Conference Proceedings

SCIENCE · PEACE · SECURITY '21
The Impact of new Technologies: Destabilizing or Enabling Resilience?
8-10 September 2021
www.sps21.fonas.org

Executive Summary

The impact of the rapid technological change on peace and security continuously grows and becomes increasingly complex. Against the background of a quickly deteriorating security environment, the international conference SCIENCE · PEACE · SECURITY '21 (RWTH Aachen University, 8-10 September 2021) examined the role of emerging technologies. The 60 speakers and 220 participants came from the natural, technical and social sciences. Diplomats and representatives from international organisations participated in the discussions. Topics included nuclear, chemical and biological arms control, autonomy in weapon systems, cybersecurity and the militarization of space among others.

The main outcome was that all of these issues could be more effectively addressed by new approaches to rigorous interdisciplinary research collaboration to create policy-relevant knowledge and by tightening the nexus between the scientist and policy communities. Both can only be achieved and sustained by funding novel structures that enable scientific-technical scholars to engage on these topics.

Key problems to be addressed by integrating natural, technical and social science perspectives include early risk assessment of potential dual-use research and technologies – especially in bio-security and epidemiology as well as IT and robotic research. Ways forward are the inclusion of norms into technology design as well as addressing questions of responsibility and standards. For military-usable technologies, entirely new regulatory approaches are necessary to prevent escalatory dynamics and to maintain accountability structures, moving from object-based to behaviour-based approaches.

Scientific-technical research contributes to peace and security in positive ways. A prominent example are nuclear verification techniques. While instruments to monitor nonproliferation and test ban commitments benefit from further improvement, many gaps on how to verify future arms control and disarmament agreements still exist and must be urgently closed.

The best cutting-edge scientific and academic expertise that is required for these complex research tasks is found in universities and other independent research institutes. Typically, however, decisionmakers draw knowledge from governmental institutions because of ease and existing connections. Therefore, efforts should be made to better connect the policy and academic communities. Communication between both can be improved by meeting on a regular basis and not only when advice on a specific issue is sought. This can foster more stable relationships and increase an understanding of each other.

Lastly, opportunities should be improved for the younger generation of scientists and technologists to engage with policymakers. It is crucial to educate and engage early-on the next generation of scientifically-literate policymakers and security-aware scientists.

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Contents

Programme Committee

Prof. Malte Göttsche
General Chair of SPS'21
Head, Nuclear Verification and Disarmament, RWTH Aachen University

Dr. Sibylle Bauer
Director of Studies, Stockholm International Peace Research Institute

Anja Dahlmann
Head of Project, International Panel on the Regulation of Autonomous Weapons, German Institute for International and Security Affairs, Berlin

Dr. Friederike Frieß
Senior Scientist, Institute of Safety and Risk Sciences, University of Natural Resources and Life Sciences, Vienna

Dr. Filippa Lentzos
Senior Research Fellow, Dept. of Global Health & Social Medicine and Dept. of War Studies, King's College

Prof. Götz Neuneck
Senior Research Fellow, Institute for Peace Research and Security Policy, Hamburg

Dr. Irmgard Niemeyer
Head of Division, Nuclear Safeguards and Security, Forschungszentrum Jülich GmbH

Thea Riebe
Research Associate, Science and Technology for Peace and Security, TU Darmstadt

Dr. Jantje Silomon
Researcher, International Cybersecurity, Institute for Peace Research and Security Policy, Hamburg

Organization

Prof. Malte Göttsche
General Chair of SPS'21
Head, Nuclear Verification and Disarmament Group, RWTH Aachen University

Prof. Christian Reuter
Professor, Science and Technology for Peace and Security, TU Darmstadt

Jakob Brochhaus
Nuclear Verification and Disarmament Group, RWTH Aachen University

Lukas Rademacher
Nuclear Verification and Disarmament Group, RWTH Aachen University

Keynote Speakers and Panellists

Dr. Kavita Berger
Director, Board on Life Sciences, U.S. National Academies of Sciences, Engineering, and Medicine

Ambassador Rüdiger Bohn
Deputy Federal Government Commissioner for Disarmament and Arms Control, German Foreign Office

Brigadier General Peter Braunstein
Director Bundeswehr Verification Center (BwVC)

Prof. Paolo Cotta-Ramusino
Secretary General, Pugwash Conferences on Science and World Affairs

Ambassador Marjolijn van Deelen
Special Envoy for Non-Proliferation and Disarmament, European External Action Service

Prof. Robin Geiß
Director, United Nations Institute for Disarmament Research

Sebastian Groth
Head of Policy Planning at the Federal Foreign Office

Prof. Frank von Hippel
Co-Founder, Program on Science & Global Security, Princeton University

Prof. Moriba Jah
Department of Aerospace Engineering and Engineering Mechanics, University of Texas at Austin

Prof. Lucas Kello
Department of Politics and International Relations, University of Oxford

Dr. Patricia Lewis
Research Director, Conflict, Science & Transformation, Chatham House

Dr. Rosamund Lewis
World Health Emergencies Programmes, World Health Organization

Prof. Erik Melander
Director, Alva Myrdal Centre for Nuclear Disarmament, Uppsala University

Prof. Catrin Misselhorn
Department of Philosophy, University of Göttingen

Prof. Ursula Schröder
Director of the Institute for Peace Research and Security Policy at the University of Hamburg

Conference Report

Malte Göttsche[1]

Today's international security environment is increasingly being marked by the demise of the classical arms control architecture, the rise of great power politics and eroding trust among states. The future course of the world order is unclear. New developments in military and dual-use technology as well as weapon modernization programmes are important factors and add complexity to any effort towards peace and security.

It is in this environment that the international conference SCIENCE · PEACE · SECURITY '21 examined the impact of new technologies, in particular emerging technologies. How can a more resilient security environment be achieved? Which research contributions and policy measures towards crisis resolution, confidence-building and arms limitations are possible in this world?

These questions can be answered by interdisciplinary approaches and studies – in particular by bringing natural, technical and social scientists as well as decisionmakers together. At the moment, there is no sufficient dialogue between these disciplines and experts. The conference offered a chance to think creatively beyond borders, find ideas for new interdisciplinary research and perhaps even forge new collaborations. The contributions to this conference came from many different disciplines and allowed us to put together a very diverse programme: During the conference, physicists, chemists, biologists, geographers, computer scientists, mathematicians, political scientists, legal scientists and ethics scholars presented their research.

Furthermore, also practitioners participated in the conference, including diplomats and representatives from international organisations. Clearly, the dialogue between scholars and practitioners is crucial for the success of international peace, security and disarmament efforts. The political objectives of nonproliferation, disarmament and arms control are met through multilateral treaties and arrangements. Negotiating and upkeeping those is the job of diplomats who need a good understanding of the topics, including the scientific and technical background.

1. Challenges and opportunities at the intersection of science, peace and security

The world is becoming increasingly complex and insecure; it is marked by multipolarity, great power competition, rapid technological change, strategic unpredictability as well as disinformation, which result in more mistrust, violence and arms investments. Examples that

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illustrate the worsening state include a renewed nuclear arms race which is marked by an increasing number of deployed weapons, the development of new delivery systems such as hypersonic weapons or nuclear-powered cruise missiles, the erosion of arms control regimes including the end of the Intermediate-Range Nuclear Forces Treaty (INF) or the difficulty to maintain the Joint Comprehensive Plan of Action (JCPOA) that limits, inter alia, the Iranian nuclear programme but also includes sanctions relief or stronger verification standards.

Beyond nuclear, new technological and military developments are worrisome: Examples are an increasing autonomy in weapon systems and concepts to base for example early warning and command and control systems on artificial intelligence. The man-made cyber-domain allows borderless communication and services worldwide, but has also become increasingly militarized and weaponized. As many incidents show, technical vulnerabilities can be exploited for espionage, sabotage or disruptive attacks on critical infrastructure by state actors to escalate conflicts. The most powerful military actors aim for digital supremacy, which will replace 20th century air supremacy as over-arching goal if this is not the case already. States are investing increasingly in hybrid defence strategies by using irregular forces or disinformation campaigns. A consequence is that threatening the use of nuclear weapons to react to cyberattacks is discussed. Clearly, hybrid wars are harder to predict.

Even though biological and chemical weapons have been legally banned for decades, chemical weapons have recently been used on several occasions, including in Syria or the poisoning of Russian citizens. Some advances in biotechnology augment the dual use dilemma, for instance in gain-of-function research or novel invasive environmental biotechnologies. The convergence of chemistry and biology introduces new challenges to regulating these weapons.

Further important issues which have also been discussed during the conference are the increasing militarization of space, the dual use potential of quantum computing, sensor technology, laser-based systems as well as stealth technologies. Importantly, technological convergence will become more relevant as synergetic aspects of these various technologies are brought together in the military context.

Against this background, scientific and technical expertise in peace and security research is essential to provide the scholarly background that informs decisionmakers. These disciplines must be involved in assessing risks of new military technologies and the dual-use potential of developments in research. Beyond this, they are instrumental in exploiting innovative science and technology as opportunities to the benefit of peace and security.

While it is impossible to capture all the topical areas addressed during the conference, two of the major themes are highlighted next to dive into some more depth. In both, natural scientists and engineers must come together with social scientists to create policy-relevant knowledge. They are very different topics requiring very different expertise, which speaks to the diversity of the field.

Addressing dual-use aspects of emerging technologies

Advances in security-relevant areas often have a dual-use character, as – in addition to their beneficial use to society – some may at the same time also carry the potential to cause harm. The speed and diffusion of innovation is accelerating, resulting in the need to adapt awareness and regulation of possible high-risk technologies. Thus, research and development in these areas need attention from both researchers and political decisionmakers. This includes early risk and technology assessment. Discussion within the research community and the society - on possible effects and legitimate applications - needs profound knowledge of the scientific base of the technological artefacts. Possible fields of security relevant research and development include, but are not limited to, bio security and epidemiology, IT and robotic research, among others.

Some ways to address dual-use issues are design approaches which work on the inclusion of norms into the technology design such as Responsible Research and Innovation (RRI) and Value Sensitive Design (VSD) as well as technology assessment, preventive arms control and addressing the questions of responsibility, norms and standards. It is evident that addressing these aspects requires knowledge from a variety of disciplines.

Among a wider range of technologies, one focus of the conference was on informatics-related topics, which are of particular importance. This discussion included artificial intelligence as well as technologies and platforms enabling information warfare.

Machine learning elements are increasingly being used across various industries, for example in finance, healthcare, or security applications. Similarly, militaries around the globe seek to integrate these elements, hoping to gain an edge over their adversaries by accelerating decision-making and exploiting larger amounts of data. This not only creates mounting pressure for others to follow suit, indicating the early stages of a new type of arms race, but also gives rise to some unique ethical, legal, and security challenges. Research must further contribute to addressing these.

On technologies and platforms with a potential to enable information warfare: Significant increases in fake news, disinformation and influence campaigns are undermining trust in experts, institutions, and other traditional sources of authority. Nonproliferation norms and regimes are no exception. Yet, there has been little systematic research to deepen understanding and to enhance international awareness of contemporary influence campaigns that undermine nonproliferation norms and regimes. Similarly, there has not yet been sufficient emphasis on increasing the ability of governments, media, international organisations, and professional societies to detect and respond to them, or prevent misuse of suited platforms in the first place. Besides technical research – for instance on detection and mitigation – studies building typologies of disinformation campaigns and means of narrative dissemination could be a way forward.

Confidence-building, regulation and verification

Arms control treaties and related regimes in different domains (CBRN, conventional weapons, outer space etc.) have been established in the last 50 years to increase predictability, transparency for war prevention and sustainable peace. In some, verification measures have played an important role. Additionally, transparency and confidence-building measures (TCBMs) aim to influence the perception of antagonists and to remove inherent ambiguity surrounding national military policies.

Given future political and ethical challenges stemming from military and technological developments, new TCBMs in different domains are a potential way forward. They can be implemented in the full weapons cycle including research, engineering and deployment. At the conference, current deficits and challenges for TCBMs within the current arms control, nonproliferation and disarmament framework were debated and further proposals to address future challenges in the areas of confidence-building, arms control, verification and threat reduction were discussed.

For instance, it was found that new missile technologies, biological weapons and deployed conventional forces need more transparency due to the demise of respective arms control treaties or their lack of efficiency. With regard to emerging technologies broadly, entirely new regulatory approaches are necessary to prevent escalatory dynamics and to maintain accountability structures. While classical arms control measures are typically based on object-based approaches such as counting tanks or aircraft, these will need to be addressed by behaviour-based approaches.

Science-based advice is crucial in all these areas, as a detailed understanding of the various technologies is key to develop effective and targeted confidence-building, regulatory or verification measures. Technical expertise and research are not only necessary to develop approaches that address emerging technologies. They are at least equally important in the classical fields, including nuclear arms control.

While verification techniques to monitor nuclear nonproliferation commitments (Safeguards) are constantly being improved, as well as the verification regime of the Comprehensive Test Ban Treaty, many open questions remain on how to verify future arms control and disarmament agreements. This begins with urgently required methods and techniques to verify limits on the number of warheads a state possesses, which may well be part of a potential successor agreement of the New START Treaty. It continues with more intrusive and more complex regimes to verify deep cuts, at some point in the future perhaps down to states giving up their nuclear arsenals.

Cutting-edge technology will be required, as some of the challenges are highly complex. For instance, confidence in disarmament processes must be built under the significant constraint that weapon states seek to protect proliferation-sensitive and otherwise classified information. Another example is the difficult detection of undeclared warheads, which do not possess signatures that could be measured from afar. Much more research and development, testing and evaluation of technologies is needed.

2. The Need to Integrate Natural, Technical and Social Science Perspectives in Joint Research on Peace and Global Security

Today, there is a rather active and important social science research community that addresses the role of technology for peace and global security. The fast-paced technological developments including the convergence of disciplines and the complex interplays that technological innovations have with regard to their impact on peace and security, however, require substantive and disciplinary expertise from scientists and engineers.

In addition to technology assessments – typically examining risks – science and technology can also contribute to peace and security in positive ways. Equally important as recognizing the need to bring in expertise from the natural and engineering sciences, however, is the insight that political and social problems can rarely be solved solely by technological innovation.

In a nutshell, neither can social scientists alone offer the required expertise to address such challenges, nor can natural scientists or engineers alone. The need for interdisciplinary approaches in this area is of course not new. Nevertheless, there is much room for expanding and strengthening collaboration. The German Science and Humanities Council emphasized this conclusion in its recent evaluation of the field of peace and conflict studies.

The most effective way is to foster integrated research projects where the fields do not work side by side or where one merely provides some specific input to questions largely addressed by the other. Instead, in an integrated project, research questions are solved by constant dialogue that results in a joint understanding.

Within the above-mentioned areas of emerging technologies and confidence-building, the examples of cybersecurity and nuclear verification regimes illustrate the need for integrated approaches. In the cyber context, social and computer scientists have different perspectives of what security means. A comprehensive understanding of what is meant by "cybersecurity" that accounts for technological as well as social aspects is a crucial step to more effectively address it. Therefore, the highly complex technological problems for instance about digital encryption and disinformation urgently need a dialogue between political scientists, policymakers and computer and data scientists.

Nuclear verification regimes are very complex and challenging both in technical and political terms: While advances in detection technologies and analysis methods can enhance verification capabilities, the perceptions that the involved stakeholders have of each other certainly influence how well confidence-building through verification can succeed. How do technical, political and social processes then need to be intertwined so that verification can be as effective as possible in a challenging and constantly changing security environment?

Such interdisciplinary dialogue requires appropriate formats, incentives and funding to collaborate. Today, not sufficient opportunities exist in this regard. Furthermore, it can even be seen as an impediment to careers: In academia, evaluations typically follow disciplinary criteria. Such dialogue is difficult as an uphill struggle, as it requires space to learn about other disciplines' approaches and methods, and develop a common language. These tasks demand effort and patience.

Lastly, beyond the communities of researchers that have built their career or plan to build it on topics of technology and security, reaching out and involving natural and technical scientists that have relevant disciplinary expertise is crucial. Experts on cyber, artificial intelligence, quantum technologies and space are just a few examples. They could collaborate with the arms control community on a project basis, but need incentives to do so, including appropriate funding opportunities.

To further strengthen this field of "scientific-technical peace research", new governmental initiatives are necessary: Within the disciplinary structure of the academic system, it is difficult or impossible for interdisciplinary research groups to grow without external support. Such support should also be in the interest of governments, as they benefit from the technical experts advising them, and as the outcome of integrated interdisciplinary research that such support enables will address their needs in the most comprehensive and effective way.

3. Overcoming the Gap of Scientific and Political Cultures

Natural and social science research provide a crucial component of political decision-making in conflict resolution, arms control, disarmament and international security. Political decisionmakers and diplomats are necessarily generalists, who do not have the time to reflect deeply on specific issues, especially if at the root are technically arcane complexities of new and rapidly evolving technologies. There are only very few opportunities for specialist careers. The pressure of office does not often reward deep reflection, but rather action. Therefore, on these complex issues, they need the help of science.

Furthermore, government officials are less free to develop their thoughts on issues of technology and security, or disarmament and arms control more broadly. Academic scholars are less bound by political narratives, which creates a chance for them to shape the agenda. Their creative ideas can give important impulses to decisionmakers. Tightening the nexus between the scientist and policy communities is crucial.

This creativity can only be fully developed in independent institutions. Typically, however, decisionmakers draw knowledge from their governmental institutions because of ease and existing connections. These can be intelligence services, national research labs or regulators. These experts can, however, only cover part of the picture and academic thinking. Reaching out to and supporting non-governmental scientists will allow them to profit from a diversity of experience and views as well as often more cutting-edge technical knowledge.

Naturally, however, there is a gap between the world of science on the one hand and politics, diplomacy and government on the other. A sober analysis of the different aspects of these two cultures is necessary in order to propose ways to overcome the gap. Science is mainly ruled by rationality, open exchange and neutrality. In the realm of politics, different interests, rhetoric and changing norms are dominating the discourses on the use of scientific-based technologies for armament and disarmament. Sometimes, scientists (outside the peace and security research communities) are not sufficiently aware of the political, security, military or other contexts of their work. Policy-makers may not always

have a technical background or understand scientific methodology in general. Lastly, there is not always sufficient recognition for scientists to engage in policy advocacy, or for decisionmakers to foster relationships with scientists.

The question then is how to connect these very different communities, what are key elements for an effective two-way engagement. So far, typically, policy-makers turn to scientists (only) when they have a concrete technical issue. A way to significantly improve communication between both communities is to connect on a regular basis, and not only when advice on a specific issue is sought. This can foster more stable relationships, and increase an understanding of each other: What are policymakers looking for from scientists and technologists? What are scientists and technologists looking for from policymakers? A way forward is for scientists to invite policy-makers to their discussions.

Certainly, there is historical experience to draw from, such as the Pugwash Conferences on 'dialogue across divides,' OPCW's interactive 'Science for Diplomats' initiative, Article 36's informal retreats for experts and policymakers, or the working groups of the International Partnership for Nuclear Disarmament Verification, where scientists work alongside diplomats. All these experiences should be critically reviewed in regard to how effective they are/were in bridging the divide, and what one can learn to improve the dialogue.

Last but certainly not least, ways should be thought about to motivate the younger generation of scientists and technologists to engage with policymakers in nonproliferation and disarmament. How can opportunities for them be improved? It is crucial to educate and engage early-on the next generation of scientifically-literate policymakers and security-aware scientists. It is these people who will later have impact as experts in national and international institutions as well as academia.

Background: The Conference

The SCIENCE · PEACE · SECURITY'21 conference was held online 8-10 September 2021. It was organized by the research group Nuclear Verification and Disarmament of the RWTH Aachen and financed by the German Foundation for Peace Research, the VolkswagenStiftung and the Research Association for Science, Disarmament and International Security (FONAS). It involved about 220 registered participants, 60 speakers, and 15 posters. There were 18 sessions, one poster session, and 7 plenary talks. It furthermore featured virtual coffee and break rooms, giving attendees the opportunity for informal exchange.

The conference series SCIENCE · PEACE · SECURITY, started in 2019 and held biannually, is not least a response to the 'Empfehlungen zur Weiterentwicklung der Friedens- und Konfliktforschung' ('recommendations for the further development of peace and conflict research') published by the German Council on Science and Humanities in July 2019. In these recommendations, the council explicitly calls for an expansion of the field's interdisciplinarity, a strengthening of scientific peace and conflict research, as well as the promotion of the field's internationalization in Germany.

As demanded by the Council, this conference aimed for international connection in peace and conflict research. The program committee was comprised of scientists from all over Europe. About 50% of the registered participants stemmed from Germany, the rest primarily from Europe. Nevertheless, all continents except Australia were represented.

Among the attendees were international experts from the universities of Harvard, Texas A&M, Berkeley, Princeton, Maryland, North Carolina and Boston (USA), Stellenbosch (South Africa), Universidad Militar Nueva Granada (Columbia), KAIST (South Korea), Tsinghua (China), Oxford, King's College, Manchester and Leicester (GBR), Rome and Genua, Barcelona, Prague, Vienna, Leiden, Antwerpen, Uppsala, and Southern Denmark. Diplomats and international organizations were represented by speakers from the CTBTO, the OPCW, UNIDIR, the EU External Action Service, the German Federal Foreign Office as well as the Bundeswehr.

The Conference Proceedings are published by RWTH Publications free of charge, a selection of conference contributions will be published as peer-reviewed papers in a special issue of the Journal of International Peace and Organization (Friedens-Warte). The follow-up conferences are already in planning - SPS'23 is scheduled at TU Darmstadt.

AGENDA
Wednesday, September 8

science
peace
security '21
Aachen, Germany

Time: UTC +2

12:30 von Weizsäcker Room

Introduction: Malte Göttsche
RWTH Aachen University

Greetings: Ulrich Rüdiger
Rector, RWTH Aachen University

Ulrich Schneckener
Chairman, German Foundation for Peace Research

13:00 von Weizsäcker Room

Welcome Address: Marjolijn van Deelen
European External Action Service

13:20 von Weizsäcker Room

Rosamund Lewis
World Health Organization
Infectious Diseases, Peace and Security –
so What Happens Next?

13:40

Break

14:40 von Weizsäcker Room

Peter Braunstein
Bundeswehr Verification Center
Confidence Building in the 21st Century

15:00

Break

15:10 von Weizsäcker Room

Sustaining Peace Through Transparency and Confidence-Building
Chair: Filippa Lentzos
Speakers: Kolja Brockmann, Gunnar Jeremias, Hartwig Spitzer

15:50

Break

16:20 von Weizsäcker Room

Confidence in Nuclear Verification
Chair: Irmgard Niemeyer
Speakers: Sara Al-Sayed, Alexander Bollfrass, Max Schalz, Carmen Wunderlich

17:00

Break

17:10-18:10 von Weizsäcker Room

Designing Verification Protocols for Nuclear Disarmament
Chair: Malte Göttsche
Speakers: Christopher Fichtlscherer, Simon Hebel, Irmgard Niemeyer, Pavel Podvig

15:10 Russell-Einstein Room

Autonomous Systems – Responsibility, Ethics and Norms
Chair: Thea Riebe
Speakers: Ingvild Bode, Niël Conradie, Niklas Schörnig

16:20 Russell-Einstein Room

Challenges for Arms Control Regimes: Complexities, Commonalities and Ways Forward
Chair: Sibylle Bauer
Speakers: Andrea Betzenbichler, Alexander Kelle, Arne Sönnichsen

17:10-18:10 Russell-Einstein Room

Applying Stability Criteria for Military Incidents and Other Dangerous Situations in Nuclear and Other Domains
Chair: Götz Neuneck
Speakers: Marina Favaro, Fabian Hoffmann, Jürgen Scheffran, Wilfred Wan

EVENING PROGRAM

19:00 Get together at Meeting Lounge

19:30 Evening Talk

Frank von Hippel
Princeton University
Bringing Scientific Analysis to Policy: Invited and Not

20:00 Get together at Meeting Lounge

AGENDA
Thursday, September 9

Time: UTC +2

11:00 von Weizsäcker Room

Information Manipulation
Chair: Mischa Hansel
Speakers: Katrin Hartwig, Monica Kaminska,
Christian Reuter

11:40

Break

11:50 von Weizsäcker Room

Robin Geiß
United Nations Institute for Disarmament Research
New Technologies and Disarmament:
Trends, Challenges and Opportunities

12:10

Break

12:20 von Weizsäcker Room

**Technology Assessment for International
Security**
Chair: Thea Riebe
Speakers: Jürgen Altmann, Friederike Frieß,
Johannes L. Frieß, Thomas Reinhold

13:20

Break

14:10 von Weizsäcker Room

Catrin Misselhorn
University of Göttingen
Three Ethical Arguments against Autonomous
Weapon Systems

11:00 Russell-Einstein Room

Peace Education
Chair: Jantje Silomon
Speakers: Hans-Georg Weinig, Martin Ziegler

12:20 Russell-Einstein Room

**Bridging the Gap between Science and Politics
in Arms Control: Lessons from the Field**
Chair: Anja Dahlmann
Speakers: Elena Gai, Moritz Kütt,
Irmgard Niemeyer, Cormac O'Reill

14:30 Posters

Poster Session
Presenters: Lisa Beumer, Johannes L. Frieß, Jan Götte, Laura Guntrum, Benjamin Jung,
Moritz Kütt, Daniel Lambach, Francesco Mancuso, Tatyana Novossiolova, Carlos M. Nupia,
Jan Opper, Shannon Kimberly Potts, Thea Riebe, Jonas Sandbrink, Stefka Schmid,
Lijun Shang, Sebastian Schwartz, Monica Zoppè

15:50

Break

16:20 von Weizsäcker Room

Kavita Berger
U.S. National Academies
Dual Use and Responsible Research and
Innovation in the Life Sciences

16:40

Break

16:50-17:30 von Weizsäcker Room

**Innovative Technologies for Nuclear
Verification Applications**
Chair: Moritz Kütt
Speakers: Lyndon Burford, Martin Kalinowski,
Paige Kunkle

16:50-17:30 Russell-Einstein Room

**Quantum Technologies: Its Dual-Use Potential
and Options for Mitigation and Other Measures**
Chair: Götz Neuneck
Speakers: Anuradha Damale, Michal Krelina,
Lindsay Rand

EVENING PROGRAM

19:00 Get together at Meeting Lounge

19:30 Evening Talk

Moriba Jah
University of Texas at Austin
Space Policy Parallels: The Law of Salvage and Non-Consensual Debris Removal

20:00 Get together at Meeting Lounge

AGENDA
Friday, September 10

science
peace
security '21
Aachen, Germany

Time: UTC +2

11:00 von Weizsäcker Room

Cyber-Security and Cyber-Peace
Chair: Christian Reuter
Speakers: Mischa Hansel, Linda Monsees,
Johannes Rundfeldt, Moritz Weiss

11:00 Russell-Einstein Room

**Deconstructing Autonomous Weapon Systems:
Drivers, Narratives, Perceptions**
Chair: Sibylle Bauer
Speakers: Anna-Katharina Ferl, Bao-Chau Pham,
Anna Nadibaidze, Guangyu Qiao-Franco, Marianna
Yevtodyeva

14:10 von Weizsäcker Room

**Panel Discussion: New Technologies:
Destabilizing or Enabling Resilience?**
Chair: Malte Göttsche, RWTH Aachen University
Panelists:
Sibylle Bauer, SIPRI
Anja Dahlmann, SWP
Götz Neuneck, IFSH
Irmgard Niemeyer, Forschungszentrum Jülich GmbH

12:00

Break

15:10

Break

12:10 von Weizsäcker Room

**Panel Discussion: The Future of Peace
Research in Natural and Technical Sciences
(in German)**
Chair: Ulrich Schneckener, DSF
Panelists: Malte Göttsche, RWTH Aachen University;
Sebastian Groth, Federal Foreign Office;
Ursula Schröder, IFSH

12:10 Russell-Einstein Room

**Dual-Use Technology and Responsible
Innovation**
Chair: Filippa Lentzos
Speakers: Marius Bales, Michael Brzoska,
Wolfgang Liebert, Luke Richards

15:40 von Weizsäcker Room

**Panel Discussion: Bringing Science and
Politics Closer Together**
Chair: Filippa Lentzos, King's College London
Panelists:
Rüdiger Bohn, Federal Foreign Office
Paolo Cotta-Ramusino, Pugwash Conferences
on Science and World Affairs
Lucas Kello, University of Oxford
Patricia Lewis, Chatham House

13:10

Break

13:30 von Weizsäcker Room

Lunch Talk: Erik Melander
Uppsala University
Title: t.b.d.

17:00 -17:30 von Weizsäcker Room

Conclusion

13:50

Break

Book of Abstracts

Wednesday, September 08

12:30 – 13:00	**Introduction and Greetings**
von Weizsäcker Room	**Prof. Malte Göttsche** *Head, Nuclear Verification and Disarmament Group, RWTH Aachen University* **Univ.-Prof. Dr. rer. nat. Dr. hc mult. Ulrich Rüdiger** *Rector, RWTH Aachen University* **Prof. Ulrich Schneckener** *Chairman, German Foundation for Peace Research*

13:00 – 13:20	**Welcome Address: Marjolijn van Deelen**
von Weizsäcker Room	Ambassador Marjolijn van Deelen *Special Envoy for Non-Proliferation and Disarmament, European External Action Service*

13:20 – 13:40	**Plenary Talk: Rosamund Lewis - Infectious Diseases, Peace and Security – so What Happens Next?**
von Weizsäcker Room	Dr. Rosamund Lewis *World Health Emergencies Programmes, World Health Organization*

14:40 – 15:00	**Plenary Talk: Peter Braunstein – Confidence Building in the 21st Century**
von Weizsäcker Room	Brigadier General Peter Braunstein *Director, Bundeswehr Verification Center (BwVC)*

15:10 – 15:50	**Parallel Sessions**
von Weizsäcker Room	**Sustaining Peace Through Transparency and Confidence-Building** Chair: Filippa Lentzos **Building transparency and confidence in the face of new missile technologies and a new space industry: Rethinking the role of the HCoC and the MTCR** Kolja Brockmann *Stockholm International Peace Research Institute*

Following the demise of the Intermediate-Range Nuclear Forces Treaty, the Hague Code of Conduct against Ballistic Missile Proliferation (HCoC) and the Missile Technology Control Regime (MTCR) remain as key international instruments on missile non-proliferation. Both instruments establish important transparency and confidence building measures (TCBMs) and harmonize aspects of non-proliferation policy. However, in their current form they both have significant limitations and face serious challenges pertaining to membership, coverage and compliance. Advances in missile technology, such as hypersonic boost-glide systems, and the advent of a new space industry challenge the effectiveness of TCBMs and

non-proliferation measures. Missile and space launch technology are two sides of the same coin, posing a dual-use dilemma, which makes TCBMs ever more important. Existing TCBMs in the area of missiles need to be improved, but policymakers and researchers should also think beyond traditional TCBMs. It is thus important to explore how the sharing of best practices and control lists, transparency in risk assessments, and open source intelligence (OSINT) can provide public goods that help to reduce the risks of misinterpretation and miscalculation and strengthen non-proliferation in the area of missile -within and without the HCoC and the MTCR.

The plural of confidence. Exploring the variable products of CBMs. The example of the Bioweapons Convention

Gunnar Jeremias
Centre for Science and Peace Research, University of Hamburg

Confidence Building Measures are implemented in a broad range of international treaty regimes and in informal settings of international relations. Although the commonly used term CBMs suggests comparability, they differ vastly by design and by the models of confidence that are supported. IR theory has not yet put great efforts in the developed of classification schemes for CBMs, though. At the example of the CBMs in the Bioweapons Convention it will be shown that even within a single arms control regime, different sorts of confidence can be addressed by the same mechanism, namely confidence in compliance and the more abstract confidence in adherence to the regime. Not all Member States have the same probability and capacities of acting against the provisions of a treaty. Still, the participation of all states in both the treaty and the CBMs has a role in building confidence. For the assessment of the effectivity of CBMs it is hence a valuable approach to go beyond absolute numbers.

Open Skies: New Roles, New Challenges, New Capabilities

Peter Jones*, Hartwig Spitzer**
*Graduate School of Public and International Affairs, University of Ottawa
**Centre for Science and Peace Research, University of Hamburg

It is approaching 30 years since the Open Skies Treaty was signed, in 1992, and 70 years since the idea was first proposed, in 1955. In that time, the idea and the actual Treaty have changed remarkably little. Confidence building through cooperative aerial observation is still the core of the treaty. This paper will examine ways, both political and technical, in which the Treaty can be modernized and enhanced to make it able to contribute more significantly to meeting today's challenges. Immediate challenges are a reentry of the US to the treaty and a continuation of the membership of the Russian Federation. The upcoming certification of digital imaging sensors onboard the Open Skies aircraft of Germany and Romania are important steps in modernizing Open Skies assets. Politically, a need exists to consider ways in which the Treaty can expand its membership, cover areas which are contested and be used for new applications such as verification and environmental protection. Technically, the treaty has provisions for adding additional sensor categories to the agreed imaging detectors. The paper will make a case for adding air sampling devices in support of nuclear test ban verification and monitoring of NPT adherence, and also for environmental applications.

Autonomous Systems – Responsibility, Ethics and Norms
Chair: Thea Riebe

How existing weapons systems with autonomous features shape what counts as meaningful human control

Ingvild Bode
Centre for War Studies, University of Southern Denmark

The debate on autonomous weapons systems (AWS) has focused on the future rather than on the past or the present. This focus is understandable but problematic because autonomous features have already been integrated into the critical functions of widely used weapon systems. I argue that such existing weapon systems are a good starting point in the debate on AWS because they allow us to address two hands-on questions without having to speculate. First, what is the current direction of travel? Second, what causes concern in terms of how human control is understood? I use these questions to examine weapon systems with autonomous features, such as air defence systems and loitering munitions. I argue that practices of developing, testing, and using these systems incrementally shape an emerging norm of meaningful human control. This emerging norm casts a diminished decision-making capacity of human operators in specific use of force situations as 'appropriate' Paying attention to this process is vital because, first, it risks undercutting potential international efforts to regulate autonomy in weapon systems through codifying meaningful human control. Second, it turns human operators into 'moral crumple zones' (Elish 2018). They come to bear the responsibility for structural failures in how AWS are designed and operated - and how they malfunction.

Autonomous Weapon Systems and Attributing Responsibility: Control, Collective Responsibility, and Distributed Burdens

Niël Conradie
Applied Ethics Group, RWTH Aachen University

The introduction of Autonomous Weapon Systems (AWS) onto contemporary battlefields raises concerns that they will bring with them the possibility of a responsibility gap, leaving insecurity about how to attribute responsibility in scenarios involving these systems. A prominent attempt to avoid this outcome has been to insist that any such systems deployed must fall under Meaningful Human Control, which will ensure that responsibility can be adequately distributed in the case of harm. However, there are shortcomings in the current conception of Meaningful Human Control as developed in the discourse. Thus, my first aim is to provide a more adequate account of Meaningful Human Control that I entitle Sufficient Moral Control. Thereafter I will demonstrate that the richly relational context in which these systems will most likely be developed and deployed will require, if responsibility gaps are to be avoided, that Sufficient Moral Control must allow for moving beyond exclusively individual-centred understandings of the autonomy, control, and responsibility at work in these cases. By opening this path, it allows collectives to have Sufficient Moral Control over an AWS that forms a part of said collective, making the collective a legitimate target for collective responsibility.

LAWS and Dignity - the easiest way to a ban?

Bernhard Koch, Niklas Schörnig*
*Peace Research Institute Frankfurt

LAWS and Dignity. In many instances critics of new military technologies have seen their very own arguments turned against them. One case in point here is the criticism that armed drones (aka UCAVs) do violate international humanitarian law (IHL). Advocates of UCAVs in contrast have pointed out that precision drone strikes will lead to reduced civilian casualties and a better compliance with IHL vis-a-vis other forms of aerial warfare, rendering the IHL-based criticism toothless. The same holds true for an ethical argument often brought forward in the context of LAWS, i.e. the claim that being killed by an

autonomous weapon system violates the very basic principle of human dignity. Acknowledging that an IHL-based argument against LAWS might fall short, some campaigners and critics now argue to "Put Human Dignity First" (Rosert and Sauer 2019). In our presentation, we argue that the dignity argument is not as clear-cut as proponents think and that framing the problem of (military) robotics and dignity in a certain way will have ramifications to other civilian technologies. In short: focussing on dignity might again be a problematic way to address the problem of LAWS.

16:20 – 17:00	**Parallel Sessions**

von Weizsäcker Room

Confidence in Nuclear Verification
Chair: Irmgard Niemeyer

Societal Verification of Nuclear Weapons Treaties
Sara Al-Sayed
Program on Science and Global Security, Princeton University

In my presentation I would like to argue that 'societal verification' in the context of nuclear weapons treaties is an evolving paradigm that promises to bring science and politics closer if certain challenges are addressed. Geopolitical developments since the end of the Cold War have revealed the limitations of the IAEA safeguards verification paradigm in detecting an NPT member state's suspicious nuclear activity. The preemptive measures adopted by the IAEA in response address the limitations only partially. Societal verification would be an attractive complement to the current paradigm. It envisions non-state actors, such as non-governmental organizations, playing a role in verifying the treaty compliance of member states and forwarding their analysis on suspicious nuclear activity to the IAEA. There are challenges though such as costly false alarms and state sensitivities on security matters. I will present the results of an exploration of configurations of incentives and capacities of non-state actors that would bring genuine added value to non-proliferation and prohibition pursuits. I will also show that emerging technologies play a key role.

Verify, but Trust?
Alexander Bollfrass
Center for Security Studies, ETH Zurich

Trust and verification are linked not only in the slogan popularized by Ronald Reagan but in theoretical and practitioner beliefs about confidence-building measures (CBMs). Applying sociological and psychological conceptualizations, this talk problematizes the relationship between trust among the relevant actors and verification procedures. It demonstrates that both trust and its absence exist in general and specific forms (mistrust and distrust, respectively), each of which has a fundamentally different relationship with verification. Drawing on original archival documentation, from post-War Germany to Qaddafi's Libya, the presentation illustrates the successes and failures of nonproliferation pacts struck throughout the nuclear age through the lens of these distinctions. Based on this historical and conceptual analysis, the presentation elaborates guiding principles for designing future efforts to advance diplomatic and cooperative reductions of nuclear arsenals. While verification can overcome distrust through CBMs, mistrust is about unverifiable intent. In its presence, CBMs may even be counterproductive.

Building Confidence in Nuclear Disarmament under Uncertainty

Malte Göttsche, Max Schalz*, Carmen Wunderlich**
*Nuclear Verification and Disarmament Group, RWTH Aachen University
**Chair of International Relations and Development Policy, University of Duisburg-Essen

In South Africa, it took the IAEA nearly two decades to confirm nuclear disarmament. Given the limited size of the nuclear program, how can there ever be confidence in the complete disarmament of states with much larger arsenals? Indeed, it seems impossible to accurately verify the completeness of fissile material and warhead declarations, given the complex histories and limited inspection resources. Building on past work, we propose a comprehensive approach to study how confidence can be built under conditions of uncertainty. First, we try to reconcile the fact of limited verification resources with the need for confidence building using simulation tools. How much confidence could be gained in a declaration as a whole if only parts of it were subjected to in-depth verification? Should one select these parts randomly or focus on key aspects? Second, due to the technical limitations it seems crucial to gain a comprehensive understanding of the social and political forces that affect the confidence-building process, e.g. mutual threat perceptions, identities, perception of (in-)justice, or emotions. Can a long-term record of transparency and good-faith cooperation help build confidence in disarmament when uncertainty remains?

Russell-Einstein Room

Challenges for Arms Control Regimes: Complexities, Commonalities and Ways Forward
Chair: Sibylle Bauer

Arms control of Dual-Use technologies and the of civil society advocacy

Andrea Betzenbichler
Chair of Global Governance and Public Policy, Ludwig Maximilian University of Munich

Motivated by the new challenges artificial intelligence poses to international arms control, this paper undertakes a systematic, comparative analysis of arms control efforts concerning dual-use technologies, such as biotechnology, nuclear technology, or space technology. There is a broad consensus in the literature on arms control that political advocacy by experts and other activists plays an important role in enabling international arms control cooperation. However, such endeavors have not been successful in all cases. By comparing arms control efforts in different areas of technology, I will identify the conditions under which international advocacy in this field has led to the formation of arms control regimes. Therefore, the project will conduct a Qualitative Comparative Analysis (QCA) of selected cases to identify the conditions of success or failure. This will be complemented with a process analysis of the causal mechanisms linking conditions and outcome. The result of the analysis will be a theoretical model that can enhance our understanding of new cases of technological innovation, such as the military application of artificial intelligence. The project contributes to two lines of research: 1) literature on international arms control that so far has neglected the issue of dual-use technologies, and 2) research on the conditions of success of advocacy networks in influencing international cooperation.

Amending the CWC Annex on Chemicals: A Case of Belated Regulation of Emerging Science and Technology

Alexander Kelle*, Jonathan E. Forman
*Institute for Peace Research and Security Policy at the University of Hamburg

Western analysts had voiced suspicions since the 1980s that the former Soviet Union had developed new types of nerve agents, so-called Novichoks. Yet, these agents were not included in the CWC's Annex on Chemicals (i.e., the 'schedules'), until CWC States Parties pressed the issue of amending the schedules in the wake of the poisoning of the former Soviet spy Skripal and his daughter in the UK in March 2018. This

paper will analyse this case of belated regulation of previously developed yet unscheduled chemical agents in the CW prohibition regime, by both reviewing the scientific underpinnings of the proposals submitted by States Parties to the Organization for the Prohibition of Chemical Weapons (OPCW) and tracing the political process that led to their adoption. The case study thus sheds light on an example of science-based political agreement within an increasingly politicized and polarized multilateral prohibition regime, demonstrating the benefits of flexibility and adaptability of regulatory instruments, as well as the importance of political will of decision makers to adopt policies and make use of existing mechanisms in support of the regime.

The militarization of space – unique challenges
Arne Sönnichsen*, Sara Hadley
*Chair of International Relations and Development Policy, University of Duisburg-Essen

Various issues contribute to the increasing complexity of defining a weapon in outer space, who is responsible for its use, and what the motivations for these actions are. First, most objects in space are dual-use simply by virtue of being in orbit and can potentially be misappropriated as weapons. Second, with varying profiles of weaponization and the sophisticated technical capabilities for detection, the attribution of an attack to a perpetrator is further complicated. Third, space assets hold a unique strategic value due to their ubiquitous military and civil applications, and space has a distinct symbolic value, both to power projection and national prestige. Against this backdrop, the article addresses four areas of interest: 1. What constitutes a weapon in space and what are the unique challenges for arms control in space? 2. How are armed attacks defined in international law and how do countries interpret the use of weapons in space empirically? 3. What are key issues and solutions in terms of governance? 4. What solutions could be transferred from other areas of academic or empirical expertise on arms regimes as a way forward?

17:10 – 18:10	**Parallel Sessions**

von Weizsäcker Room

Designing Verification Protocols for Nuclear Disarmament
Chair: Malte Göttsche

Trust or Verify? Warhead Authentication and Cheating Possibilities
Moritz Kütt, Christopher Fichtlscherer*
*Institute for Peace Research and Security Policy at the University of Hamburg

Despite recent setbacks in nuclear arms control, disarmament, and non-proliferation, it is commonly accepted among states that technical verification approaches will play a crucial role in future nuclear disarmament efforts. Related research and development endeavors often focus on the protection of nuclear weapon states' secrets. Cheating possibilities for nuclear weapon states are rarely addressed or discussed. Here, the overarching question is: How can we assess the likelihood of cheating in a process where the potential cheater has an information advantage? The discussion will be based on a practical example: The possible use of hoax objects in warhead authentication approaches. Using only publicly available information, we assess potential vulnerabilities of gamma spectroscopy-based approaches. The results should help to reduce existing obstacles and create new opportunities for future disarmament processes.

Playing to get serious: Using exercises and role-play to develop a realistic nuclear dismantlement regime

Jan Geisel-Brinck, Simon Hebel*, Philip Kegler, Gerald Kirchner, Manuel Kreutle, Stefan Neumeier, Irmgard Niemeyer
*Centre for Science and Peace Research, University of Hamburg

Future nuclear disarmament treaties will depend on the availability of a sound and robust verification regime. Developing the methodology for inspecting the successful dismantlement of declared nuclear warheads is an endeavour of staggering technological and political complexity that has been successfully addressed by conducting role-playing exercises. The multilateral nuclear disarmament exercise NuDiVe was organised by Germany and France to support the work of the International Panel for Nuclear Disarmament Verification (IPNDV) by offering and demonstrating a powerful but feasible regime for inspecting nuclear dismantlement within a multilateral treaty. By creating and role-playing a fictitious treaty and scenario, it was possible to involve various participants from scientific and policy-making backgrounds and provide a space conducive to impartial thinking and creative approaches. This talk will offer an organiser's perspective and introduce some of the follow-up projects.

Developing and strengthening verification regimes through gameplay exercises

Simon Hebel, Philip Kegler, Gerald Kirchner, Manuel Kreutle, Stefan Neumeier, Irmgard Niemeyer*
*Nuclear Safety and Safeguards Division, Forschungszentrum Jülich GmbH

Gameplay exercises provide opportunities to test and train concepts and approaches developed for verification regimes: They can demonstrate whether defined user requirements are heading in the right direction and to what extend verification concepts can be translated into a regime that is practical and usable. During exercises, verification techniques and technologies can be tested under quasi-realistic conditions. Exercises also allow stakeholders to engage in a secure environment in order to address needs as to collaboration, team building and other "soft skills". Lessons learned during exercise may also have a wider application for the overall verification system. In the context of nuclear disarmament verification, some experiences exist from exercises run by the UK Norway Initiative, the Quad Nuclear Verification Partnership, and the Franko-German Nuclear Disarmament Verification (NuDiVe) initiative under the International Partnership for Nuclear Disarmament Verification (IPNDV). In continuation of the NuDiVe exercise held in September 2019 at Forschungszentrum Jülich, a relaunch of this exercise is planned for November 2021. The talk will discuss the general role of exercises in developing and strengthening verification regimes and present the goals of NuDiVe 2021.

Elimination of nuclear weapons without access to sensitive information

Pavel Podvig
United Nations Institute for Disarmament Research

Elimination of nuclear weapons without access to sensitive information Nuclear disarmament is a complex undertaking that must include the elimination of nuclear weapons. It must also ensure that fissile materials released in the process are not available for military purposes. Disarmament would not be complete unless it is done verifiably, so the disarming state and its counterparts can be certain that the nuclear arsenal has been irreversibly eliminated. Verification will be an essential element of the disarmament process, whether it is done as part of a bilateral treaty or unilaterally. One of the challenges of designing nuclear disarmament verification arrangements is the sensitivity (perceived or real) of information about nuclear weapons and fissile materials that they contain. For example, states may not wish to disclose information about the number of warheads or fissile materials they contain. This could seriously complicate verification arrangements and might be used as a pretext for stalling the disarmament. This talk will describe an approach to nuclear disarmament verification that does not require access to any sensitive information about nuclear weapons.

Applying Stability Criteria for Military Incidents and Other Dangerous Situations in Nuclear and Other Domains
Chair: Götz Neuneck

Flustered and Clustered: Understanding Emerging Technologies According to their Nuclear Risk Profile
Marina Favaro
Institute for Peace Research and Security Policy at the University of Hamburg

It is a foregone conclusion that emerging technologies are changing the nuclear landscape. The more interesting questions "which ones?" and "how?". This study endeavours to close these research gaps. Two research questions guide this study: (1) Which emerging technologies are most likely to impact crisis stability in the next 10 years? And (2) How can we cluster these technologies in order to better understand which technologies pose similar challenges to crisis stability? By using empirical research, I considered the ability of emerging technologies to disrupt, degrade and/or augment the United Kingdom's nuclear capabilities in the next 10 years. Ultimately, ten technologies were clustered into four technology clusters. This project aims to create a 'dialogue across the divide'. Firstly, this participatory study boasts equal representation from policy folk and technical folk amongst the technology scorers. Secondly, this study uses innovative methods (i.e., STREAM) and data analysis techniques (i.e., Machine Learning k-means clustering) which are rarely found in qualitative social sciences research. Together, STREAM and k-means clustering quantify and make more robust the difficult task of prioritising and clustering emerging technologies. Neither of these approaches have been previously used to assess how emerging technologies will impact crisis stability, or how we can cluster technologies according to the types of challenges that they create.

Towards Cross-Domain Stability
Fabian Hoffmann
Defense and Military Analysis Programme, International Institute for Strategic Studies

The increasing cross or multi-domain nature of inter-state conflict seems to be a striking feature of the contemporary international system. Although an impressive body of literature emerged in recent years, inquiring into various facets of cross-domain strategy, major gaps in the literature remain. In particular, broader conceptual engagement with cross-domain strategy remains the exception rather than the norm. This is lack of theoretical interest is unfortunate, seeing that while it is important to advance our empirical understanding of cross-domain strategy, our conceptual understanding, ordering and informing the research agenda, should not lack behind.

This presentation argues that working toward strategic stability in today's complex cross-domain environment, i.e. 'cross-domain stability,' presupposes a proper conceptual understanding of cross-domain strategy. In this regard, the presentation proposes a new conceptual framework, which conceptualizes today's cross-domain environment as a complex three-dimensional space in which different types of domains interact across three distinct cross-domain dimensions: an operational military dimension, a grand strategic dimension, and a functional dimension. Within each of these cross-domain dimensions, distinct types of domains interact with each other, producing different types of cross-domain outcomes.

The conceptual framework's usefulness is illustrated by an illustrative case study of NATO-Russia relations, which outlines how the development and deployment of cross-domain capabilities and strategies allow both actors to compete across different domains and cross-domain dimensions. In addition, the presentation provides recommendation on how to best maintain cross-domain stability, and concludes with outlining key implications of the research with regard to policy and theory.

Dual-use, risk and preventive arms control of missiles, missile defense and space: From negative to positive nexus

Jürgen Scheffran

Research Group Climate Change and Security, University of Hamburg

The triangular nexus between missiles, missile defense and space is driving an arms race which is expensive, risky, complex and destabilizing. Linkages includes dual-use of civil and military satellites, of space launchers and ballistic missiles that are vulnerable to attacks by ballistic missile defense and anti-satellite weapons which can threaten each other. Weaponization of space undermines security on earth and in space. Space operations and weapons testing could trigger a cascading chain of space debris limiting space use. These interactions could destabilize the strategic situation, exacerbated by technical developments, power projections and private interests. To avoid tipping points and risk cascades requires incremental-comprehensive approaches of preventive arms control for reducing risk and complexity. To move from a negative nexus of mutually enforcing threats to a positive nexus of strengthening synergies between missile control and disarmament, restraints on missile defense and improving international space law towards space security and space weapons ban. This could be connected to nuclear, cyber and conventional arms control, e.g. the Ban Treaty as an adaptive framework for missile control. An international system of confidence-building, monitoring and verification could integrate multiple control regimes.

Redefining Military Incidents

Wilfred Wan

United Nations Institute for Disarmament Research

There exists a Cold War-era toolkit to guard against the possibility of escalation and crises linked to military behaviors and incidents that could be perceived as provocative. This includes the bilateral INCSEA Accords and Prevention of Dangerous Military Activities Agreements, as well as relevant provisions in the OSCE's Vienna Document. Yet these TCBMs are limited geographically, centered in the Euro-Atlantic, with non-binding counterparts more common in East Asia. They also appear increasingly dated, a product of changes in military operations and capabilities in a multipolar world. Where is there scope to enhance the escalation prevention and management toolkit? The changed operational environment calls for a re-examination - to expand the list of provocative actions to be avoided or specify new rights and provisions to be granted. This is necessary given new capabilities (underwater drones, anti-submarine weapons) and operational practices ('snap' exercises, live-fire tests) in the air and maritime domains. Doing so may in fact help to address nuclear risk linked to misperception, miscalculation, and misunderstanding.

19:30 – 20:00	**Evening Address: Bringing Scientific Analysis to Policy: Invited and Not**

Evening Talk
Room

Prof. Frank von Hippel
Co-Founder, Program on Science & Global Security, Princeton University

Scientists are invited to provide input to a governmental policy-making processes. Sometimes they are appointed to advisory committees. In the US, the National Academies of Science, Engineering and Medicine are often requested to organize a study whose findings they publish. Sometimes scientists associated with non-governmental organizations or universities publish analyses on their own initiative and hope some attention will be paid.

I have seen this process evolve over 50 years in the United States. Indeed, I studied it before joining in. In 1974, Joel Primack and I published a book, Advice and Dissent: Scientists in the Political Arena, that includes case studies ranging from physicists' criticisms as insiders and outsiders of proposed defenses against nuclear-armed ballistic missiles to the original formation of the US NGO, the Union of Concerned Scientists, around the issue of nuclear power plant safety. We also published an article, "Public Interest Science," in which we reported the surprisingly large impact that even junior scientists can have on public policy if their findings are found to be newsworthy.

My own engagements with public policy have been quite varied. Sometimes, they had at least temporary impact. I will discuss some of these experiences and what I have learned from them.

Thursday, September 09

Parallel Sessions

von Weizsäcker
Room

Information Manipulation
Chair: Mischa Hansel

European responses to Covid-related disinformation
Monica Kaminska
The Hague Program for Cyber Norms, Leiden University

Over the course of the Covid-19 pandemic, the boundary between foreign disinformation and domestic disinformation has become increasingly blurred. Some governments have developed new departments to deal with the "infodemic" while others, like Hungary, have engaged in their own information operations to crowd out anti-government rhetoric. This short talk will examine the nature of the information operations detected during the pandemic and compare and contrast the various responses of European governments.

Information Warfare and the Technical Support in Dealing with Fake News
Katrin Hartwig*, Christian Reuter*
*Chair of Science and Technology for Peace and Security, Technical University of Darmstadt

The importance of social media as a source of information has increased significantly in recent years. This goes hand in hand with an increased spread of Fake News and similar phenomena. A representative survey (N = 1,023) on the perception of fake news in Germany already showed in 2017 that 78% of respondents see fake news as a threat to democracy and about half of the participants (48%) said they had already encountered fake news themselves. Particularly in the context of the COVID-19 pandemic, it is clear that Fake News can indeed have serious consequences. Technical support measures in social media have great potential to counteract this. These measures include, on the one hand, automatic detection and, building on this, the implementation of technical countermeasures. Facebook, Twitter and Co. have repeatedly adapted their countermeasures in the course of the pandemic, where they vary, for example, between deletion, binary labeling, downsizing and warnings. From another representative study in 2019, it emerged that the German population attaches particular importance to reasons why content is flagged as fake news. Complementing this finding, semi-structured interviews and a representative online experiment were conducted to evaluate how approaches should be presented on social media to address users' needs and experiences and to test how effective they are. Again, the preference for transparent and explanatory warnings as a countermeasure was confirmed. In line with these research findings, the TrustyTweet browser plugin is being iteratively developed and evaluated, which in its current version combines the automatic detection of fake news using the BERT algorithm with the automatic display of understandable indicators.

Russell-Einstein Room	**Peace Education** Chair: Jantje Silomon

OPCW Advisory Board on Education and Outreach - Supporting the OPCW's engagement with external partners
Hans-Georg Weinig
Organisation for the Prohibition of Chemical Weapons

The Advisory Board on Education and Outreach (ABEO), established in 2015, provides specialized advice in areas of education and outreach relevant to the OPCW's mandate. The ABEO provides advice on the development of education and outreach strategies, key messages and partnerships that support the implementation of the Chemical Weapons Convention. The board also identifies global education and outreach activities relevant to the Convention and those related to disarmament and non-proliferation. The presentation summarizes the ABEO-work covering nearly two terms of office, 2016 - 2021, and highlights activities towards scientists, academia, industry, policy makers, civil society, media, and the next generation as the most important target audiences. https://www.opcw.org/about/subsidiary-bodies/advisory-board-education-and-outreach

(MM)ORPGs for Peace Education
Hyunwoo Lee, Martin Ziegler*
School of Computing, KAIST

Gamification is a popular tool in training contexts. We propose to harness the popularity of massively multimedia online roleplaying games (MMORPGs) for peace education: as natural extension of the vision and achievements of CTW from TV to the digital age. Throughout 15 years, World of Warcraft (WoW) has been a major player (pun!) among the MMORPGs. Its central challenges (=user goals) train fighting against NPCs as well as player-vs-player combat. Now imagine MMORPGs teaching peaceful interaction instead of an adversarial perspective, cooperation instead of competition: by putting the users into carefully scenarios that reward mutual collaboration and trust among each other and in (indistinguishable) NPCs, intrinsically -- not just within a team against some common opponent. We suggest that mathematical Game Theory provides valuable guidance for designing such scenarios. Recall that for example Prisoner's Dilemma encourages trusting collaboration, whereas Chicken is arguably responsible (via Thomas Schelling and John von Neumann) for the 1960/70ies Cold War.

11:50 – 12:10	**Plenary Talk: Robin Geiß - New Technologies and Disarmament: Trends, Challenges and Opportunities**
von Weizsäcker Room	Prof. Robin Geiß *Director, United Nations Institute for Disarmament Research*

Parallel Sessions

Technology Assessment for International Security
Chair: Thea Riebe

Small Armed Aircraft and Missiles - Dangers for International Security
Mathias Pilch, Jürgen Altmann*, Dieter Suter
Physics and Disarmament Research Group, TU Dortmund University

Armed uninhabited aerial vehicles (UAVs) are being deployed by an increasing number of states. These have wingspans of many metres and payloads of hundreds of kg. Technological advance, mainly in sensors and computers, allows much smaller UAVs, their research and development (R&D) has intensified in the last decade. In a project funded by the German Foundation for Peace Research (DSF) (https://url/tu-dortmund.de/pacsam) we have collected information on small (size <= 2 m) and very small (<= 0.2 m) UAVs. Our UAV database contains 129 types from 27 countries, 24 types are armed. Much less R&D has gone into small and very small missiles (diameter <= 0.07 m and 0.04 m, respectively) that e.g. could be used for small UAVs: our missile database has 6 entries at present. With strongly limited payloads, small UAVs and missiles would bring limited destructive effect, but militarily relevant damage could be produced at soft spots or on a larger scale by mass use in swarms. With further proliferation, development of swarming and integration into war fighting, military stability and international security would decrease. Qualitative and quantitative preventive limits need to be devised and proposed to the international community

Gene Drive Modelling – Suitable for environmental risk assessment?
Johannes L. Frieß*, Bernd Giese
Institute of Safety and Risk Sciences, University of Natural Resources and Life Sciences, Vienna

Synthetic gene drive (GD) systems represent a form of novel invasive environmental biotechnology whose power has the potential for conflict. These population control technologies harbour far-reaching dimensions beyond those of conventional genetically modified organisms (GMOs). Because of their propagative properties and a possibly unrestricted spread in time and space, releases of increasing scales common to conventional GMOs are not feasible with gene drive organisms (GDOs). A first release already represents an ecological and social real-world experiment. From a regulatory perspective, an environmental risk assessment must be conducted prior to release. Therefore, computer simulations and modelling are the only way to predict the behaviour of released GDOs in the field. However, models published to date are largely limited to testing the efficacy of various GD systems. The absolute majority tends to model laboratory conditions and only a small fraction addresses release issues. Even in these simulations, only a few ecological parameters are implemented and mostly in an abstracted form with questionable reliability. In the context of responsible research and innovation, this paper aims to highlight the difficulties and open questions that urgently need to be answered with regard to a GD release and corresponding environmental risk assessment.

Arms control for AI - Why its urgent and why we will possibly still go wrong
Thomas Reinhold
Chair of Science and Technology for Peace and Security, Technical University of Darmstadt

Artificial intelligence (AI) is an ongoing trend in military debates and technological developments suggest that within a few years, AI can build into existing weapon systems, thus increasing their effectiveness or providing advantages on the battlefield. The technology itself is often envisioned as a "big digital brain" that is or should be put into charge of integrating and processing the information flow of subordinate systems in order to control complex processes like e.g. autonomous swarm robots, unmanned arial wingman systems, tactical battlefield management or even as part of nuclear command automation. But

following this narrative has its pitfalls and might distract from other challenges. AI has been, is and probably further will be at its strongest, where it is used for very specific, small scale problems like pattern recognition, information classification or limited autonomous path finding. These tasks have been intensively researched and put into small and cheap off-the-shelf application ready microchips, which makes it much more probable that it will be built into widespread weapon systems like small arms, mines, automated cyber systems, smaller drones or even target tracking ammunition. The talk will asses this development, the specific answers it demands and aims to provide food for thought on the challenges it presents for arms control.

Russell-Einstein Room

Bridging the Gap between Science and Politics in Arms Control: Lessons from the Field
Chair: Anja Dahlmann

Building Capacity on Multilateral Verification of Nuclear Disarmament: Options for Broadening and Sustaining Involvement Globally
Elena Gai
Verification Research, Training and Information Centre, London

Since the foundation of the UN, NGOs have enjoyed a consultative status. In intergovernmental processes they introduce additional knowledge and information into the decision making process, provide expert advice in areas of pertinence, offer relevant contributions to consensus building processes in the domains of policy, law and science. VERTIC is undertaking a multi-year project in support of the development and strengthening of effective nuclear disarmament verification (NDV) measures for the achievement and maintenance of a world without nuclear weapons. The project focuses on multilateral approaches to NDV, including non-nuclear weapon states. As such, we are engaging Argentina, Brazil, Kazakhstan and South Africa to explore harnessing their capabilities for involvement in NDV activities in particular through the establishment of a national or regional hubs. The project also aims to support activities at the level of the UN in light of UN General Assembly Resolution 71/67 to consider the role of verification in advancing nuclear disarmament. The project builds on VERTIC's long-standing work investigating effective approaches to verification of nuclear disarmament. We present the objectives and preliminary results of this project and provide recommendations to bring science and politics closer together through a more assertive role to be played by NGOs in science diplomacy.

'Arms Control and Emerging Technologies': Interdisciplinary Research Made in Hamburg
Alexander Graef*, Moritz Kütt, Ulrich Kühn
Institute for Peace Research and Security Policy at the University of Hamburg

Since 2019, the Institute for Peace Research and Security Policy at the University of Hamburg is home to the project 'Arms Control and Emerging Technologies' Through this four-year capacity-building project, founded by the German Federal Foreign Office, IFSH has become Germany's largest research and knowledge transfer hub in the field of arms control. One of its unique selling points is its interdisciplinary approach, bringing together political scientists, physicists, computer scientists, historians, and regional studies experts. Its thematic foci range from conventional arms control to the regulation of weapons of mass destruction, the impact of novel technologies, and the relevant European peace and security institutions, addressing the question: How do changes to political orders and technologies interact with the arms control policies of bigger and smaller powers? Aside from basic research, project's scholars also engage with decision-makers in ministries and national parliaments and the general public. We will present the project and lessons-learned on how to improve and expand interdisciplinary collaboration in the field of arms control research.

Strengthening verification measures through international collaboration

Katharina Aymanns, Philip Kegler, Thomas Krieger, Stefan Neumeier, Irmgard Niemeyer*
Nuclear Safeguards and Security Division, Forschungszentrum Jülich GmbH

Verification requires in general continuous technical development, further improvement of verification concepts and measures, and implementation support. However, if verification entities have no dedicated budget and infrastructure for research, development and training, fulfilling verification tasks may become a major challenge. The Member State Support Programmes (MSSPs) in the context of IAEA safeguards provide a model example how countries support the IAEA in based on keeping pace with emerging challenges and opportunities in the field of nuclear verification. Germany established its Safeguards Support Programme in 1978 and has since then contributed significantly to the development of a number of tools, techniques, methodologies and expertise required for effective and efficient safeguards. The talk will highlight some recent developments under the German Support Programme and discuss their potential for verification measures of other (non-nuclear) regimes. In the outlook, some ideas on how to apply the model of support programmes in other verification regimes will be presented.

Science Diplomacy and Non-Proliferation and Disarmament Policy: the example of the Organisation for the Prohibition of Chemical Weapons

Cormac O'Reilly
Organisation for the Prohibition of Chemical Weapons

The concept of 'science diplomacy' has gained currency among academics and practitioners seeking ways to better apply a scientific lens to international policy discussions. Yet in the field of WMD non-proliferation and disarmament the use of scientific expertise to further policy goals has long been central. If one accepts a useful taxonomy of science diplomacy to encompass (a) science in diplomacy, or the use of science advice to inform and support foreign policy objectives (b) diplomacy for science, or the use of diplomacy to facilitate international scientific cooperation and (c) science for diplomacy, the use of scientific cooperation to improve international relations, the experience of the Organisation for the Prohibition of Chemical Weapons (OPCW) is instructive. From participation of scientists in the negotiation of the Chemical Weapons Convention (CWC), to compliance verification, providing advice to policymakers, and science communication, the OPCW continues to strengthen relationships on the science-policy nexus. This presentation will focus on relevant experiences and lessons learned, including from the Organisation's advisory boards dealing with science and policy.

14:10 – 14:30	**Plenary Talk: Three Ethical Arguments against Autonomous Weapon Systems**

von Weizsäcker Room

Prof. Catrin Misselhorn
Department of Philosophy, University of Göttingen

So-called "killer robots"- i.e. autonomous weapon systems that are able to select and attack military targets without human intervention - are a particularly controversial topic in ethics. Open letters calling for a ban on autonomous weapon systems have already appeared several times and a number of renowned AI researchers and other scientists support the campaign to stop killer robots.

Three fundamental ethical objections against killer robots are discussed in this talk: (1) the argument from the responsibility gap (Sparrow 2007), (2) the argument from moral agency (Leveringhaus2016), and (3) the argument from the lack of a moral obligation to kill (Misselhorn 2018). The first argument claims that killer robots undermine the ascription of responsibility and that this is morally not acceptable when it comes to acts of killing. The second argument is supposed to show that human moral agency is of intrinsic moral value and should not be replaced by artificial moral agency. The point of the third argument is that killer robots are morally wrong because they presuppose a moral obligation to kill and that there is no such obligation.

References:
Leveringhaus, Alex (2016): Ethics and Autonomous Weapons. Palgrave mcmillan: Oxford.
Misselhorn, Catrin (2018): Grundfragen der Maschinenethik, Reclam: Ditzingen (4th 2020).
Sparrow, Robert (2007): Killer Robots. In: Journal of Applied Philosophy 24 (1) S. 62-77.

14:30 – 15:50	**Poster Session (see below)**

16:20 – 16:40	**Plenary Talk: Dual Use and Responsible Research and Innovation in the Life Sciences**

von Weizsäcker Room

Dr. Kavita Berger
Director, Board on Life Sciences, U.S. National Academies of Sciences, Engineering, and Medicine

First coined in 2003, the term 'dual use dilemma' refers to legitimate life science research that could be misapplied for malicious purposes. Examples initially were considered to have dual use potential included conferring antimicrobial resistance, evading vaccine protection against pathogens, enhancing pathogen virulence and transmissibility, altering pathogen host range, and enabling pathogen stability. Since this time, much of the international discourse relating to dual use life sciences research has focused on the responsibility of scientists to identify, assess, and mitigate potential risks of malicious exploitation of pathogen research. These efforts have led to the development of biorisk management practices, which involves a common set of capabilities to promote safe and security pathogen research, and to the use of ethical frameworks to promote responsible science. Within the context of responsible science, the American Society of Microbiology and The Netherlands Academy of Sciences developed a code of conduct that scientists should follow to reduce dual use risks, and the American Association for the Advancement of Science and U.S. National Academies engaged scientists on research integrity and ethical norms. Applying these and other existing frameworks to address dual use risks while also enabling continued innovation will be needed as the life sciences advance.

Parallel Sessions

Innovative Technologies for Nuclear Verification Applications
Chair: Moritz Kütt

Designing a peaceful world without nuclear threats: How to trigger a global nuclear verification race using blockchain technology
Lyndon Burford
Centre for Science and Security Studies, King's College London

This paper proposes leveraging blockchain's economic and logistical capabilities to make peace a profitable business, triggering a self-sustaining global nuclear verification race that can help to verifiably reduce and eliminate nuclear weapons and threats. Game theory will align incentives of actors at all levels, out of economic and political self-interest, to help develop verification mechanisms, increasing multilateral capacity and political will for verified disarmament. Crypto-economics and sales of 'digital disarmament collectibles' will crowd-source and incentivise rollout of a public, permissionless blockchain, used to store verification data as cryptographic hashes, generated by a global lattice of socio-technical verification mechanisms, including a high-security Internet of Verification Things (IoVT). All states and persons can regain political agency and contribute to global security by funding verification R&D, hosting blockchain nodes, and deploying IoVT devices. This 'global nuclear verification' system iteratively builds trust through regular, verified enactment of disarmament commitments, favouring norms of global solidarity and accountability.

Addressing the challenges of CTBT radionuclide monitoring: Methods for discriminating nuclear explosion signals from normal radioactivity in the atmosphere
Martin Kalinowski
Scientific Methods Section, Comprehensive Nuclear-Test-Ban Treaty Organization

For the International Monitoring System (IMS) of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) to be effective, it is vital that nuclear explosion signals can be distinguished from natural and man-made radioactivity in the atmosphere. Policy makers expect from scientific experts to get the signals and parameters of the IMS data analysis be presented in a way that supports their decision making. This presentation explains the challenges for this decision making caused by the highly variable background of man-made radioactivity in the atmosphere. It explains how the International Data Centre (IDC) addresses these challenges while leaving the final judgement up to the States Signatories. The IDC applies standard event screening criteria, with the objective of characterizing, highlighting, and thereby screening out, events considered to be consistent with natural phenomena or non-nuclear, man-made phenomena. This presentation sketches out what methods that were already demonstrated can be enhanced and implemented, which novel methods appear promising to be developed and it creates a vision of highly effective screening for the longer future. As a conclusion, much has been achieved but future developments have the potential of making the detection of radionuclide signals of nuclear explosions much more effective.

Nuclear Security Potential in Far-Field Reactor Monitoring with Neutrino Detectors
Jake Hecla, Paige Kunkle*
*Department of Physics, Boston University

A major risk in the path to establishing peaceful nuclear energy programs is the potential for nuclear power facilities to be used for the production of nuclear weapons. As a result, international nonproliferation treaties are created to address this concern. A possible safeguards measure to prove treaty compliance is reactor monitoring by verifying antineutrino fluxes using large liquid-based neutrino

detectors, as the antineutrino signal cannot be spoofed and can be detected from the mid- to far-field. Such detectors offer a means of monitoring reactor power which does not require physical access to the reactor site and therefore addresses concerns expressed by some states related to intrusion, often associated with more conventional reactor monitoring approaches. As neutrino signals can be detected over great distances, these detectors could additionally exclude the presence of operating reactors in some defined region. Aside from the direct application to nonproliferation, neutrino detectors double as physics experiments, and offer host countries the benefits of participation in "Big Science" adding to their national prestige and developing their scientific workforces. Further development and adoption of these technologies could increase the robustness of current verification methods of reactor operations, strengthening existing safeguards agreements and decreasing the routes to fission explosives a country might pursue.

Russell-Einstein Room

Quantum Technologies: Its Dual-Use Potential and Options for Mitigation and Other Measures
Chair: Götz Neuneck

Emerging technologies in novel operating environments: Quantum-space convergence
Anuradha Damale*, Grant Christopher
*Verification Research, Training and Information Centre, London

Development of and innovation in space-based quantum communication technology must occur in parallel with the development of a suitable regulatory framework. Up to this point, development of space-based technology has occurred without a sufficient framework in place. This led to ineffective attempts to form norms and regulation retroactively, where key stakeholders were locked out of the process. When building a regulatory framework, differing priorities between communities and states must be considered in order to craft effective regulation and policy, for instance, when these differences can lead to arms races and crises. By using Quantum Key Distribution (QKD), delivered from small sats, as a case study, we outline what will be required by stakeholders to craft effective regulations well in advance of the systems being deployed at scale. We will also examine how the failure to regulate anti-satellite-weapons contributed to an arms race for these systems, in order to provide a guide-rope to avoid the pitfalls of the past.

Quantum technology as the new technology that needs assessment
Michal Krelina
Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University

Quantum technology (QT) is an emergent area with the potential to be disruptive and affect many human activities. QT also is a typical technology with significant dual use. Specifically, the potential QT military applications were recently mapped [1]. Although QTs do not introduce any new standalone weapon systems, they can significantly sharpen, especially the combination of various QTs, present weapon as well as command and control systems, including in the cyber domain. On the other hand, they also can provide information-theoretic secure communication or enhanced medical imaging. This contribution aims to introduce QTs and their possible applications, time scale, theoretical capabilities and current status. Then, the military-related application will be discussed more in detail, and potential problems for international security will be mentioned. In the end, the basic background of the main actors and investment landscape will be provided.

Dual-Use Governance of Quantum Sensing
Lindsay Rand
Center for International and Security Studies at Maryland, University of Maryland

Quantum sensing (QS) will have a significant impact on the security field. QS is an area of quantum information sciences (QIS) that applies quantum systems or phenomena to measure physical properties. Compared to classical counterparts, QS enables better sensitivity and operability in more adverse environments. Security applications for QS include position, navigation, and timing (PNT), detection of objects/cavities underground or in water, and radio frequency signal detection. However, QS also has many civilian applications, making it a dual-use technology. Treatment of QS by policymakers will not only impact the development of the QS itself but will also impact the broader QIS ecosystem. Beyond the listed applications, QS is a technical requirement for operating quantum computers. Thus, policies implemented to address dual-use concerns of QS may negatively impact the QIS ecosystem at large. My research surveys the strategic implications of QS and analyzes the sector-wide impacts for various governance mechanisms. Through this approach, I hope to identify policies able to balance the goals of mitigating security risks, enabling innovation, and minimizing impacts to economic gains.

19:30 – 20:00	**Evening Address: Space Policy Parallels: The Law of Salvage and Non-Consensual Debris Removal**

Evening Talk Room

Prof. Moriba Jah
Department of Aerospace Engineering and Engineering Mechanics, University of Texas at Austin

Addressing the hazardous congestion of low earth orbit has vexed scientists and policymakers alike. While the technical and financial barriers are high, so too are the legal impediments. One such impediment results from Article VIII of the Outer Space Treaty which stipulates that a state which has launched an object into space "shall retain jurisdiction and control over such object...while in outer space or on a celestial body." Consequently, orbital debris generated by a state cannot be removed by another state or company without the express approval of the launch state. Each anthropogenic space object (ASO) has a so-called space traffic footprint which can be loosely interpreted as the burden that each ASO poses on the safety and sustainability of orbital space. This can be further quantified in an orbital "carrying" capacity. It is unreasonable to have a nation state hindered from the peaceful use of outer space because the needed orbital carrying capacity is being used by debris under the liability of another nation state, refusing to grant explicit consent for its removal. This paper will explore the benefit of translating a norm from another relevant legal domain: the maritime law of salvage. This principle provides that states or companies who voluntarily remove hazardous wrecked ships are due compensation for their actions given that they have contributed to the common good by protecting the marine environment. A space law of salvage could provide adequate incentive for a commercial entity to engage in non-consensual debris removal, perhaps serving a sustainable means of mitigating orbital debris. Where care must be taken is that the opportunity and capability to remove non-cooperative space objects could be viewed as a threat in that it aligns with so-called dual-use technologies, and the intent of their use is the demarcation between a threat and an otherwise peaceful use. We propose that the protocols developed under this non-consensual space debris removal process be used as a Transparency and Confidence Building Measure (TCBM) related to space security and allay notions of on-orbit threats by making the intent of use more explicitly and predictively known.

Friday, September 10

11:00 – 12:00   **Parallel Sessions**

von Weizsäcker
Room

Cyber-Security and Cyber-Peace
Chair: Christian Reuter

Crowdsourcing Arms Control: Bug Bounty Programs as a Global Public Good
Jantje Silomon, Mischa Hansel*, Fabiola Schwarz
Institute for Peace Research and Security Policy at the University of Hamburg

The ever-increasing number of devices connected to the Internet, such as mobiles, laptops, computers or 'smart everythings', also lead to a constantly growing attack surface rife of vulnerabilities that can be exploited. This susceptibility can result in a variety of cyber-attacks, ranging from mere nuisance to serious state-actor endeavours.

In a bid to mitigate these vulnerabilities, a growing number of vendors are turning towards crowd-sourcing to improve their product's security, for example in the form of Bug Bounty Programs (BBPs) hosted on platforms or by creating their own alongside more traditional approaches, such as in-house testing and professional security reviews. These platforms, such as Bugcrowd or HackerOne, reward individuals for discovering, reporting, and responsibly disclosing software bugs.

Whether providing an alternative or merely supplementary path to organisational cybersecurity, these newer approaches go beyond increasing product security. For example, financial rewards incentivise the ethical side of cyber security research, while co-operation can be fostered between various actors. In the past, research has focussed on various aspects of BBPs, such as reward structures, actor motivations, or effectiveness. However, the wider impact on peace and stability in cyber space has rarely been examined. Nor has the potential for this approach to be used as a form of crowdsourced preventative arms control – after all, the vast majority of cyber attacks rest upon exploiting vulnerabilities.

Looking at BBPs more specifically, should they be treated as a Public Good and if so, what would the benefits and drawbacks be for cyber security and arms control more broadly? How will the recent regulatory developments regarding vulnerability disclosures impact BBPs? Do geopolitical divisions and political interference affect BBPs? This paper will answer these questions by first introducing BBPs in the context of arms control, and asses their potential as a Public Good. Various regularly developments will be examined with a strong focus on practical aspects as well as their impact on cyber security more broadly. Two case studies will be used to elucidate these varied approaches and place them in the context of global cyber security.

Understanding Cybersecurity – A dialogue across discipline
Linda Monsees
Center for Governance of Emerging Technologies, Institute of International Relations Prague

This talk focuses on the dialogue between political scientist, policymakers and computer and data scientists in the context of cybersecurity. Engaging across disciplines has its challenges but can be fruitful if the distinct expertise is acknowledged and a common problem definition exists. I show where possible problems in dialogue between disciplines lie when it comes to highly complex, technological problems. Drawing on my research on digital encryption and disinformation from a political science perspective, I show how a core problem lies in different problem definitions. As a way out of this I highlight the need for a more comprehensive understanding of what we mean by "cybersecurity" that accounts for technological as well as social aspects. Insights from social science research highlight how class, race and gender determine our access to networked technology and creates distinct vulnerabilities. This needs to be recognised on all levels of research and policymaking. As a result, this talk contributes to a better mutual understanding across disciplines and put forward a more encompassing concept of what cybersecurity can mean.

Concept to increase the national Crisis Response Capacities in large-scale Cyber Disasters

Johannes Rundfeldt

AG KRITIS

Whereas in conventional disasters the predominantly volunteer helpers of the private aid organizations and, by extension, the official institutions are available to protect the population and ensure that sufficient help is available even in extraordinary situations, volunteer structures for digital disasters do not yet exist. The quantitative increase in IT and OT, their long operating lives, the high speed of technical progress and the ever greater interconnectedness of the systems each increase the probability of occurrence of a large-scale breakdown or even catastrophic disruption of our vital and therefore critical infrastructures. There are currently almost 2,000 critical infrastructures in Germany. In case of a disaster, only about 15 full-time BSI MIRT employees are responsible for the government incident response. We believe that this is not enough. In order to be able to provide rapid assistance to restore critical services in the event of disasters whose size and potential impact exceed the very limited capacities of the authorities, we believe that civilian volunteers must organize themselves and join forces, analogous to the aid organizations that already exist in other areas.

The rise of cybersecurity warriors?

Moritz Weiss

Chair of International Relations, Ludwig Maximilian University of Munich

The increasing demand for cybersecurity has been met by a global supply, namely, a rapidly growing market of private companies that offer their services worldwide. Cybersecurity firms develop both defensive (e.g. protection of own networks) and offensive innovations (e.g. development of zero days), whereby they provide operational capacities and expertise to overstrained states. Yet, there is hardly any systematic knowledge of these new cybersecurity warriors to date. Who are they, and how can we differentiate them? I seek to give an initial overview of the coordination between public and private actors in cyberspace by mapping the emerging market for cybersecurity services. The analysis departs from a newly generated data set of almost one hundred companies. As a result of this stock-taking exercise, I suggest how to theorize public-private coordination as network relationships, which provides a number of preliminary insights into whether we move towards the rise of a military-cyber-industrial complex or towards an increasingly securitized Silicon Valley.

Russell-Einstein Room

Deconstructing Autonomous Weapon Systems: Drivers, Narratives, Perceptions

Chair: Sibylle Bauer

Sociotechnical Imaginaries of Lethal Autonomous Weapon Systems

Anna-Katharina Ferl*, Bao-Chau Pham**

Peace Research Institute Frankfurt
**Department of Science and Technology Studies, University of Vienna*

Technological developments that enable increasing autonomy in weapon systems are one of the most frequently cited future threats for international security. Nonetheless, various rounds of talks at the CCW have to date not marshalled any international consensus for an arms control convention on so-called lethal autonomous weapon systems (LAWS).

Policy-makers, advocates, and researchers rely on particular imaginaries to make the potential impacts of these emerging technologies on international security intelligible. These visions and narratives have

consequences also in processes of arms control for LAWS: sociotechnical imaginaries of LAWS influence how they are understood and thus what options for regulation are thinkable and made possible.

This contribution employs the concept of sociotechnical imaginaries (Jasanoff 2015) to shed light on an understudied question: How are international security and LAWS co-produced in sites of arms control? The sensitizing notions of sociotechnical imaginaries and co-production (Jasanoff 2004) not only allow us to trace how particular visions around LAWS become possible but to also make sense of competing narratives. Sociotechnical imaginaries are also performative, hence shaping the trajectories of legislation, research and innovation, and thereby international arms control. By unpacking how LAWS are being imagined by various actors in arms control, specifically in the regional contexts of the US, EU and China, and parsing out their similarities and differences, this pitch contributes to discussions on trust- and confidence-building measures in the multilateral regulation of LAWS. In addition, it enables us to explore the social, political and technical configurations that are important in the 'making' of LAWS and their governance.

State Identity in Practices: The Development of Weaponised Artificial Intelligence in Russia

Anna Nadibaize

Center for War Studies, University of Southern Denmark

The discussion about Autonomous Weapons Systems (AWS) is often framed as if this technology will be arriving in a distant future. However, some governments are already using AI for military purposes. In my research I examine how military and security practices can affect foreign policy identities. Combining practice theory and social constructivism in International Relations, I seek to understand the relationship between the development of militarised AI in Russia and how this country perceives its status as well as threats to its identity and ontological security. My short pitch will present the usefulness of a practice-based approach to discuss the implications of the development and use of military AI for states' perceptions of their international roles. Understanding the link between practices and state identity would enrich our comprehension of how governments (in this case, Russia) conceive of military technology, international law governing warfare and the role of human control in the use of force. Such a discussion would also contribute to learning about the motivations of other states developing AWS and the possibilities of implementing an international ban on AWS.

Across the divide between domestic and international dimensions of practices: A two-level analysis of China's position on autonomous weapons systems

Guangyu Qiao-Franco

Center for War Studies, University of Southern Denmark

Weaponised Artificial Intelligence features heavily in national security policies. Since 2013, the use of autonomous weapons systems (AWS) has been discussed under the framework of the United Nations (UN) Convention on Certain Conventional Weapons. China is the first and only permanent member of the UN Security Council that supports installing a legal instrument banning lethal AWS to prevent automated killing by machines. This position is puzzling given the emphasis of Chinese leaders on pursuing technical innovation, including the application of AI, to catch up with and surpass more powerful militaries. Moreover, China has argued to be ahead in military and commercial applications of technologies required to introduce autonomy into military operations such as drones. Then why is China's international position on AWS out of step with its domestic practices? The paper posits that an analytical framework that accounts concurrently for domestic and international practices can bring useful insights to China's position on AWS. At the domestic level, practices related to the development, testing and deployment of AI produced a more favourable view of the 'appropriate' use of AWS in military operations. While at the international level, China's traditional practices of aligning with the Global South to gain legitimacy while constraining adversaries led to views against the use of fully lethal AWS. China's position on AWS is more in line with its international practices given its authoritarian system can compel domestic compliance and would be thus less sensitive to domestic practices. This two-fold analysis complements the international practice theory by providing an informative approach for conceptualising cases featuring divides between domestic and international practices.

Control of unmanned autonomous systems: current state and development
Marianna Yevtodyeva
Group of Military and Economic Globalization Processes, Primakov National Institute of World Economy and International Relations

While technologies and production of the unmanned systems rapidly advance, there are significant challenges in controls of the autonomous combat systems, i.e. export control regimes (MTCR and Wassenaar Agreements) and in the dialogue on the control of lethal autonomous systems (LAWS) within the UN Certain Conventional Weapons Convention (CCW). The weaknesses of the MTCR and WA in terms of controlling unmanned systems are that China, Israel, and some other key producers remain outside the scope of these regimes. The was a little progress in the discussions on regulating of LAWS under the CCW over the past few years as well, with the exception of adoption of 10 guiding principles on the use of LAWS. Ways to solve these problems may consist of: a) finding acceptable arrangements to most CCW member countries on the definition of LAWS, semi- and fully autonomous systems, stages of human control b) agreeing on possible principles for verifying such controls (e.g., by presenting of video recordings of operators' work with UAVs and other autonomous systems) c) increasing the transparency of data on UAVs and other unmanned systems in national and international reporting mechanisms, d) integration of control over UAVs and other unmanned systems into regional confidence building mechanisms, such as the OSCE Vienna Document.

12:10 – 13:10	**Parallel Sessions**

| von Weizsäcker Room | **Panel Discussion: The Future of Peace Research in Natural and Technical Sciences** |

Moderation: Prof. Ulrich Schneckener

Prof. Malte Göttsche
Head, Nuclear Verification and Disarmament Group, RWTH Aachen University

Sebastian Groth
Head of Policy Planning at the Federal Foreign Office

Prof. Ursula Schröder
Scientific Director of the Institute for Peace Research and Security Policy at the University of Hamburg

In 2018/19, the German Peace Research Foundation (DSF) sponsored projects from the natural sciences in a funding line entitled "New Technologies: Risks and Opportunities for International Security and Peace". SCIENCE PEACE SECURITY '21 is the conclusion for this thematic funding.

The panel builds on this and takes up the evaluation of the field of peace and conflict research by the German Science Council (Wissenschaftsrat). Their publication "Recommendations for the Further Development of Peace and Conflict Research" focused on the natural sciences in this area in Germany: Long-term security and institutional strengthening are central requirements.

Moderated by the chairman of the DSF board, Professor Ulrich Schneckener, the one-hour panel discussion will be devoted to these issues. The conversation revolves around strategic questions of future thematic challenges; of further development of the research field and its capacities as well as the dialogue between research and political practice.

Dual-Use Technology and Responsible Innovation
Chair: Filippa Lentzos

The Kalashnikov of the air? Conditions for the use of commercial drones by non-state armed groups
Marius Bales*, Max M. Mutschler
*Bonn International Center for Conversion

Unmanned aerial vehicles (UAV) were initially exclusively found in advanced, well-funded militaries. Due to technology advances and lower costs, civilian use has grown exponentially over the last years. Today, inexpensive, highly capable UAVs are used by various non-state armed groups (NSAGs) on the world's battlefields. However, while NSAGs on the Arabian Peninsula, the Middle East's Levant, North Africa, and the Donbass use UAVs, other groups at the Horn of Africa, the Indian subcontinent or West Africa's Sahel region don't. We seek to explain this difference. The militarized drones used by NSAGs are composed chiefly of commercially available parts, such as engines, servo actuators, autopilots and electronics, which are exported from industrialized countries. As such dual-use goods are now available almost anywhere in the world, it is not the general access to technology that explains drone use by NSAGs. Rather, we find that the role of states who support NSAGs with technical and military advice and training in the production and use of UAVs is crucial. On this basis, we discuss the outlook for the regulation of respective dual-use technologies.

Economic actors' interests in controlling military applications of dual-use technologies
Michael Brzoska
Institute for Peace Research and Security Policy at the University of Hamburg

The prime objective of this paper is to analyze past efforts at restricting dual-use technologies and dual-use goods with a view of distilling lessons which may have relevance for current emerging technologies. To that effect the paper presents a brief analysis of past efforts based upon a general framework for the analysis of the role of economic actors in regulating "public bads" associated with dual-use technologies.

Proliferation resistant shaping of new nuclear technology – A remedy for dangers of civil-military ambivalent nuclear technology?
Wolfgang Liebert
Institute of Safety and Risk Sciences, University of Natural Resources and Life Sciences, Vienna

For two decades, international efforts have been underway to further develop nuclear technologies for power generation. Objectives of the Generation IV International Forum (GIF) and the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) of the International Atomic Energy Agency (IAEA) explicitly include orientation towards the criterion of proliferation resistance. In order to assess whether a proliferation-resistant shaping of new reactor systems and fuel cycles can actually eliminate proliferation dangers posed by nuclear technology to the greatest possible extent, two questions must be clarified: 1. Of what does the civil-military ambivalence of nuclear technology consist, and how is it to be assessed? 2. What is actually meant by the concept of proliferation resistance and what specific (technological) objectives does it aim to achieve? On this basis and taking into account the framework conditions of the international non-proliferation regime as well as historical experience, it can be analyzed to what extent proliferation resistance could become an effective antidote to proliferation threats.

Bridging cultures or cultural divides within dual-use technology and responsible innovation for artificial intelligence (and other technologies)
Luke Richards
Stockholm International Peace Research Institute

Responsible innovation (RI) can mean different things to different actors, at its most basic level RI should be socially desirable and undertaken in the public interest and must account for the varying interests of these actors, such as researchers, funders, the public and other stakeholders. National security too is socially desirable and mostly within the public interest, yet it relies on a different logic to assess the needs of the state and the military: the 'stakeholders' often include other states, with decisions made through levels of secrecy and are not often open to participatory decision making outside of standard democratic processes. Although both sets of communities are trying to attain similar goals they do so in contrasting ways. This talk will speak about responsible innovation in the context of peace and security and the current limitations between RI discourse and practice and the needs of the defence and security communities within the field of artificial intelligence. By doing so it will attempt to highlight research gaps that need to be understood to properly discuss RI in the context of dual-use technologies.

13:30 – 13:50	**Lunch Talk: Erik Melander**
von Weizsäcker Room	**Prof. Erik Melander** *Director, Alva Myrdal Centre for Nuclear Disarmament,* Uppsala University

This Lunch Talk is a presentation of the new Alva Myrdal Center. The Alva Myrdal Center for Nuclear Disarmament (AMC) was established in 2021 at Uppsala University, Sweden, to provide teaching, research, and policy support on nuclear disarmament. AMC studies the whole process in which nuclear disarmament occurs; i.e., preconditions and hurdles, negotiations and decision-making, and implementation and verification. AMC combines insights from different disciplines such as peace and conflict research, applied nuclear physics, and international law. In cooperation with other stakeholders, AMC disseminates knowledge of nuclear disarmament by holding and hosting conferences and workshops. AMC raises public awareness about nuclear disarmament and contributes to the public debate on the challenges of disarmament work.

14:10 – 15:10	**Panel Discussion: New Technologies: Destabilizing or Enabling Resilience?** Moderation: Prof. Malte Göttsche
von Weizsäcker Room	**Dr. Sibylle Bauer** *Director of Studies, Stockholm International Peace Research Institute* **Anja Dahlmann** *Head of Project, International Panel on the Regulation of Autonomous Weapons, German Institute for International and Security Affairs, Berlin* **Dr. Irmgard Niemeyer** *Head of Division, Nuclear Safeguards and Security, Forschungszentrum Jülich GmbH* **Prof. Götz Neuneck** *Senior Research Fellow, Institute for Peace Research and Security Policy, Hamburg*

Developments in science and technology impact today's increasingly complex and unstable international security environment in various manners, as this conference has explored. For instance, on the one hand, technological developments in the military domain can be destabilizing. On the other hand, science and technology can enable effective regulation and contribute to confidence-building.

This panel discussion summarizes the main debates that occurred during the conference. What are the most significant challenges and opportunities at the intersection of science, peace and security? Furthermore, we will reflect upon us as a research community: What do we already understand well, what do we need to understand better? How well does the dialogue across natural, technical and social sciences on these issues work; how can it be improved?

15:40 – 17:00	**Panel Discussion - Bringing Science and Politics Closer Together**
	Moderation: Dr. Filippa Lentzos

von Weizsäcker Room	**Ambassador Rüdiger Bohn**
	Deputy Federal Government Commissioner for Disarmament and Arms Control, German Foreign Office

Prof. Paolo Cotta-Ramusino
Secretary General, Pugwash Conferences on Science and World Affairs

Prof. Lucas Kello
Department of Politics and International Relations, University of Oxford

Dr. Patricia Lewis
Research Director, Conflict, Science & Transformation, Chatham House

Natural and social science research provide a crucial component of political decision-making in conflict resolution, arms control, disarmament and international security. Yet too often, scientists ignore the political, security, military or other contexts of their work, and politicians do not appreciate the value of science or understand basic technical details and scientific methodology. How can we bring science and politics closer together? We are interested to explore both historical and current experiences, as well as to consider historical and current experiences of engaging the next generation of scientifically-literature policymakers and security-aware scientists. The sorts of questions we'll be focusing on are: How can the non-proliferation community overcome the gap between scientific and political cultures? What are key elements for successful two-way engagement? How can we measure success? What are policymakers looking for from scientists and technologists? What are scientists and technologists looking for from policymakers? What motivates the younger generation of scientists and technologists to engage with policymakers in non-proliferation and disarmament? What opportunities are there to involve the younger generation of scientists and technologists in non-proliferation and disarmament work? How can these be improved? Do we need new formats of engagement to capture emerging technologies and their interconnections?

17:00 – 17:30	**Conclusion**

von Weizsäcker Room	**Malte Göttsche**
	Head, Nuclear Verification and Disarmament, RWTH Aachen University

Poster Session

Verification from space – building transparency and confidence through earth observation big data

Lisa Beumer

Nuclear Safety and Safeguards Division, Forschungszentrum Jülich GmbH

Earth observation through satellite imagery has historically played a unique role in nuclear verification. Together with auxiliary data, it can be used as a reference source to aid in field and inspection planning, to detect changes and monitor activities at nuclear facilities, to verify the information supplied by a member state as well as to investigate alleged illegal activities related to nuclear non-proliferation, arms control or disarmament. As satellite imagery providers deploy new constellations of satellites, with the aim of images covering the globe several times a day, both quality and quantity of this data are increasing rapidly as are the methods to process and analyze the datasets. The resulting repositories of satellite imagery will offer analysts distinct insights into nuclear facilities and nuclear activities from space worldwide. The deluge of data, however, requires the further automation of processing. New robust data science methods can offer analysts automated alerts that flag for instance changes occurring within a nuclear facility's infrastructure. Several studies have demonstrated the potential of data science methods for nuclear verification, such as statistical time series analysis, deep learning methods, and convolutional neural networks. The poster will discuss the state-of-the art of data science in earth observation for nuclear verification and how this can contribute to transparency and confidence building.

What could possibly go wrong? Dual-Use and the development of Autonomous Vehicles

Sebastian Schwartz*, Laura Guntrum*, Christian Reuter

Chair of Science and Technology for Peace and Security, Technical University of Darmstadt

In a digital age, the vision of autonomous vehicles (AVs) is vibrant. Research is being conducted worldwide to integrate AVs into our everyday lives in the future, spending considerable amounts of money in the development process. Actors from both engineering and social sciences are involved in this research, with technical disciplines strongly dominating. In addition to perceived progress of numerous newly developed technologies such as AVs, challenges should also be cited. According to research analysis, the transferability of autonomous cars to the military sphere seems to be frequently forgotten or ignored (dual-use). For technical peace and conflict research, the question arises which aspects of autonomous driving can be particularly problematic in the context of the LAWS debate. Due to the fragmentation of the technology and research it is uncertain, what parts are potentially usable for military manners and which are too specialized for normal traffic circumstances. Furthermore, the question arises, if there is an awareness among the developers for the dual-use potential of AVs. Since not much research has been done yet on the potential deployment of autonomous driving development steps into military domains, 25 semi-structured interviews with developers and researchers living in Germany and involved in the field were conducted in 2020.

The Potential Role of Nuclear Archaeology in Denuclearizing North Korea

Benjamin Jung*, Antonio Figueroa, Malte Göttsche

Nuclear Verification and Disarmament Group, RWTH Aachen University

The Democratic People's Republic of North Korea presents a high-profile case when it comes to conceptualizing a step-by-step disarmament procedure. We present a case for nuclear archaeology as an important verification tool in this process. Especially in the early stages of a potential denuclearization framework, nuclear archaeology techniques provide a good balance between intrusiveness and confidence when it comes to verifying fissile material declarations. They aim at estimating fissile material inventories by reconstructing past production. Methods to assess plutonium production are more advanced than those to reconstruct uranium enrichment. The Graphite Isotope Ratio Method is an already somewhat established method to deduce information about a reactor's past plutonium production by analyzing measurements taken from permanent reactor core structures. To complement this method, the composition of the high-level reprocessing waste – to the extent it is available and accessible in North Korea – could be studied to gain further insights into the operational history of the reactor for additional confidence. These methods are particularly relevant as they do not require inspectors to have

access to the actual fissile material inventory, much of which is contained in weapons, but only to the Yongbyon nuclear complex. Thus, North Korea could be permitted to maintain a level of secrecy about the location of its fissile material and weapons, at least in the initial stages of the denuclearization process. Currently, fissile material inventories can only be assessed using limited information from inspections in the past and open source information such as satellite imagery. Using nuclear archaeology, the uncertainty of fissile material estimates can be reduced, likely by several weapon equivalents.

The "Security and Technology in Outer Space" (Sicherheit und Technologie im Weltraum) Network

Daniel Lambach*, Arne Sönnichsen, Anna-Lea Pietsch
*Research Centre 'Normative Orders', Goethe University Frankfurt

This poster will introduce and give an overview of the multidisciplinary research network SichTRaum ("Sicherheit und Technologie im Weltraum"). Our mission to support and stimulate collaborative research on empirical aspects and theoretical approaches to space policy and security. SichTRaum was founded in 2020 and currently works on the following themes:- Armed attacks in space- Space as a commons- Space culture- Teaching and learning space- Visions of future use of space The network consists of 20 members from disciplines like political science, law, cultural studies, geography and science and technology studies.

A discursive analysis of the interaction between ELN guerrilla and Colombian Government (1965 - 1973), using a theoretical artificial intelligence model

Luisa Fernanda García, Francesco Mancuso*
*International Relations, Strategy, and Security Faculty, Nueva Granada Military University

The Ejército de Liberación Nacional (ELN, National Liberation Army) is the oldest guerrilla group in Colombia that is still in arms. A negotiated solution to the conflict has not been possible due to the guerilla's political and military characteristics and because of the parties' inability to establish a dialogue, i.e. the Guerrilla Group and the National Governments fail to communicate effectively. In this proposal, we present a model to analyze the ELN's warfare and the strategies created by the different Colombian governments to eliminate the guerrilla threat. The main novelty of this work is the construction of a model based on Artificial Intelligence (AI), which allows identifying multiple emerging scenarios from the political-military interactions between the ELN and the Colombian Government. To achieve this objective, we will carry out a discourse analysis of the interactions between the actors, which will be the basis to design an Artificial Intelligence model. The latter allows identifying the strategies for the State and the ELN to begin a negotiation. For the analysis, we consider the first interactions between the Government and this guerrilla group. Thus, the study is limited to the period between 1965 and 1973. At this stage, the model proposed will be theoretical.

Promoting Awareness of Biological Security in the Life Sciences: Integrating Cartoons with Team-Based Learning Principles

Tatyana Novossiolova*, Lijun Shang, Malcolm Dando
*Center for the Study of Democracy, Bulgaria

The ongoing rapid progress of science and technology over the recent decades coupled with increasing international instability and global diffusion of technical expertise and capabilities pose complex multifaceted challenges to the integrity of the international chemical and biological non-proliferation and disarmament regime. Engaging those in the chemical and life sciences with the security implications of their work through education and outreach has been recognised by the States Parties to the Chemical Weapons Convention and the Biological and Toxin Weapons Convention as an important element of the full and effective implementation of both Conventions. This poster builds upon earlier research on life sciences professional responsibility in an age of dual-use research and reports on the utility of innovative active learning strategies for fostering awareness of chemical and biological security issues among science stakeholders. The poster has been developed in collaboration with Prof Malcolm Dando, University of Bradford, UK and Prof Lijun Shang, London Metropolitan University, UK.

Arms control and the challenge of scientific knowledge in the Colombian army after the peace agreement

Carlos M. Nupia
German-Colombian Peace Institute

Despite the signature in 2016 of the Peace Agreement between the Colombian government and the FARC guerrillas, the military expenditure in this country increased from 8.676 million of USD in 2016 to 10.084 in 2019. Official reports confirm that exports of military industry increased eight times from 2017 to 2018. Results of military R&D investment shows that shotguns, handguns, sub-machine guns, bombs and emulsions for blasting are among the most innovative products of this industry, confirming that defense market is a possible option for the army during peace times. Although "national security" is still an argument to keep R&D products of the military industry secret, the recent COVID-19 pandemic showed the potential of military knowledge for humanitarian purposes (i.e., demining) and civil applications (i.e., health, agriculture, etc.). The ambiguity of using science to improve the quality of armament exports or to contribute to socio-economic development in a post-conflict environment, challenges TCBMs established at two levels: that of the local Peace Agreement and that of the international treaties for arms control signed by the Colombian government.

Dual Use in the 21st century

Jan Opper*, Rosa Ullmer
Centre for Science and Peace Research, University of Hamburg

Dual use technologies have been a security concern ever since the beginning of the atomic age. Rooted in its Cold War tradition, dual use shows the "Janus Faced" nature of many technologies. Technologies can take different paths from their "upstream" development and have peaceful as well as hostile "downstream" applications. However, new technologies especially in the area of life science or cyber technologies challenge this notion, as they do not have different development path but are fundamentally ambiguous technologies that can be used for hostile or peaceful purposes without any changes. Thus, for those ambiguous technologies it is almost impossible to know whether they are used for peaceful or hostile purposes. This poses significant challenges for the control of dual use technologies. The proposed contribution will analyze the dual use concept emergence, development and current use in order to identify weaknesses in the concept and thus provide a basis for a systematic discussion of possible improvements of the concept.

Production of Microparticulate Reference Materials for Particle Analysis Methods in Nuclear Safeguards

Shannon Kimberly Potts
Nuclear Safeguards and Security Division, Forschungszentrum Jülich GmbH

The International Atomic Energy Agency (IAEA) implements technical measures, or safeguards, in order to verify the compliance of member states to their international legal obligations with respect to the Non-Proliferation Treaty (NPT) to use nuclear material and technology only for peaceful purposes. One of these technical measures are analytical measurements of swipe samples taken by IAEA safeguards inspectors during in-field verification activities. The implementation of this measure goes hand in hand with the further development of analytical methods and quality control, including the provision of suitable particle-based reference materials. To this purpose, an aerosol-based process to produce microparticulate reference materials was developed and established at Forschungszentrum Juelich. The poster will present how microparticles with consistent isotopic compositions and uranium contents according to the IAEA's requirements can be produced and how these advanced materials can be applied as certified reference materials for particle analysis methods in nuclear safeguards.

From Security to Mass Surveillance: The dual-use of Open Source Intelligence

Thea Riebe*, Julian Bäumler, Christian Reuter
Chair of Science and Technology for Peace and Security, Technical University of Darmstadt

Open Source Intelligence (OSINT) is gaining popularity in cyber security research because it automates monitoring and, in some cases, enables predictive analysis. Automated threat and intrusion detection methods are on the rise, combining the collection of open source and closed source data and using machine learning and artificial intelligence for its analysis. Governments are increasingly utilizing OSINT to monitor risks posed by misinformation, vulnerabilities, as well as to prevent terrorist attacks. To improve international cyber security information sharing, OSINT might be deployed as part of cyber defense and security monitoring. Since the benefits seem to be clear, the data sources and analysis need to be assessed with regard to their dual-use of concern, e.g., to prevent mass surveillance or to avoid biased decision making. This contribution examines the application of OSINT in cyber security research and on the technological innovations that are associated with the rise of OSINT in other application areas of, such as for monitoring and predictive security analytics. In the second part of the contribution, dual-use of concern aspects regarding the data sources and models are discussed to provide points of awareness, design implications, and policy recommendations to thwart the misuse of OSINT innovations.

Managing biological dual-use risks in the wake of COVID-19

Jonas Sandbrink*, Sriharshita Musunuri, Joshua Monrad, Gregory Koblentz
Future of Humanity Institute, University of Oxford

COVID-19 has showcased the global vulnerability to biological events, potentially increasing the threat from deliberate biological events caused by actors with malicious intent. To reduce this threat, we need to take special care to reduce dual-use risks in the wake of the COVID-19 pandemic. Global research efforts have increased the engagement of researchers around the globe in viral engineering and have lowered the tacit knowledge barrier to engaging in such activities. The necessary urgency of pandemic response efforts has led to a rise in preprint publishing which highlights the insufficiency of assessing dual-use risks at the publication stage. Investment into new approaches and technologies for preventing and responding to biological events is critical, however, improving responses to natural pandemics must not come at the expense of increasing risks from accidental or intentional biological threats. Considerations around the dual-use potential of gain-of-function work and predicting the next zoonotic pandemic, research into improving viral vector vaccines to overcome anti-vector immunity, and proposals like the creation of transmissible vaccines need to feed into the post-COVID-19 research agenda.

Regional Innovations in AI: Trust, Risk Awareness, and Visions of R&D

Stefka Schmid*, Christian Reuter
Chair of Science and Technology for Peace and Security, Technical University of Darmstadt*

Recent technological developments, indicated by a global increase in research and development of artificial intelligence (WIPO 2019), have raised questions of control of autonomous weapons systems not only regarding states' efforts of proliferation but also on a human-machine level. US-Sino competition in research and development of new technology is strong across both civilian and military spheres. While both have formulated different AI initiatives, dual-use or military programs with a focus on AI, the European Union, albeit a less dominant actor, has also made efforts to put related innovations into (military) practice as well as to create an ethical guideline for human-centered AI (Trustworthy AI). In the context of these developments, scholars and practitioners of arms control have focused on how to ensure (meaningful) human control of increasingly autonomous weapon systems and emphasized the risk of unanticipated consequences of technology and human-machine interactions with black box AI. US, Chinese and European guides consider this issue, highlighting values of trust(worthiness), transparency, explainability, or interpretability. Identifying these values as determining the extent of human control, an analysis of states' guidelines indicates prevalent understandings and possibilities of

ensuring substantial human control as the former may be incorporated into technology and interactions. At the same time, views on trust in AI are accompanied by an awareness of risk, errors, approaches to tackle problems and challenges of anticipation. An analysis of Chinese, US, and EU ideas of trust in "explainable" or "interpretable" AI contributes not only to a better understanding of how these powers envision human control but also offers an interdisciplinary lens through which potentially different directions of R&D of AI may be indicated.

Using cartoons as an effective way of communicating BTWC between politicians and scientists and general public after COVID-19

Tatyana Novossiolova, Malcolm Dando, Lijun Shang*
*School of Human Sciences, London Metropolitan University

There is a longstanding norm against the development and use of chemical and biological weapons, which is embodied in two international prohibition regimes. These regimes, however, need tending in response to technological and political change. In 2020, we started a project on "Informing Policymakers of the Progress in Strengthening the Chemical and Biological Weapons Non-Proliferation and Disarmament Regime" as part of civil society efforts to strengthen the norm against chemical and biological weapons. The project aims to inform the UK Parliament and general public about the present state of these regimes and the options for strengthening them after the pandemic in the run up to the 2022 9th Review Conference of the Biological and Toxin Weapons Convention (BTWC) and the 2023 5th Review Conference of the Chemical Weapons Convention (CWC). In this poster we present the project concept and the activities that have been implemented. The poster is based on the final project report which is available at:

http://repository.londonmet.ac.uk/6445/1/Project%20Summary%20Report%20-LMU-2021.pdf

High Level Biosecurity Laboratories around the world. A global threat

Monica Zoppè
Institute of Biophysics, National Research Council of Italy

High-Level Biosecurity Laboratories, so-called BSL (Bio Safety Level) 3 and 4, perform, by their nature, dangerous research and experiments. These frequently involve bacteria and viruses with very high pathogenic potential both for humans and for livestock, agriculture, and the environment. Contrary to our desire and ambition, it is humanly impossible to prevent accidents, as demonstrated by the long list of reported cases, certainly incomplete. Of the estimated 80 hi-level biosafety labs in a handful of Countries, most have strong links with the military, and their research is to a great extent kept secret. This situation is highly dangerous at the global and local level, and often strong and justified protests have un-welcome their constructions and operations. International public and political dialogue about the risks and control on these facilities need a major boost. A possible stepping stone to foster this dialogue could be a proposal for an initiative that is both achievable and widely supported: the true and definitive elimination of smallpox.

Crucial knowledge gaps in viral vectored crop plant genome editing

Johannes L. Frieß*, Bernd Giese
Institute of Safety and Risk Sciences, University of Natural Resources and Life Sciences, Vienna

In an attempt to develop a biotechnology to secure crop provision and protect from crop loss due to adverse biotic and abiotic conditions, be they of natural or engineered origin, the Defense Advanced Research Project Agency is funding the Insect Allies program. The virus-based transfer of beneficial traits onto crop plants by the use of insect vectors envisioned by the Insect Allies program is criticized for its dual-use potential. So far, the debate is more focused on the technology's perceived intent and compatibility issues with existing policies and treaties than on the scientific culprits and knowledge gaps that arise in its development. Even if only considering a peaceful application, this Novel Invasive Environmental Biotechnology warrants a thorough technology assessment because the tendency to spread rapidly and control deficits could harbor considerable potential for

conflict. In view of the high exposure potential, a prospective view is needed, accounting for the non-knowledge arising from all three entities virus, vector and host in relation to molecular genetics, the target entity and ecological interaction. The contribution intends to provide a prospective technology assessment as a basis for a discourse of responsible research and innovation.

Not only Warheads: Verified Elimination of Nuclear Weapon Programmes

Moritz Kütt

Institute for Peace Research and Security Policy at the University of Hamburg

Complete nuclear disarmament requires nuclear weapon states to take actions beyond destroying all nuclear warheads. They also need to eliminate or convert their nuclear weapon programmes, including the facilities for research and development, component production, and nuclear weapon assembly. While several nuclear weapon states have already eliminated elements of their programmes in post-Cold War arms reductions, no verification accompanied these unilateral actions. So far, the international community only has experience in verifying the elimination of one, very small, successful programme (South Africa) and few other, unsuccessful attempts to produce nuclear weapons (e.g. Iraq, Libya). This contribution discusses main technical and procedural issues for verifying the elimination or conversion of nuclear weapon programmes of large nuclear weapon states. There are four key verification objectives: Ensuring the termination of facility operation, confirming facility elimination, certifying facility conversion and confirming the absence of undeclared facilities. For all four objectives, potential verification technologies will be presented.

Speakers

Jürgen Altmann

Physics and Disarmament Research Group, TU Dortmund University

PD Dr. Jürgen Altmann is a physicist and peace researcher TU Dortmund University, Dortmund, Germany. He is also the chairman of the German Research Association for Science, Disarmament and International Security (FONAS), which aims to promote scientific work on issues of disarmament, international security and international peace using methods from mathematics, natural or engineering science – taking into account multidisciplinary approaches – in research, in teaching and in public dissemination of knowledge.

Marius Bales

Bonn International Center for Conversion

Master in Political Science from the University of Bonn. PhD-Researcher at the Bonn International Center for Conversion. Currently working in the DFG-funded project "on the road to liquid warfare", focusing on the question of how the proliferation of modern military technology for remote warfare transforms war and warfare practices of autocratic states and non-state armed groups. My regional focus is the Middle East.

Sibylle Bauer

Stockholm International Peace Research Institute

Dr Sibylle Bauer is Director of Studies, Armament and Disarmament, at SIPRI. She has a long record of research and publication on armaments and export control issues, especially regarding the European Union. Since 2005 much of her work has focused on export control capacity building, in particular in legal and enforcement areas. Dr Bauer joined SIPRI in August 2003.

Kavita Berger

Board on Life Sciences, U.S. National Academies of Sciences, Engineering, and Medicine

Dr. Kavita Berger is the Board Director of the Board on Life Science of the National Academies of Sciences, Engineering, and Medicine. She is a life scientist with extensive experience in biological science and security policy. Throughout her career, she has worked on problems at the intersection of health, science, national security, and policy. Prior to joining the National Academies, Dr. Berger was a principal scientist at Gryphon Scientific. There, she led numerous projects involving biotechnology landscape analyses, biosecurity and biodefense policy, risk and benefits of life science research and technologies, and international bioengagement. Recently, she led system-based analyses of the entire U.S. biosecurity and biodefense policy landscape and of dual use capabilities of scientists. She also has led a comparative analysis of genome editing technologies, examination of biosecurity considerations associated with high-consequence pathogens and enabling biotechnologies, and development of scenario-based training exercises on laboratory biosecurity and biosafety concepts in the Middle East and North Africa. Dr. Berger was responsible for several biosecurity and biodefense initiatives at the American Association for the Advancement of Science (AAAS). At AAAS, she developed activities that engaged Washington-DC-based science policy and security experts on topics ranging from health security to biological weapons. Dr. Berger has a Ph.D. in genetics and molecular biology from Emory University and conducted pre-clinical research on HIV and smallpox vaccines.

Andrea Betzenbichler

Chair of Global Governance and Public Policy, Ludwig Maximilian University of Munich

Andrea Betzenbichler is a PhD researcher at the Chair of Global Governance and Public Policy at Ludwig-Maximilians-Universität München. Her research focus lies on arms control, emerging dual-use technologies, and influence of experts and political activists on international regime-building. Before joining LMU in 2020, she worked in the civil society sector, including as a project manager at the ZEIT-Stiftung Ebelin und Gerd Bucerius, Hamburg.

Lisa Beumer

Nuclear Safety and Safeguards Division, Forschungszentrum Jülich GmbH

Lisa Beumer is working on her PhD at the Forschungszentrum Jülich, where she is a research associate on the DSF-funded project "Multi-temporal satellite imagery analysis in support of nuclear non-proliferation, arms control and disarmament verification".

Ingvild Bode

Centre for War Studies, University of Southern Denmark

Dr Ingvild Bode is Associate Professor at the Centre for War Studies, University of Southern Denmark. She works on changing use of force norms in the context autonomous weapon systems and artificial intelligence. Her research is funded by the European Research Council (AUTONORMS under grant agreement no. 852123).

Rüdiger Bohn

German Federal Foreign Office

Ambassador Rüdiger Bohn is Deputy Federal Government Commissioner for Disarmament and Arms Control at the German Foreign Ministry. His career has included posts at German diplomatic missions in Amman, Brussels (German NATO Delegation), Tashkent and Washington DC. He also worked in various departments at the Foreign Ministry in Berlin including as Director for Conventional Arms Control in Europe. Previously, he served as Director for Security Policy, Arms Control and bilateral relations with Western Europe and the US at the Federal Chancellery. Rüdiger Bohn owns a diploma in Arabic studies (Leipzig University) and a Master's degree in Public Administration (Kennedy School of Government, Harvard).

Alexander Bollfrass

Center for Security Studies, ETH Zurich

Dr. Alexander K. Bollfrass is a senior researcher at the Center for Security Studies (CSS). He was previously a Stanton nuclear security postdoctoral fellow with the Harvard Kennedy School's Belfer Center. He was a nuclear weapons policy researcher at the Arms Control Association and Stimson Center, before earning a Ph.D. in security studies from Princeton University.

Peter Braunstein
Bundeswehr Verification Center (BwVC)

Peter Braunstein was born in 1957. He holds the rank of brigadier general of the Bundeswehr and is Director of the Bundeswehr Verification Center. He joined the Bundeswehr in 1977 and attended the national General Staff Course at the Bundeswehr Command and Staff College in Hamburg from 1989 to 1991.

Following several national and international assignments, he served in various functions in the Federal Ministry of Defense from 1998 to 2010, inter alia as Assistant Branch Chief for overall defense matters, as Deputy Branch Chief of the Bundeswehr Operations Branch and as Office Manager of the Director, Armed Forces Staff. In 2006, he was appointed Senior Military Assistant to then Federal Minister of Defense Franz-Josef Jung and, as of October 2009, to his successor Karl-Theodor zu Guttenberg. Subsequently, he served as Commander of the Berlin Garrison Command. In this capacity, he was responsible for representing the Bundeswehr's interests in the German capital. He filled this post until February 2015 when he took charge of the Bundeswehr Verification Center.

From August 2014 to January 2015, Brigadier General Braunstein served as Commander of the NATO Liaison and Advisory Team in Pristina/Kosovo.

Kolja Brockmann
Stockholm International Peace Research Institute

Kolja Brockmann is a Researcher in the Dual-use and Arms Trade Control Programme at the Stockholm International Peace Research Institute (SIPRI). He graduated from King's College London with an MA (distinction) in Non-Proliferation and International Security. Kolja conducts research in the fields of export control, non-proliferation and technology governance. His current research focuses on multilateral export controls, missile non-proliferation and the impact of emerging technologies. He frequently presents his research findings to a wide range of academic, practitioner and policy audiences.

Michael Brzoska
Institute for Peace Research and Security Policy at the University of Hamburg

Michael Brzoska is an economist and political scientist who until 2016 directed the Institute for Peace Research and Security Policy (IFSH) at the University of Hamburg. He now is a Senior Research Fellow at the IFSH as well as an Associate Senior Fellow at the Stockholm International Peace Research Institute (SIPRI). He has published widely on economic and political aspects of peace, conflict and security.

Lyndon Burford
Centre for Science and Security Studies, King's College London

Dr Lyndon Burford is a Visiting Research Associate at the Centre for Science and Security Studies, King's College London. He studies the politics, theories and technologies of nuclear disarmament, deterrence and risk. Lyndon is a member of the New Technologies for Peace working group in the Vatican's COVID-19 Commission, and was an advisor on the New Zealand delegation to the 2015 NPT Review Conference. His essay on a user-pays model for nuclear risk reduction won the CNS McElvany Prize.

Niël Conradie
Applied Ethics Group, RWTH Aachen University

Dr Niël Conradie is a postdoctoral researcher working in the Applied Ethics Group of the Department of Society, Technology, and Human Factors at RWTH Aachen University, in Germany. His current research is focused on collective responsibility and how this relates to AI and other emergent technologies. He earned his PhD in philosophy, focussed on the intersection of responsibility and action theory, at the University of St Andrews, Scotland. Before this he received his MA in philosophy and BA at the University of Stellenbosch, South Africa.

Paolo Cotta-Ramusino
Pugwash Conferences on Science and World Affairs

Paolo Cotta-Ramusino has been Secretary General of Pugwash Conferences on Science and World Affairs (Nobel Peace Prize 1995) since August 2002. He is also Professor of Mathematical Physics at the University of Milano (Italy) and Senior Researcher at the Italian National Institute of Nuclear Physics. As a mathematical physicist he has been working on mathematical aspects of quantum field and string theories. In 1983, he co-founded the Italian Union of Scientists for Disarmament (USPID). He was formerly Director of the Program on Science, Technology and International Security at the Landau Network Centro Volta (Como). He is a member of the International Institute for Strategic Studies, and the World Academy of Art and Sciences. His research and teaching experience have included visiting positions at the University of North Carolina, CERN, and Harvard University. He received his doctorate (laurea) in physics in 1971 from the Università degli Studi di Milano.

Anja Dahlmann
German Institute for International and Security Affairs

Anja Dahlmann is an associate at the Berlin-based think tank Stiftung Wissenschaft und Politik (SWP) – German Institute for International and Security Affairs. She holds a master's degree in political science of the University of Göttingen. As principal researcher of the International Panel on the Regulation of Autonomous Weapons (iPRAW) she closely follows the debate on lethal autonomous weapon systems at the United Nations. Her work includes international arms control, emerging military technologies, and the respective German and European defence policy.

Anuradha Damale
Verification Research, Training and Information Centre, London

Anuradha is an Assistant Researcher on the Verification and Monitoring Programme at VERTIC. She has research interests in nuclear disarmament verification and space safety and security. She holds a BSc in Physics from Durham University and an MSc in Science and Technology Policy from the Science Policy Research Unit at the University of Sussex.

Marjolijn van Deelen
European External Action Service

Marjolijn van Deelen assumed the position of EU Special Envoy for Non-proliferation and Disarmament on 1 September 2020. She is a career diplomat of the Netherlands. Before joining the EU External Action Service (EEAS), she headed the Non-proliferation, Disarmament and Nuclear Affairs Division of the Ministry of Foreign Affairs of the Netherlands. She held several posts abroad (to the international organisations in Vienna, at the Dutch Embassies in Bucharest and San Jose), as well as positions in The Hague (Europe Division, Middle East Division, UN Division, Development Assistance).

Ms. Van Deelen holds a Masters in Geophysics from the University of Utrecht, the Netherlands, as well as a BA in Economics from the American University in Washington DC.

Marina Favaro
Institute for Peace Research and Security Policy at the University of Hamburg

Marina Favaro is a Research Fellow at IFSH Hamburg, where her research focuses on the impact of emerging technologies on arms control. She is also working as a Consultant at the Centre for Science and Security Studies (CSSS) at King's College London, where she is developing a project with Dr Heather Williams focused on Technology and Bridge Building, with the objective of increasing trust in the global nuclear regime. Previously, Marina managed the Emerging Technologies research programme at the London-based think tank BASIC and worked as an Analyst at RAND Europe, where her research focused on space governance, cybersecurity, defence innovation, conventional weapons control and the impact of emerging technologies on society.

Anna-Katharina Ferl
Peace Research Institute Frankfurt

Anna-Katharina Ferl is a doctoral researcher at the Peace Research Institute Frankfurt (PRIF/HSFK) and part of a research project on non-proliferation, arms control, and disarmament. She is also a member of PRIF's research group 'Research on Emerging Technologies, Order and Stability'. Her research focuses on arms control processes of emerging technologies, especially in the area of lethal autonomous weapons systems.

Christopher Fichtlscherer
Institute for Peace Research and Security Policy at the University of Hamburg

Christopher Fichtlscherer is a researcher for the project "Arms Control and New Technologies" and works on the DSF-funded project "Nuclear Warhead Authentication Based on Gamma and Neutron Emissions - How to Discourage Cheating?". In parallel, he is working on his Ph.D. in the "Nuclear Verification and Disarmament" research group at RWTH Aachen.

Johannes L. Frieß

Institute of Safety and Risk Sciences, University of Natural Resources and Life Sciences, Vienna

Dr. Johannes L. Frieß, studied biology at the Technical University of Darmstadt and received his PhD in in 2015. Since 2017, he has been working at the Institute for Safety/Security and Risk Sciences at the University of Natural Resources and Life Sciences, Vienna (BOKU) in the field of bio- and nano-sciences. His expertise is the technical assessment of novel invasive environmental biotechnologies such as Gene Drives and Horizontal Environmental Genetic Alteration Agents (HEGAA).

Friederike Frieß

Institute of Safety and Risk Sciences, University of Natural Resources and Life Sciences, Vienna

Friederike Frieß holds a PhD in Physics from Darmstadt University of Technology and currently works as Senior Researcher at the Institute of Safety and Risk Sciences, University of Natural Resources and Life Sciences, Vienna. Friederike is an expert on issues related to nuclear safety, nuclear material management and nuclear proliferation. She is on the board of the International Nuclear Risk Assessment Group (INRAG) and the Research Association Science, Disarmament and Security (FONAS). She participates in various consultancy services regarding nuclear topics.

Elena Gai

Verification Research, Training and Information Centre, London

Elena is a Senior Researcher at VERTIC, where she conducts research and analysis on non-proliferation, disarmament, and arms control. Before joining VERTIC, Elena served in the Office of disarmament, arms control and non-proliferation of the Italian MFA during the Italian G7 Presidency. In the past, she had the opportunity to sharpen her knowledge of nuclear non-proliferation related topics at NATO, the CTBTO and the UN First Committee on Disarmament. Elena graduated cum laude in International Relations and European Studies (MA) at the University of Florence.

Robin Geiß

United Nations Institute for Disarmament Research

Prof. Geiß is the Director of UNIDIR. He brings to the position close to twenty years of experience in peace and security, with focus on the impact of new technologies in these areas. Most recently, he served as Director of the Glasgow Centre for International Law and Security at the University of Glasgow and as the Swiss Chair of International Humanitarian Law with the Geneva Academy of International Humanitarian Law and Human Rights. He was a Visiting Professor at the Paris School of International Affairs at Sciences Po in Paris.

He has managed large-scale research projects and held multiple posts in academia, including as Visiting Professor for the University of Vienna (2017), Distinguished Guest Professor for the Institute for International Peace and Armed Conflict in Bochum (2016), and Visiting Fellow for the German Institute for International and Security Affairs in Berlin (2016). He was a Professor of Public International and European Law at the University of Potsdam (2011-2013) and Research Project Director for the Collaborative Research Center at the Freie Universität Berlin (2014-2017).

He served as Legal Adviser for the International Committee of the Red Cross (ICRC) Legal Division for Geneva/New York (2007-2010) and Geneva (2004-2005). Dr. Geiß holds a Ph.D. in law from the University of Kiel and obtained an LL.M. in international legal studies from the New York University.

Malte Göttsche
Nuclear Verification and Disarmament Group, RWTH Aachen University

Malte Göttsche is junior professor at RWTH Aachen University, where he leads the Nuclear Verification and Disarmament Group. Previously, he was postdoc in Princeton University's Program on Science and Global Security. Göttsche develops concepts and scientific techniques for nuclear disarmament verification. He is a Young Academy Fellow of the North Rhine-Westphalian Academy of Sciences, and a Freigeist Fellow of the Volkswagen Foundation. Göttsche holds a doctorate in physics from the University of Hamburg.

Alexander Graef
Institute for Peace Research and Security Policy at the University of Hamburg

Alexander Graef joined the IFSH as part of the project Arms Control and Emerging Technologies Research in March 2019. He holds a BA in Cultural Studies from the European-University Viadrina and an MA in International Relations from the Free University Berlin and the Moscow State Institute of International Relations (MGIMO). His PhD thesis (2019) at the University of St. Gallen explored Russian experts and think tanks in the field of foreign and security policy. In 2017-2018 Alexander Graef was a Doc.Mobility fellow of the Swiss National Science Foundation at the National Research University Higher School of Economics in Moscow. He is part of the FLEET-network of young experts specialising in security and cooperation in wider Europe, which was founded by the Regional Office of the Friedrich Ebert Foundation (ROCPE) in Vienna.

Sebastian Groth
German Federal Foreign Office

Sebastian Groth was appointed Director for Policy Planning at the German Federal Foreign Office in April 2019. His previous assignments were as Deputy Director for Policy Planning (September 2016 – March 2019), and Head of the State Secretaries' Office (2014 – 2016). From 2010 – 2014, he worked as Adviser for Foreign Policy and French-German relations in the Cabinet of the French Prime Ministers François Fillon, Jean-Marc Ayrault et Manuel Valls. From 2004 – 2010 he was member of the Policy Planning Staff, working on energy and climate policy and on global economic affairs. In 2001, he started his diplomatic career as First Secretary at the German Embassy in Nairobi, Kenya, working on Somalia, South Sudan and Burundi and as Press and Cultural Attaché. Sebastian Groth studied economics and sociology in Cologne and in Montpellier/ France.

Laura Guntrum

Chair of Science and Technology for Peace and Security, Technical University of Darmstadt

Laura Guntrum (M.A.) is a German research associate at the research group for Science and Technology for Peace and Security (PEASEC) at the Department of Computer Science at the Technical University of Darmstadt. Her research interests are intersectional approaches within peace and conflict research (especially feminist issues and social protest movements), dual-use technologies, and political violence.

In her bachelor degree she studied Business and Cultural Studies and European Studies at the University of Passau and at the Rey Juan Carlos University in Madrid. She completed her Master's degree in International Studies/Peace and Conflict Studies at the TUDa and the Goethe University in Frankfurt. She spent a semester abroad at the University of Costa Rica. Besides her studies, Laura Guntrum worked as a freelancer in the field of Global Learning, focusing on sustainability, justice and feminist theory. After her Master's degree, she further completed a training as a peace specialist at the German Civil Peace Service (ZFD).

Mischa Hansel

Institute for Peace Research and Security Policy at the University of Hamburg

Mischa Hansel leads IFSH's research on "International Cybersecurity" (ICS) since February 2021. Previously, he spent several years outside academia, as a program and media officer at the Development and Peace Foundation (sef:) and at the German Aerospace Center (DLR). Between 2013 and 2018, he worked as postdoctoral researcher and lecturer in International Relations at RWTH Aachen University and the University of Giessen respectively. Mischa Hansel studied political science, history, and German language and literature at the University of Cologne, where he completed his PhD with a thesis on conflict and cooperation in the field of international cybersecurity. He also worked as a visiting fellow at George Washington University, the European Space Policy Institute in Vienna, the Vrije Universiteit Amsterdam, and Leiden University.

Katrin Hartwig

Chair of Science and Technology for Peace and Security, Technical University of Darmstadt

Katrin Hartwig is a research associate and PhD student at the Chair of Science and Technology for Peace and Security (PEASEC) in the Department of Computer Science at Darmstadt University of Technology. Her scientific interests lie at the interface of computer science and psychology, especially in the area of fake news, usable security, and human-computer interaction.

Simon Hebel

Centre for Science and Peace Research, University of Hamburg

Simon Hebel is a physicist who has spent much of his career on environmental and nuclear physics related to nuclear disarmament. One focus was the use of radioactive noble gases to verify nuclear arms control treaties, including his dissertation on conducting Krypton measurements for NPT verification. Today, he works mainly on methods and technologies for nuclear disarmament verification.

Frank von Hippel

Program on Science & Global Security, Princeton University

Frank von Hippel is Senior Research Physicist and Professor of Public and International Affairs emeritus at Princeton University where, in 1975, he co-founded and co-chaired for three decades the Program on Science and Global Security. In 2006, he co-founded the International Panel on Fissile Materials and co-chaired it for its first nine years. During 1983-90, he worked with President Gorbachev's advisor, Evgenyi Velikhov, to develop a number of successful initiatives to end nuclear testing, end the production of plutonium and highly enriched uranium for weapons, and eliminate excess weapons materials. He has advised U.S. Administrations and Congress on nuclear security issues since the Carter Administration. During 1993-4, he served as Assistant Director for National Security in the White House Office of Science and Technology Policy and helped develop U.S.- Russian cooperative initiatives on nuclear threat reduction.

Fabian Hoffmann

Defense and Military Analysis Programme, International Institute for Strategic Studies

Fabian is a Research Assistant in the Defence and Military Analysis Programme, providing research and administrative assistance on the IISS' emerging technologies portfolio. In addition, he is also a student at King's College London, where he is currently completing his postgraduate degree in War Studies. Prior to joining the IISS, Fabian completed a research internship with the British American Security Information Council (BASIC), where he supported a project on nuclear weapons policy in the Asia-Pacific region. In addition, Fabian held internship positions at MBDA Germany, the German Institute for Security and International Affairs (SWP) and the German Federal Foreign Office.

Jan Opper

Centre for Science and Peace Research, University of Hamburg

Jan Opper is a PhD Candidate in Political Science, in the Carl Friedrich von Weizsäcker-Centre for Science and Peace Research (ZNF) at the University of Hamburg's Interdisciplinary Research Group for the Analysis of Biological Risks (INFABRI). His dissertation studies the regulation of life science experiments with security implications.

Moriba Jah

Department of Aerospace Engineering and Engineering Mechanics, University of Texas at Austin

Dr. Moriba Jah joined the Department of Aerospace Engineering and Engineering Mechanics in 2017. His research interests are in non-gravitational astrodynamics and advanced/non-linear multi-sensor/object tracking, prediction, and information fusion. His expertise is in space object detection, tracking, identification, and characterization, as well as spacecraft navigation. He received his B.S. in Aerospace Engineering from Embry-Riddle Aeronautical University, Prescott, Arizona, and his M.S. and Ph.D. in Aerospace Engineering Sciences from the University of Colorado at Boulder specializing in astrodynamics and statistical orbit determination.

Prior to being at UT Austin, Dr. Jah was the Director of the University of Arizona's Space Object Behavioral Sciences with applications to Space Domain Awareness, Space Protection, Space Traffic Monitoring, and Space Debris research to name a few. Preceding that, Dr. Jah was the lead for the Air Force Research Laboratory's (AFRL) Advanced Sciences and Technology Research Institute for Astronautics (ASTRIA) and a Principal Investigator for Detect/Track/Id/Characterize Program at AFRL's Space Vehicles Directorate. Before joining AFRL in 2007, he was a spacecraft navigator for NASA's Jet Propulsion Laboratory (JPL) in Pasadena, CA, serving on Mars Global Surveyor, Mars Odyssey, Mars Express (joint mission with ESA), Mars Exploration Rovers, Hayabusa (joint mission with JAXA), and the Mars Reconnaissance Orbiter.

Dr. Jah is a world-recognized subject matter expert in astrodynamics-based Space Domain Awareness sciences and technologies with 75+ publications in peer-reviewed journals, conferences, and symposia. He's been an invited lecturer and keynote speaker at 20+ national and international space events, workshops and fora.

Gunnar Jeremias
Centre for Science and Peace Research, University of Hamburg

Gunnar Jeremias is head of the Interdisciplinary Research Group for the Analysis of Biological Risks at the Center for Science and Peace Research at Hamburg University (ZNF/INFABRI). He holds a PhD in political Sciences and is currently leader of the BMBF-financed junior research group BIGAUGE. Gunnar's main research interests are biological arms control, governance of emerging risk technologies, and ethics in science.

Peter Jones
Graduate School of Public and International Affairs, University of Ottawa

Dr. Peter Jones is an Associate Professor at the University of Ottawa, Canada. Prior to joining academe, he was a civil servant and was deeply involved in the negotiation of the Open Skies Treaty. He is the author of: *Open Skies: Transparency, Confidence-building and the End of the Cold War*, (Stanford University Press).

Benjamin Jung
Nuclear Verification and Disarmament Group, RWTH Aachen University

Benjamin Jung completed a Bachelor's and a Master's degrees in physics at RWTH Aachen University. During the research phase of the Master's degree, he focused on nuclear disarmament, specifically nuclear archaeology and the Isotope Ratio Method. The final thesis entailed a study of uncertainties of the Isotope Ratio Method. Currently Benjamin is working at the Nuclear Verification and Disarmament group at RWTH Aachen and starting research for his PhD studies.

Monica Kaminska

The Hague Program for Cyber Norms, Leiden University

Monica Kaminska is a postdoctoral researcher at The Hague Program for Cyber Norms at Leiden University – Institute of Security and Global Affairs. Monica's research examines international cyber conflict, particularly states' responses to hostile cyber operations. Conceptually, Monica's work applies theories and frameworks of "risk management" drawn from international relations and sociology to analyse how states address the uncertainties inherent in the cyber domain. Previously, she worked on projects investigating political polarization and misinformation on social media in electoral contexts, a topic that she continues to explore today. Monica is currently finishing her PhD in Cyber Security at Oxford University. At Oxford, she was a Research Affiliate at the Centre for Technology and Global Affairs, where she coordinated the work of the Cyber Studies Programme. During this time, she also served as an expert contributor for Oxford Analytica. Monica previously worked in the professional services sector in London and also has experience with the UK Foreign and Commonwealth Office. Outside of her academic work, Monica has a strong interest in malware research and cybersecurity threat intelligence.

Martin Kalinowski

Scientific Methods Section, Comprehensive Nuclear-Test-Ban Treaty Organization

Dr. Martin B. Kalinowski is Head, Scientific Methods Section, of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) in Vienna, Austria. Before re-joining the CTBTO in 2012, he served as Professor for Science and Peace Research at the University of Hamburg, Germany. Dr. Kalinowski holds a PhD in nuclear physics and his main expertise is on effective strategies and analysis methodologies for environmental sample analysis, specifically for nuclear explosion monitoring.

Alexander Kelle

Institute for Peace Research and Security Policy at the University of Hamburg

Alexander Kelle is Senior Researcher in the project "Investigating and penalizing chemical weapons use" at the IFSH Berlin Office. Previously he was a Senior Policy Officer in the Office of Strategy and Policy of the Organisation for the Prohibition of Chemical Weapons (2013-2019).

Lucas Kello

Department of Politics and International Relations, University of Oxford

Lucas Kello is Associate Professor of International Relations at Oxford University. He serves as Senior Lecturer/Director of the Centre for Technology and Global Affairs, a major research initiative exploring the impact of modern technology on international relations, government, and society. He is also Co-Director of the interdisciplinary Centre for Doctoral Training in Cyber Security at the Department of Computer Science. His publications include The Virtual Weapon and International Order (Yale University Press), "The Meaning of the Cyber Revolution: Perils to Theory and Statecraft" in International Security, and "Security" in The Oxford Companion to International Relations (Oxford University Press).

Michal Krelina
Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University

Michal Krelina has a PhD in experimental nuclear physics from the Czech Technical University (CTU) in Prague. After his postdoctoral position at Universidad Tecnica Federico Santa Maria in Chile, he returned as a research scientist to CTU. Currently, he is a vising scientist at Heidelberg University. He is also founder, principal researcher, and consultant at Quantum Phi in Prague, Czech Republic. His areas of interest are theoretical high energy particle and nuclear physics, and quantum technologies with emphasis on applications for defence, space, and security sector and quantum technology risk and threat assessment.

Paige Kunkle
Department of Physics, Boston University

Paige Kunkle is a graduate student in physics at Boston University, working on neutrino-related topics.

Moritz Kütt
Institute for Peace Research and Security Policy at the University of Hamburg

Moritz Kütt is a senior researcher in the research area "Arms Control and Emerging Technologies" at the Institute for Peace Research and Security Policy at the University of Hamburg (IFSH). Prior to his time in Hamburg, he was a Postdoctoral Research Associate at Princeton University's Program on Science and Global Security. In his research, he develops new approaches and innovative tools for verification of nuclear arms control, non-proliferation and disarmament agreements.

Daniel Lambach
Research Centre 'Normative Orders', Goethe University Frankfurt

Daniel Lambach is a Heisenberg Postdoctoral Fellow at the Cluster of Excellence 'The Formation of Normative Orders' at the Goethe-Universität Frankfurt. He is also a Fellow of the Institute for Development and Peace at the University of Duisburg-Essen. He holds a Dr. rer. pol. (PhD) in Political Science from the University of Cologne (awarded 2006) and has previously worked at the University of Duisburg-Essen (2007-2018), the German Institute of Global and Area Studies (2006-2007) and the University of Marburg (2003-2004).

Filippa Lentzos
Centre for Science and Security Studies, King's College

Dr Filippa Lentzos is a Senior Lecturer in Science & International Security, with a joint appointment in the Department of War Studies and the Department of Global Health & Social Medicine. She also serves as Co-Director of the Centre for Science and Security Studies (CSSS). Dr Lentzos' research and teaching are broadly focused on biological threats and biosecurity. She has published widely on issues related to transparency, confidence-building and compliance assessment of biodefence programmes and high-risk bioscience; emerging technologies, governance and responsible innovation; information warfare and deliberate disinformation related to global health security; and intelligence, biological threat assessment and intelligence-academia engagement. A biologist and social scientist by training, Dr Lentzos has researched and been actively involved in biological disarmament and non-proliferation

for 20 years. She serves as the NGO Coordinator for the Biological Weapons Convention. She is also an Associate Senior Researcher at the Stockholm International Peace Research Institute (SIPRI); a biosecurity columnist at the Bulletin of the Atomic Scientists and Co-Chair of the IEEE Industry Connections program on 'Driving responsible innovation of AI, life sciences and next generation biotech'. She regularly consults for the United Nations and the World Health Organization.

Dr. Patricia Lewis
Chatham House

Dr Patricia Lewis leads the International Security programme at Chatham House. Previously she served as deputy director and scientist-in-residence at the Center for Nonproliferation Studies at the former Monterey Institute of International Studies; director of the UN Institute for Disarmament Research; and director of the Verification Research, Training and Information Centre in London. She was on Hans Blix's 2004–06 WMD Commission; the 2010–11 advisory panel on the future priorities of the Organisation for the Prohibition of Chemical Weapons; and was an adviser to the 2008–10 International Commission on Nuclear Non-proliferation and Disarmament. She received the American Physical Society's 2009 Joseph A Burton Forum Award for 'outstanding contributions to the public understanding or resolution of issues involving the interface of physics and society'. She has a PhD in Nuclear Physics from Birmingham University and graduated in Physics from Manchester University.

Dr. Rosamund Lewis
World Health Emergencies Programmes, World Health Organization

Dr Rosamund Lewis heads the WHO Smallpox Secretariat of the WHO Health Emergencies Programme Emerging Diseases and Zoonoses Unit in Geneva, Switzerland, leading on emergency preparedness and advising on health security for the agency. Dr Lewis joined the WHO COVID-19 response team as the health sciences lead for management of infodemics. A public health physician with an early career in family and emergency medicine, Rosamund has served WHO, the Government of Canada and other agencies at global, national and municipal levels in emergency preparedness and health security, disease surveillance and response, offering country support for a range of immunization and disease control programmes. Other roles focussed on field epidemiology in emergency settings (MSF/ Epicentre) and new vaccines and health systems (GAVI / CIDA). Along with a Bachelor of Science and medical degree from McGill University, Rosamund holds a Master of Science in Epidemiology and Biostatistics, a Master of Management in Health Leadership, and fellowships in Family Medicine and Public Health and Preventive Medicine and has published extensively in her areas of work. Rosamund holds an appointment as Adjunct Professor in the School of Epidemiology and Public Health, University of Ottawa.

Wolfgang Liebert
Institute of Safety and Risk Sciences, University of Natural Resources and Life Sciences, Vienna

Professor and head of the Institute of Safety/Security and Risk Sciences (ISR) at University of Natural Resources and Life Sciences (BOKU) Vienna. PhD in physics. 1999-2012 Scientific Director of the Interdisciplinary Research Group in Science, Technology and Security (IANUS) of Technical University Darmstadt and Lecturer at the Institute of Philosophy. Main interests in research and teaching: science and technology assessment, arms control, nuclear and energy technologies, ethics.

Francesco Mancuso

International Relations, Strategy, and Security Faculty, Nueva Granada Military University

Francesco Mancuso is Ph.D. in Geopolitics of the University of Pisa, Italy. He is a full professor of the International Relations, Strategy, and Security Faculty at Universidad Militar Nueva Granada in Colombia, Campus Nueva Granada. Luisa García is an Electronics Engineer from Pontificia Universidad Javeriana, Colombia with a Ph.D. in Social and Human Sciences. Since 2003, she has worked as a professor in engineering design and digital systems design at several universities in Colombia.

Erik Melander

Alva Myrdal Centre for Nuclear Disarmament, Uppsala University

Erik Melander is the incoming director of the Alva Myrdal Centre for Nuclear Disarmament. He is professor in the Department of Peace and Conflict Research at Uppsala University. He was previously the Director of the Uppsala Conflict Data Program (UCDP). His research interests include the causes and dynamics of armed conflict, peace processes, and the role of gender.

Catrin Misselhorn

Department of Philosophy, University of Göttingen

Catrin Misselhorn holds a Chair for philosophy at the University of Göttingen. From 2012 until 2019 she was Chair for the Philosophy of Science and Technology at the University of Stuttgart. Prior she was visiting professor at the Humboldt University in Berlin, the University of Zürich and the University of Tübingen. In 2003 she received her PhD at and in 2010 she finished her habilitation the University of Tübingen. 2007-2008 she was Feodor Lynen research fellow at the Center of Affective Sciences in Geneva, at the Collège de France and the Institut Jean Nicod for cognitive science in Paris.

Her main research areas are philosophical problems in AI, robot- and machine ethics. She is leading a number of third party funded projects on the ethical assessment of assistive systems in different areas, for instance, in care, at the workplace and in education.

Linda Monsees

Center for Governance of Emerging Technologies, Institute of International Relations Prague

Linda Monsees (PhD, 2017) is an international relations scholar working on the politics of digital security. Her most recent research deals with the social values of cyber-risks funded by the AXA-research grant. Before that she has worked at Queen Mary University of London and Goethe University Frankfurt. She has worked on digital encryption, surveillance and security. Her research has been published in Security Dialogue, Critical Studies on Security, European Review of International Studies and Internet Policy Review.

Anna Nadibaize
Center for War Studies, University of Southern Denmark

Anna Nadibaidze is a PhD Student at the Center for War Studies, University of Southern Denmark, where she researches the development and use of weaponised Artificial Intelligence in Russia. She is also a member of the AUTONORMS research project, which looks at how norms related to Autonomous Weapons Systems are shaped through practices. She holds an MSc in International Relations from the LSE and a BA in Political Science from McGill University.

Götz Neuneck
Institute for Peace Research and Security Policy at the University of Hamburg

Götz Neuneck is Senior Research Fellow at the IFSH and Professor at the MIN Faculty at the University of Hamburg. He is an expert in arms control, disarmament, new technologies, nuclear weapons, verification, science diplomacy, missile defence and space armament. From 2008 – 2018 he was scientific director of the postgraduate "Peace and Security Studies" Master's programme at the University of Hamburg. He is a member of the Council of the "Pugwash Conferences on Science and World Affairs", Pugwash representative of the Verband Deutscher Wissenschaftler (VDW) and chairman of the working group "Physik und Abrüstung" / Physics and Disarmament of the DPG, as well as member of editorial boards of specialist publications, and Amaldi representative of the Union of German Academies of Science and Humanities, elected foreign member of the Russian and Armenian Academy of Science. After completing his degree in physics in Düsseldorf in 2984, he was part of the working group of Horst Afheldt and Carl-Friedrich von Weizsäcker run by the Max Planck Society in Starnberg. After receiving his PhD in Mathematics (Dr. rer. nat. 1985) at the University of Hamburg, he became a researcher at the IFSH under Egon Bahr.

Irmgard Niemeyer
Nuclear Safeguards and Security, Forschungszentrum Jülich GmbH

Irmgard Niemeyer is head of the Nuclear Safety and Safeguards Division at Forschungszentrum Jülich. Her responsibilities include the scientific coordination of programs in international safeguards, nonproliferation and disarmament. Niemeyer is member of the Standing Advisory Group on Safeguards Implementation, the International Partnership for Nuclear Disarmament Verification, and the UN Governmental Group of Experts on Nuclear Disarmament Verification (2021/22). She holds a doctorate in geography from the University of Bonn.

Tatyana Novossiolova
Center for the Study of Democracy, Bulgaria

Dr Tatyana Novossiolova is a Research Fellow with the Law Program of the Center for the Study of Democracy, Bulgaria where she conducts policy research and analysis on security issues, including CBRN risk governance, counter-radicalisation, and counter-terrorism. She is experienced with the development and use of interactive training resources intended to facilitate life sciences stakeholder engagement with biological security.

Carlos M. Nupia

German-Colombian Peace Institute

Administrative Director of the CAPAZ Institute. PhD in Political Science, Freie Universität Berlin-FUB. Researcher in topics of scientific international cooperation, international organizations, international transfer knowledge and institutional change in public policies. I am currently investigating the interface between science, knowledge production and public policy to face the transition process to peace in Colombia. I have worked with WFP, UNDP, the Colombian Observatory of Science and Technology and the Colombian Ministry of Science, among other institutions.

Cormac O'Reilly

Organisation for the Prohibition of Chemical Weapons

With a background in legal practice as a barrister-at-law, Cormac O'Reilly has worked for the last twenty years in international relations and non-proliferation and disarmament policy including as a diplomatic officer with the Irish Foreign Ministry, External Relations Officer at the Comprehensive Nuclear-Test-Ban Treaty Organization, and now as Senior Policy Officer with the Organisation for the Prohibition of Chemical Weapons.

Bao-Chau Pham

Department of Science and Technology Studies, University of Vienna

Bao-Chau Pham is a PhD student at the Department of Science and Technology Studies, University of Vienna. She completed her undergraduate studies in International Relations at the University of St Andrews and holds a Master's degree from the War Studies Department, King's College London. For her PhD she explores the co-production of artificial intelligence and society, especially in security settings, as well as public sense-making and the governance of artificial intelligence.

Pavel Podvig

United Nations Institute for Disarmament Research

Pavel Podvig is a Senior Research Fellow at the UN Institute for Disarmament Research and a researcher with the Program on Science and Global Security at Princeton University. His current research focuses on technical and political aspects of nuclear disarmament, nuclear disarmament verification, and U.S.-Russian arms control process.

Shannon Kimberly Potts

Nuclear Safeguards and Security Division, Forschungszentrum Jülich GmbH

Shannon Kimberly Potts is PhD student at Forschungszentrum Juelich GmbH in the Nuclear Safeguards and Security division of the Institute of Energy and Climate Research – IEK-6: Nuclear Waste Management and Reactor Safety. She studied chemistry at the RWTH Aachen University (Germany) and started her PhD last year in the field of materials science of nuclear materials with focus on microparticles as reference materials for particle analysis in nuclear safeguards.

Guangyu Qiao-Franco
Center for War Studies, University of Southern Denmark

Dr Guangyu Qiao-Franco is a postdoctoral fellow at the Centre for War Studies, Southern Denmark University. She earned her PhD in Arts (international relations) from the University of Melbourne. Her research interests include autonomous weapons systems, policy diffusion, practice theories, climate change, human trafficking and international organisations. Her recent work appeared in Practice Review, International Relations of the Asia Pacific and Policy Studies.

Lindsay Rand
Center for International and Security Studies at Maryland, University of Maryland

Lindsay Rand is a PhD student at the University of Maryland School of Public Policy and a research fellow at the Center for International and Security Studies at Maryland (CISSM). Rand's research focuses on the intersection of science and policy in international security. Her dissertation will examine the implications of quantum sensing on strategic stability and nuclear force structure. Rand has an MS from Georgetown University and a BA in physics and classical history from Carleton College.

Thomas Reinhold
Chair of Science and Technology for Peace and Security, Technical University of Darmstadt

Thomas Reinhold is a research assistant at the Chair of Science and Technology for Peace and Security (PEASEC) at TU Darmstadt. He deals with the increasing militarization of the cyberspace and the influence of artificial intelligence on military developments, especially regarding questions of disarmament and arms control.

Christian Reuter
Chair of Science and Technology for Peace and Security, Technical University of Darmstadt

Christian Reuter is Full Professor at Technical University of Darmstadt. His chair Science and Technology for Peace and Security (PEASEC) in the Department of Computer Science with secondary appointment in the Department of History and Social Sciences combines computer science with peace and security research. On the intersection of the disciplines (A) Human-Computer Interaction, (B) Cyber Security and Privacy as well as (C) Peace and Conflict Studies he and his team specifically address (1) Crisis Informatics and Information Warfare, (2) Usable Safety, Security and Privacy as well as (3) Technical Peace Research.

Luke Richards
Stockholm International Peace Research Institute

Luke Richards is a Research Assistant working on emerging military and security technologies where he is currently focusing on responsible innovation and artificial intelligence. He has formerly interned at SIPRI during which he worked on the security implications of human enhancement. His interests lay at the intersection of science, technology, innovation and international affairs, themes of which featured in his MSc dissertation, 'The Civil-Military Entanglement of Global Innovation'. Prior to joining SIPRI, he worked at the International Institute for Strategic Studies where he was involved with a project that sought to create a methodology for understanding the cyber power of states. He is also involved in a number of projects around technology and has previously presented his work at the European Workshops in International Studies.

Thea Riebe

Chair of Science and Technology for Peace and Security, Technical University of Darmstadt

Thea Riebe is a research associate and PhD student at the Chair of Science and Technology for Peace and Security (PEASEC) in the Department of Computer Science at Technical University of Darmstadt. Her research focusses on questions of computer science and peace and conflict studies, crisis informatics, as well as interdisciplinary approaches to dual-use and responsible research and innovation.

Johannes Rundfeldt

AG KRITIS

Johannes Rundfeldt joined the Pirate Party in 2007 out of curiosity about base democracy and internet policy, but left again in 2009. This first experience sparked his interest in digital policy deeply. From 2011-2013 and from 2017 to 2019, he worked for Jimmy Schulz MdB in his Bundestag office and moved to the office of Mario Brandenburg, MdB in 2020. In his spare time he is involved in c-base e.V., LOAD e.V. and sometimes in the CCC. Together with others, he founded the AG KRITIS in 2017, of which he is also a speaker. He is also a board member of the European Society for Digital Sovereignty e.V..

Jonas Sandbrink

Future of Humanity Institute, University of Oxford

Jonas Sandbrink is a medical student at the University of Oxford. He has a background in infection and immunology, has worked with leading vaccine researchers and published on platform vaccine technologies. Working with the Future of Humanity Institute, University of Oxford, he has published on the dual-use potential of vaccines and related technologies. He is a consultant to the Nuclear Threat Initiative on biosecurity and dual-use regulation pertaining to the Global Health Security Index.

Max Schalz

Nuclear Verification and Disarmament Group, RWTH Aachen University

Max Schalz is a PhD student in physics at the Nuclear Verification and Disarmament Group at RWTH Aachen University, Germany, where he also obtained his physics master's degree. His research focuses on the reconstruction of comprehensive nuclear fuel cycles and uranium enrichment. Apart from that, he is interested in the political aspects of verification.

Jürgen Scheffran

Research Group Climate Change and Security, University of Hamburg

Jürgen Scheffran is professor in geography at Universität Hamburg and chair of the Research Group Climate Change and Security at CLICCS Cluster of Excellence and Center for Earth System Research and Sustainability. He had positions at the universities of Marburg, Darmstadt, Illinois and Potsdam Institute for Climate Impact Research. Research fields include: climate security, environmental conflict and migration, complexity and sustainability, technology assessment and arms control of missiles, space and nuclear weapons.

Stefka Schmid
Chair of Science and Technology for Peace and Security, Technical University of Darmstadt

Stefka Schmid is a research associate and PhD student at the Chair of Science and Technology for Peace and Security (PEASEC) in the Department of Computer Science at Technical University of Darmstadt. Her scientific intersts lie in technical peace and conflict studies, crisis informatics, and interdisciplinary approaches to responsible research and innovation.

Niklas Schörnig
Peace Research Institute Frankfurt

Dr. Niklas Schörnig is Senior Researcher at the Peace Research Institute Frankfurt and head of PRIF's research group on Emerging Technology, Order and Stability (rETOS).

Ursula Schröder
Institute for Peace Research and Security Policy at the University of Hamburg

Ursula Schröder has been Director of the Institute for Peace Research and Security Policy at the University of Hamburg and Professor of Political Science, in particular Peace Research and Security Policy, at the University of Hamburg since 2017. She was previously Professor of International Security Policy at the Otto Suhr Institute for Political Science at Free University of Berlin. She studied at Humboldt Universität Berlin, Freie Universität Berlin as well as at the University of Wales in Aberystwyth, Wales, and received her doctorate from the European University Institute in Florence, Italy.

Sebastian Schwartz
Chair of Science and Technology for Peace and Security, Technical University of Darmstadt

Sebastian Schwartz (M.A.) is a German research associate at the research group for Science and Technology for Peace and Security (PEASEC) at the Department of Computer Science at Technical University of Darmstadt (TUDa). His scientific interests lie in the field of technical peace and conflict research and strategic studies. His research focuses on autonomous systems, human-machine teaming, the automation of war and the social impact of autonomous systems.

The interdisciplinary lateral thinker and sci-fi enthusiast with international professional experience in the digital and mobility sector studied International Studies/Peace and Conflict Studies at the Goethe University Frankfurt, TU Darmstadt, and Chung-Ang University Seoul, as well as Social Sciences and History at the University of Erfurt and Vilniaus Universitetas.

Lijun Shang
Center for the Study of Democracy, Bulgaria

Professor Lijun Shang is a Professor of Biomedical Sciences at the School of Human Sciences. In recent years he expanded his research interests into biological and chemical weapons and science convergence. Since 2020, he is leading a series of projects in the effort to provide a civil society input into the broad Biological and Toxin Weapons Convention (BTWC) and the Chemical Weapons Convention (CWC) threat spectrum and the measures we would wish to work on with the Parliament.

Jantje Silomon

Institute for Peace Research and Security Policy at the University of Hamburg

Jantje Silomon joined IFSH as a researcher in April 2019 and became part of the "International Cybersecurity" (ICS) team in January 2021. Previously, Jantje was based at the University of Oxford, conducting her doctoral research on the topic of malware weaponisation. She completed her BSc in Computer Science, before spending some time in South East Asia, predominantly China. Upon returning to the UK, she worked in academia and industry, while also gaining an MRes in International Security and Global Governance.

Arne Sönnichsen

Chair of International Relations and Development Policy, University of Duisburg-Essen

Arne Sönnichsen is PhD candidate in International Relations with a project on how technologies affect international governance at University of Duisburg-Essen. Together with Daniel Lambach he is coordinator of the DSF funded SichTRaum network dealing with issues of security and technology in outer space.

Hartwig Spitzer

Centre for Science and Peace Research, University of Hamburg

Dr. Hartwig Spitzer is retired professor of physics at Universität Hamburg, Germany. He has observed since 2005 as a consultant the work of the sensor group of the Open Skies Consultative Commission (OSCC) in Vienna.

Wilfred Wan

United Nations Institute for Disarmament Research

Wilfred Wan is Lead Researcher in the WMD and Other Strategic Weapons Programme at UNIDIR. He has published on issues of nuclear risk and risk reduction, sanctions, and the non-proliferation regime, and is the author of Regional Pathways to Nuclear Non-Proliferation (University of Georgia Press, 2018).

Hans-Georg Weinig

Organisation for the Prohibition of Chemical Weapons

Dr Weinig is the 2021 Chairperson of the OPCW Advisory Board on Education and Outreach. He serves as inaugural member of the Board since 2016, now in his 2nd and final term of office. In 2015 he took part in the OPCW preparatory workshops for the establishment of The Hague Ethical Guidelines. In his professional affiliation, he is Director Education, Career and Science at the German Chemical Society (GDCh). He holds a PhD in Organic and Bioorganic Chemistry from Humboldt University Berlin.

Moritz Weiss

Chair of International Relations, Ludwig Maximilian University of Munich

Moritz Weiss is a senior lecturer in International Relations at the LMU University of Munich. His research focuses on the governance of international security and technological innovation. He has completed the DFG-funded research project "Diversity or convergence? Explaining the development of defense-industrial policies". Moritz Weiss has published, among others, in Governance, Review of International Political Economy, Journal of European Public Policy, Journal of Global Security Studies, European Journal of International Security, and Security Studies.

Carmen Wunderlich

Chair of International Relations and Development Policy, University of Duisburg-Essen

Dr. Carmen Wunderlich is a Senior researcher and lecturer at the University of Duisburg-Essen at the Chair of International Relations and Development Policy and a research fellow at the Peace Research Center Prague (PRCP). Prior to that she was employed at the Peace Research Institute Frankfurt (PRIF) as a doctoral student in the program area "International Security" and worked as postdoc in the transfer project "Society Extreme: Radicalization and De-Radicalization in Germany" (Gesellschaft Extrem: Radikalisierung und De-Radikalisierung in Deutschland). In the context of her dissertation on "rogue states" as norm entrepreneurs, she was a visiting scholar at the Berlin Social Science Center and the Vienna Center for Disarmament and Non-Proliferation (VCDNP). She earned her doctorate at the Goethe University Frankfurt in 2016.

Marianna Yevtodyeva

Group of Military and Economic Globalization Processes, Primakov National Institute of World Economy and International Relations

Head of the group of military and economic globalization processes in the Primakov National Institute of World Economy and International Relations (IMEMO). Before joining IMEMO worked as a military analyst at the "Krasnaya Zvezda" newspaper under the Russian Ministry of Defence. Member of the Russian Pugwash Commitee. The author of many publications in the media and scientific journals on conventional arms control, military-technical cooperation, and new technologies in the military sphere.

Martin Ziegler

School of Computing, KAIST

Martin Ziegler was professor of Mathematical Logic at TU Darmstadt and spokesperson of the IANUS group on Technology Assessment. Since 2015 he is professor of Computer Science at KAIST and increasingly interested in questions of pedagogy and education (also regarding his own children).

Monica Zoppè

Institute of Biophysics, National Research Council of Italy

Monica Zoppè is a biologist at the Institute of BioPhysics in Milano, Italy. Her research spans different topics in biomedical research: cellular biology, molecular animation and representation, scientific communication, and includes themes of social aspects of research. She has been specifically interested in biological weapons and dangerous research, from a pacifist perspective, since the early 2000s.