Department of Nuclear Science and Engineering

The Department of Nuclear Science and Engineering (NSE) provides educational opportunities for undergraduate and graduate students interested in advancing the frontiers of nuclear science and engineering and in developing applications of nuclear technology for the benefit of society and the environment. We prepare our students to make contributions to the scientific fundamentals of our field; to the development and engineering of nuclear systems for low-carbon energy generation, security, health care, and other applications; and to the integration of nuclear systems into society and the natural environment.

Our vision is a sustainable future where nuclear science and technology are used for the benefit of humankind and the planet.

Our mission is to develop the next generation of leaders of the global nuclear community, advance basic research, provide technical leadership on energy and non-energy applications of nuclear technology, and inform public discussion about nuclear science and technology, in order to address global grand challenges.

In the past year, the NSE department has focused on continued growth of the department through the hire of a new junior faculty and a professor of the practice. The Department has also welcomed its last hire that was made using the shared faculty position with the MIT Stephen A. Schwarzman College of Computing. Another major achievement was the re-design of our graduate experience to provide our incoming student greater opportunity for research in their first two years in the program.

Diversity, Equity and Inclusion (DEI) Update

The NSE department has also continued its efforts towards diversity in its recruitment and hiring practices. The student driven Graduate Application Assistance Program (GAAP) continues to be impactful in our admission process, and NSE has also participated in selected recruiting events at large international diversity focused conferences, as well as participated in virtual career fairs hosted by the American Physical Society (APS) and the American Nuclear Society (ANS). NSE once again participated in the MIT Summer Research Program (MSRP) program in strong numbers, offering internships in broad areas of the field, as well as hosting information sessions. The department also hosted the inaugural Nuclear Energy Agency Rising Star symposium which is a global event that brings together promising early career women researchers. The event was coordinated with the NSE Rose Lecture, a lecture series in honor of the late Professor David J Rose, with the International Atomic Energy Agency Director General Dr. Rafael Mariano Grossi as the speaker.

Alumni Engagement Update

In the past year, Professors Benoit Forget and Emilio Baglietto hosted a virtual departmental update, which also included a research presentation by Professor Jack Hare and a description of the PUlser For Fundamental Investigations (PUFFIN) experiment under development in his lab. The department also hosted an alumni event at the American Nuclear Society Winter meeting in Washington, DC that brought together many NSE alums.

Faculty and Administration

Professor Mingda Li was promoted to Associate Professor.

Professor Emilio Baglietto was promoted to full professor and appointed Associate NSE Department Head. He was also appointed the Norman C. Rasmussen Professor of Nuclear Science and Engineering.

Professor Jacopo Buongiorno was elected to the United States National Academy of Engineering,

Professor Ian Hutchinson retired to become Professor Emeritus of Nuclear Science and Engineering.

Assistant Professor Ericmoore Jossou joined the department.

Professor Nuno G Loureiro was named Director of the Plasma Science and Fusion Center (PSFC).

Professor Anne White became Associate Vice President for Research Administration

Research Highlights

The Computational Reactor Physics Group (CRPG) led by Professor Benoit Forget has continued work on the development of high-fidelity and efficient methods for radiation transport. A key focus of the work has been on the extension of the in-house open-source Monte Carlo OpenMC and its extended use for both nuclear fission reactor analysis and fusion shielding applications, as well as initial developments on new deterministic and stochastic methods for modern computing architectures. Research has focused once again on improving nuclear data models for greater accuracy and efficiency with an increased focus on the treatment of nuclear data uncertainties. Key developments were achieved in modelling nuclear reaction across the energy range of interest of nuclear systems. These nuclear data models have a similar theme of reducing the storage need, facilitating the sequential memory access, and improving the sampling efficiency. On the uncertainty quantification front, the embedded Monte Carlo method that was previously developed in our group was implemented and tested in OpenMC on nuclear reactor benchmarks demonstrating the path towards better integration of uncertainties in the simulations. Additionally, integration of these novel nuclear data models was demonstrated for high-fidelity multiphysics simulations of small nuclear reactors with a focus on thermal deformation and hydride diffusion.

Professor Anne White's research group focuses on the study of turbulent transport in fusion plasmas, with the goal of controlling and optimizing the transport and improving performance of tokamaks and stellarators. This year the team has worked primarily at the ASDEX Upgrade tokamak, where the experimental team leads experiments and develops diagnostics and leads validation projects using advanced turbulence simulation codes. They study turbulence and transport in negative triangularity plasmas, perform predictive modeling for SPARC, develops new optimization tools at ASDEX Upgrade. New hardware at AUG developed this year will allow simultaneous core to edge turbulence measurements in high performance plasmas. In addition, group members have been collaborating with the companies nT-Tao and Commonwealth Fusion Systems (CFS) on design and development of profile radiometers for high density and temperature plasmas, including exploration of discrepancies reported between different types of electron temperature measurements.

Professor Jacopo Buongiorno and his student Emile Germonpre' conducted a study on decentralized hydrogen production using transportable, plug-and-play nuclear microreactors, or nuclear batteries (NBs). The study suggests that a sizeable potential market for these novel systems exists. Through a detailed treatment of a wide variety of NB-powered hydrogen projects, and by considering the full lifecycle cost of hydrogen, the work identifies five factors required for competitiveness. The first factor is the cost decline from first-of-a-kind to Nth-of-a-kind systems, and thus, related to it, the learning rates in the NB fabrication costs. The second factor is the importance of a sufficiently large facility size to dilute the cost of on-site security that likely will be demanded by the regulator. The third factor is the leveraging of clean energy subsidies and fair emissions accounting. The fourth factor is the efficient use of the NB capabilities, namely the high-temperature heat and standalone capabilities. The fifth factor is the benefit of local hydrogen production, which keeps NBs competitive despite their higher electricity cost than wholesale prices. In the context of hydrogen production, however, the distribution cost savings of on-site production (at the "gas station" scale) compared to community-scale production (at the "city" scale) are not sufficient to offset the production cost difference. Decentralized, community-scale projects following these principles achieve a cost of hydrogen of 3.7 $/kg, which is competitive with other low-carbon, decentralized technologies but not with centralized Steam Methane Reforming using CCS – when compared on a production cost basis. The results of this work could open a whole new market for use of nuclear energy to help decarbonize the transportation sector.

Professors Koroush Shirvan and Neil Todreas continued their collaboration within the overall mini reactor program of Professor Jacopo Buongiorno on development of mini reactor designs with physical security characteristics which can operate without an on-site guard force. The scheme being evaluated is the Consequence-Based Analysis (CBA) whose objective is to study close consequences of hypothetical malicious attacks on the facility from any technically possible intruder actions within a limited time before the offsite security force can respond.

Professor Zachary Hartwig continues to lead multiple research and engineering initiatives within NSE and the PSFC. These efforts are principally focused on advancing the state of large-scale high-field superconducting magnets and deploying new techniques for high-fidelity irradiation of materials for nuclear environments. Professor Hartwig oversees the Vault Laboratory, which hosts a 12 MeV superconducting proton cyclotron, a 2 MV ion tandem accelerator, and 2 D-T neutron generators within a large concrete vault. The Vault is utilized by a number of research groups, including for irradiation of structural materials for nuclear systems, tritium breeding and control for fusion power plants, development of advanced nuclear diagnostics for the SPARC net-energy tokamak, and nuclear security research into weapons verification and detection. Professor Hartwig also oversees work in applied large-scale superconductivity, including overseeing a large superconducting magnet test facility at the PSFC, research into defect-tolerant superconductors, and cryogenic proton and neutron irradiation and in situ testing of high temperature superconductors for fusion and high energy physics applications. Professor Hartwig leads the PSFC engineering group, a team of 35 professional engineers, designers, and technicians, which provide midscale engineering support to scientists, staff, and students at the PSFC and other academic departments and centers.

Dr. Charles Forsberg is developing the Crushed Rock Ultra-large Stored Heat (CRUSH) system to provide 100+ GWh of heat storage at incremental capital costs of $5/kWh, a factor of five to ten under existing heat storage technologies. Heat provided by nuclear or concentrated solar power plants or low-price electricity when available is stored in crushed rock. Nitrate salt or oil moves heat in and out of storage but these more expensive materials are not used for heat storage. Heat from CRUSH is used to provide peak electricity at times of high prices. The very low cost may enable daily to seasonal heat storage enabling base-load nuclear reactors with heat storage to replace gas turbines coupled to underground natural gas storage for variable electricity production. Dr. Forsberg is also building a forced circulation liquid-salt loop at the MIT reactor that includes heating the salt to 700°C, irradiating the salt and cooling the salt. The general-purpose test loop will investigate corrosion, tritium and fission product transport, and be a test bed for instrumentation and salt cleanup systems for molten salt reactors, fluoride-salt-cooled high-temperature reactors and salt blankets for fusion reactors.

Professor Emilio Baglietto's research group is at the forefront of developing and implementing advanced modeling and simulation approaches to enhance the economics of the current operating fleet and accelerate the deployment of small modular and advanced reactors. Supported by ARPA-E and in collaboration with GE-Hitachi, Professor Baglietto's team has recently pioneered high-fidelity, digital twin modeling for the BWRX-300 reactors. These digital twins are instrumental in optimizing maintenance decisions, thereby reducing operation and maintenance costs. Professor Baglietto co-leads a university consortium supported by the DOE, where his group is at the cutting edge of qualifying advanced hybrid turbulence heat transfer methodologies and uncertainty quantification approaches. TerraPower has recognized the value of these innovations, adopting them to support the licensing of their NATRIUM reactor. They are sponsoring a project led by Professor Baglietto's team to assemble and qualify a CFD-based reactor transient analysis approach for NATRIUM. The group also continues to push the boundaries of CFD methods for the predictive assessment of Critical Heat Flux (CHF). In collaboration with Canadian Nuclear Laboratories and sponsored by Ontario Power Generation, they are advancing simulations of CHF in crept CANDU channels. Additionally, a DOE-sponsored NEUP project is leveraging the group's multiphase CFD expertise to reduce uncertainties in licensing CHF correlations. Professor Baglietto's work is closely aligned with Professor Bucci's experimental research under the Naval Nuclear Lab support, particularly in advancing the fundamental physical representation of CHF across all flow regimes. This collaboration is yielding rapid progress in understanding and representing boiling heat transfer, with further implications for cryogenic fluid management. The group's success in modeling cryogenic cooling, demonstrated through two SBIR/NASA-sponsored projects, has led to new support from NASA to model cryogenic management in low-gravity conditions, crucial for Lunar and Mars exploration programs.

Professor Matteo Bucci is expanding his research activities at the intersection of experimental heat transfer research, advanced diagnostics, and machine learning. His laboratory develops cutting-edge experimental capabilities and high-resolution diagnostics to investigate two-phase heat transfer phenomena. The core of the Red Lab research focuses on the understanding and enhancement of the boiling performance in nuclear reactors. His team is also investigating experimentally boiling heat transfer in cryogenic fluids simulating cryogenic fuels for space propulsion. The team has perfected a facility to study these phenomena using high-resolution high-speed phase-detection diagnostics, and conducted experiments in micro-gravity conditions during two parabolic flight campaigns. This research is performed in collaboration with the group of Professor Baglietto. The team is also leading efforts towards the development of an autonomous experimental platform to study boiling heat transfer.

Professor Koroush Shirvan continued his development of first open-source bottom-up nuclear capital cost estimation tool as part of the work funded by industry. The tool application has been expanded to technologies beyond water-cooled reactors including sodium, gas-cooled small modular reactors and microreactors. The tool has continued to help guide technology selection and policy recommendation in U.S. and oversees. The tool capability to project cost of waste disposal cost and operation and maintenance costs have matured. Last year, the tool capability was also used for fusion energy as part of a fusion energy study by the MIT Energy Initiative by Professor Shirvan's team. The existing US nuclear fleet plans to adopt high burnup fuel and selected near term Accident Tolerant Fuels (ATFs) by 2025 to improve safety and reduce nuclear fuel cycle cost. Professor Shirvan focused on utilization of ATFs to enable power uprates for the existing fleet. Professor Shirvan continued a research project on irradiation testing of ATF concepts in collaboration with all US fuel vendors. He also explored the benefits of ATFs for water-cooled Small Modular Reactors (SMR) in collaboration with all the leading SMR developers in the US and UK. Professor Shirvan also ramped up his activities on space nuclear technology in supporting NASA's mission for human transit to Mars, power source for surface of the moon and exploration of objects beyond the kipper belt.

Professor Paola Cappellaro and her group introduced innovative protocols for networked, quantum-enhanced sensing and for robust many-body dynamics. By exploiting a spin coupled to an optically-active quantum probe, they were able to characterize and control far-away spins, beyond the quantum survival time of the probe. The larger network of qubit sensor could measure spatial and temporal correlations. PhD candidate Minh-Thi Nguyen developed a method to detect rotations with nuclear spin associated with spin defects. The coupling to the spin defect can provide up to a thousand-time enhancement of the signal, thus enabling a practical quantum spin gyroscope. Finally, they were able to experimentally demonstrate a time crystal, a phase of matter that breaks time-translation symmetry with an emerging periodic structure. They developed control to alter the nuclear spins interaction strength, thus constructing a phase diagram for the conditions under which a time crystal would either exist or "melt". In cases where time-crystalline order emerged, the quantum system persisted for a very long times, which is unusual for systems out of equilibrium at relatively high temperatures and could be exploited for future quantum devices.

Professor Ju Li's group (http://Li.mit.edu) has applied artificial intelligence, robotic experimentation, and active learning to materials research [*Nature Reviews Materials* 8 (2023) 563], including better electrolyzer catalysts [*Cell Reports Physical Science* 4 (2023) 101662]. Using the materials genomics approach, they have developed metal-ceramic nanocomposites with superior radiation resistance, helium tolerance, and creep resistance [*Acta Materialia* 266 (2024) 119654; *J. Materiomics* 10 (2024) 377].

In collaboration with Professor Paola Cappellaro, the Li group have theoretically predicted that neutrons can have μeV-deep bound states in nanoscale quantum dots [*ACS Nano* 18 (2024) 9063]. These hydride nanocrystals of tens of nanometers diameter and the correct nuclear-spin polarization can trap neutrons, whose energy and momentum can be subsequently manipulated by mechanical oscillations of the quantum dot. Utilizing the strong interaction, one of the four fundamental forces in nature, for quantum information processing would be interesting. Also, they have developed a theory called optonuclear quadrupolar (ONQ) effect, where two photons (100 THz and above) are used to manipulate nuclear spins that typically evolve at much slower (~MHz) timescales. The ONQ effect has been scoped for potential applications in quantum memory, quantum transduction, isotope spectroscopy, and for inducing population inversion between the isomeric and ground state of ^{229}Th (8.3 eV) that could lead to gamma-ray laser [*Physical Review A* 108 (2023) L021502].

The Laboratory for Applied Nuclear Physics (LANPh), led by Professor Areg Danagoulian, has continued its research in arms control, non-proliferation, and cargo security. Research in cargo security has focused on the capabilities and limitations of currently fielded radiographic systems which are used to screen the commercial cargo for nuclear threats and other anomalies. Our research has shown that while current X-ray scanners deployed in the ports of entry are highly limited due to fundamental reasons, advanced algorithmic methods can yield significant information about the cargo material. This has led to very fruitful collaborations with Rapiscan Inc. In the area of functional fabrics, the team has continued its collaboration with Professor Yoel Fink's group at MIT in the Material Science and Engineering Department. Last year saw significant challenges as well as progress in achieving a functional fiber which can detect external radiation signals via a photodetector embedded in a scintillating fiber which also acts as a wave guide. LANPh has also continued its work with multiple groups at Pacific Northwest National Laboratory and Lawrence Livermore National Laboratory in arms control and nuclear safeguards. The collaborations have focused on the use DT-based Neutron Resonance Transmission Analysis (NRTA) and Neutron Resonance Capture Analysis (NRCA) techniques to study the isotopics of various fissile materials, as well as the use of Dense Plasma Focus Z-Pinch techniques for high precision NRTA techniques. The team is also continuing their collaboration with Professor Forget in the area of transmutation technologies studying the potential of transmuting long-lived fission products using available accelerator technologies.

Professor Jack Hare’s research group has continued their investigations into magnetized high-energy-density plasmas. The PUlser For Fundamental Investigations (PUFFIN) pulsed-power facility continues to be built, with the first experiments expected in 2024. PUFFIN will be used to study fundamental plasma physics processes, including magnetic reconnection, which leads to potentially catastrophic solar storms which can cause significant damage to satellites and electrical grids. Professor Hare is also the principal investigator of the Magnetically Ablated Reconnection on Z (MARZ) collaboration, which has been allocated seven shot days on the Z-machine, the largest pulsed-power facility in the world at Sandia National Laboratories. The fourth shot took place in April 2024, and was very successful, providing a unique opportunity to study magnetic reconnection in the laboratory under conditions found in extreme astrophysical environments such as black hole coronae. Professor Hare's group published three papers related to these experiments in January 2024.

Professor Mingda Li and the Quantum Measurement Group studies at the intersection between quantum materials, spintronics, radiation detection, machine learning, and topological quantum computation. One study focuses on topology-stabilized magnetism in the magnetic Weyl semimetal CeAlGe, revealing that magnetic order can be stabilized above the transition temperature due to interactions with Weyl fermions. Another research demonstrates a breakthrough in field-free, room-temperature switching of a van der Waals (vdW) ferromagnet, Fe3GaTe2, using spin-orbit torque from an adjacent WTe2 layer, paving the way for next-generation spintronic devices. Advances in radiation mapping are also presented through a Tetris-inspired detector pixel system, achieving high-resolution directional prediction and source localization using neural networks and Monte Carlo simulations. In topological quantum computation, a machine learning model has been developed to accurately distinguish Majorana zero modes from trivial states using zero-bias peak data, offering a robust tool for identifying exotic quantum states. Additionally, the virtual node graph neural network significantly enhances the prediction of phonon spectra and full phonon dispersions, offering a scalable solution for materials design. Finally, precise Fermi-level engineering in the Weyl semimetal tantalum phosphide is achieved through accelerator-based hydrogen implantation, allowing for ultra-fine tuning that preserves the material's quantum properties and paves the way for precise property control in quantum materials. These advancements underscore the growing intersection of quantum physics, materials science, and machine learning, each contributing to the development of cutting-edge technologies in electronics, computation, and environmental monitoring.

Professor R Scott Kemp and his group, the Laboratory for Nuclear Security and Policy (LNSP), have been working to understand the options for reducing society’s dependence on nuclear weapons by replacing them with ultraprecision conventional weapons. These weapons would have lower collateral damage, lower escalation potential, and may better avoid catastrophic consequences in great-power conflicts. Simulations of hard-target kill (e.g., missile silos) indicate that hypersonic impact by a conventional weapon will likely produce the required effect without a nuclear blast. Conventional strategic weapons only become feasible if strategic-grade, ultraprecision guidance and maneuvering at hypersonic speeds can be made possible. Solutions to these problems are being developed, but early work indicates feasibility. Complementary work on the political and game-theoretic consequences of reducing or abandoning nuclear weapons is also underway. In the energy space, LNSP has recently published work on the potential for small modular reactors to electrify developing regions in *Nature Energy;* and on the security considerations for HALEU, a novel reactor fuel, in *Science*. The group is now looking at electric-grid expansion, which will be required to accommodate low-flexibility or low-reliability low-carbon generating technologies such as nuclear power, wind, or solar. Of particular concern are regulatory structures that have incentivized technical configurations of the grid that lead to lower grid reliability for consumers, which in turn forces natural-gas generation over low-carbon technologies. LNSP will be evaluating new regulatory frameworks for achieving a grid that enables cleaner energy to compete on the grid

Professor Haruko Wainwright's group is advancing environmental monitoring and simulation capabilities to address soil and groundwater contamination at former nuclear weapon production sites and establish strategies for the safe disposal of nuclear waste. She is leading the DOE's Advanced Long-Term Environmental Monitoring Systems project funded by DOE, which aims to develop the new paradigm of groundwater contamination monitoring through the integration of sensors, simulation capabilities and machine learning. Last year, her group developed a surrogate modeling method for accelerating contaminant transport simulations to assess the climate vulnerability of residual contaminants under various climate change scenarios. In addition, her group published papers on monitoring sensor network optimization and geochemical database development integrated with machine learning. In parallel, her group has developed an open-source Python framework to assess the environmental impact of advanced nuclear reactor waste. The framework includes the direct connection between reactor physics simulations and repository assessment models, enabling the identification of key reactor parameters for the waste characteristics and environmental impacts. Such a framework is useful for reactor developers to evaluate their waste management as well as to improve the reactor design for reducing waste and its associated environmental impacts. At the same time, she continues to develop K-12 educational resources to improve environmental science literacy and the understanding of sustainable energy.

Professor Ericmoore Jossou's group is building a machine learning-assisted nuclear materials synthesis and advanced X-ray characterization program. The group successfully fabricated pure and doped uranium borides through carbothermic reduction, demonstrating a method of producing advanced fuel forms such as uranium carbides and nitrides with potential economies of scale. The group successfully completed major X-ray imaging measurements at National Synchrotron Light Source II, European Synchrotron Radiation Facility, and synchrotron SOLEIL using in situ and operando setups developed in our group. Professor Jossou and his student will return to these light sources, including the Deutsches Elektronen-Synchrotron, Germany, for coupled extreme environments imaging in real-time. The results will have implications for the design of radiation, hydrogen embrittlement, and corrosion-resistant materials.

The Materials for Extreme Environments Laboratory will come online in September 2024, with advanced sintering equipment, such as a spark plasma sintering suite funded by DOE-NE, becoming available in early 2025. Professor Jossou is also starting a research project on three-dimensional imaging of U-10Zr alloy funded by DOE-NE with concurrent efforts to understand the fundamental mechanisms that drive the solidification process during vacuum induction melting using nanotomography combined with machine learning algorithms for sparse data reconstruction.

Education

A total of 136 students pursued graduate degrees in NSE. Thirty-two (32%) percent of these students worked in the fission energy field, 46% in fusion and plasma physics, 10% in materials, and 11% in other nuclear science and technology applications, including nuclear technology management and policy, nuclear security, and quantum engineering, and 1% were Leaders for Global Operations (LGO) dual degree (SM+MBA) students.

The department awarded 18 SM degrees, including our LGO graduates, and 14 Doctoral degrees (13 PhD and 1 ScD). Thirty-six students entered the graduate program in fall 2023.

A total of 27 students were enrolled in the undergraduate programs during the past year. Course 22 - 5 sophomores, 4 juniors, 5 seniors. Course 22-ENG – 3 sophomores, 7 juniors, and 2 seniors. Ten students completed the requirements for the bachelor's degree: 5 in nuclear science and engineering, and 5 in engineering as recommended by the department of nuclear science and engineering.

The department continued to provide communication support to its students through the NSE Communication Lab, a peer-coaching program launched in 2014 to help students and postdoctoral associates with their writing, speaking, and visual design needs. Staffed by seven graduate students and one graduate-student-turned postdoc serving as Comm Lab Fellows (as well as two reserve Fellows who provided additional coaching for students preparing for their qualifying exams), the NSE Communication Lab held 185 one-on-one coaching sessions with 85 clients (compared with 159 appointments and 79 clients during the same time period last year), representing 24.6% of NSE graduate students and 59.3% of NSE undergraduate students. 52.3% of clients made two or more appointments, which reflects ongoing satisfaction with the service.

In addition to 1:1 coaching, the Comm Lab Fellows offered three communication-focused workshops to NSE students and provided targeted in-class communications support to five NSE academic courses and communications mentoring to two thesis-writing cohorts. In her capacity as a science communication lecturer, Comm Lab Manager Erika Reinfeld collaborated with NSE faculty members to strengthen the communications support provided to students in 22.911 Seminar in Nuclear Science and Engineering and to expand the scope of the annual NSE Research Expo. Other collaborations included work with the AeroAstro Communication Lab around broader impacts and outreach, the cross-departmental Comm Lab Symposium in honor of the initiative's tenth anniversary, and the MIT Summer Research Program (MSRP). Fellow Alexis Devitre spoke on a panel at the Symposium while Fellow Ralitsa Mihaylova co-led a workshop for MSRP students with the central Comm Lab office. Ongoing coordination with Career Advising and Professional Development (CAPD), Teaching & Learning Lab (TLL), and the Writing and Communication Center (WCC), and the MIT Summer Research Program (MSRP) rounded out cross-Institute efforts by the NSE Comm Lab.

Faculty Awards, Honors, and Activities

Professor Jacopo Buongiorno was elected to the National Academy of Engineering in February, 2024. He was honored for his work on nuclear reactor safety, advanced nuclear power development, and community outreach. He has published over 100 journal articles on reactor safety and design, two-phase flow and heat transfer, and nanofluid technology.

Professor Cappellaro was awarded the American Physical Society (APS) fellowship in Atomic Molecular and Optical Physics.

Professor Richard K Lester, Vice President for Climate and Japan Steel Industry Professor of Nuclear Science and Engineering, was honored with the 2024 Gordon Y. Billard Award. The award is given to individuals who have had impact beyond normal job duties, and created important, lasting, and wide-ranging contributions to the MIT community.

Professor Michael Short was the 2024 recipient of the Capers (1976) and Marion McDonald Award for Excellence in Mentoring and Advising. Established by the Capers and Marion McDonald. This award is presented to a faculty member in the MIT School of Engineering who – through tireless efforts to engage minds, elevate spirits, and stimulate high-quality work – has advanced the professional and personal development of students and colleagues.

Professor Emeritus Neil Todreas, along with Professor Richard Lahey of Rensselaer Polytechnic Institute, were honored at the 20th International Topical Meeting of the Nuclear Reactor Thermal Hydraulic Conference (NURETH) series in August, 2023 for their leadership in the creation of the ANS Thermal Hydraulics Division and the associated NURETH Conference series 40 years ago.

Professor Haruko Wainwright received the PAI Outstanding Faculty Award, presented by the student chapter of the American Nuclear Society

Professor Emeritus Sidney Yip received the 2023 *Sigma Xi Monie A. Ferst Research Award*. Also, monograph, "*Molecular Mechanisms in Materials – Insights from Atomistic Modeling and Simulation*", was published by the MIT Press. He is continuing the advocacy of collaborative molecular simulation studies of nuclear fusion irradiation damage relevant to SPARC-ARC developments.

Professor Bilge Yildiz, Breene M. Kerr (1951) Professor in the Departments of Nuclear Science and Engineering and Materials Science and Engineering, was selected as the 2024 recipient of the Faraday Medal from the Royal Society of Chemistry.

Student Awards and Activities

Haowei Xu won the 2023 Del Favero Thesis Prize for the best PhD thesis work in Department of Nuclear Science and Engineering, "Optical control over nuclear degrees of freedom".

Zhichu Ren, Zhen Zhang, Yunsheng Tian and Ju Li, received the NeurIPS 2023 (Neural Information Processing Systems) Best Student Paper Award "Accelerated High-Entropy Alloys Discovery for Electrocatalysis via Robotic-Aided Active Learning," Workshop on Adaptive Experimental Design and Active Learning in the Real World (RealML), presented on December 16, 2023 in NeurlPS 2023 New Orleans, the top paper out of 7 spotlight talks, 80 accepted papers.

Talia Gershon received the University Nuclear Leadership Program Scholarship, U.S. Department of Energy scholarship.

Marco Graffiedi G received the Manson Benedict Award presented to a graduate student for excellence in academic performance and professional promise in Nuclear Science & Engineering.

Assil Halimi and Marco Graffiedi received the Department's Outstanding Service award as the ANS Co-Presidents.

Assil Hamili also received an American Nuclear Society, Graduate Scholarship – for outstanding efforts and academic achievements; The Engine Accelerator, Blueprint Program Fellow for venture development; MIT Sandbox Innovation Fund Program Fellow for venture development; Best Graduate

Design Paper, American Nuclear Society winter meeting in DC 2023 (with NSE students Loukas Carayannopoulos, Isabel Naranjo De Candido, and Gyutae Park.

Mateo Pisinger ’24 received the Roy Axford Award for academic achievement by a senior in Nuclear Science & Engineering.

Jonas Rajagopal ’25 was awarded the Irving Kaplan Award for academic achievement by a junior in Nuclear Science & Engineering.

Emily Neill ’26 received the Outstanding UROP Award for outstanding contributions in an NSE project by a first-year or second-year in Nuclear Science & Engineering

Kaitlyn Yanna ’25 received Outstanding UROP Award for outstanding contributions in an NSE project by a third-year or fourth-year in Nuclear Science & Engineering

William Reed Kendrick G received the Outstanding TA & Mentorship Award for exceptional contributions as a teaching assistant and mentor to other students in the Department.

Amaury Le Person and Jeremy Mangin, visiting students from the French Ecole Polytechnique, performed research on blast threats and fire threats respectively and was presented at the ANS Advanced Reactor Safety Conference in Los Vegas in June 2024. The paper of Amaury Le Person, coauthored with Professors Koroush Shirvan and Professor A Whittaker of SUNY, Buffalo won the best student conference paper award.

Minh-Thi Nguyen was awarded an NSF fellowship.

Department Outstanding Service awards were given to: Anna Kudriavtseva G for her outreach to high schoolers and the public in response to inquiries in the department and service over and above to many NSE professional courses as well as ANS seminars; Brianna Ryan G for service to the academic office; to Assil Halimi G and Marco Graffiedi G as ANS co-presidents.

Staff Awards and Activities

Matthew Hughes received the Outstanding Postdoctoral Research Award for outstanding contributions in an NSE project by a postdoc in Nuclear Science & Engineering.

Postdoctoral Associate Angus Wylie received the Department’s Outstanding Postdoctoral Service Award.

Nancy Iappini received the Outstanding Staff Award, presented by the student chapter of the American Nuclear Society.

Valerie Censabella received the NSE Unsung Hero Award.

Benoit Forget
Korea Electric Power Professor of Nuclear Engineering
Department Head and Professor of Nuclear Science and Engineering