Princeton School on Science and Global Security

Held jointly with the Abdus Salam International Centre for Theoretical Physics

Trieste, Italy, July 26–31, 2026

Book of Abstracts

SCIENCE & GLOBAL SECURITY
PRINCETON UNIVERSITY

ICTP The Abdus Salam International Centre for Theoretical Physics

PUBLISHED BY THE PROGRAM ON SCIENCE AND GLOBAL SECURITY, PRINCETON UNIVERSITY

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First printing, July 2026 (Revision 0)

The Princeton School on Science and Global Security

The Princeton School on Science and Global Security, launched in 2020, trains next-generation scientists and engineers from around the world in technical perspectives on understanding, reducing, and ending the threat from nuclear weapons. The goal is to provide skills and insights that participants can use in their own research, encourage and inspire them to investigate new ideas to advance global security and a safer and more peaceful world and to foster an international community of such researchers. The School is organized by Princeton University's Program on Science and Global Security (SGS), part of the School of Public and International Affairs. The meeting includes presentations by invited graduate students, post-doctoral researchers and established researchers on topics such as nuclear weapon effects, space security, nuclear proliferation, artificial intelligence, the Treaty on the Prohibition of Nuclear Weapons, and the role of scientists.

History

The Princeton School on Science and Global Security traces its origins to the international School on Science and World Affairs organized by the forerunner of the Program on Science and Global Security and the Moscow Institute of Physics and Technology held over eight days in September 1989 outside Moscow. Princeton hosted the second International Summer School on Science and World Affairs in August 1990. The two schools grew out of discussions between the U.S. physicist Frank von Hippel and the Soviet physicist Roald Sagdeev about the lack of a younger generation of Russian scientists knowledgeable about arms control issues. These discussions also led to the publication of a new international journal, *Science & Global Security,* with an initial editorial board of U.S. and Soviet scientists. These meetings became known as the International Summer Symposium on Science and World Affairs. Since the first meeting in 1989, these gatherings have hosted over 700 scientists and researchers from almost 50 countries.

The Program on Science and Global Security

Princeton University's Program on Science and Global Security (SGS), based in the School of Public and International Affairs, conducts scientific, technical and policy research, analysis and outreach to advance national and international policies for a safer and more peaceful world. The Program was founded in 1974 by Harold Feiveson (1935–2025) and Frank von Hippel. Throughout its history, SGS has worked on nuclear arms control, nonproliferation, and disarmament to reduce the dangers from nuclear weapons and nuclear power. SGS works to understand and reduce the risks from nuclear weapons and the strategies, postures, forces and policies of the nine nuclear armed states. SGS also works on satellite imagery, nuclear weapon and nuclear war effects, proliferation risks of nuclear and fusion energy, and dual-use aspects of AI and robotics. SGS does research to support the 2017 United Nations Treaty on the Prohibition of Nuclear Weapons and the goal of the verified and irreversible elimination of all nuclear weapons and weapon programs. SGS is home to *Science & Global Security,* the leading academic peer-reviewed journal for technical arms-control analysis. SGS provides training opportunities for post-doctoral and senior scientists interested in science and security policy. It has helped train technical nuclear arms control and nonproliferation researchers from around the world.

The Abdus Salam International Centre for Theoretical Physics

The Abdus Salam International Centre for Theoretical Physics (ICTP) was founded in 1964 in Trieste, Italy, by Pakistani Nobel Laureate in Physics Abdus Salam. It is supported by the Italian government, the International Atomic Energy Agency (IAEA) and the United Nations Educational, Scientific and Cultural Organization (UNESCO). ICTP supports research groups in several areas of physical sciences, mathematics, and interdisciplinary science. It provides opportunities to scientists especially from the Global South. It is committed to science advocacy and international cooperation through science by providing an forum for scientists from all countries. Each year, ICTP brings together more than 6,000 world-leading and early career scientists from more than 150 countries to participate in advanced workshops and conferences. ICTP believes that solving the crises faced by our world, including climate change, nuclear security, pandemics, and ensuring our food supply, requires a global response that transcends national borders.

Participants and Abstracts



Mona Amer
University of British Columbia

Application of Artificial Intelligence and Large Language Models in Modern Warfare

Abstract. Modern warfare has reached another level of unpredictability through the use of artificial intelligence (AI). Lethal autonomous weapons based on AI have been used extensively in the Russia-Ukraine War or Israel's genocide in Gaza. They can obscure the responsibility and remove accountability from humans. The U.S.-Israeli war on Iran demonstrated AI's role in decision support on the battlefield. A comprehensive understanding of how AI and large language models (LLMs) are utilized on the battlefield is necessary to reduce the lack of controllability and accountability.

This study investigates the role of AI and LLMs in modern warfare by looking at the technologies applied and the data used for training. Recent reports on AI-supported battlefield decisions and the impact of automation bias are reviewed. Finally, the special risks that could result from incorporating AI into nuclear weapons command and control will be studied by means of a fictional case study.

Biography. Fascinated by natural sciences and their application, I decided to pursue studies in mechanical engineering. I was always interested in the theoretical, more math-oriented portion of engineering, so I continued my path in Applied Mechanics and focused on Mechanical Vibrations in my PhD. During my master program, I started thinking how I can use my skills for the greater good. I decided to do an internship in development aid and became more politically active. In my current postdoc, I research wind energy in seismic-prone areas and keep exploring opportunities to work more interdisciplinary to achieve just transitions in various areas.



Denia Djokić
University of Michigan

Governing Advanced Nuclear Energy: Anticipating Global Risks

Abstract. Small modular reactors (SMRs) and other emerging advanced nuclear energy technologies have been gaining attention as solutions to energy insecurity, climate change, and growing global energy demands driven by urbanization and AI infrastructure. Yet the accelerating development and anticipated implementation of SMRs threatens to outpace the governance frameworks needed to manage their broader systemic societal risks. The University of Michigan report *The Reactor Around the Corner: Understanding Advanced Nuclear Energy Futures* applies an analogical case study method examining the history of past technologies similar in form, function, or potential impacts to anticipate the societal, environmental, ethical, equity, and geopolitical implications of widespread SMR adoption. It provides policy recommendations for governing the development and implementation of advanced nuclear energy for the public interest. In my presentation, I will discuss relevant findings from this report, focusing on the geopolitical implications of SMRs.

Biography. Denia Djokić is an Assistant Research Scientist at the University of Michigan's Department of Nuclear Engineering and Radiological Sciences, where she researches the social, political, equity, and environmental justice dimensions of nuclear energy and waste. She holds a PhD and MS in nuclear engineering from the University of California, Berkeley, and a BS in physics from Carnegie Mellon University. She has been a Levenick Resident Scholar in Sustainability Leadership at the University of Illinois at Urbana-Champaign, a fellow at the Harvard Kennedy School's Project on Managing the Atom, a fellow at Harvard's Program on Science, Technology and Society, and a science policy advisor for the Ecuadorian government.



Noelle Dwyer (she/they)
San José State University

Impact of Nuclear Fires on Emissions and Plume Development

Abstract. Any nuclear weapon detonation would have global consequences. Exploded over a city, nuclear weapons can cause mass fires. Black carbon lofted into the stratosphere as a result of nuclear fire can absorb and block incoming solar radiation (i.e., nuclear winter), triggering widespread agricultural losses, food insecurity, and additional casualties. Here we present a new framework to assess the contribution of nuclear-driven urban fires to black carbon emissions and their vertical distribution in the atmosphere with the coupled fire-atmosphere model WRF-SFIRE. This framework parameterizes nuclear ignition as a function of weapon yield, burst height, and topography and simulates subsequent fire spread through the urban environment according to building geometry and flammability. To account for the difference in emissions from burning biomass and petrochemical urban materials, characteristic time profiles are used. As a result, the model yields increases in heat fluxes, total energy, and black carbon emission heights relative to prior studies for an equivalent fuel load.

Biography. Noelle Dwyer is a graduate researcher at San José State University in Wildfire Meteorology. Noelle has an undergraduate degree in Engineering and GIS from the George Washington University, and has worked as a GIS analyst in the disaster management space. As a GIS Analyst, Noelle worked with state and local governments to identify where vulnerable communities and critical infrastructure overlapped, and create natural disaster response plans.



Gerson Esquivel García
University of Wisconsin at Madison

Evaluating the Direct and Cascading Effects of Nuclear War in Mexico

Abstract. Mexico is a member of the Latin American nuclear-weapon-free zone and a party to the UN Treaty on the Prohibition of Nuclear Weapons. Yet, as a proximate and economically integrated neighbor of the United States, a nuclear-armed state, Mexico remains exposed to the consequences of nuclear conflict.

This study revisits and updates Cold War-era assessments of nuclear war impacts in Mexico. We evaluate the cross-border effects of nuclear explosions aimed at destruction of U.S. military installations, critical infrastructure, and key economic targets near the U.S.–Mexico border, including radioactive fallout and extend the analysis to examine the indirect cascading economic consequences from such attacks. To do so, we employ a new target database and couple a nuclear war effects simulator with a global market-equilibrium model. Our results show that disruptions to energy and transport systems amplify impacts through tightly coupled supply chains between the two countries.

Biography. Gerson Esquivel is a PhD student in Nuclear Engineering and Engineering Physics at the University of Wisconsin at Madison, working with Professor Sébastien Philippe. His research aims to quantify the cascading economic and humanitarian impacts of nuclear war by integrating large-scale modeling frameworks. Prior to starting his PhD studies, Gerson earned a Bachelor of Science degree in Nuclear Engineering from the University of Wisconsin at Madison.



Zhengqing Fang
Tsinghua University

Assessing the Impact of Prompt Effect of a High-Altitude Nuclear Explosion on Non-Military LEO Satellites

Abstract. Growing military and civilian demands, combined with decreasing launch costs and technological advancements, have led to a rapid increase in Low Earth Orbit (LEO) satellites. However, these unprotected systems are highly vulnerable to radiation effects from high-altitude nuclear explosions (HANE). This talk examines the prompt effects of an orbital nuclear explosion on non-military LEO satellites to assess HANE's potential to permanently disable them. By simulating various detonation scenarios, this study evaluates lethal zones across different explosion scales, demonstrating that a single HANE could permanently disable a substantial portion of operational non-military satellites. This poses a severe threat to current orbital infrastructure and future mega-constellations like Starlink. Additionally, the analysis demonstrates how states could exploit differences in orbital distributions by optimizing detonation coordinates, altitude, and yield to maximize adversary damage while minimizing collateral damage to their own.

Biography. Zhengqing Fang is currently a PhD student at the School of Aerospace Engineering, Tsinghua University, Beijing, China. He is also a student in the dual-degree Master's program in Global Governance at School of Social Sciences, Tsinghua University. He received his bachelor's degree in Engineering Mechanics (Tsien Excellence in Engineering Program) from School of Aerospace Engineering, Tsinghua University, Beijing, China in 2022. His current research interests include orbital mechanics and control, constellation configuration design, and outer space policy.



Kate Futrowsky
Georgia Tech University

The Geometry of Keep-out Zones in Geosynchronous Orbit

Abstract. Military communication and early-warning satellites in geosynchronous (GEO) orbits are used in nuclear and non-nuclear operations. Close approaches to these and other GEO satellites by potential adversaries are increasingly common. They could be interpreted as preparation for nuclear war and drive escalation. To reduce the risk of escalation posed by these close approaches, U.S. analysts have proposed that there be an agreed 700-km radius keep-out zone around all GEO satellites operated by the United States, Russia, and China.

This presentation investigates the utility of the proposed keep-out zones. It determines all instances in which U.S., Russian, and Chinese GEO satellites entered within 700 km of each other from 2014–2024. It shows that this was primarily for short durations resulting from routine longitudinal shift maneuvers. This indicates that a keep-out zone for these satellites could be more meaningful if it were a different shape or size, geometrically or temporally dynamic, or intrusion-duration dependent.

Biography. Kate Futrowsky is a Physics PhD and an International Security MS candidate at Georgia Tech. She earned dual B.S. degrees in Physics and Astronomy from the University of Maryland, College Park and a MS degree in Physics from Georgia Tech. For her PhD thesis, she is working to characterize galaxies that may host massive black hole binaries. Kate is also characterizing geosynchronous satellite behavior with the Engineering Space Policy Laboratory. Broadly, Kate is interested in how the civil, commercial, and military space sectors interact, and how space is utilized in international security.



Brianne Gutmann (she/they)
San José State University

Building Capacity for Conversations about Ethics and Nuclear Weapons in Physics Classrooms

Abstract. Physics has greatly impacted society, both in solving problems and perpetuating harm, yet we rarely provide opportunities for physics students to grapple with the responsibilities imparted by this duality. Our group's previous research has unearthed many factors which support students to practice ethical reasoning around nuclear weapons, as well as broadly around interactions of science and society. Ongoing research additionally aims to complement the student perspective by understanding experiences of instructors around these topics, especially around building capacity and bravery to facilitate conversations that may be difficult and/or beyond "typical" physics classroom norms. This presentation will share student data that motivates the work as well as lessons learned to support both students and instructors to engage in critical conversations about nuclear weapons and physicists' responsibilities to society.

Biography. Brianne Gutmann is an Assistant Professor at San José State University. She does physics education research with expertise in adaptive online learning tools, identity-responsive mentoring and community building, and ethics, science, and society in physics classrooms. They received their PhD from the University of Illinois at Urbana-Champaign, and did postdoctoral work developing, implementing, and evaluating curricula about science and society. She was also a AAAS Science & Technology Policy Fellow and a Next-Generation Fellow for the Physicists Coalition for Nuclear Threat Reduction. Additionally, Brianne is an organizer for the Access Network, which connects student-led organizations working for equity in STEM.



Nour Hammoud
University of Manchester

Fusion Energy and Nonproliferation

Abstract. Fusion energy is approaching commercial deployment, yet the global nuclear nonproliferation regime was not designed with it in mind. This talk examines three areas where current frameworks fall short: first, neutron environments capable of producing weapons-usable fissile material in significant quantities do not automatically trigger safeguards obligations; second, light isotopes (tritium, lithium-6, and deuterium) fall entirely outside IAEA safeguards despite their weapons-program relevance, with tritium inventories set to grow by orders of magnitude once fusion is deployed at commercial scale; and third, the co-location of these materials on a single site means a facility could combine capabilities to produce fissile material with the isotopes needed for a weapon, and current safeguards don't address this scenario. Mapping these considerations against existing UK regulatory frameworks reveals that radiation protection, export controls, and bilateral supply arrangements address legitimate but different objectives, none of these instruments were designed to answer the nonproliferation question for fusion. The talk concludes with an overarching recommendation to establish a technical expert group, and actions covering assessment of proliferation risks, accountancy and export control measures for light isotopes, facility-level assessment of co-located risks, and collaboration across the fusion and fission sectors.

Biography. Nour Hammoud is a Fusion Policy, Regulation & Non-Proliferation Fellow at the University of Manchester's Dalton Nuclear Institute. Her research focuses on proliferation and diversion risks associated with fusion energy, including tritium handling, dual-use neutron sources, and export-control vulnerabilities. She holds a PhD in Nuclear Engineering from the University of Manchester and has previously worked with the UK Atomic Energy Authority, Kyoto Fusioneering, and the International Atomic Energy Agency.



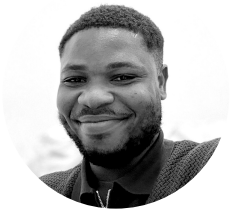
Pavel Kiparisov
International Institute for Applied Systems Analysis

Cascading Disruptions in Global Natural Gas, Fertilizer, and Food Trade Following a Nuclear War

Abstract. Following a nuclear attack, countries are expected to reduce or cease bilateral trade and may start grouping into preferential trading blocs depending on security perceptions and economic interests and needs. This study employs a global three-stage cascade network model to quantify food security vulnerabilities for eleven critical staple crops across all countries and twenty trading bloc configurations. The research models sequential disruptions in natural gas and fertilizer trade, which subsequently reduce crop production capacity. Using spatially explicit shock response coefficients, the study calculates production losses at each stage of the cascade and aggregates results by country and bloc.

Key findings indicate that no country is immune to food security collapse, regardless of its development status; countries already facing vulnerabilities will be disproportionately affected. Furthermore, non-nuclear-weapon states, even when united, cannot pressure nuclear-weapon states to disarm through trade restrictions, as they too will suffer the consequences.

Biography. Pavel was born and raised in southwestern Siberia. Over the past decade, he has studied in Hungary, Belgium, and Austria, while also working at the Food and Agriculture Organization, the United Nations Office for Outer Space Affairs, and various research institutes. Pavel recently completed a PhD in environmental sciences, where his research focused on urban resilience and how natural disasters and explosions restrict access to critical city infrastructure.



Wilfred Massiasta
Ghana Atomic Energy Commission

Ghana's Commitment to Global Nuclear Nonproliferation: The GHARR-1 HEU-to-LEU Conversion Program and International Treaty Obligations

Abstract. In June 1962, President Kwame Nkrumah convened the "World Without the Bomb" conference in Accra, establishing Ghana as an early national voice in the global disarmament movement. Over the six decades of nuclear diplomacy since that conference, Ghana's nuclear policy has been marked by advocacy for global disarmament, adherence to non-proliferation norms, and pursuit of peaceful applications of nuclear energy for national development. This presentation analyses Ghana's successful conversion in 2017 of its Chinese-supplied 30 kilowatt Miniature Neutron Source Reactor (GHARR-1) from proliferation sensitive highly-enriched uranium to more secure low-enriched uranium fuel, eliminating approximately one kilogram of weapons-grade uranium while maintaining full research capabilities. Ghana became the first non-Chinese MNSR operator to complete this conversion and offers a case study in responsible nuclear statecraft and multilateral nonproliferation cooperation.

Biography. Wilfred Sedofia Massiasta holds an MPhil in Nuclear and Radiochemistry and is a nuclear scientist at the National Nuclear Research Institute of the Ghana Atomic Energy Commission. His expertise spans activation analysis, gamma spectroscopy, and radiation transport simulation. He interned at the IAEA's Nuclear Science and Instrumentation Laboratory, contributing to neutron spectroscopy systems for DD/DT generators. He is a 2026 African Atomic Policy Lab Fellow of International Student/Young Pugwash (ISYP), bridging technical expertise with policy analysis.



Laura Mertes
Peace Research Institute Frankfurt

Monitoring Fissile Material Production in Fast Reactors

Abstract. Worldwide, a modernization of nuclear arsenals is in progress, which raises concerns that states grow their nuclear arsenal as well. How much and fast the number of nuclear weapons can increase depends – besides the stockpile – on the production of fissile material. To understand the potential impact of fast reactors on the fissile material stockpile, the presentation will focus on the Chinese fast reactor CFR-600 as an example. Fast reactors are typically associated with proliferation risks, because they can be operated to produce more fissile material than they consume, and the bred plutonium can be weapons-grade. The presentation will show burnup simulation results on the CFR-600 plutonium production using the open-source software OpenMC. Due to a lack of available data, that are required for the simulation, information of similar reactor types which may share significant similarities to the CFR-600 are included. The results are compared with different fast breeder reactors.

Biography. Laura is a postdoctoral researcher at the Peace Research Institute Frankfurt (PRIF) in the field of nuclear disarmament and non-proliferation with a focus on verification. In her research, she monitors fissile material production by performing nuclear reactor simulations which rely on open-source information. As a member of the research network VeSPoTec (Verification in a complex and unpredictable world: social, political and technical processes), she contributes to interdisciplinary research on nuclear disarmament and safeguards in tabletop exercises and workshops. Laura holds a PhD in physics from TU Darmstadt.



Geraldine Nneka Okoye
Ahmadu Bello University

OSINT-Based Early Warning Indicators for Unauthorized Extraction of Nuclear Materials in Conflict-Affected Regions of Nigeria

Abstract. Unauthorized extraction of strategic minerals in conflict zones poses growing security and governance challenges. Northern Nigeria provides a compelling case study for exploring how low-cost technical monitoring tools can strengthen preventive safeguards against the unauthorized extraction of strategic minerals. This presentation proposes an open-source intelligence (OSINT)-based early warning framework for identifying indicators of unauthorized extraction activities using publicly available, non-intrusive data sources. The framework integrates multiple open-source datasets, including geological maps, conflict event records, transport corridor data, and local media reports. Using techniques such as land-use change detection and conflict trend analysis, it identifies anomalous activities around known uranium-bearing zones and classifies them into risk-based alerts for further investigation. By applying geospatial analytics and data fusion to emerging nuclear security risks, this work demonstrates how low-cost technical tools can support accountability, non-proliferation, and resource security in under-monitored regions.

Biography. Geraldine Nneka Okoye is an early-career nuclear policy professional with a foundation in nuclear science, international security, and policy research. She is the research team lead at Nuclear-Aware Africa, a fellow at the African Atomic Policy Lab and a member of the BASIC Emerging Nuclear Network with experience contributing to research and dialogue on arms control, nonproliferation, and nuclear risk reduction. Her work focuses on advancing African perspectives in global nuclear governance through mentorship and public engagement. In parallel, Geraldine is a data professional and hosts A Woman in Nuclear Podcast, a platform dedicated to amplifying underrepresented female voices.



Priscilla Obeng Oforiwaa
Tsinghua University

Impact of Radiological Release of Radionuclides on Food Safety and Developing Remediation Strategies

Abstract. The release of radionuclides from nuclear weapons testing can contaminate soil, water, and food systems, posing long-term risks to human health and the environment. This study evaluates the transfer and impact of Cs-137, Sr-89, and I-131 within the food chain using a semi-mechanistic modeling approach, which combines experimentally measured soil and environmental data with mathematical transfer models to estimate radionuclide movement through agricultural and aquatic pathways. The research assesses long-term contamination effects and supports the implementation of Articles 6 and 7 of the Treaty on the Prohibition of Nuclear Weapons. Particular emphasis is placed on identifying effective remediation measures to reduce radionuclide transfer into crops, livestock, and aquatic products, while highlighting the role of international cooperation in environmental monitoring, technology sharing, and the application of best practices for contaminated land management.

Biography. Priscilla Obeng Oforiwaa is a Ghanaian research scientist and IAEA Lise Meitner Programme alumna. She holds a BSc in Renewable Energy Engineering, an MSc in Nuclear Science and Engineering Management, and a PhD in Nuclear Science and Technology. She completed a postdoctoral fellowship in nuclear security and policy and an internship at the IAEA in Vienna. Her research focuses on nuclear safety and security, environmental risk assessment, emergency preparedness, and policy modeling to support the safe and peaceful use of nuclear technology.



Milan Pathak
Universität der Bundeswehr München

When is a Satellite a Weapon?
A Framework for Definition and Identification

Abstract. The rise of dual-use and dual-purpose space technologies, especially satellites, increasingly blurs the line between commercial and research space-systems and potential space weapons, especially without a universally agreed definition. Capabilities such as active debris removal, in-orbit inspection, and servicing may appear peaceful but could be repurposed for hostile acts. Therefore, defining space weapons requires consideration of technical features and behavioral aspects. To address this challenge, this research develops a Space Weapon Framework (SWF) to establish criteria for defining and identifying space weapons by integrating technical and behavioral aspects of space systems. It also addresses ambiguity surrounding dual-use and dual-purpose technologies by suggesting only satellites with specific capabilities (e.g., sufficient propulsion, fuel reserves, and advanced thrusters) can be employed as space weapons or pose credible threats to other space assets. The SWF aims to contribute to global security by clarifying the risks posed by emerging space technologies, enabling a more transparent understanding of their implications for strategic stability.

Biography. Milan Pathak is a PhD student at the Universität der Bundeswehr München. His research focuses on space weapons and space weaponization, applying systems engineering methods to assess emerging space technologies. He holds a Master degree in Satellite Technology from Julius-Maximilians-Universität Würzburg. He has contributed to space research projects funded by DLR, including advancing antenna deployment mechanisms for space exploration missions and developing an Electromagnetic Docking Unit (EDU) for the TAMARIW mission. His Master thesis focused on the thermal analysis of electromagnetic docking and undocking systems for 3U CubeSats in low Earth Orbit, where he developed simulation based passive thermal control solutions.



Ananth Ranjithkumar
University of Exeter

Nuclear War Modeling: Climate Disruption & Radiological fallout

Abstract. Escalating geopolitical tensions in Eastern Europe underscore the urgency of addressing the climatic and radiological consequences of a regional nuclear conflict. This presentation uses the UK Earth System Model (UKESM) to explore some environmental consequences from a hypothetical conflict involving air- and surface-burst nuclear weapon detonations near the Ukraine-Russia border, releasing substantial amounts of aerosol particles (black carbon) and radionuclides into the atmosphere. Black carbon absorbs solar radiation efficiently, heating the surrounding air and driving the smoke plume higher into the atmosphere, where it can block incoming sunlight and persist for years in the stratosphere with impacts on global and regional climate and long-term climate recovery. It also looks at both short- and long-term radiological fallout. It will also share early insights from the Nuclear War Model Intercomparison Project (Nuke-MIP). Together, these modeling studies provide a physics-based projection of the aftermath of nuclear war.

Biography. I am a research scientist specializing in the climate and environmental impacts of nuclear war, using advanced Earth System Models to investigate how large-scale aerosol injections into the stratosphere affect global climate, atmospheric circulation, and radiological fallout. My work focuses on quantifying the consequences of regional nuclear conflict, including surface cooling, disruption to precipitation patterns, and surface sunlight reduction. My broader interests lie at the intersection of climate science, risk assessment, and policy. I am particularly motivated to bridge the gap between complex scientific modeling and real-world decision-making, ensuring that the global risks associated with nuclear weapons are clearly understood and effectively communicated.



Naomi Satoh (she/her)
University of Maryland

A New Resource Guide to Literature on Nuclear Arms Control

Abstract. The development of a robust educational framework to educate about the physics of nuclear weapons and the nuclear threat is a necessary element of nuclear threat reduction efforts. Accessible, inclusive, and thoughtful education on nuclear issues for younger audiences can be a successful way to divest physics candidates from the nuclear weapons complex, motivating studies on how to engage younger audiences in disarmament work. Our focus starts with scientists and technical researchers, as increasing ways they engage younger audiences can help increase the likelihood of nuclear weapons disarmament engagement. I will present a Resource Letter, commissioned by the American Physical Society, which provides a guide to the literature on nuclear arms control for general audiences and nonspecialist audiences. This letter is an extension of the 2008 Resource Letter by Alexander Glaser and Zia Mian, expanding and adding new topics.

Biography. Naomi Satoh is a second-year Master of Public Policy student at the University of Maryland, where she studies international security and nuclear policy. She currently works as an intern at the Council on Foreign Relations on the Nuclear Security team and was previously a nuclear policy intern at the Arms Control Association. Naomi is one of the 2025 Next Generation Fellows with the Physicists Coalition for Nuclear Threat Reduction. Before graduate school, she was an undergraduate physics and education student at Illinois State University.



Annika Simon
University of Hamburg

Drones for Nuclear Justice: Measuring Nuclear Weapon Test Contamination

Abstract. Since 1945, more than 2,000 nuclear tests have been conducted, mostly on colonized or Indigenous land. Although nuclear explosions are understood to spread debris and radiation over a wide radius, the exact environmental impacts of these historical testing regimes remain underconstrained. To understand the potential radiological harm of the tests, it is important to take radiation measurements. However, compiling a large set of independently verifiable and accessible measurements is complicated by factors such as inaccessible terrain, and lack of interest from countries which conducted the tests. Additionally, some historical measurements provided by nations that conducted tests have been found to be inaccurate. This talk will introduce the issue with a focus on the aspects of nuclear justice and present first results from an assessment of the global radionuclide inventory. Further, it will outline how uncrewed aerial vehicles (UAVs, drones) can make the collection process not only efficient but also reduce entry barriers to making measurements. UAVs have been used in several radiation monitoring processes, but not yet in nuclear weapons tests monitoring. Beyond the technical requirements of drone flight and sensor development, the project also has a special focus on usability, in the long run enabling those affected by the tests to conduct measurements themselves.

Biography. Annika is a PhD student with HaNDL, working on UAV-borne dose-rate measurements in nuclear weapons tests areas to investigate the long-term consequences of nuclear weapons testing. They hold a Bachelors degree in Physics and a Masters in Mathematical Physics. During their studies, Annika worked as a research assistant with the Institute for Peace Research and Security Policy in Hamburg, working on issues related to the effects of nuclear weapons, nuclear winter, cheating mechanisms during inspection procedures, and the TPNW.



Yannick Vogt
University of Natural Resources and Life Sciences

Safeguards for Deep Geological Repositories: Safety Case, Risk, and Policy

Abstract. Spent nuclear fuel poses long-term environmental and proliferation risks. Current strategies plan to dispose of it in deep geological repositories, with states required to accept international safeguards to verify the non-diversion of civil nuclear material, including in these repositories. Safeguards by Design integrates verification measures into repository planning, ensuring they provide reliable information without compromising safety functions, where strategies must adapt technological options to site-specific conditions.

Many fissile isotopes have half-lives of thousands of years, necessitating sustained oversight for decades to centuries. The timeframe for safeguards, however, is not predetermined, raising questions about their long-term viability. Sustained verification requires preserving records (Continuity of Knowledge) and maintaining public risk awareness, while resilient policy frameworks must withstand institutional or political change. The key challenge is implementing safeguards that ensure a security-oriented repository design with robust, institutionally anchored long-term verification

Biography. Yannick is a first-year PhD student and research assistant at the Institute for Safety and Risk Sciences, University of Natural Resources and Life Sciences (BOKU), Vienna. He holds a B.Sc. in Renewable Energy Technologies from the University of Applied Sciences Vienna and an M.Sc. in Environment and Bioresources Management with an energy focus from BOKU. A semester in Energy Engineering at Universidad Carlos III de Madrid broadened his international perspective. Motivated by the real-world implications of nuclear technologies and weapons policy, his research examines nuclear risk domains, including radioactive waste management and safeguards.



Eliot Jane Walton (she/her)
Princeton University, as of Fall 2026

Small-scale Neutrino-based Tools for Nuclear Verification

Abstract. Verifying the peaceful use of nuclear sites is a key issue for the nuclear nonproliferation regime. Traditional verification protocols confirm compliance through onsite inspections. Neutrino detectors may complement traditional protocols by reducing onsite access and providing information on the power level and fuel evolution of a reactor core. The typical detection channel for reactor neutrinos is inverse beta decay, requiring proton-rich targets and large detector masses in the range of tons or kilotons, with required material increasing with distance. However, locating a massive detector near the reactor core requires significant accommodation by the host. Recent advances in neutrino detection technology enable the use of coherent elastic neutrino-nucleus (CEνNS) scattering for monitoring nuclear-site activity with kilogram-scale detectors. These detectors may require fewer onsite modifications for deployment than their ton-scale counterparts. This talk will explore the potential of CEνNS-based detection methods to verify the peaceful use of nuclear sites.

Biography. Eliot Jane Walton received her PhD in high-energy physics from Monash University, Australia, and the University of Warwick, UK. Her doctoral research focused on understanding the role of the nuclear environment in the production of heavy subatomic particles in proton-proton collisions at the Large Hadron Collider. She holds a BSc (Hons) in Physics and a BA in Archaeology and English Literature from Monash University. Eliot's research interests lie at the intersection of science and policy, with a particular focus on applying physics-based methods to challenges in nuclear arms control and verification.



Egor Zverev
Institute of Science and Technology Austria

Secure-by-Design AI Agents: Threat Models, Guarantees, and Global Security

Abstract. AI agents are systems that autonomously plan, retrieve information, and take actions using external tools. They are already widely deployed in consumer products and software engineering, and increasingly also in research and security-relevant settings. With the deployment of these tools come new classes of security threats. For example, an attacker can hide instructions in the data an agent reads, such as a webpage or a document, causing it to leak sensitive information or take unauthorized actions. In response, the AI security community has developed 'secure-by-design' architectures: systems that enforce security guarantees structurally, rather than relying on the model to behave correctly.

This talk will introduce AI agents, the threat landscape, and the secure-by-design approach. It will then examine its relevance to global security through the case of AI in nuclear inspections and monitoring, where agentic systems are appealing, but the same data dependencies that make them useful also leave them open to manipulation.

Biography. Egor Zverev is a PhD student in Machine Learning at the Institute of Science and Technology Austria (ISTA), working on large language model security, instruction-data separation, and secure-by-design AI agents. He is co-supervised through the ELLIS PhD Program by Christoph Lampert (ISTA) and by Florian Tramer (ETHZ). He is currently a PhD Research Intern at Microsoft Research Cambridge. He was the main organizer of EurIPS'25 Foundations of Model Security Workshop and was a co-panelist at IASEAI'26. Egor studied Applied Mathematics and Computer Science at the Moscow Institute of Physics and Technology in the Yandex Department of Data Analysis.

School Lecturers & Organizers



Ray Acheson (they/them)
Princeton University

Ray Acheson is a scholar, writer, activist, and visiting researcher at the Program on Science and Global Security. From 2007 to 2026, Ray led Reaching Critical Will, a project to monitor, analyze and engage international disarmament processes at the United Nations and in civil society. Ray served from 2008 through 2024 on the steering group of the International Campaign to Abolish Nuclear Weapons (ICAN), which won the 2017 Nobel Peace Prize. Ray also is involved in the Stop Killer Robots coalition to halt development of fully autonomous weapons, the International Network on Explosive Weapons, and campaigns against the international arms trade.



Roohi Dalal
American Astronomical Society

Roohi Dalal is the Deputy Director of Public Policy at the American Astronomical Society (AAS) and a Research Collaborator with SGS. She received her PhD in Astrophysical Sciences in 2024 from Princeton University. Roohi was a Postdoctoral Fellow at the Outer Space Institute and University of British Columbia. She has served as Vice Chair of AAS's Committee for Protection of Astronomy and the Space Environment. Roohi received her B.S. in Astrophysics and History from the California Institute of Technology, and was a Fulbright Scholar at Leiden University. She helped found the Women in Physics, Math and Astronomy organization at Caltech, and served as President of the Women in STEM Leadership Council at Princeton.



Julia Georgiana (she/her)
Princeton University

Julia is the SGS Program Manager, overseeing the day-to-day operations and financial processes of the Program. Since joining Princeton University in 2017, Julia has worked as the Graduate Program Administrator for the Department of Politics and as Study Abroad Coordinator in the Office of International Programs. Previously, Julia worked at various universities, including Rutgers, where she held responsibilities for student affairs and university advancement and donor relations. Julia has an undergraduate degree in Business Management from St. John's University, New York, and a graduate degree in Higher Education Administration from Northeastern University.



Alex Glaser (he/him)
Princeton University

Alexander Glaser is a professor in the School of Public and International Affairs and in the Department of Mechanical and Aerospace Engineering. Alex has been co-directing the Program on Science and Global Security since 2016. For Princeton's work on nuclear warhead verification, Foreign Policy Magazine selected him as one of the 100 Leading Global Thinkers of 2014. In September 2020, Alex was elected a Fellow of the American Physical Society and, more recently, received the 2025 Leo Szilard Lectureship Award. Alex holds a PhD in physics from Darmstadt University, Germany.



Ralf Kaiser
Abdus Salam International Centre for Theoretical Physics

Ralf Kaiser is Head of Programmes at the Abdus Salam International Centre for Theoretical Physics (ICTP), where he leads international scientific programmes that advance research, education and collaboration, particularly for scientists from developing countries. An experimental nuclear physicist by training, he studied physics and mathematics at the University of Münster and earned his PhD from Simon Fraser University. Before joining ICTP, he headed the Physics Section at the International Atomic Energy Agency (IAEA) and held a faculty position at the University of Glasgow. He also founded the award-winning technology company Lynkeos and is a Fellow of the Royal Society of Edinburgh.



Timur Kadyshev
Institute for Peace Research and Security Policy

Timur Kadyshev is a Senior Researcher with the Institute for Peace Research and Security Policy (IFSH), Hamburg Germany. His research focuses on missile proliferation and missile defenses, with a particular interest in capabilities of missile defenses and their effects on global and regional military balances. He was Senior Research Scientist at Moscow's Center for Arms Control, Energy, and Environmental Studies, and has been affiliated with Princeton's Program on Science and Global Security, Stanford University's Center for International Security and Cooperation, and the MIT Defense and Arms Control Studies Program.



Moritz Kütt
University of Hamburg

Moritz Kütt is an Associate Professor in the Department of Physics at the University of Hamburg, founder of the Hamburg Nuclear Disarmament Laboratory (HaNDL), and a Visiting Research Collaborator with SGS. From 2019–2025, he was Senior Researcher at the Institute for Peace Research and Security Policy (IFSH) in Hamburg. He was a postdoctoral researcher (2017–2019) at SGS. He received his PhD in Physics (2016) from Technische Universität Darmstadt, Germany, and was a visiting graduate student researcher at SGS. He holds undergraduate degrees in Physics and Political Science. Moritz is a member of the Scientific Advisory Group of the Treaty on the Prohibition of Nuclear Weapons.



Gordon MacKerron
University of Sussex

Gordon MacKerron is Emeritus Professor of Science and Technology Policy and former Director of the Science Policy and Research Unit (SPRU) at the University of Sussex, UK. He has specialized in the economics and policy issues of electricity and especially nuclear power. He was founding chair of the UK government's independent Committee on Radioactive Waste Management. He is a member of the International Panel on Fissile Materials (IPFM) and has been a visiting researcher at the Princeton Program on Science and Global Security.



Ryan Manzuk
Princeton University

Ryan Manzuk received his PhD in Geosciences at Princeton University in October 2024. His thesis used image analysis and computational methods to investigate the physical properties of ancient environments preserved in rocks, mostly fossil reefs, to investigate feedbacks between the physical environment, climate, and biological evolution. He also works with Situ Studio, Brooklyn, NY, as part of a team combining visual investigations, science, law, and advocacy on issues of human rights, environmental justice, policing, and civil liberties. As a Peace Corps volunteer he spent two years in Guinea working with a small village on sustainable food production practices.



Geralyn McDermott (she/her)
Princeton University

Geralyn McDermott joined the Program on Science and Global Security as Administrative Assistant in 2012. She provides administrative and research support to the Program's faculty, staff, and graduate students. In addition, Geralyn coordinates logistics for domestic and international conferences, arranges travel, and is responsible for expense reporting, and purchasing.



Zia Mian
Princeton University

Zia Mian is a physicist and co-director of Princeton University's Program on Science and Global Security. His research interests include issues of nuclear arms control, nonproliferation, and disarmament and international peace and security. He is a co-founder of the Physicists Coalition for Nuclear Threat Reduction. Mian serves on the Board of the Union of Concerned Scientists. In 2022, he was appointed to the UN Secretary-General's Advisory Board on Disarmament Matters. He is the co-chair of the Scientific Advisory Group of the Treaty on the Prohibition of Nuclear Weapons.



Sébastien Philippe (he/him)
University of Wisconsin-Madison

Sébastien Philippe is an Assistant Professor of Nuclear Engineering and Engineering Physics at the University of Wisconsin-Madison and an Associate Faculty member at the La Follette School of Public Affairs. His work focuses on modeling and addressing the global security and environmental challenges associated with nuclear weapon testing and nuclear war, nuclear arms control, disarmament and emerging technologies. In July 2025, he was appointed by the United Nations Secretary-General to the UN Scientific Panel on the Effects of Nuclear War. Philippe is a 2025 MacArthur fellow.



Sara Sabry
Abdus Salam International Centre for Theoretical Physics

Sara is a Programme Assistant at ICTP/UNESCO, where she supports the planning and delivery of international scientific programs, workshops, and conferences. Since joining the Conference Support Team in 2025, she has coordinated the end-to-end administration of scientific activities, serving as the primary point of contact between external organizers and internal departments. She works closely with scientific and administrative colleagues to foster an inclusive environment that supports international scientific exchange and brings together participants from around the world, particularly from the Global South.



Frank von Hippel
Princeton University

Frank von Hippel is a senior research physicist and professor of public and international affairs emeritus with the Program on Science & Global Security, which he co-founded in 1974. He received a D.Phil. in theoretical physics in 1962 from the University of Oxford. In 1993–1994, he was assistant director for national security in the White House Office of Science and Technology Policy. Von Hippel's many awards include a MacArthur Prize Fellowship.



Sharon Weiner (she/her)
American University

Sharon K. Weiner is an Associate Professor of International Relations at American University's School of International Service and a visiting researcher with SGS. Her book *Our Own Worst Enemy? Institutional Interests and the Proliferation of Nuclear Weapons Expertise* (MIT Press, 2011) was the winner of the 2012 Louis Brownlow award from the National Academy of Public Administration. She also is the author of the book *Managing the Military: The Joint Chiefs of Staff and Civil-Military Relations* (Columbia University Press, 2022). Sharon has worked in both houses of Congress, the Pentagon's Joint Staff Strategic Plans and Policy directorate, and as a program examiner with the National Security Division at the White House Office of Management and Budget. She holds a PhD in Political Science from MIT.