriated to the US. Unfortunately, neither NATO nor the EU seems to be ready to tackle this thorny issue at the moment (*Nadia Arbatova, Russian Academy of Science*).

A similar assessment holds for France and Israel (lectures from *Venance Journé*, CNRS and *Avner Cohen*, University of Maryland, respectively), where the prospects of nuclear disarmament appear grim at the moment, especially due to a lack of civil society involvement and an open discussion on this sensitive matter. The prospects of cooperating on the vision of a world without nuclear weapons looked a bit brighter for China (*Bates Gill*, SIPRI) and India *(Pal Sidhu, East West Institute*), two countries with great power ambition on one hand, but who exercised nuclear restraint over the last decades on the other hand. This would open up the possibility to carefully look for some future balance of power in a ZNW world.

The conference ended with this slightly optimistic spirit and identified a number of crucial dates which might be decisive for the future of the campaign to eliminate all nuclear weapons: a new NATO nuclear posture, which could be announced at this year's NATO Summit, a thorough review of the US nuclear posture expected in 2009 and the NPT Review Conference in 2010. These events will most likely be at the centre of attention of future ISODARCO conferences.

Giorgio Franceschini

Annual Report of FONAS (in German)

Tätigkeitsbericht des FONAS-Vorstandes für den Zeitraum 1.12.2006 bis 30.9.2008

Dieser Bericht umfasst die Tätigkeitsfelder und Aktivitäten der letzten 22 Monate, die seit den letzten Vorstandswahlen vergangen sind. Vorstandsmitglieder waren in dieser Zeit: *Jürgen Altmann, Matthias Englert, Martin Kalinowski, Ulrike Kronfeld-Goharani, Wolfgang Liebert* (Vorsitz), *Götz Neuneck* (stellv. Vors.), *Christoph Pistner* (Kassenwart), *Ole Roß*.

1. Stand des Vereins

Die Mitgliederzahl ist auf 71 angewachsen. Neuaufnahmen 2007 und 2008: *Dr. Matthias Zähringer* (Freiburg), *Dr. Daniel Lübbert* (Berlin), *cand. phys. Felix Gorschlüter* (Dortmund), *Dipl.-Phys. Simon Hebel* (Hamburg), *cand. phys. Christoph Weber* (Dortmund), *Dipl.-Phys. Matthias Tuma* (Bochum), *Renate Zundel* (Salzburg), *Berghof-Stiftung* (Berlin), *cand. phys. Hans Christian Gils* (Hamburg). Der Verein besteht nun über zwölf Jahre und versteht sich weiterhin als der deutsche Fachverband für naturwissenschaftlich orientierte Friedensforschung.

Die Gemeinnützigkeit des Vereins besteht weiter. Den Finanzstand weist ein gesonderter Bericht des Schatzmeisters (C. Pistner) aus.

2. Interne Zusammenarbeit

Ein Rundbrief an die Mitgliedschaft mit aktuellen Informationen über den Stand des Vereins wurde am 7.9.2007 versandt. Der von C. Pistner betreute *FONAS-Listserver* wurde für Mitteilungen aus dem Kreis der Mitglieder weiterhin genutzt.

Der achte *FONAS-Newsletter* (Erstellung durch U. Kronfeld) erschien im Sommer 2007.

Wie in den letzten Jahren wurden größere halbjährliche FONAS-Treffen (bei der DPG-Frühjahrstagung und die Herbsttagung) vorbereitet. Damit hat unsere Fachszene regelmäßig die Gelegenheit zum intensiven inhaltlichen und persönlichen Austausch. Darüber hinaus werden weitere Interessenten im Umfeld angesprochen.

3. Vorstandstätigkeiten

Der Vorstand hat sich am 12.1.2007 in Kassel, am 4.5. 2007 in Hamburg, am 17.10.2007 und am 29.9.2008 jeweils in Osnabrück zu Vorstandssitzungen getroffen. Weiterhin fanden im Berichtszeitraum nahezu monatlich zusätzliche Telefonkonferenzen statt.

Sehr viel Zeit beansprucht die Vor- und Nachbereitung von Tagungen:

- Die Nachbereitung der Fachtagung „Forschung für Abrüstung und Sicherheit“ aus Anlass des zehnjährigen Bestehens unseres Forschungsverbundes FONAS am 30. Nov. 2006 im Magnus-Haus der Deutschen Physikalischen Gesellschaft in Berlin (Erstellung einer dokumentierenden DVD und einer Buchveröffentlichung unter Nutzung der Beiträge);
- DPG-Jahrestagung (gemeinsam mit der AG Physik und Abrüstung der DPG) im März 2007 in Regensburg (Vorbereitung: Götz Neuneck, Jürgen Altmann, Matthias Englert);
- Fachgespräch *Global Missile Defense* im April 2007 in Berlin (Vorbereitung: Götz Neuneck, Jürgen Altmann, Wolfgang Liebert);
- Fachgespräch *Spaltbare Nuklearmaterialien* im Juni 2007 in Berlin (Vorbereitung: Martin Kalinowski und Wolfgang Liebert);
- FONAS-Herbsttagungen im Oktober 2007 in Osnabrück (Vorbereitung: Ulrike Kronfeld und Wolfgang Liebert);
- Fach- und Pressegespräch *Raketenabwehr* im Februar 2008 in Berlin (Vorbereitung: Götz Neuneck und Wolfgang Liebert);
- DPG-Jahrestagung (gemeinsam mit dem AK Physik und Abrüstung der DPG) im Februar 2008 in Berlin (Vorbereitung: Götz Neuneck, Jürgen Altmann, Matthias Englert);
- CliSAP-ZNF-FONAS-Workshop zu Energieszenarien im September 2008 in Hamburg (Vorbereitung: Martin Kalinowski);
- FONAS-Herbsttagung im September/Oktober 2008 in Osnabrück (Vorbereitung: Wolfgang Liebert und Ulrike Kronfeld);
- ZNF-INES-FONAS Tagung *Teaching Ethics and Peace* im Oktober 2008 in Hamburg (Vorbereitung: Martin Kalinowski, Götz Neuneck und Hartwig Spitzer).

Eine Buchpublikation ist in Vorbereitung, die Beiträge zur Jubiläumsveranstaltung und zu den letzten Fachgesprächen enthalten wird. Auch eine DVD zur Dokumentation ist in Arbeit.

In der zweiten Jahreshälfte 2007 hat der Vorstand ein Konzept für ein Schwerpunktheft *Wiederkehr der Rüstungsdynamik und Renuklearisierung der Welt* für Wissenschaft und Frieden (W&F) erarbeitet und zehn Beiträge aus dem FONAS-Kreis koordiniert (Federführung: Wolfgang Liebert, Matthias Englert, Götz Neuneck). Das ansehnliche Ergebnis liegt mit dem W&F-Heft 1/2008 vor.

2007 wurde ein kleiner Antrag an die Berghof-Stiftung bewilligt, der Jürgen Altmann ermöglicht, seine Tätigkeit zur Thematik sogenannter *nicht-tödlicher Waffen* durch Teilnahme an internationalen Konferenzen fortzusetzen.

Seit Frühjahr 2008 ist ein Übersichtsbeitrag über die Motivation, Geschichte und aktuelle Ausführung naturwissenschaftlich orientierter Friedensforschung unter dem Titel *Naturwissenschaft, Krieg und Frieden* (Autoren: Martin Kalinowski, Jürgen Altmann, Ulrike Kronfeld-Goharani, Wolfgang Liebert, Götz Neuneck) in Vorbereitung. Er wird in dem von der *Arbeitsge-*

meinschaft Friedens- und Konfliktforschung (AFK) angeregten und herausgegebenen Buch *Friedens- und Konfliktforschung – Ein Studienbuch* im Nomos Verlag erscheinen.

Der Vorstand hat sich 2008 mit dem Abbau der friedenswissenschaftlichen Studiengänge an der Fernuniversität Hagen befasst und Möglichkeiten einer klug organisierten Fortführung an einer anderen nordrhein-westfälischen Hochschule diskutiert.

Tabelle: FONAS-Tagungen 2007 und 2008

2007		
28.-29. März	DPG-Fachsitzung „Physik und Abrüstung“ (mit DPG-AGA)	Regensburg
3. April	Fachgespräch „Global Missile Defense…“	Berlin
14. Juni	Fachgespräch „Spaltbare Nuklearmaterialien…“	Berlin
16.-18. Okt.	FONAS-Herbsttagung	Osnabrück
2008		
28. Feb.	Fach- und Pressegespräch „Raketenabwehr“	Berlin
27.-29. Feb.	DPG-Fachsitzung „Physik und Abrüstung“ (mit DPG-AGA)	Berlin
11./12. Sept.	„Energy Scenarios“ (mit ZNF und CLiSAP)	Hamburg
29.Sept.-1.Okt.	FONAS-Herbsttagung	Osnabrück

Die Planungen für eine Tagung gemeinsam mit dem AKA der DPG (und später eventuell der VDW und der DPG) zu den Herausforderungen im Nuklearbereich kamen leider nicht zum Zuge.

Es wird über Möglichkeiten der Internationalisierung unserer Bemühungen im europäischen Rahmen nachgedacht. Namen und Adressen werden gesammelt (Ansprechpartner: Martin Kalinowski). Der nächste Newsletter wird weitgehend in englischer Sprache abgefasst sein.

Der Vorstand hat sich auf Themensuche begeben, um die inhaltliche Arbeit von FONAS über die traditionelleren Themen hinaus und mit naturwissenschaftlicher Perspektive inhaltlich voran zu bringen. Dazu gehören als mögliche Themen: Asymmetrische Kriege, Sicherheitsforschung, Energie- und Ressourcenkonflikte, Strukturelle Verwundbarkeit der Industriegesellschaften.

Im Sommer 2008 hat der Vorstand eine Stellungnahme zu den Vorbereitungen für eine zweite deutsche Stiftungsprofessur im Bereich naturwissenschaftlich-orientierter Friedensforschung an der TU Darmstadt erarbeitet und an die Beteiligten gesandt.

Zu den sehr arbeitsaufwändigen Tagungen, in denen sich FONAS präsentieren kann und die Kommunikation untereinander und mit anderen intensiviert wird, sowie den weiteren skizzierten Tätigkeiten im Berichtszeitraum, sind die ebenfalls zeitraubende – und manchmal nervenaufreibende – Vorbereitung des Newsletters (Ulrike Kronfeld) und die Führung der Finanzen (Christoph Pistner) als wesentliche und unverzichtbare Vorstandstätigkeiten zu nennen.

4. Tagungen und Veranstaltungen

Die alte Tradition der FONAS-Fachgespräche in der Bundeshauptstadt wurde mit der Organisation des 14.-16. Fachgesprächs erfolgreich wieder belebt. Die Fachgespräche waren durchweg sehr gut besucht und die Diskussionen wurden auf hohem Niveau geführt. Beim Thema Raketenabwehr berichteten mehrere Zeitungen über die beim Fachgespräch geäußerten kritischen Positionen.

Am 3. April 2007 fand das Fachgespräch „Global Missile Defense, Weltraumbewaffnung und Europa?“ statt. Nach einer Einführung durch Wolfgang Liebert sprachen Geoffrey Forden (MIT) über den chinesischen Antisatelliten-Waffentest vom 11.1.2007 und seine Implikationen für eine drohende Weltraumbewaffnung. Götz Neuneck sprach über die konkret anstehen-den neuen US-Raketenabwehrpläne für Europa (tschechische und polnische Station) und ihre Implikationen für Europa und Russland und den globalen Kontext, sowie Jürgen Altmann über physikalisch-technische Details der Raketenbahnen und Radarhorizonte der geplanten US-Stellungen. Den Abschluss bildete ein Kommentar von Geoffrey Forden zu der Missile Defense-Diskussion in den USA, dem sich eine ausführliche Diskussion mit dem Publikum anschloss.

Am 14. Juni 2007 folgte das Fachgespräch „Spaltbare Nuklearmaterialien: Proliferationsgefahr und internationale Umgangsstrategien – Schwerpunkt Urananreicherung und hochangereichertes Uran“. Martin Kalinowski trug vor zu neueren Entwicklungen hinsichtlich einer Aushandlung eines *Fissile Material Cutoff Treaty* und der Gesamtproblematik spaltbarer Nuklearmaterialien weltweit. Wolfgang Liebert hielt einen Vortrag über das Proliferationspotenzial von Gasultrazentrifugen zur Urananreicherung. Matthias Englert sprach über mögliche Wege zur Umrüstung von Forschungsreaktoren auf nichtwaffentaugliches schwach angereichertes Uran mit Fokus auf den Münchner Forschungsreaktor.

Ein weiteres Fachgespräch wurde am 28. Feb. 2008 als Pressgespräch im Magnus-Haus der DPG in Berlin durchgeführt. *Ted Postol* (MIT) stellte seine technische Analyse zu den US-Raketenabwehrplänen vor, insbesondere zum US Ground-based Midcourse Defense System (GMD) und zu den Konsequenzen für das Verhältnis mit Russland. Die Presse berichtete in der Folgezeit darüber. Ted Postol und Götz Neuneck

waren auch im Auswärtigen Amt zu Gast bei einer Gesprächsrunde zum gleichen Themenkreis.

Zum 13. Mal veranstaltete die Arbeitsgruppe Physik und Abrüstung (AGA) im Rahmen der Frühjahrstagung der Deutschen Physikalischen Gesellschaft in Berlin vom 27. bis 29. Februar 2008 die Fachsitzung „Abrüstung und Verifikation". Zuvor hatte Ted Postol, Professor of Science, Technology and National Security vom MIT/ Cambridge USA, in seinem Plenarvortrag vor ca. 1.000 Zuhörern, technisch fundiert gezeigt, dass die auch in Europa geplante Raketenabwehrkomponente durch vielfältige Gegenmaßnahmen wie elektronische Sender, Ballons oder Attrappen leicht in die Irre geführt werden kann. Auch können die geplanten Abfangraketen russische Interkontinentalraketen erreichen und stellen somit ein Problem für die russische Abschreckung dar. Schwerpunkt der ersten AGA-Sitzung waren Safeguards, Simulationsrechnungen und Proliferationsrelevanz von zukünftigen Fusionsanlagen. Ein weiterer Schwerpunkt bildete das Proliferationspotenzial von Ultrazentrifugen und von Beryllium sowie das Problem des spaltbaren Materials im Rahmen der geplanten amerikanisch-indischen Nuklearkooperation. Optimierungsrechnungen zur Konversion von HEU auf LEU wurden von M. Englert und W. Liebert vorgestellt. Wichtig bleibt die Verbesserung der Verifikationsmöglichkeiten im Rahmen des Umfassenden Kernteststoppvertrages CTBT durch atmosphärische Spurenanalyse von Xenon und Krypton-85 (M. Kalinowski, O. Ross et al.), durch Fernerkundung (I. Niemeyer et al.), und durch On-Site-Inspektionen. Auch Infraschall kann für die Verifikation im Rahmen von konventioneller Rüstungskontrolle verwendet werden. Die Sitzungen waren sehr gut besucht.

Vom 16.-18. Oktober 2007 fand die FONAS-Jahrestagung zum vierten Mal in den Geschäftsräumen der Deutschen Stiftung Friedensforschung (DSF) in Osnabrück statt. 18 Teilnehmer und Teilnehmerinnen nahmen daran (vgl. den Tagungsbericht von Ulrike Kronfeld-Goharani auf S. 20).

Am 11. und 12. September 2008 trafen sich FONAS-Mitglieder und Klimawissenschaftler mit Energieexperten zu einem gemeinsamen Workshop. Dabei wurde die Grundlage für eine gemeinsame Arbeit über sozio-technische Maßnahmen zur Verringerung der CO_2-Emissionen geschaffen. Am ersten Tag wurden Szenarien für die zukünftige Energieverbrauchsentwicklung und die damit verbundenen CO_2-Emissionen behandelt. Am zweiten Tag wurde die Zukunft der Kernenergie und deren möglicher Beitrag zur Vermeidung klimaschädigender Emissionen diskutiert. Veranstalter waren neben FONAS der Hamburger Exzellenzcluster CliSAP (Integrated Climate System Analysis and Prediction), das ZNF und das IFSH.

5. Ausblick

Die Verjüngung des FONAS-Vorstandes kommt nach den letzten Vorstandswahlen langsam voran.

Wolfgang Liebert, 27. Sept. 2008 (im Namen des gesamten FONAS-Vorstands)

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Announcements

04.-06.03.2009: Fachsitzung der Arbeitsgruppe „Physik und Abrüstung" (AGA) im Rahmen der DPG-Frühjahrstagung (02.-06.03.2009) in Hamburg,
Contact: Prof. Dr. Götz Neuneck, Institut für Friedensforschung und Sicherheitspolitik an der Universität Hamburg, Beim Schlump 83, D-20144 Hamburg, Telefon: +49 (0)40-86 60 77-0, E-mail: neuneck@public.uni-hamburg.de.

04.-06.05.2009: International Conference "Competition and Conflicts on Resource Use", TU Darmstadt,
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(Voraussichtl.) 05-07.10.2009: FONAS-Herbsttagung bei der Deutschen Stiftung Friedensforschung (DSF) in Osnabrück, Am Ledenhof 3-5, 49074 Osnabrück, Kontakt: Dr. Ulrike Kronfeld-Goharani, Tel.: 0431-880-6332, E-Mail: kronfeld@frieden.uni-kiel.de.

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Summer Academy Young Scientists Cooperate for Peace (SCooP)

2nd - 15th of August 2009

at the Carl Friedrich von Weizsäcker Centre for Science and Peace Research
University of Hamburg

The SCooP Summer Academy aims at the encouragement of the coming generation of scientists to strive for excellence in research. Directed to sustain permanent peace it gives advanced training within the frameworks of interdisciplinary peace research to challenge, integrate and reinforce European research efforts in the field of contemporary global conflicts, arms-control and conflict-resolution.

The academic programme is based on the combination of lectures and supporting working groups. The subjects discussed are in the field of monitoring and verification of nuclear, biological and chemical weapons as well as effects of global warming. The scientific staff of the ZNF and the lecturers will assist the working groups in the treatment of their respective issues and exercises.

All outcomes will be presented to the public and the media. Short talks and posters summarizing the results will be exhibited at the end of the second week during the public talk.

Additionally two excursions are planned, one to the Research Institute for Protective Technologies and NBC Protection (WIS) of the Federal Arms, based at Munster and the second one to the Bernhard-Nocht-Institute for Tropical Medicine located in Hamburg.

To culminate the first week of SCooP, professionals and prominent experts from international organisations, research institutions, the military or industry sector will share their respectable knowledge giving talks addressing the participants. Afterwards they will attend a panel discussion about a controverse topic on global warming and Europe's future energy production strategy which will be open to the public as a high media event. The discussion will be moderated by a well-known journalist.

On the last day of the ScooP event Prof. Dr. Ernst Ulrich von Weizsäcker besides other outstanding and well-known professionals will give insights into their work and life.

The cultural programme offers a welcome dinner, sightseeing tours of Hamburg and the harbour as well as a workshop on jobs and careers in international organisations, peace research institutes and industrial research programmes with focus on developing and peacekeeping technologies. The workshop will be held in close cooperation with the Career Center of the University of Hamburg.

The SCooP Summer Academy is open to master degree students registered in studies of natural sciences or other disciplines with strong interest in natural science. PhD students as well as post-docs are welcome. Minimum academic requirement for application is a bachelor's degree.

The selection will be carried out in accordance with the following criteria:

- Good academic achievements and strong determination to work in the field of science and peace research
- EU/Schengen Member State or European country citizenship
- Age up to 35 by the time for applications

The number of participants is restricted to 30. You can find a registration form under www.znf.uni-hamburg.de/scoop.html which has to be compiled and sent to scoop@uni-hamburg.de.

Please add curriculum vitae, a copy of the latest university certificate and a letter of motivation with a maximum of 500 words and send all documents before the deadline of 31 May 2009.