



NEW YORK CITY COLLEGE OF TECHNOLOGY

CITY TECH

CUNY

24th ANNUAL POSTER SESSION

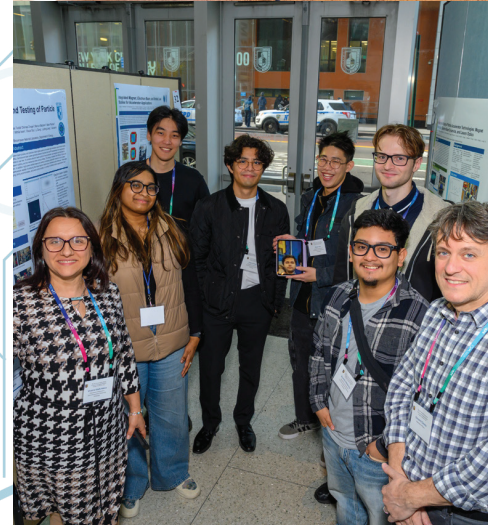
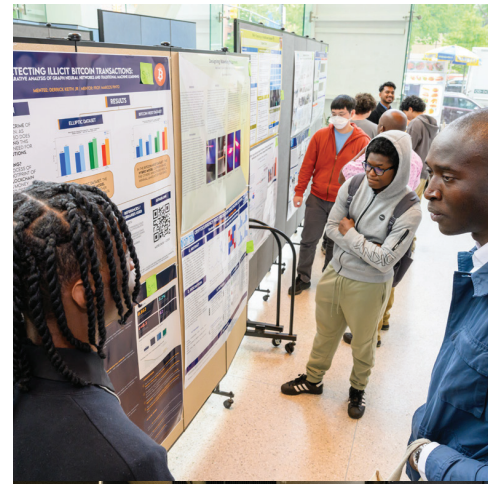
A Showcase of City Tech Faculty
and Students' Research

11.12.2026

12:00 pm - 3:30 pm

Academic Complex Lobby

SEE WHERE TECH CAN TAKE YOU.



24th POSTER SESSION, 2026

12:00 pm - 3:30 pm

WELCOME AND GREETINGS

1:00 pm-1:15 pm

Dr. Milton Santiago

Interim President

Dr. Pamela Brown

Provost and Vice President of Academic Affairs

Dr. Reginald Blake

Associate Provost and Dean of Curriculum and Research

Prof. Suzanne Miller

Interim Dean of the School of Arts & Sciences

Dr. Hong Li

Interim Dean of the School of Technology & Design

Dr. Maureen Archer

Dean of the School of Professional Studies

AWARDING CEREMONY

1:15 pm - 1:30 pm

PROGRAM FOR ONE-MINUTE ORAL PRESENTATIONS

1:30 pm - 2:00 pm

2:00 pm - 3:30 pm

Discussions, Q&A in the lobby

AWARDING CEREMONY

The Organizing Committee of the 23rd Annual Faculty and Student Research Poster Sessions, the Provost, Associate Provost, and Deans of Schools have selected for special recognition the following awardees from among over 60 excellent posters. The names of presenters of the awarded posters are given in bold and identified with an asterisk*.

23rd POSTER SESSION AWARDEES, 2025



Samaneh Gholitabar*

Owen Murphy. Planning a Health Impact Assessment Framework for Major Events in New York City.



Vishwas Joshi

Ligand Design and Synthetic Strategies for Nanopatterning Bismuth Nanoparticles



Marissa J. Moran

Challenges Posed when Using Emerging Technologies in Law Practice.

POSTERS FACULTY

ARCHITECTURE

- 1 Lia Dikigoropoulou and Michael Ray Malonjao. Adaptive Reuse in Post-Apartheid South Africa: Architecture, Memory, and Urban Transformation.

BIOLOGY AND HEALTH SCIENCES

- 2 Christopher Blair, Tomas Flouri, Felipe de Medeiros Magalhães, Lauren M. Chan, Daniel G. Mulcahy, Sungsik Kong, and Adam D. Leaché. Genomic Analysis of Sagebrush Lizards Highlights Extreme Phylogenomic Conflict and a Complex Demographic History.
- 3 Mai Zahran, Adrian Guin-Rizzo, and Alberto Martínez. Testing New Multi-Target Compounds for Alzheimer's Disease: From the Bloodstream to the Brain.
- 4 Emerson Ea, Mary Jo Vetter, Margaret Rafferty, Benito Mendoza, and Kayle Williams. Bridging Gaps in Geriatric and End-of-Life Education Through Innovative Online Microcredentials.
- 5 Eduardo Luna Juarez, Biba Kone, and Annika Daphne Bilog. Beyond the Silent Killer: Designing Bilingual Hypertension Education with and for older Puerto Rican Adults.
- 6 Amanda Reyes, Sophia Zheng, Sanai Quinones-Grant, and Annika Daphne Bilog. The Invisible Shift: Reimagining Breastfeeding Support and Maternal Well-Being for Working Mothers.
- 7 Wenhsing Yang. Integrative Pain Management for Cancer Patients: Evaluation of a Self-Paced Online Learning Course.
- 8 Wenhsing Yang and Lisette Santisteban. Evaluating Student Learning Through Comprehensive Assessment Testing: A Pre- and Post-CAT Study in AAS Nursing Program.

BUSINESS

- 9 Alyssa Dana Adomaitis, Ben Mendoza, Kelly Valladares, and Kat Roberts. Embedding Micro-Credentials in Fashion Education: A Teaching Strategy for Reinforcing Professional Skills and Design Thinking.

CHEMISTRY

- 10 Alberto Martinez and Jacky Deng. Interaction with Human Serum Albumin (HSA) of Caffeic Acid and Resveratrol Derivatives.
- 11 Vishwas Joshi. Lithium-Ion Battery Anode Based on Graphene-SPION Nanocomposite.
- 12 Ivana Radivojevic Jovanovic and Eduardo Bravo Jr. Optimizing Synthesis of Analog 5-Phenyl-Indole-3-Acetic Acid (5-Ph-IAA).

COMMUNICATION DESIGN

- 13 Noreen Whysel, Shari Thurow, and Bev Corwin. Anatomy of an Artificial Intelligence Search: Mapping Query Fan-out for Science Gateways.

COMPUTER ENGINEERING AND INFORMATION SYSTEM TECHNOLOGY

- 14** Mary Tedeschi, Bob Mutwalib, and Sergio Belich. Advanced Adequacy in Caring for the Elderly Through Advances in Technology.

CONSTRUCTION MANAGEMENT AND CIVIL ENGINEERING

- 15** Samaneh Gholitabar. A Health Impact Assessment Framework for Major Events in New York City.

ELECTRICAL AND TELECOMMUNICATIONS ENGINEERING TECHNOLOGY

- 16** Ahmed Hassebo. Feasibility Study of 4G LTE and 5G Cellular Networks for Smart LED Streetlight Applications in Smart Cities.

- 17** Daniela Viviana Vladutescu, Dismas Choge, Tianyi Zhao, Antonio Verderosa, Mikhail N. Polyanskiy, Efrain Luna, and Henry Ye. Model Validation of Damage Mechanisms in LWIR and NIR Materials in Femtosecond Regime.

ENTERTAINMENT TECHNOLOGY

- 18** David B. Smith. Distributed Collaborative Intelligence in a Human–AI Compositional Pipeline: A Balanced Blended Space Workflow.

- 20** Frederick Bianchi and David B. Smith. Simulator Integration, Live Telemetry Coupling, and High-Density Multichannel Cockpit Audio Rendering for Military Vehicle Simulation.

- 19** David B. Smith, Gabriel Aguilar, Sunima Dangol, and Isaiah Martinez. The Self-Aware Room: An Evolvable Architecture for Balanced Blended Environments.

HEALTH SCIENCES

- 21** Noemí Rodríguez and Laura M. Penalo. High-Quality Simulations for the Undergraduate Health Management Curriculum: A Pragmatic Approach for Learner Engagement.

HOSPITALITY MANAGEMENT

- 22** Alejandro Cantagallo. From Jobs to Generational Success: Rethinking Career Pathways in NYC Public Schools.

LAW AND PARALEGAL STUDIES

- 23** Marissa J. Moran. Law and Emerging Technologies.

MATHEMATICS

- 24** Andrew Douglas, Hubert de Guise, and Joe Repka. Unitary and Nonunitary Representations of the Heisenberg–Weyl Lie Algebra.
- 25** Hans Schoutens. The Benign Logic of Equivalences.
- 26** David M. Bradley and Johann Thiel. Generating Functions for Maximally Expanded α -trees.

PHYSICS

- 29** Nafis Arafat, Oleg L. Berman, Godfrey Gumbs, Ryo Hanai, and Peter B. Littlewood. Microscopic Theory of Temperature-Controlled Switching Between Lower and Upper Polariton Condensates.
- 30** Vitaliy Dorogan, Ivana Radivojevic Jovanovic, Wenli Guo, and Viktoriia Rutckaia. QUEST for Quantum Future: An Experiential Learning Program for Undergraduate STEM Students.
- 31** Charlotte Olsen, Charlotte Welker, and Ena Chia. Spatially Resolved Star Formation Histories Show How Galaxies Grow and Fade.
- 32** Anastasia Spiridonova. Controllable Intervalley Magnetotronics in Xenes.
- 33** Klaus Ziegler. Quantization of First-Detection Statistics in Monitored Quantum Systems.
- 34** Roman Kezerashvili. Lightest Nuclei with Hidden and Open Strangeness.
- 35** Andrea Ferroglia. How a Bottom Quark Falls Apart, and Why it Matters.
- 36** Boris A. Gelman. An Effective Field Theory for Recently Discovered Doubly Charmed Hadrons.
- 37** Mario R.G. Marques and German Kolmakov. Numerical Optimization of Microwave-Optical Coupling in GaAs/AlGaAs Coupled Quantum Wells.
- 38** Asher Minkoff and German Kolmakov. Benchmarking QAOA for Solving Systems of Linear Equations on an IBM Quantum Computer.
- 39** John Woods, Maya Goldgisser, Vitaliy Dorogan, Arno Thielens, Gabriele Grosso, and German Kolmakov. Microwave-Induced Enhancement of Exciton Photoluminescence in Monolayer WSe₂.

RADIOLOGIC TECHNOLOGY AND MEDICAL IMAGING

- 40** Subhendra Sarkar. Observation of EM Field Difference from Corona Versus Solar interior During Solar Eclipse of 2024 Using the Eyes of Strong Magnets: Can MRI RF Noise Explain Animal Confusion During Solar Eclipse?
- 41** Subhendra Sarkar and Chen Xu. Application of Near Infrared Spectroscopy (NIRS) to Characterize Physiological Alterations after Infusion of Toxic Medical Reagents in Living Tissue.

RESTORATIVE DENTISTRY

- 42** Avis J. Smith. Injury Prevention Using Mouth Guards

SOCIAL SCIENCES

- 43** Unurjargal Nyambuu and Lucas Bernard. Balancing the Stream: Using Dynamic Modeling to Predict Sustainable Revenue in the Live Streaming Economy.
- 44** Lisa Pope Fischer. Putting Science into Anthropology.

COLLABORATIVE RESEARCH

FACULTY–STUDENT

ARCHITECTURE

- 45** Kevin Hernandez, Kenneth Conzelmann, and Chris Leung. The Architecture of Water: From Forest to Village to City.
- 46** Rebekah Zayas, Zayed Baig, Alfonzo Grant, Mahir Rafed, Joel Rosales, Kenneth Conzelmann, Patricia Semmler, and Chris Leung. The Canal House: A New Prototype for Tropical Savanna Climate.
- 47** Juliana Trujillo, Brislis Fernandez, Patricia Semmler, Kenneth Conzelmann, Chris Leung, Porie Saikia, Diamonique Watson, and Jean-Pierre Demerieux Gomez. Environmental and Architectural Conditions in the NYC Subway: Queensboro Plaza Station.
- 48** Christopher Gabriel Lopez, Patricia Semmler, Kenneth Conzelmann, Chris Leung, Porie Saikia, Diamonique Watson, and Jean-Pierre Demerieux Gomez. Passive Design Strategies at Union Square Station.
- 49** Muhammad Abubakar, Amani Alkobadi, Jahaira Casicana, Patricia Semmler, Kenneth Conzelmann, Chris Leung, Porie Saikia, Diamonique Watson, and Jean-Pierre Demerieux Gomez. Sustainable Design Strategies to Improve Environmental Conditions at 191st Street.

COMPUTER SYSTEMS TECHNOLOGY

- 50** Shiu Wong, Christopher Chow, and Ahmet Yuksel. GeoPTM: Graph Attention-Based Prediction of Primate Post-Translational Modification Sites via Protein Language Model Embeddings.
- 51** Kazi Tamim Nomany, Kazi Tasin, Kazi Rahimu Islam, and Samuel Greenberg. Agentic Invoice Reconciliation: Multi-Agent Orchestration for Financial Operations.

COLLEGIATE SCIENCE AND TECHNOLOGY ENTRY PROGRAM (CSTEP)

- 52** India Barker, Tanzina Begum, Angelo Gomez, and Travis Lake. Cloud Security Assessment: Progress Software Vulnerabilities.
- 53** Kazi Tamim Nomany, Shayla Cuatianquiz, Wei Chong, and Sara Moshtarizohrehnama. LLM Applications in Software Vulnerability Detection: A Systematic Review.

QUEST FOR QUANTUM FUTURE

- 54** Khaoula Dehhou, Vitaliy Dorogan, Ivana Radivojevic Jovanovic, Wenli Guo, Malvika Garikapati, Khalid Musa. Non-contact Characterization of Liquid Composition Using Single-Photon Vibrometer (SPV).
- 55** Kevin Lin, Noshin Siyara Haque, Vitaliy Dorogan, Ivana Radivojevic Jovanovic, Wenli Guo, Viktoriia Rutckaia. Development of an Automated Micro-Photoluminescence Platform for Semiconductor Metrology.
- 56** Tomas Gonzalez, Vitaliy Dorogan, Ivana Radivojevic Jovanovic, Wenli Guo, Andrew Rotunno, Pojen Wang. How Quantum Optimizers Can Solve Combinatorial Optimization Problems.
- 57** Rachica Jean Baptiste, Mithila Islam, Vitaliy Dorogan, Ivana Radivojevic Jovanovic, Wenli Guo, Mike Marcotte, Cesar Martinez, Nick Vrohoretis, Dashami Chandrashekar. The Design and Development of FPGA Interface Boards for a Quantum Photonics System.

ELECTRICAL AND TELECOMMUNICATIONS ENGINEERING TECHNOLOGY AND PHYSICS:

Science and Engineering Student Apprenticeship Program in Accelerator Research and Development (SESAPARD) at Brookhaven National Laboratory

- 58** Raul Barajas Vargas, Viviana Vladutescu, Mikhail Polyanskiy, William Li, Li Geng, Vikas Teotia, Lufeng Leng, Marcus Babzien, Dismas Choge, Giovanni Ossola, Christopher Chow, Tianyi Zhao, Anita Nam, Aldane Duncan, Axel Lojas, Henry Ye, Efrain Luna, Avanti Williston, and Sheikh Tusher. A Comprehensive Study of Laser Optics, Superconducting Magnets and Electron Beams to Better Understand Particle Accelerator Physics.
- 59** Christopher Chow, Tianyi Zhao, Anita Nam, Viviana Vladutescu, Mikhail Polyanskiy, William Li, Li Geng, Vikas Teotia, Lufeng Leng, Marcus Babzien, Giovanni Ossola, Aldane Duncan, Axel Lojas, Henry Ye, Raul Barajas Vargas, Efrain Luna, Avanti Williston, and Sheikh Tusher. Discovering Optical Materials from AI-Generated Crystal Structures and AI assisted UED alignment.
- 60** Aldane Duncan, Viviana Vladutescu, Mikhail Polyanskiy, William Li, Marcus Babzien, Vikas Teotia, Christopher Chow, Raul Barajas Vargas, Axel Lojas, Efrain Luna, Anita Nam, Sheikh Tusher, Avanti Williston, and Tianyi Zhao. Applications and Computational Modeling in Accelerator Science.
- 61** Axel Lojas, Dismas Choge, Li Geng, William Li, Giovanni Ossola, Mikhail Polyanskiy, Vikas Teotia, Viviana Vladutescu, Raul Barajas Vargas, Christopher Chow, Aldane Duncan, Efrain Luna, Anita Nam, Sheikh Tusher, Avanti Williston, Henry Ye, and Tianyi Zhao. Exploring Accelerator Physics with Laser Optics, Superconducting Magnets, Ultrafast Electron Diffraction, and IQ Modulation.
- 62** Efrain Luna, Viviana Vladutescu, Mikhail Polyanskiy, William Li, Vikas Teotia, Marcus Babzien, Dismas Choge, Mark Palmer, Li Geng, Lufeng Leng, Giovanni Ossola, Aldane Duncan, Anita Nam, Avanti Williston, Axel Lojas, Christopher Chow, Sheikh Tusher, Henry Ye, Raul Barajas Vargas, and Tianyi Zhao. Integrating Optics, Magnetism, and Beam Dynamics in Accelerator Science.
- 63** Anita Nam, Viviana Vladutescu, Mikhail Polyanskiy, Vikas Teotia, William Li, Marcus Babzien, Dismas Choge, Li Geng, Giovanni Ossola, Raul Barajas Vargas, Christopher Chow, Aldane Duncan, Axel Lojas, Efrain Luna, Sheikh Tusher, Avanti Williston, Henry Ye, and Tianyi Zhao. Particle Accelerators at the Junction of Artificial Intelligence (AI), Optics, Superconducting Magnets (SCM), and Ultrafast Electron Diffraction (UED).
- 64** Sheikh Tusher, Mikhail Polyanskiy, Viviana Vladutescu, William Li, Li Geng, Vikas Teotia, Lufeng Leng, Marcus Babzien, Giovanni Ossola, Dismas Choge, Aldane Duncan, Axel Lojas, Henry Ye, Raul Barajas Vargas, Efrain Luna, Avanti Williston, Christopher Chow, Tianyi Zhao, and Anita Nam. Integrated Accelerator Research at BNL: Automatic Laser Alignment, Quadrupole Magnet Design, and UED Beam Dynamics.
- 65** Avanti Williston, Viviana Vladutescu, Mikhail Polyanskiy, Dismas Choge, Li Geng, Marcus Babzien, Vikas Teotia, Lufeng Leng, William Li, Giovanni Ossola, Jhair Alzamora, Sheikh Tusher, Tianyi Zhao, Henry Ye, Efrain Luna, Raul Barajas Vargas, Aldane Duncan, Anita Nam, and Christopher Chow. Automation, Simulation, and Instrumentation Used in Particle Accelerators: Automated Laser Alignment, 3D Magnet Design, IQ Modulation Replacement, Particle Simulation.
- 66** Henry Ye, Viviana Vladutescu, Vikas Teotia, Mikhail Polyanskiy, William Li, Marcus Babzien, Dismas Choge, Sheikh Tusher, Axel Lojas, Christopher Chow, Anita Nam, Efrain Luna, Raul Barajas Vargas, Aldane Duncan, Avanti Williston, Li Geng, Giovanni Ossola, Tianyi Zhao, and Lufeng Leng. Computational Modeling and Application in Accelerator Science at BNL.

HEALTH CARE POLICY AND MANAGEMENT

- 67** Fatima Barnes, Amy Bermeo, Milsy Peña, Kyene Pratt, and Justin Harnandan. Barriers to Community Board Participation in New York City: Strengthening Civic Engagement to Advance Community Health.
- 68** Justin G. Harnandan and Noemí Rodríguez. Rethinking How We Prepare the Public Health Workforce.

COMPUTER ENGINEERING TECHNOLOGY

- 69** Emmanuel Akpona, Eduardo Alcala, Anthony Delarosa, Binay Ghimire, and Aparicio Carranza. Adaptive Virtual Infrastructure: Observability, Reconfiguration, and Changing Operations Conditions.
- 70** Victor Baez, Ethan Cyrus, Jose Palacios, Diego Reyes, and Aparicio Carranza. Wireless Networking Technologies.
- 71** Faridjon Jamshidov, Christopher Gutierrez, Jaiden Sampilo, Aisha Ayub, and Aparicio Carranza. The Hidden Threat Within AI Systems.
- 72** Mehedul Khan, Ruitao Xiong, Samuel Ajeleti, and Aparicio Carranza. Analysis of Suspicious Login Activity Using Machine Learning for Cybersecurity.
- 73** Jamie Labriel, Kyle Huang, and Aparicio Carranza. Low-Overhead Flow-Level Performance Tracing in Multi-Tenant OpenStack Clouds Using eBPF and Programmable Virtual Switches.
- 74** Kimberly McLauring and Aparicio Carranza. CloudTransit: Distributed Transit Monitoring and Passenger Information System.
- 75** Karl Richards and Aparicio Carranza. Integrating Data and AI Into Cybersecurity.
- 76** Angel Sanchez, Rizwan Chowdhury, Shomik Islam, and Aparicio Carranza. Access Control and Security for AI Systems.
- 77** Maisey Khaimov, Tavarae Thomas, Pavel Perz, Randy Landaverde, and Aparicio Carranza. Understanding GitHub and Cloud Concepts.
- 78** Jose Velez, Nathaniel Bruce, Yasser Mohajiry, Javon Ane, and Aparicio Carranza. Building and Exploring Networks with Raspberry Pi.
- 79** Zhuofan Zheng, Ivan Wu, Weibo Zhou, and Aparicio Carranza. A High-Accuracy Detection Scheme for VM Escape Attacks.

PROGRAM FOR ONE-MINUTE ORAL PRESENTATIONS

- | | | | |
|----------|---|-----------|--|
| 1 | Christopher Blair, Tomas Flouri, Felipe de Medeiros Magalhães, Lauren M. Chan, Daniel G. Mulcahy, Sungsik Kong, and Adam D. Leaché. Genomic Analysis of Sagebrush Lizards Highlights Extreme Phylogenomic Conflict and a Complex Demographic History. | 8 | Avis J. Smith. Injury Prevention Using Mouth Guards. |
| 2 | Wenhsing Yang. Integrative Pain Management for Cancer Patients: Evaluation of a Self-Paced Online Learning Course. | 9 | Shiu Wong, Christopher Chow, and Ahmet Yuksel. GeoPTM: Graph Attention-Based Prediction of Primate Post-Translational Modification Sites via Protein Language Model Embedding. |
| 3 | David B. Smith. Distributed Collaborative Intelligence in a Human–AI Compositional Pipeline: A Balanced Blended Space Workflow. | 10 | Khaoula Dehhou, Vitaliy Dorogan, Ivana Radivojevic Jovanovic, Wenli Guo, Malvika Garikapati, Khalid Musa. Non-contact Characterization of Liquid Composition Using Single-Photon Vibrometer (SPV). |
| 4 | Alberto Martinez and Jacky Deng. Interaction with human serum albumin (HSA) of caffeic acid, and resveratrol derivatives. | 11 | Christopher Chow, Tianyi Zhao, Anita Nam, Viviana Vladutescu, Mikhail Polyanskiy, William Li, Li Geng, Vikas Teotia, Lufeng Leng, Marcus Babzien, Giovanni Ossola, Aldane Duncan, Axel Lojas, Henry Ye, Raul Barajas Vargas, Efrain Luna, Avanti Williston, and Sheikh Tusher. Discovering Optical Materials from AI-Generated Crystal Structures and AI assisted UED alignment. |
| 5 | Noemí Rodríguez and Laura M. Penalo. High-Quality Simulations for the Undergraduate Health Management Curriculum: A Pragmatic Approach for Learner Engagement. | 12 | Fatima Barnes, Amy Bermeo, Milsy Peña, Kyene Pratt, and Justin Harnandan. Barriers to Community Board Participation in New York City: Strengthening Civic Engagement to Advance Community Health |
| 6 | Huseyin Yuce. Analysis of Rare Events in Healthcare Intervention Using Department of Defense Data. | | |
| 7 | Boris A. Gelman. An Effective Field Theory for Recently Discovered Doubly Charmed Hadrons. | | |

ABSTRACTS OF PRESENTATIONS

FACULTY

Architecture	12
Biology and Health Sciences	12
Business	14
Chemistry	14
Communication Design	14
Computer Engineering and Information System Technology	15
Construction Management and Civil Engineering	15
Electrical and Telecommunications Engineering Technology	15
Entertainment Technology	16
Health Sciences	17
Hospitality Management	17
Law and Paralegal Studies	17
Mathematics	17
Physics	18
Radiologic Technology and Medical Imaging	19
Restorative Dentistry	21
Social Sciences	22

FACULTY-STUDENT

Architecture	22
Computer Systems Technology	23
Collegiate Science and Technology Entry Program (CSTEP)	24
QUEST for Quantum Future	24
Electrical and Telecommunications Engineering Technology and Physics: Science and Engineering Student Apprenticeship Program in Accelerator Research and Development (SESAPARD) at Brookhaven National Laboratory	25
Health Care Policy and Management	28
Computer Engineering Technology	29

ABSTRACTS OF PRESENTATIONS FACULTY

ARCHITECTURE

1. **Adaptive Reuse in Post-Apartheid South Africa: Architecture, Memory, and Urban Transformation**

Lia Dikigoropoulou and Michael Ray Malonjao /
Department of Architecture, NYC College of Technology, CUNY

This research examines adaptive reuse in Cape Town, Johannesburg, and Durban through nine case studies documenting the transformation of existing buildings and urban precincts. Conducted during the 2025-2026 Faculty Fellowship Leave, the study combines field observation, photographic documentation, archival research, and interviews with architects, academics, developers, historians, and planners. The projects range from former prisons, industrial buildings, and schools to cultural institutions and large urban precincts. Within South Africa, these transformations are inseparable from the spatial legacies of colonialism, industrialization, and apartheid. The research finds that adaptive reuse can preserve architectural and cultural memory while supporting new civic, cultural, educational, and economic activity. Although individual projects cannot resolve broader patterns of inequality, they demonstrate how existing structures can contribute incrementally to urban transformation in post-apartheid South Africa.

BIOLOGY AND HEALTH SCIENCES

2. **Genomic Analysis of Sagebrush Lizards Highlights Extreme Phylogenomic Conflict and a Complex Demographic History**

Christopher Blair^{1, 2}, Tomas Flouri³, Felipe de Medeiros Magalhães¹,
Lauren M. Chan⁴, Daniel G. Mulcahy⁵, Sungsik Kong⁶, and Adam D. Leaché⁷

¹ Department of Biological Sciences, NYC College of Technology, CUNY

² Biology PhD Program, CUNY Graduate Center

³ Department of Genetics, Evolution and Environment, University College London

⁴ Department of Biological Sciences, California Polytechnic State University

⁵ Collection Future, Museum für Naturkunde, Berlin

⁶ RIKEN Center for Interdisciplinary Theoretical and Mathematical Sciences

⁷ Department of Biology & Burke Museum of Natural History and Culture,
University of Washington

Next-generation DNA sequencing continues to revolutionize diverse biological disciplines. In systematics and phylogenomics, these data sets have demonstrated widespread phylogenomic conflict between gene trees due to both biological and analytical causes. Using a geographically widespread lizard complex and 100,000+ loci, we demonstrate genome-wide phylogenetic instability of species trees using both random sets of loci and reference-guided markers. Our methodology explicitly accounts for ancestral polymorphisms (incomplete lineage sorting) in species tree estimation, indicating that gene flow among populations may be distorting phylogenetic signal. This is supported by subsequent migration and introgression analyses. Biologically, the *Sceloporus graciosus* complex represents a system that underwent rapid divergence into multiple geographic lineages, many of which should be recognized as distinct species.

We recommend that contemporary phylogenomic studies perform subsampling experiments to determine the robustness of species tree topologies to quantify uncertainty for downstream evolutionary and biogeographic inference.

3. **Testing New Multi-Target Compounds for Alzheimer's Disease: From the Bloodstream to the Brain**

Mai Zahran¹, Adrian Guin-Rizzo¹, and Alberto Martínez²

¹ Department of Biological Sciences, NYC College of Technology, CUNY

² Department of Chemistry, NYC College of Technology, CUNY

Alzheimer's disease is the most common cause of dementia, and current treatments relieve symptoms without slowing it. Because the disease damages the brain in several ways at once, we designed compounds that act on more than one target. We combined computer modeling with laboratory assays to test six such compounds for three properties a drug candidate needs: transport in the blood, permeability across the blood-brain barrier, and activity against its target. Modeling placed all six in the same pocket of human serum albumin, the protein that carries drugs in the blood, and predicted that compounds 5 and 6 span both binding regions of acetylcholinesterase, the enzyme blocked by current Alzheimer's drugs. In the assays, all six bound albumin without changing its structure, four showed high permeability, and compound 5 was the strongest inhibitor. Calculated binding energies correlated with the measured inhibition. We found that compounds 5 and 6 are the most promising candidates for further development.

4. **Bridging Gaps in Geriatric and End-of-Life Education Through Innovative Online Microcredentials**

Emerson Ea, Mary Jo Vetter, Margaret Rafferty, Benito Mendoza, and Kayle Williams /
Department of Nursing, NYC College of Technology, CUNY

The rapidly aging population and increasing demand for skilled professionals prepared to care for older adults highlight important gaps in nursing and health professions education. Traditional curricula often emphasize acute and hospital-based care, providing limited exposure to the continuum of aging services, community-based care settings, and end-of-life care. To address these educational and workforce gaps, a nursing school within an urban public university in the United States (US) developed two innovative asynchronous online microcredentials designed to enhance knowledge, career awareness, and preparedness among nursing and health sciences students: (1) Ageless Care: Care Continuum in the Care of Older Adults, and (2) Peaceful Transitions and End-of-Life Care. More specifically, this presentation will describe the development, implementation, and integration of these microcredentials into nursing and health sciences education.

The first microcredential introduces learners to person-centered care across the continuum of aging services, including long-term care, home care, and other out-of-hospital settings. The module highlights interprofessional collaboration, common geriatric conditions, and diverse career opportunities in aging services. The second microcredential prepares learners to provide compassionate, evidence-based care during end-of-life transitions focusing on palliative care principles and support for patients and families experiencing serious illness, loss, and grief.

Outcomes data related to enrollment, completion rates, knowledge acquisition, and career awareness will be presented. These microcredentials offer a practical and scalable approach to strengthening workforce readiness, improving geriatric and palliative care competencies, and expanding students' understanding of career pathways that address the needs of an aging population.

5.

Beyond the Silent Killer: Designing Bilingual Hypertension Education with and for older Puerto Rican Adults

Eduardo Luna Juarez, Biba Kone, and Annika Daphne Bilog /
Department of Nursing, NYC College of Technology, CUNY

Hypertension, often called “el asesino silencioso” (“the silent killer”), is a concern for older Puerto Rican adults in New York City. About 596,000 New Yorkers identify as Puerto Rican, and a 2018 study estimated that 61% of Latino adults aged 60 and older had hypertension. Misconceptions can hinder its management: that high blood pressure matters only when symptoms appear, stress is its sole cause, or medication can stop once readings improve. This design-thinking project aims to develop culturally responsive outreach shaped by older Puerto Rican adults’ needs and feedback. By listening to community members, defining their concerns, and testing solutions, we will create education that replaces myths with facts and practical guidance. Using vibe coding, we will aim to develop an interactive resource in English and Spanish that explains home monitoring and encourages conversations with healthcare professionals.

6.

The Invisible Shift: Reimagining Breastfeeding Support and Maternal Well-Being for Working Mothers

Amanda Reyes, Sophia Zheng, Sanai Quinones-Grant, and Annika Daphne Bilog /
Department of Nursing, NYC College of Technology, CUNY

According to a 2024 survey, 43% of American parents remain unaware of available workplace lactation support. Evidence suggests that mothers who perceive high levels of workplace breastfeeding support are more likely to continue breastfeeding than those who perceive low levels of support. This design-thinking project explores how a virtual lactation support tool with a built-in tracker can better support working mothers in the community. Using vibe coding, the tool will be developed and refined shaped by mothers’ feedback. The tool will enable mothers to track pumping and feeding sessions, receive personalized reminders for pumping and breast milk storage, access brief educational videos, and receive daily supportive messages that promote maternal well-being and breastfeeding confidence. The project aims to provide accessible, ongoing lactation support that empowers working mothers to sustain their breastfeeding goals while navigating their return to work.

7.

Integrative Pain Management for Cancer Patients: Evaluation of a Self-Paced Online Learning Course

Wenhsing Yang /
Department of Nursing, NYC College of Technology, CUNY

Background: Cancer-related pain has physical, psychological, emotional, and cultural dimensions. Integrative pain management combines conventional pharmacologic treatment with evidence-based complementary therapies and emphasizes culturally sensitive, patient-centered care.

Purpose: This evaluation assessed the effectiveness and learner experience of a self-paced online Pain Management for Cancer Patients course, focusing on knowledge, engagement, applicability, and assessment performance.

Methods: Seventy students enrolled, and 63 completed all course requirements (90% completion rate). Forty-four students completed a five-point Likert-scale post-course survey. Learning outcomes were evaluated using a pre-diagnostic assessment, course assessments, and a final examination.

Results: Learners reported high ratings for course objectives, organization, and understanding (4.68–4.80/5), with strong engagement and perceived applicability (4.48–4.68/5). Mean performance increased from 8.7 on the pre-diagnostic assessment to 97.4 on the final examination. Students highlighted clinical relevance, effective quizzes, and increased confidence.

Conclusion: The course demonstrated strong engagement, perceived relevance, and improved assessment performance.

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8.

Evaluating Student Learning Through Comprehensive Assessment Testing: A Pre- and Post-CAT Study in AAS Nursing Program

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This pilot study evaluated changes in nursing students’ performance using Pre-Comprehensive Assessment Tests (Pre-CAT) and Post-Comprehensive Assessment Tests (Post-CAT) during the 2025–2026 academic year at CUNY. Faculty analyzed assessment results to identify learning gaps and developed targeted NCLEX-RN preparation workshops addressing content weaknesses, clinical judgment, Next Generation NCLEX-style questions, and test-taking strategies. Faculty also provided individualized coaching and remediation based on student performance.

Among matched students, the Fall 2025 cohort (n=42) increased from a mean Pre-CAT score of 2.25 to 2.49, an average gain of 0.24. The Spring 2026 cohort (n=49) increased from 2.20 to 2.46, a gain of 0.26. Both cohorts demonstrated measurable improvement.

Findings provide preliminary evidence that assessment-guided, student-centered NCLEX preparation is feasible. Larger multisite studies with structured attendance tracking and longitudinal outcomes are needed to further evaluate effectiveness.

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BUSINESS

9. Embedding Micro-Credentials in Fashion Education: A Teaching Strategy for Reinforcing Professional Skills and Design Thinking

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The fashion industry is changing rapidly, shaped by technological advancements, increasing focus on sustainability, and more interdisciplinary design approaches. These changes mean that fashion graduates need to develop skills that go beyond traditional technical knowledge and creativity. While standard courses lay a solid foundation, they often lack flexible ways to strengthen professional skills and keep up with new industry practices. In response, many higher education institutions are turning to micro-credentials, short, skill-focused certifications that highlight learning achievements through specific experiences (UNESCO, 2022). These micro-credentials are seen as part of a larger system that promotes lifelong learning and offers more adaptable paths for recognizing specialized skills (Brown et al., 2021). As universities adapt to the needs of the evolving workforce, these credentials are becoming an important way to embed real-world industry skills into academic programs, complementing traditional degrees (Coursera, 2025). Research suggests that non-degree credentials can strengthen connections between higher education and workforce development when employers understand and value these credentials (Fong et al., 2023). Digital credentialing systems further enhance this by allowing learners to share evidence of their competencies through professional networks and online portfolios.

CHEMISTRY

10. Interaction with Human Serum Albumin (HSA) of Caffeic Acid, and Resveratrol Derivatives

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This study used fluorescence spectroscopy and circular dichroism (CD) to characterize the binding of caffeic acid (CA), chlorogenic acid (CGA), resveratrol and some derivatives to human serum albumin (HSA) at physiological pH. The intrinsic fluorescence on HSA (Trp-214) was excited at 295 nm, and the emission spectra were collected between 300 and 510 nm at 15°C and at 37°C. The maximum emission at 336 nm was mathematically analyzed to determine binding and thermodynamic parameters. Fluorescence quenching was determined to be static with association constants in the 10^4 - 10^5 M⁻¹ range for all compounds, indicating moderate affinity. Van't Hoff analysis yielded negative ΔG values at both temperatures for all compounds, indicating spontaneous association. Concentration ratios of 1:1 and 1:10 of HSA to all compounds were made, and CD spectra were collected at 185-260 nm. The resulting spectra were then analyzed using BetSel (SP175 basis set) to obtain an estimation of the structural composition of HSA. Results showed that the structure of HSA remained predominantly α -helical in all cases. In conclusion, the compounds under study showed a favorable interaction with HSA, without significant modification of the secondary structure of the protein, which could have important implications in the therapeutic potential of these compounds.

11. Lithium-Ion Battery Anode Based on Graphene-SPION Nanocomposite

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Graphitic carbon-super paramagnetic iron oxide composite nanoparticles were prepared by thermal treatment of mPEG-2000 carboxylic acid stabilized super-paramagnetic iron nanoparticles (SPION). Surface passivation by PEG was confirmed by IR, and 2- and 4-probe conductivity measurements (resistivity $\sim 1 \times 10^{-9}$ ohm-meter). The particles can be easily dispersed in water and show excitation wavelength dependent photoluminescence. TEM and STEM/HAADF analysis indicated that the iron oxide sizes range between 2-20 nm with an average size of ~ 9 nm. HR-TEM confirmed their crystalline nature (equal lattice spacing of 0.285 nm and equal angle of $\pi/2$), while the SAED suggested a BCC crystal structure. EDX-SEM analysis shows higher composition of carbon than iron suggesting that the iron oxide nanoparticles are dispersed within carbon-quantum dot matrix. The magnetization curves indicated ferromagnetic behavior with very low coercivity (M_s 1.99×10^{-4} emu; $M_r/M_s = 0.07$). The new composite is being evaluated as anode for Li-ion battery.

12. Optimizing Synthesis of Analog 5-Phenyl-Indole-3-Acetic Acid (5-Ph-IAA)

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5-phenyl-indole-3-acetic acid (5-Ph-IAA) is a synthetic derivative of natural plant hormone auxin indole-3-acetic acid (IAA) and is used as a selective ligand for protein degradation. The Auxin-Inducible Degron 2 (AID2) technology relies on this ligand for improved specificity and efficiency of protein degradation for multiple experimental systems, such as yeast, *C. elegans*, mammalian cell culture, etc. However, the ligand is expensive and not always available. Here, we are optimizing a two-step published protocol, using Suzuki coupling of 5-chloroindole and phenylboronic acid to form 5-phenylindole in the first step. Then using the 5-phenylindole and a 2-oxo-2-(5-phenyl-1H-indol-3-yl) acetic acid intermediate to form 5-Ph-IAA. This low-cost synthesis can be conducted in any laboratory equipped for routine organic chemistry work.

COMMUNICATION DESIGN

13. Anatomy of an Artificial Intelligence Search: Mapping Query Fan-out for Science Gateways

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When a user submits a single question to an artificial intelligence (AI)-driven search system, that question rarely triggers a single retrieval action. Query fan-out is the process by which an AI-driven search system expands a single user query into multiple related sub-queries before retrieving and synthesizing a response. Current practice identifies five recognized fan-out types generated simultaneously: lexical variation, definitional, relational, procedural, and decomposition. For Science Gateway teams building frequently asked questions (FAQ) and knowledge base

content, understanding this fan-out behavior is essential to writing content that gets retrieved, cited, and trusted. Yet the mechanics of AI query fan-out remain largely invisible to content authors.

Lexical variation rephrases the query using synonyms, alternate terminology, or acronym expansions. Definitional fan-out establishes foundational understanding of what a concept fundamentally is. Relational fan-out maps how the queried entity connects to or is positioned alongside other entities. Procedural fan-out generates sub-queries about steps or actions needed to accomplish a task. Decomposition breaks a complex, multi-part query into narrower sub-queries, each addressing one specific facet.

These fan-out types connect directly to content decisions. FAQ and knowledge base entries need to work with their full-page context, not against it. Titles, headlines, metadata, surrounding body text, and linkage properties all continue to influence ranking and retrieval. The goal is ensuring that context reinforces the answer rather than being required to complete it.

The most reliable source for identifying the questions that gateway users genuinely ask remains direct interactions between users and gateway teams, rather than computer-generated guesses at likely phrasing. Practical implications include but are not limited to: (1) anticipating rephrased and decomposed versions of common user queries drawn from these real interactions, (2) structuring content so that both narrow and broad phrasings of a topic are addressed somewhere in the documentation, and (3) ensuring headlines and other supporting text clearly signal the specific question each section answers.

Creating content that accurately answers real user queries serves the people who need help first, and, as an added benefit, helps AI search systems retrieve and interpret that content correctly, reducing the risk of AI hallucination in generated responses. This practice, known as generative engine optimization (GEO), means optimizing for people who use AI, not optimizing for AI only, just as search engine optimization (SEO) means optimizing for people who use search engines. Ultimately, fan-out clarity is a foundational consideration for any team writing FAQ or knowledge base content.

Keywords: artificial intelligence (AI) search; query fan-out; lexical variation; definitional fan-out; relational fan-out; procedural fan-out; decomposition; generative engine optimization (GEO); information retrieval; science gateways; frequently asked questions (FAQs); knowledge base content; fan-out engine.

COMPUTER ENGINEERING AND INFORMATION SYSTEM TECHNOLOGY

14. Advanced Adequacy in Caring for the Elderly Through Advances in Technology

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The rising demand for elder care is creating significant challenges for Adult Family Homes (AFH), many of which rely on outdated, labor-intensive manual systems that limit efficiency and compromise resident safety. This paper introduces WakSense, an innovative AI and IoT-enabled platform specifically designed to address the operational, regulatory, and caregiving needs of AFH. WakSense enables realtime monitoring of residents, intelligent medication management, automated care routines, and a digital framework for creating, tracking,

and updating Negotiated Care Plans (NCP). The platform also provides advanced caregiver support through job matching, recruitment modules, and tools that assist families in selecting the most appropriate AFH for their loved ones. This study details the system's technical architecture, identifies current market and workflow gaps, and outlines practical implementation strategies aimed at modernizing care delivery, improving resident safety, and reducing caregiver workload, while promoting greater operational efficiency and compliance across AFH.

Keywords: Adult Family Homes, Aging in Place, Artificial Intelligence, Assistive Technologies, Caregiver Support, Digital Care Plans, Elder Care Technology, Elder Safety, Internet of Things, Medication Management, Real-Time Monitoring, Smart Healthcare.

CONSTRUCTION MANAGEMENT AND CIVIL ENGINEERING

15. A Health Impact Assessment Framework for Major Events in New York City

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In collaboration with the New York City Department of Health and Mental Hygiene (DOHMH), we established a Health Impact Assessment (HIA) framework to assess potential health impacts and neighborhood vulnerabilities associated with major events. The framework integrates environmental hazards, population sensitivity, socioeconomic conditions, healthcare access, mobility, and event characteristics to identify areas that may require enhanced preparedness and resources. Key areas of vulnerability include extreme heat, air quality related to traffic and wildfire smoke, communicable diseases, mass congregation, and population mobility. The framework provides a data-driven approach to vulnerability mapping, monitoring, and equitable resource allocation using the FIFA World Cup 2026 in New York City as a case study.

ELECTRICAL AND TELECOMMUNICATIONS ENGINEERING TECHNOLOGY

16. Feasibility Study of 4G LTE and 5G Cellular Networks for Smart LED Streetlight Applications in Smart Cities

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Smart connected light-emitting diode (LED) streetlights are becoming an essential part of future smart city infrastructure. Besides adaptive lighting control, these systems can support smart city services such as environmental monitoring, traffic management, public safety, and HD video surveillance through embedded sensors, cloud connectivity, and real-time communication. This paper investigates the feasibility and comparison of using 4G LTE and 5G cellular networks to provide reliable communication between large numbers of smart streetlight hub nodes (HNs) and cloud management systems.

Simulation results show that 4G LTE can support mission-critical APP1 and APP2 applications with packet delay budget (PDB) satisfaction rates of approximately 60% and 50%, respectively, making it a practical and cost-effective solution for basic smart streetlight deployments. However, its performance decreases in dense deployments and high-bandwidth applications due to higher latency and limited capacity. In contrast, 5G provides significant improvements in bandwidth, latency, reliability, and massive device connectivity. The results show that 5G improves the PDB satisfaction rates of APP1 and APP2 to about 98% and 90%, respectively, while also achieving extreme lower packet loss ratios for mission-critical applications of less than 10^{-6} . Therefore, 4G LTE is suitable for early-stage smart streetlight systems, whereas 5G is a more effective long-term solution for large-scale and mission-critical smart city applications. Based on these findings, a unified 5G-enabled architecture is proposed to support future smart city infrastructure.

17.

Model Validation of Damage Mechanisms in LWIR and NIR Materials in Femtosecond Regime

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Optical technology is pushed to the upper limits of damage with the advent of ultrafast high-power (UFHP) lasers. UFHP are at the forefront of particle accelerators. The UFHP laser levels, repetition rates, and operating environmental conditions lower the damage threshold of the optical components of femtosecond lasers rendering them useless if not used in the given parameters. In this regard, the present study provides the threshold levels for various optical components used in 800nm, and 9.2 μ m UFHP lasers. The optical materials tested, analyzed and discussed here are ZnSe, ZnS, NaCl, BaF₂ and other materials which are of particular interest used in different applications with UFHP lasers in Near Infrared and Long Wave Infrared laser system at Brookhaven National Laboratory. Post-experiment analysis using optical and scanning electron microscopy revealed detailed damage structure, providing insights into the material behavior under high-intensity laser exposure. Additionally, we modeled the possible mechanisms in these materials using Gamaly and Keldysh methods to analyze and compare the models with the experimental results.

ENTERTAINMENT TECHNOLOGY

18.

Distributed Collaborative Intelligence in a Human-AI Compositional Pipeline: A Balanced Blended Space Workflow

David B. Smith /

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This work documents and generalizes an implemented human-AI compositional pipeline for distributed collaborative intelligence across music and text in operatic and musical theatre productions. Informed by Balanced Blended Space (BBS), the workflow identifies mediation pathways through which creative effort moves among physical, virtual, and blended spaces and across human, computational, and formal intelligences. Separate musical and textual streams are developed through analysis, formal transformation, human-AI generation, and

human curation before converging in a shared generative process. Subsequent stages include audio decomposition, symbolic recovery, notational reconstruction, orchestration, and performance realization. The workflow remains recursive, allowing musical outcomes to reshape textual constraints and vice versa. Final realization occurs within a Blended Ensemble comprising human singers, human instrumentalists, and computationally mediated virtual musicians. Individual works can be treated as specific instantiations of this generalized compositional pipeline.

19.

The Self-Aware Room: An Evolvable Architecture for Balanced Blended Environments

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The Self-Aware Room (SAR) is an evolving research environment that investigates how physical, virtual, and conceptual spaces can be coordinated through sensing, computation, and immersive media to observe, represent, interpret, and respond to human and environmental activity. Developed within City Tech's Center for Holistic Integration, SAR combines modular T-slot architectural structures, projection surfaces, spatial audio, cameras, sensors, and a generalized computational pipeline. Rather than defining "self-awareness" as an anthropomorphic property, the project treats it operationally as the capacity to transform heterogeneous observations into bounded, uncertainty-aware representations, semantic interpretations, policy-governed decisions, and traceable actions. Current research examines how heterogeneous sensor observations can be normalized, correlated across modalities, and transformed into traceable room-state representations without collapsing uncertainty or prematurely assigning meaning. The project is designed as an evolvable platform for research, teaching, performance, and student-led experimentation within balanced blended environments.

20.

Simulator Integration, Live Telemetry Coupling, and High-Density Multichannel Cockpit Audio Rendering for Military Vehicle Simulation

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The Autonomous Vehicle Mobility Institute (AVMI), in collaboration with the U.S. Army Ground Vehicle Systems Center (GVSC), is developing a simulation ecosystem for investigating human interaction with autonomous ground and aerial systems in complex vehicle operations. This project develops the audio component of that environment, treating sound as a dynamic source of situational information rather than as a collection of prerecorded effects. The system combines field-recorded samples, physics-based acoustical modeling, real-time digital signal processing, and spatial audio rendering so that vehicle, terrain, and environmental sounds respond continuously to simulated operating conditions. The current phase establishes parallel immersive-audio research environments at Worcester Polytechnic Institute and City Tech, evaluates multichannel speaker configurations and perceptual realism, and develops a documented library of controllable sound objects linked to simulation parameters. The research addresses perceptual accuracy, localization, computational efficiency, and synchronization across auditory, visual, and physical simulation.

HEALTH SCIENCES

21. High-Quality Simulations for the Undergraduate Health Management Curriculum: A Pragmatic Approach for Learner Engagement

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Benefits of simulation-based education are well documented. Nonetheless, they are limited in undergraduate health management programs. Perhaps faculty in these programs are unfamiliar with the design and implementation of high-quality simulations. Here we present an approach for utilizing simulations—grounded in Healthcare Simulation Standards of Best Practice and The Jeffries Simulation Theory—using the experience of an undergraduate healthcare policy and management course at a large urban public university. We provide the method for an Online Standardized Participant Simulation (OSP-Sim) activity, including a detailed description of the simulation design, prebriefing, online standardized participant scenario, and debriefing. Unique features such as the integration of carefully trained actors, learner assessment and evaluation strategies, and a validated PEARLS debriefing tool are shared. The goal is to offer undergraduate health administration and management faculty a replicable, high-impact simulation model that enhances student learning and engagement.

HOSPITALITY MANAGEMENT

22. From Jobs to Generational Success: Rethinking Career Pathways in NYC Public Schools

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This study examines whether New York City career-pathway initiatives (FutureReadyNYC, Career and Technical Education, and Career Readiness and Modern Youth Apprenticeship) are designed for durable socioeconomic stability or short-term labor-market entry. Drawing on scholarship on vocationalism, wealth inequality, job quality, social capital, and institutional access, it develops a four-dimensional framework of generational success: financial resilience, advancement-rich work, institutional and civic capacity, and durable networks of recognition. The framework is applied to the City's accountability architecture, including the 2015 13 Common Metrics, with Hospitality as a case sector. Findings combine policy-document analysis with five semi-structured interviews of educators, workforce practitioners, career professionals, and employer-side leaders. Existing metrics omit benefits access, union coverage, advancement, wealth accumulation, and civic participation. A two-tier investment structure also places Hospitality students outside the most resourced pathways. Respondents viewed long-term success as relational and structurally conditioned. The study calls for shared accountability, longer evaluation horizons, and success measures centered on durability rather than entry.

Keywords: career pathways; generational success; workforce development; accountability metrics; vocational education; hospitality; job quality; New York City

LAW AND PARALEGAL STUDIES

23. Law and Emerging Technologies

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Challenges that arise as a result of using and relying upon Artificial or Super Intelligence Tools in law practice and when learning about the law, highlight the need for guidance. The impact and ramifications regarding the use of these emerging technologies on judges, seasoned lawyers, law clerks, law students, and paralegals have yielded several responses.

In legal education, it has resulted in the creation of policies and procedures addressing whether emerging technology tools should be used when taking law school exams or in completion of assignments. In case law decisions, use of such tools have tested the boundaries of the attorney-client privilege and work product doctrine. Further, the evolving nature and our understanding of such tools are demonstrated in Executive Order 14434, signed by President Donald J. Trump, introducing the term "Super Intelligence," when referring to AI.

MATHEMATICS

24. Unitary and Nonunitary Representations of the Heisenberg–Weyl Lie Algebra

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The Heisenberg–Weyl Lie algebra arises in quantum mechanics and is an important example in representation theory, the study of how algebraic structures act through matrices and linear operators. We examine both unitary and nonunitary representations of this algebra. We construct a large family of finite-dimensional, nonunitary representations that cannot be split into independent smaller parts. Our construction uses representations of a larger symplectic Lie algebra and shows that this property persists when the action is restricted to the Heisenberg–Weyl algebra. We also study tensor products of Schrödinger representations, which combine two representations into a new one. We give explicit transformations that describe the structure of these combined representations.

25. The Benign Logic of Equivalences

Hans Schoutens /
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In mathematics, one is constantly faced with the following two-headed quandary: given two objects/structures, whether, or when, are they "the same"? The isomorphism notion answers the whether-question, but the when-question then becomes hard. A weaker notion is that of being equivalent. I will describe the logic of benign formulas that both respects equivalences and tests for them.

26.

Generating Functions for Maximally Expanded α -trees

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We construct generating functions whose coefficients enumerate certain directed planar trees known as maximally expanded α -trees. We show that the number of such trees can be expressed as an integer linear combination of consecutive Catalan numbers. We also provide a general (non-closed form) formula for the number $c_{\ell,m,n}$ of maximally expanded $01\bar{0}1m01n$ -trees.

27.

Analysis of Rare Events in Healthcare Intervention Using Department of Defense Data

Huseyin Yuce /

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For rare events and diseases, maximum likelihood estimates in logistic regression are biased and underestimate predicted probabilities. This work examines two remedies proposed by King and Zeng: prior correction of the intercept and population-based weighting. We use Department of Defense claims data to model intravenous immune globulin (IVIg) use among 2,720 adults with bullous pemphigoid, of whom only 14 (0.5%) were treated. Both corrections use a population IVIg rate of 0.539%, which is an uncorrected subsample of all events, and 140 non-events illustrating the cost of outcome-based sampling. Standard logistic regression underestimated predicted probabilities by 11-102% compared to prior correction and by 15-107% compared to weighting. The uncorrected subsample overstated probabilities 10- to 20-fold; however, once the subsample is prior-corrected, this inflation reduces to 0.7- to 1.0-fold (Baser, Yuce, Samayoa 2025). Therefore, accurate rare-event estimation is essential for assessing the burden of rare diseases and the cost of their therapies.

28.

Connect the DOTS

Ariane Masuda, Kate Poirier, and Jonas Reitz /

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Connect the DOTS (2022-26) is a collaboration between the Mathematics, Physics, and Computer Systems Technology Departments and City Tech's OpenLab focused on supporting students who encounter mathematical challenges in non-mathematics STEM courses. The project grew from a recognition that many students pursuing STEM struggle to transfer and apply mathematical concepts across disciplinary contexts. In response, our team has created engaging, asynchronous resources designed to help students make these crucial connections at their moment of need. We also developed and released the underlying software, the OpenLab Module Builder, as a free Wordpress plugin. All resources are publicly available on the OpenLab. Funding for the project was provided by the Department of Education's MSEIP program.

PHYSICS

29.

Microscopic Theory of Temperature-Controlled Switching Between Lower and Upper Polariton Condensates

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Microcavity polaritons are quasiparticles, formed by the linear superposition of excitons in the two-dimensional material embedded in a microcavity, and microcavity photons. Recent experiments on GaAs/AlGaAs microcavities show that microcavity polaritons condense in the lower branch at low temperatures and in the upper branch at elevated temperatures, and switch stochastically between the two branches near 80 K. We develop a microscopic Schwinger-Keldysh theory of this switching. The mean-field theory of co-existing condensates of low polaritons and upper polaritons is presented in Ref. [1]. By integrating out the electron-hole reservoir, we derive coupled stochastic Gross-Pitaevskii equations for excitons and photons together with rate equations for the carriers, without phenomenological rates. We find that the exciton dissipation is non-ohmic, so the damping and the noise of the exciton field are independent quantities. Since the two polariton branches lie at different energies, they experience different damping and noise, which we propose as the origin of the switching. We will present the temperature dependence of the exciton damping and noise, the incoherent exciton density, and the condensation thresholds of both branches, from which we construct the phase diagram and the switching temperature.

[1] A. N. Arafat, O. L. Berman, G. Gumbs, and P. B. Littlewood, Theory of two-component superfluidity of microcavity polaritons, *Journal of Physics: Condensed Matter* 38, 205402 (2026).

30.

QUEST for Quantum Future: An Experiential Learning Program for Undergraduate STEM Students

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The rapid integration of microelectronics, photonics, and quantum computing has created an urgent need for a skilled domestic workforce in advanced semiconductor chip manufacturing and quantum technologies. Funded by the National Science Foundation ExLent grant, the QUEST for Quantum Future program addresses this need through a structured, eight-month experiential learning framework that prepares associate- and bachelor-level STEM students for high-demand careers.

The program offers participants direct access to immersive research, specialized curriculum training, and industry internships across three key phases of technology development: research, commercialization, and large-scale manufacturing. Through a cross-sector partnership among City University of New York (CUNY) institutions—New York City College of Technology, Queensborough Community College, and the Advanced Science Research Center—and major industry leaders including NY Creates, GlobalFoundries Inc., and Quantum Computing Inc., students gain invaluable hands-on experience. Key opportunities include:

Hands-On Research & Training: Students engage in specialized curriculum modules, foundational workshops, and intensive hands-on bootcamps covering semiconductor fundamentals, modern chip fabrication processes, and quantum platform applications.

Industry Internships & Career Pipelines: Participants gain direct exposure and entry into high-demand industry internships, supported by industry site visits and targeted professional development.

Designed to train more than 45 students over three years, QUEST for Quantum Future serves as a replicable, industry-aligned model that equips undergraduate STEM students with the practical skills and research experience needed to succeed in emerging quantum and semiconductor industries.

31. Spatially Resolved Star Formation Histories Show How Galaxies Grow and Fade

Charlotte Olsen, Charlotte Welker, and Ena Chia /
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Spatially resolved galaxy properties are routinely derived from integral-field spectroscopy and increasingly from multi-band photometry as a wealth of photometric data becomes available in large surveys. Spatially resolved star formation histories (SFHs) offer a detailed view of galaxy growth and quenching by tracing the timing and location of star formation within a galaxy. However, stellar migration between spaxels can strongly bias these reconstructions. Quantifying how much bias we expect in observations remains challenging because many zoom-in simulations do not resolve initial stellar dispersions or migration rates. We use the well-validated h277 Milky-Way-mass cosmological zoom simulation, which resolves both via advanced molecular-cloud modeling, to compare the actual radial distribution of star formation to the distribution inferred from the resolved SFHs up to a lookback time of ~ 1.6 Gyr in several evolutionary windows. Measuring migration rates in annuli matched to typical spaxel scales, we quantify how well we can recover the radial profiles from resolved SFHs at different time steps and find them consistent in slope and the relative shape of the scatter up to 1 Gyr lookback time.

32. Controllable Intervalley Magnetotriions in Xenes

Anastasia Spiridonova /
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We investigate the behavior of intervalley triions in buckled Xene monolayers under perpendicular electric and magnetic fields. We treat the problem within an effective-mass model that incorporates carrier interactions through the Rytova–Keldysh potential. For the special case of equal electron and hole effective masses, the three-particle Hamiltonian separates into center-of-mass and relative-motion contributions. The center-of-mass motion is described by a two-dimensional harmonic oscillator, giving rise to quantized Landau states that form electrically tunable Landau surfaces. Their energies depend on both the magnetic field and the electric-field-induced variation of the carrier effective masses. The internal triion states are obtained using the hyperspherical harmonics method. Our calculations show that the triion binding energy increases with both electric and magnetic fields due to enhanced carrier masses and magnetic confinement, respectively. Among the considered Xenes, silicene exhibits the strongest binding. These results show that external fields can independently control the collective and internal dynamics of magnetotriions.

33. Quantization of First-Detection Statistics in Monitored Quantum Systems

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Quantum measurements can fundamentally alter the temporal dynamics of closed quantum systems and give rise to universal and topologically quantized first-detection statistics. We discuss monitored quantum walks and related finite-dimensional quantum systems subjected to repeated, random-time, weak, and indirect measurements. A central result is the quantization of the mean number of measurement attempts required for a first detected return: for stroboscopic projective monitoring it is governed by a winding number of the return amplitude, while for random-time monitoring of finite-dimensional systems the corresponding mean attempt number is fixed by the accessible Hilbert-space dimension. The physical mean return time is obtained by multiplying this quantized attempt number by the appropriate mean measurement interval. We further examine fluctuations and divergences of return times near critical sampling conditions, spectral degeneracies, and quantum-Zeno regimes, revealing connections between topology, localization, and time-energy uncertainty. Conditional null measurements generate additional phenomena, including dynamically selected states, oscillatory decay, dark states, and exceptional points. Weak and indirect monitoring provides a complementary route to controlling first-detection dynamics, with characteristic scaling laws in the measurement strength. These theoretical predictions have been supported by quantum-walk experiments on IBM quantum processors, demonstrating quantized return statistics, enhanced transition times near degeneracies, and measurement-induced effects in finite graphs. Together, these results establish monitored quantum walks as a versatile framework for exploring the interplay between quantum dynamics, measurement, topology, and temporal statistics.

34. Lightest Nuclei with Hidden and Open Strangeness

Roman Kezerashvili /
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Atomic nuclei are typically built from protons and neutrons, but exotic particles can also be bound within them to create unique nuclear systems. Using advanced theoretical models, this study explores how two types of exotic particles—the Ω^- baryon (which contains "open strangeness") and the ϕ meson (which contains "hidden strangeness")—interact inside small clusters of 3 to 5 particles [1,2].

By modeling these systems in precise 3D spatial configurations, we calculated how strongly these particles bind together and how the addition of each extra proton or neutron changes their structure. Our calculations show that the strong, short-range attraction between the exotic particles and surrounding nucleons generates tightly bound states, including newly predicted mesic nuclei such as ${}^4_1\text{H}$, ${}^4_1\text{H}$, and ${}^5_1\text{He}$ [3]. We also evaluated how electrical forces (Coulomb attraction) and particle spin affect these binding energies. Overall, this research provides key insights into the fundamental forces that hold exotic matter together, shedding light on the behavior of subatomic particles under extreme conditions.

[1] R. Lazauskas, R. Ya. Kezerashvili, and I. Filikhin, Faddeev–Yakubovsky calculations for ϕ -mesic nuclei with HAL QCD potential, *Phys. Rev. D* 113, 074024 (2026).

[2] I. Filikhin, R. Ya. Kezerashvili, and B. Vlahovic, Bound states of Ω baryons in light nuclei. *Phys. Rev. C* 113, 015201 (2026).

[3] R. Lazauskas, R. Ya. Kezerashvili, and I. Filikhin, Possible existence of ${}^4_1\text{H}$, ${}^4_1\text{H}$, and ${}^5_1\text{He}$ nuclei, *Phys. Lett. B* 877, 140496 (2026).

35.

How a Bottom Quark Falls Apart, and Why it Matters

Andrea Ferrogli /

Department of Physics, NYC College of Technology, CUNY

Quarks are the Standard Model's shyest particles: they never travel alone, and we only ever meet them locked inside bigger particles. That makes life hard for physicists. When a bottom quark decays into a lighter quark, a charged lepton, and a neutrino, the quarks' constant chatter via the strong interaction blurs the picture, and extracting a fundamental parameter of the Standard Model from the data requires very careful bookkeeping of those quantum corrections.

Our project did the bookkeeping at state-of-the-art precision. Since pen and paper were not up to the task, we wrote a numerical code, blended it with exact results from effective field theories, and distilled everything into compact approximate formulas that describe how the decay unfolds. When tested against existing calculations, the agreement is very good. The results were published in the Journal of High Energy Physics and will help make sense of data from current and future experiments.

36.

An Effective Field Theory for Recently Discovered Doubly Charmed Hadrons

Boris A. Gelman /

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In this poster I briefly demonstrate how the effective field theory framework can be used to study properties of exotic short-lived strongly interacting particles discovered in the last two decades in several high-energy particle accelerators. Particularly interesting are two tetraquark states, $X(3872)$ and $T_{cc}(3875)$, which have extremely small binding energies and decay rates compared to other hadrons with similar masses. This scale separation between the particles' masses and their binding energies can be used to construct an effective field theory in which the low-energy properties of the particles are described in terms of contact interactions between charm mesons and pions, similar to how the nuclear force between neutrons and protons arises from pion-exchange interactions.

37.

Numerical Optimization of Microwave-Optical Coupling in GaAs/AlGaAs Coupled Quantum Wells

Mario R.G. Marques and German Kolmakov /

Department of Physics, New York City College of Technology, CUNY

Coupled quantum wells enable control of excitonic and optical properties through heterostructure design and applied electric fields [1,2]. We study GaAs/AlGaAs wells, where electric fields control carrier localization and can drive transitions between direct and indirect excitons [1]. Well and barrier thicknesses and aluminum concentration modify quantum confinement, tunneling, and electronic structure [2,3]. Our goal is to optimize the exciton optical response using these parameters. We implement an effective-mass model of interacting excitons. The exciton wavefunction is expanded in a multichannel basis of noninteracting electron and hole states, while in-plane radial motion is discretized on a finite-difference grid. Exciton energies, oscillator strengths, and transition dipole moments are calculated as functions of electric field and structural parameters. Benchmark calculations show good agreement with published results. The model enables design

of heterostructures with tailored excitonic states and optical response, including electrically tunable dipole transitions for microwave coupling.

[1] K. Sivalertporn, L. Mouchliadis, A. L. Ivanov, R. Philp, and E. A. Muljarov, "Direct and indirect excitons in semiconductor coupled quantum wells in an applied electric field," *Phys. Rev. B* 85, 045207 (2012). [2] A. M. Fox, D. A. B. Miller, G. Livescu, J. E. Cunningham, and W. Y. Jan, "Excitonic effects in coupled quantum wells," *Phys. Rev. B* 44, 6231 (1991). [3] M. Gurioli, J. Martinez-Pastor, M. Colocci, A. Bosacchi, S. Franchi, and L. C. Andreani, "Well-width and aluminum-concentration dependence of the exciton binding energies in GaAs/AlGa1-xAs quantum wells," *Phys. Rev. B* 47, 15755 (1993).

38.

Benchmarking QAOA for Solving Systems of Linear Equations on an IBM Quantum Computer

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Systems of linear equations arise throughout science and engineering, including optimization, weather prediction, atmospheric modeling, and machine learning. Solving large, dense systems classically costs $O(N^3)$ with direct methods. Iterative methods cost roughly $O(N^2 \cdot \sqrt{\kappa})$ per solve, where κ is the condition number, which motivates the search for quantum alternatives. Fault-tolerant algorithms such as HHL promise an exponential speedup, but only under strict conditions: sparsity, bounded κ , efficient state preparation, and readout of only summary statistics of the solution. These conditions are far beyond current hardware. We investigate a near-term alternative: solving linear systems with the quantum approximate optimization algorithm (QAOA) on IBM's 156-qubit Marrakesh processor. Each unknown is encoded in fixed-point binary form, which turns the problem of minimizing $\|Ax - b\|^2$ into a quadratic unconstrained binary optimization (QUBO). The number of qubits sets both the precision of the solution and the size of the search space. We study how solution accuracy depends on the total number of qubits in the encoding. Below 20 qubits, QAOA circuit parameters are optimized with a classical circuit simulator before running on hardware. At 20 qubits and above, simulation exceeds our computational resources, so we use predefined parameters transferred from the infinite-size Sherrington-Kirkpatrick limit. We present benchmarks against exact classical minimization of the QUBO for small problems and against strong approximate classical solvers (simulated annealing and parallel tempering) for larger ones. We measure accuracy, time to solution, and how both scale with problem size, and we identify how hardware noise and circuit depth on a densely connected problem limit any practical speedup. Finally, we discuss potential applications to image recognition.

39.

Microwave-Induced Enhancement of Exciton Photoluminescence in Monolayer WSe2

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² Advanced Science Research Center, The City University of New York

Optical interconnects between superconducting quantum processors are a promising route toward modular quantum computing and quantum networking. Excitons in transition metal dichalcogenides offer a platform for investigating microwave-dependent optical responses. We study the photoluminescence (PL) of monolayer tungsten diselenide (WSe2) at 13 K using cryogenic optical spectroscopy combined with microwave delivery to the sample. Under optical excitation

at 1.847 eV, PL spectra are recorded with and without an applied microwave field. A 2.74 GHz microwave signal increases the ground-state A1s exciton PL peak intensity by up to approximately 20% relative to the microwave-off measurement. This observation establishes a measurable microwave-dependent change in exciton emission, but does not constitute a calibrated measurement of microwave-to-optical conversion efficiency. We discuss the implications of this result for future studies of exciton-based microwave-to-optical interfaces, including gated coupled quantum wells, toward applications in quantum networking.

RADIOLOGIC TECHNOLOGY AND MEDICAL IMAGING

40. Observation of EM Field Difference from Corona Versus Solar Interior During Solar Eclipse of 2024 Using the Eyes of Strong Magnets: Can MRI RF Noise Explain Animal Confusion During Solar Eclipse?

Subhendra Sarkar /
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Solar eclipse causes confusion and induces nocturnal behavior in birds and other animals. The cause and effects are unknown. It is believed birds navigate by sensing the curvature of magnetic field lines, thus the flight toward poles or equator as well as by sensing the intensity of earth's magnetic fields. They may be using tiny magnetite crystals in their beak to sense the ultra-small changes in magnetic fields as they fly. To understand and detect the changing transient magnetic fields particularly the mystery of ionic discharge from solar corona as opposed to that from solar interior an experiment was designed simultaneously in two 3T magnets in Boston during 2024 almost total solar eclipse, lasting for about 2 hours. The radiofrequency noise (RF) that depends on EM fields entering through cracks and open doors of MRI scan room was the main observable. As moon started covering the sun as well as when moved away from the visible path of sun rays the EM disturbance was imaged in separate paramagnetic sample solutions containing 1 wt% gadolinium or 1 wt% saline solutions and compared to RF noise from paramagnetics free distilled water using magnetic inhomogeneity sensitive T2* MRI sequence with the scan room door open and the magnet bore directly facing Sun. A comparable MR system also ran the experiment simultaneously with magnet bore perpendicular to open door. The RF noise was approximately 20% more for the system directly facing Sun. But most importantly the RF noise during the moon approaching Sun, thus disturbing EM fields from corona, seem to couple the front of the sample with the back that is frequency encoding direction involving only the highly paramagnetic Gadolinium samples. As moon passed the majority of the Corona and the Sun was visible again, the RF noise was approximately 25% less and coupled the Gadolinium samples with the saline samples from right to left along phase encode direction avoiding the Gadolinium to Gadolinium pathway. Such a switching of noise coupling is not seen during day or night on control days with no Solar eclipse events. RF noise measurement also was done at another equivalent system in New York, located 2 floors below ground

level on non-solar eclipse days and the noise level was lower than the systems at ground level at Boston and did not show any directional switching. This experiment seems to point to a complex interaction between the EM fields that originate at corona and the radiation that originates at the bulk of Sun. Perhaps birds and other species are used to the mix and not with the single radiation group that comes out from corona alone during a solar eclipse. The darkness during eclipse may not be blamed for the confusion animals experience.

41. Application of Near Infrared Spectroscopy (NIRS) to Characterize Physiological Alterations after Infusion of Toxic Medical Reagents in Living Tissue

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¹ Department of Radiologic Technology and Medical Imaging, NYC College of Technology, CUNY

² Department of Computational Engineering Technology, NYC College of Technology, CUNY

Toxic chemicals often induce stress to biological systems. We have injected various medical contrast agents in plant and animal tissues and imaged the response by MRI, X-ray and Near Infrared Spectroscopy (NIRS). NIRS can image the average material content as well as time dependent molecular vibrations in the picosecond time scale. Hence, the interaction between NIR radiation and molecular vibrations forms the core of NIR's analytical strength. Overtone and combination bands reveal intricate molecular structures and acts as a unique 'molecular fingerprint,' reflecting specific molecular bonds. In this work Gadolinium and Iodine containing organic cage structures are added to plant walls, thus disturbing normal root/wall nutrient flow. Our NIRS experiments have the potential to fingerprint the identity and possibly the mechanism underlying toxin induced physiologic changes in living tissue.

RESTORATIVE DENTISTRY

42. Injury Prevention Using Mouth Guards

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Injury prevention is a common thing that happens in sports, and athletic participation, requiring intervention of regulatory agencies for protecting participants from injuries. Mouthguards are a way to reduce incidents in sports, but mouthguards can also be used for sleep apnea and grinding of teeth. Mouthguards have an increased usage rate in both areas of sports, for amateurs and professionals, as well as other health areas.

SOCIAL SCIENCES

43.

Balancing the Stream: Using Dynamic Modeling to Predict Sustainable Revenue in the Live Streaming Economy

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² Department of Business, NYC College of Technology, CUNY

Live-streaming platforms rely on a complex of audience visibility, social capital, content value, influencer participation, recognition, and creator competition to shape monetary transfers and drive revenue. This paper introduces a dynamic tractable two-state model of gifters and streamers to study sustainable income generation within the platform-based economy. By employing a Nonlinear Model Predictive Control (NMPC) framework, we distinguish short-term revenue spikes from sustainable, long-run ecosystem management. The NMPC policy dynamically balances current platform choices against predicted future effects on viewer participation, creator entry, viewer fatigue, and revenue. We demonstrate a dynamic system designed for calibration, simulation, and empirical testing using platform trace data.

44.

Putting Science into Anthropology

Lisa Pope Fischer /

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This chapter written for an introductory Anthropology textbook, explores how cultural anthropology operates as a scientific discipline, utilizing my own research methodology as a practical case study. While the field covers diverse topics, its defining characteristic is a systematic reliance on fieldwork. Data collection is deliberate and grounded in strict selection criteria, rigorous procedures, and ethics, moving far beyond casual interaction. Anthropologists use various technologies to document what they see, hear, and experience. Upon returning from the field, we analyze this information to develop and test theories that explain core cultural patterns. Ultimately, this evidence-based research is shared with the wider community through presentations at academic conferences, classroom teaching, peer-reviewed journal articles, and ethnographic books.

COLLABORATIVE RESEARCH FACULTY-STUDENT

ARCHITECTURE

45.

The Architecture of Water: From Forest to Village to City

Kevin Hernandez, Kenneth Conzelmann, and Chris Leung /

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(Emerging Scholars Program)

New York City's 8.5 million residents are served with over 1.1 billion gallons of fresh potable water every day, also considered one of the best-tasting and finest waters for any large city on Earth. This research project is an overview of how we procure our drinkable water, from remote rural areas to dense urban centers, mapping the origins of collection, storage, and transportation of water from the Catskill Mountains to NYC by gravity. We look at the land where the rainwater falls, the reservoirs that store it, the structures above, and the infrastructures below, the pipelines and tunnels, and the rooftop water tanks atop our city's buildings. And we ask: what is the architecture of water?

46.

The Canal House: A New Prototype for Tropical Savanna Climate

Rebekah Zayas, Zayed Baig, Alfonzo Grant, Mahir Rafed, Joel Rosales,

Kenneth Conzelmann, Patricia Semmler, and Chris Leung /

Department of Architecture, New York City College of Technology, CUNY
(Emerging Scholars Program)

This project explores design options for a near off-grid house in southwest Florida's tropical savanna climate. Located on a flat, sandy quarter-acre corner lot where two canals meet, the site experiences intense sun, strong winds, and seasonal storms. The design responds to these conditions with a compact, low-profile building elevated slightly above grade for resilience and environmental performance. Setbacks place the house near the center of the property, while durable materials such as concrete and metal provide protection from weather and reduce maintenance needs. Sustainable systems, including solar power and other renewable energy technologies, support a largely self-sufficient lifestyle. The project also considers the relationship between the home, the canals, the street, and the surrounding neighborhood, seeking a balance between openness, privacy, and connection to place. Ultimately, the proposal demonstrates climate-responsive strategies for contemporary off-grid living.

47.

Environmental and Architectural Conditions in the NYC Subway: Queensboro Plaza Station

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(Collegiate Science and Technology Entry Program, CSTEP)

Summer heat accumulation in MTA subway stations creates uncomfortable conditions for thousands of commuters and can negatively affect rider comfort, health, and transit experience. According to the Regional Plan Association's 2019 report From Summer of Hell to Summer of Extreme Subway Heat,

50.

GeoPTM: Graph Attention-Based Prediction of Primate Post-Translational Modification Sites via Protein Language Model Embeddings

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Technology, CUNY

Post-translational modifications (PTMs) are critical in regulating protein function and experimental identification of these sites are extremely resource intensive. With the advent of machine learning methods and increased computational power, computational prediction of these sites can offer a solution. However, these methods are challenged by severe class imbalance because the vast majority of amino acids are unmodified. We present a graph neural network-based model for per-residue, multi-class PTM site prediction that combines frozen protein language model features with graph attention learning over local residue neighborhoods. Sequence data was processed as 33-length windows centered on Phosphorylation sites then randomly shifted based on a gaussian curve with a sigma of 4. Embeddings were extracted using a pretrained ESM2-8M encoder where the 320-dimensional embeddings are used as node features in a static contact graph where each residue is connected to 5 sequential neighbors upstream and downstream of the residue of interest. The embeddings were sent through a single GATv2Conv layer with four attention heads, a multi-layer perceptron with layer normalization, GELU activation function, and 0.4 drop out which produces per-residue logits over six output classes corresponding to Phosphorylation, Acetylation, Methylation, O-GlcNAcetylation, and Hydroxylation. Training was supervised by a multi-class focal loss with gamma of 2.5 and optimized with AdamW and an adaptive learning rate scheduler. A class average AUPRC of 0.7860 was achieved demonstrating that graph attention neural networks used alongside protein language model embeddings provides effective multi-class PTM site prediction without full sequence or multi-dimensional inputs.

51.

Agentic Invoice Reconciliation: Multi-Agent Orchestration for Financial Operations

Kazi Tamim Nomany, Kazi Tasin, Kazi Rahimu Islam, and Samuel Greenberg /
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Technology, CUNY

Organizations often spend significant time manually reconciling invoices and payment records, especially when transactions contain inconsistent vendor names, missing references, partial payments, duplicate entries, or mismatched amounts. These issues can delay financial reporting, increase manual workload, and make it difficult to determine whether records have been matched correctly.

A multi-agent AI orchestration system can address this problem by dividing the reconciliation process across specialized agents while maintaining centralized coordination. An Orchestrator Agent manages the workflow and assigns tasks to agents responsible for document extraction, transaction matching, discrepancy investigation, and result verification. When evidence is incomplete or a match is uncertain, the Orchestrator Agent can request additional investigation before a reconciliation decision is finalized.

The system combines fuzzy matching, anomaly detection, deterministic calculations, and agent-based reasoning to analyze invoices and payment records. It can identify partial payments,

temperatures on New York City subway platforms have reached 101°F during extreme heat events, underscoring the need to better understand heat buildup and improve station design. This research examines thermal conditions and commuter comfort at Queensboro Plaza Station to identify factors contributing to excessive heat and evaluate opportunities for improvement. The study combined on-site observations, temperature measurements, and analyses of wind patterns, shading, heat island effects, station geometry, and construction materials to assess environmental performance. Findings provide a foundation for architectural design strategies that can reduce heat accumulation, improve passenger comfort, and support more resilient, sustainable, and climate-responsive transit environments.

48.

Passive Design Strategies at Union Square Station

Christopher Gabriel Lopez, Patricia Semmler, Kenneth Conzelmann, Chris Leung, Porie Saikia, Diamonique Watson, and Jean-Pierre Demerieux Gomez /
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As rising summer temperatures, poor air quality, and increasing energy demands affect New York City's subway system, there is a growing need for strategies that improve environmental comfort in underground transit spaces. This research examines 14th Street Union Square Station, one of Manhattan's busiest transit hubs, serving approximately 23 million commuters annually. The station's multiple underground levels experience varying conditions of heat buildup, airflow, and air quality that influence passenger comfort and overall user experience. Through field observations, environmental monitoring, and architectural analysis, the study identifies opportunities to improve station performance through passive design. Proposed interventions include redesigned air-intake entrances, stack-effect ventilation, daylighting, vegetation, low-heat absorption materials, and photochromic glazing. Together, these strategies demonstrate how transit infrastructure can become more climate-responsive, energy-efficient, and comfortable, while improving environmental conditions for passengers and supporting the development of healthier, more sustainable public spaces.

49.

Sustainable Design Strategies to Improve Environmental Conditions at 191st Street

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Hot summers in New York City intensify harsh environmental conditions inside deep-tunnel subway stations, where heat and pollution accumulate far below street level. This project examines conditions at the 191st Street station and explores sustainable design strategies to improve air quality and passenger well-being. The station's deep layout, limited ventilation, and frequent train activity contribute to elevated particulate matter (PM2.5), heat buildup, and stagnant airflow. Through observational analysis and environmental research, the study evaluates how tunnel geometry, platform configuration, and material surfaces influence pollutant movement and accumulation. Findings indicate that poor air circulation allows ferrous PM2.5 from brake dust, rail friction, and tunnel debris to remain suspended, increasing commuter exposure. To address these issues, the project proposes interventions including forced ventilation systems, enhanced filtration, angled ceiling panels that improve airflow, platform screen doors, and moisture-absorbing materials. These strategies demonstrate how targeted design improvements can create healthier, more resilient subway environments.

duplicate transactions, inconsistent vendor names, missing references, amount mismatches, and other reconciliation issues. The system is designed for businesses, nonprofits, educational institutions, public agencies, and other organizations that manage financial records.

The multi-agent orchestration architecture will be evaluated using financial records containing both standard and complex reconciliation scenarios. Evaluation will measure transaction-matching accuracy, discrepancy detection, false alerts, resolution of ambiguous transactions, and the amount of manual review required. The overall goal is to create a more efficient, reliable, and scalable financial reconciliation process while preserving transparency in how reconciliation decisions are reached.

COLLEGIATE SCIENCE AND TECHNOLOGY ENTRY PROGRAM (CSTEP)

52. Cloud Security Assessment: Progress Software Vulnerabilities

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Progress Software, a vendor of widely deployed enterprise solutions including MOVEit Automation and WhatsUp Gold, has experienced significant product vulnerabilities that have attracted ransomware groups. This research investigates whether vulnerability exposure windows—the time between disclosure and patch availability—have decreased over time. We examined four critical vulnerabilities disclosed between May 2024 and April 2026: CVE-2024-4885, CVE-2024-6670, CVE-2026-4670, and CVE-2026-5174. Using CISA's Known Exploited Vulnerabilities catalog, security advisories, and researcher reports, we compared disclosure dates, patch release dates, and exploitation timelines. Exposure windows decreased from 30 days to 14 days and then to 0 days for the two April 2026 MOVEit Automation vulnerabilities. These results show improved vendor response, while exploitation after patch availability indicates that organizational patching delays remain a significant risk. The study provides a framework for evaluating vulnerability response and patch management.

53. LLM Applications in Software Vulnerability Detection: A Systematic Review

Kazi Tamim Nomany, Shayla Cuatianquiz, Wei Chong, and Sara Moshtarizohrehnama / Collegiate Science and Technology Entry Program (CSTEP), New York City College of Technology, CUNY

Large language models (LLMs) have emerged as a promising approach to software vulnerability detection. Traditional static analysis tools match predefined syntactic patterns, which leaves them blind to complex, logic-based flaws that require understanding what the code actually means. LLMs are appealing because they can reason about source code semantically, like a human reviewer, but at scale. This review surveys recent research on LLM-based detection, recording for each study the model used, the dataset employed, and the vulnerability types targeted. We find the field clusters around a few models (GPT-3.5/4, CodeBERT-family) and a small set of mostly C/C++ datasets (BigVul, Devign), with newer work shifting toward hybrid and retrieval-augmented

methods that add context to cut false positives. Critically, the same model families report strong results when fine-tuned on familiar benchmarks but fall close to random under stricter evaluation, partly because LLMs still treat code as text rather than fully grasping its structure. We conclude that LLMs are valuable assistants that reduce triage time but remain brittle enough to require human-in-the-loop validation and that the field needs more diverse, standardized benchmarks before these results can be trusted in real-world security work.

QUEST FOR QUANTUM FUTURE

54. Non-Contact Characterization of Liquid Composition Using Single-Photon Vibrometer (SPV)

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Single-photon vibrometry is a non-contact optical method that can measure surface vibrations without directly contacting the material. This study investigates whether changes in liquid composition produce measurable differences in the vibration response of a container—liquid system. A metal container was filled with aqueous sucrose solutions of different compositions and positioned near a speaker providing controlled acoustic excitation. The container, liquid volume, excitation conditions, and optical measurement geometry were kept as consistent as possible between measurements. Surface vibrations were detected using a single-photon vibrometer, and the recorded photon-count signals were analyzed in the frequency domain using a fast Fourier transform (FFT). The measurements showed composition-dependent differences in the vibration spectra, particularly in the amplitudes of selected frequency components. These changes may be related to differences in liquid density, viscosity, compressibility, acoustic impedance, and fluid–structure interactions. Further experiments are being conducted to improve repeatability and better understand the physical mechanisms behind the observed response.

55. Development of an Automated Micro-Photoluminescence Platform for Semiconductor Metrology

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Accurate semiconductor characterization requires precise sample positioning, efficient photon collection, and stable temperature control. This work presents the development of an automated micro-photoluminescence (μ -PL) platform for reliable and repeatable temperature-dependent optical measurements. The system integrates an excitation laser, objective lens, dichroic mirror, collection optics, imaging system, spectrometer, detector, and a Linkam THMS600 cryogenic stage. Custom C++ software was developed to control a motorized stage, enabling precise, repeatable sample positioning while reducing operator-dependent variability. Challenges involving optical alignment, photon collection efficiency, and system integration were addressed through iterative alignment, calibration, and automated positioning. The completed platform was validated

using temperature-dependent photoluminescence and carrier-lifetime measurements on semiconductor samples, providing a flexible platform for semiconductor metrology, optical spectroscopy, and advanced materials characterization.

56.

How Quantum Optimizers Can Solve Combinatorial Optimization Problems

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Computers bringing forth solutions to calculations have given us the technology of the world around us today. There still remain countless computational challenges that have yet to be solved due to a variety of factors. Computer scientists and engineers alike have classified a type of problem as ‘non-polynomial time hard’ (“NP hard”) problems, which require exponential computational power. One of the most famous NP-hard problems in computer science is the traveling salesman problem (TSP). This scenario involves a salesman who needs to visit a number of cities ‘n’ and be as conservative as possible with the total distance traveled. As n grows, however, the required computational runtime and power on a classical computer grow exponentially too. Since the calculations have been concluded to be impractical on classical computers, differing algorithms have been executed on classical hardware throughout history, offering approximate but not exactly the shortest calculations. Of the many algorithms for TSP, three were chosen for evaluation in this research: The brute force algorithm (BFA), the greedy algorithm (GA), and the Christofides algorithm (CA). The BFA yields the shortest possible distance of all cities, the GA takes into perspective all edges on the graph and adding the lowest weights, and finally the CA takes the cheapest way to connect the cities without a loop and cuts off a dead end to return a loopable network. These algorithms were taken and executed on a classical computer, while the BFA was executed on a quantum optimizer from Quantum Computing Incorporated (QCI) called the Dirac-1. The Dirac-1 is specialized for solving the ground state of a complex system with intercorrelated variables and has the potential to solve quadratic unconstrained binary optimization problems (QUBOs). The areas where it can be applied include finance, routing, graph analysis, and more. The problems must be formulated into a minimum Hamiltonian format in the Dirac-1 processor. On another one of QCI’s machines, the ‘Dirac-3’, experimentation occurred as well, which required the construction of a Hamiltonian, except with a different build-up process. First, the TSP must have been formulated with nodes and edges; then a conflict graph must be made, and all calculations must be verified by the Motzkin-Straus theorem. The Hamiltonian was then executed on the Dirac 3, which unfortunately returned unverifiable results.

57.

The Design and Development of FPGA Interface Boards for a Quantum Photonics System

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This project focuses on designing PCBs that interface FPGAs with optical components in a quantum photonics system. Unlike superconducting quantum computing systems that require cryogenic temperatures, quantum photonics systems operate

at near-ambient temperatures using light-based technologies. Photonic devices often require signal conditioning and voltage translation for reliable communication. One of the interface boards supports communication using an I²C protocol, which requires pull-up resistors for its open-drain bus and a bidirectional level shifter to translate signals between different voltage levels. Another board utilizes a DAC to generate analog signals for optical devices such as a Fiber Polarization Controller (FPC). The FPC adjusts the polarization of light traveling through an optical fiber, allowing the desired polarization state to pass while filtering out others. Both boards use a four-layer PCB stack-up for improved power distribution, signal integrity, and routing. These interface boards provide reliable communication and precise control for quantum photonics devices.

ELECTRICAL AND TELECOMMUNICATIONS ENGINEERING TECHNOLOGY

AND PHYSICS: Science and Engineering Student Apprenticeship Program in Accelerator Research and Development (SESAPARD) at Brookhaven National Laboratory

58.

A Comprehensive Study of Laser Optics, Superconducting Magnets and Electron Beams to Better Understand Particle Accelerator Physics

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Through the SESAPARD/RENEW program, we worked on Accelerator Research and Development while assisting in enhancing the functionality and efficiency of the Accelerator Research & Technology Department at Brookhaven National Laboratory. This work was conducted in the Accelerator Test Facility through modules focused on laser optics, superconducting magnets, and ultrafast electron diffraction (UED) respectively. During the laser optics module, an automated laser alignment system prototype was developed using high-resolution cameras, motorized mirror mounts, precision irises, and Python-based image processing to replicate a conventional two-mirror alignment procedure. Supporting exercises reinforced concepts in beam propagation, optical focusing, fiber optic alignment and signal timing relevant to accelerator laboratories. During the superconducting magnets module, accelerator quadrupole magnets were studied through theoretical analysis and finite-element simulations using SIMULIA OPERA. Two magnet geometries were evaluated under varying excitation currents, with MATLAB used to analyze the resulting magnetic-field distributions and harmonic content. Lastly, during the UED module, electron beam dynamics were investigated using the particle accelerator simulation software ImpactX. Beam transport through drifts, solenoids, quadrupoles, and RF cavities was modeled to study Courant-Snyder parameters, transverse focusing, longitudinal

bunching and Space charge effects. Simulations examined how beam emittance, energy, and RF phase influence beam size, energy gain, and bunch evolution, providing practical experience with accelerator beam dynamics and the optimization of electron beams for UED applications. This study aligns with Brookhaven's mission to advance scientific discovery and technological innovation while preparing the next generation of scientists. Professional development included technical communication, scientific presentations, collaborative research, computational modeling, and exposure to accelerator technologies used in national laboratory research. This work was supported by the Science and Engineering Student Apprenticeship Program in Accelerator Research and Development (SESAPARD) program of Reaching a New Energy Sciences Workforce Program of the U.S. Department of Energy, Office of Science, Grant #DE-SC0025742 and the Workforce Development and Science Education Program at Brookhaven National Laboratory.

59. Discovering Optical Materials from AI-Generated Crystal Structures and AI assisted UED alignment

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Optical materials play pivotal roles in optical and laser systems, ultra-fast electron diffraction (UED), and related instruments used in accelerator science research and development. Identifying novel optical materials to improve accelerators remains difficult due to the vast number of material formulas and crystal structures that would need to be validated which are computationally expensive. This work develops an AI system for optical materials discovery that combines large language model (LLM) crystal generation, physical and chemical validity screening, graph neural network optical property prediction, and density functional theory (DFT) validation to identify promising candidate materials while evaluating the robustness of their predicted properties after structural relaxation. A dataset of 8,330 optical materials was prepared from JARVIS-DFT and used to fine-tune Qwen2.5-1.5B, a large language model, through low-rank adaptation (LoRA) to generate new materials and crystal structures. As an initial baseline, XGBoost was used in conjunction with CGCNN and material optical property data to predict the refractive index of the generated materials with an R2 of 0.76. Three ALIGNN graph neural network models were also tested and finetuned on the optical dataset to predict bandgap (eV), refractive index, and transmission width (nm) achieving test MAE of 0.435, 0.181, and 1.406, respectively. The top 10 materials were chosen based on their novelty and chemical and physical plausibility. The crystal structures of the top materials used DFT structural relaxation with Quantum Espresso and the predicted bandgap and refractive index were obtained by using the fine-tuned ALIGNN model with the relaxed structures as input. The DFT structural relaxation computations resulted in 7 of the 10 candidate structures converging. A comparison of pre-relaxation and post-relaxation predictions was conducted and out of the top 10 candidates, 3 candidates were found to have low bandgap, refractive index, and crystal structure shifts illustrating that fine-tuned LLMs can generate chemically and physically valid crystal structures and materials. Novelty checks were also conducted and identified that HfTiO3 and AlPO3 were not in the training or Materials Project dataset, and the five other converged candidates are unique crystal structures. This project provided hands-on research experience in artificial intelligence, computational materials science, and scientific computing while strengthening the technical and analytical skills needed to

contribute to multidisciplinary research in accelerator science. These experiences provided a foundation for future accelerator science and engineering careers and were supported by The Science and Engineering Student Apprenticeship Program in Accelerator Research and Development (SESAPARD) program of Reaching a New Energy Sciences Workforce Program of the U.S. Department of Energy, Office of Science, Grant #DE-SC0025742 and the Workforce Development and Science Education Program at Brookhaven National Laboratory.

60. Applications and Computational Modeling in Accelerator Science

Aldane Duncan¹, Viviana Vladutescu¹, Mikhail Polyanskiy², William Li², Marcus Babzien², Vikas Teotia², Christopher Chow¹, Raul Barajas Vargas¹, Axel Lojas¹, Efrain Luna¹, Anita Nam¹, Sheikh Tusher¹, Avanti Williston¹, and Tianyi Zhao¹

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The work presented here includes studies conducted at the Accelerator Test Facility of the Brookhaven National Laboratory in three interrelated modules: laser-optics experimental setups, superconducting magnets for accelerator applications, and electron-beam physics work together in advanced accelerator experiments. The first module focused on laser-beam alignment using a helium-neon laser, steering optics with and without motorized mounts, irises, off-axis parabola mirrors and a digital camera. The optical system was modeled in 3DOptix before laboratory assembly, and automated optical alignment was conducted using Python for image processing, which was used to recognize the laser-beam centroid relative to the iris center. Fiber optic coupling and electrical signal delay were analysed for optical and electrical synchronization purposes. The second module used SIMULIA Opera-3D, the TOSCA magnetostatic solver, and MATLAB to model and analyze a quadrupole accelerator magnet. The study examined magnetic-field distribution, gradient, integrated strength, and harmonic content to understand how magnet geometry, excitation current, and field quality influence electron-beam focusing and transport. The third module used analytical calculations and ImpactX simulations to study 10 MeV and 100 MeV electron beams for ultrafast electron diffraction. Topics included emittance, magnetic rigidity, solenoid focusing, beam waist, minimum beam size, quadrupole systems, RF bunching, and space charge. Additionally, magnetic strength measurements were conducted to assess a dipole magnet's performance at different current levels. The results showed that higher-energy beams require stronger magnetic fields, lower emittance improves focusing, and space charge can enlarge the beam and reduce compression efficiency. Together, the modules demonstrated that precise laser alignment, accurate magnetic fields, and controlled electron-beam properties are interdependent. Reliable accelerator operation depends on all three systems working together to maintain beam position, size, energy, timing, and experimental accuracy. The project also strengthened skills in optics, electronics, programming, simulation, instrumentation, data analysis, safety, teamwork, documentation, and scientific communication. These experiences provided a foundation for future accelerator science and engineering careers and were supported by The Science and Engineering Student Apprenticeship Program in Accelerator Research and Development (SESAPARD) program of Reaching a New Energy Sciences Workforce Program of the U.S. Department of Energy, Office of Science, Grant #DE-SC0025742 and the Workforce Development and Science Education Program at Brookhaven National Laboratory.

61.

Exploring Accelerator Physics with Laser Optics, Superconducting Magnets, Ultrafast Electron Diffraction, and IQ Modulation

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Accelerator science integrates experimental physics, engineering, and computational modeling to address challenges in modern particle accelerators. Through the SESAPARD/RENEW program at Brookhaven National Laboratory, research was conducted in laser optics, superconducting magnets, ultrafast electron diffraction, and IQ modulation. A camera-based automated laser-alignment system was developed using image processing and motorized mirrors. Quadrupole magnet geometries and magnetic-field characteristics were evaluated using SIMULIA Opera and MATLAB. ImpactX simulations were used to study electron-beam transport and the effects of emittance, energy, RF phase, and space charge. In addition, an IQ modulator was characterized by measuring RF magnitude and phase under controlled I and Q voltages. Together, these projects demonstrated the integration of experimental measurements, simulation, automation, and data analysis in accelerator science and engineering.

62.

Integrating Optics, Magnetism, and Beam Dynamics in Accelerator Science

Efrain Luna¹, Viviana Vladutescu¹, Mikhail Polyanskiy³, William Li³, Vikas Teotia³, Marcus Babzien³, Dismas Choge³, Mark Palmer³, Li Geng¹, Lufeng Leng¹, Giovanni Ossola¹, Aldane Duncan¹, Anita Nam², Avanti Williston¹, Axel Lojas², Christopher Chow¹, Sheikh Tusher¹, Henry Ye¹, Raul Barajas Vargas¹, and Tianyi Zhao¹

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This report presents research conducted at Brookhaven National Laboratory's Accelerator Test Facility (ATF) across three interconnected areas of particle accelerator science and engineering: Optical Laser Systems, Superconducting Magnets, and Ultrafast Electron Diffraction. Particle accelerators are vital tools driving the U.S. Department of Energy's mission to advance discovery and energy security, serving as "ultra-high-speed atomic cameras" to study fundamental matter. The first module focused on laser optics and the development of an automated laser beam alignment system. The automated laser beam alignment system was developed using digital cameras and Python-controlled motorized actuators to calculate spatial errors in real time. This closed-loop system automatically steers the laser beam through the target irises, significantly improving alignment and beam stability over manual methods. In the second module for superconducting magnets, finite-element simulations were performed in SIMULIA Opera and analyzed using MATLAB to evaluate quadrupole magnet geometries, verifying that magnetic flux density scales linearly with excitation current without core saturation. In the third module, electron beam transport and phase-space dynamics were modeled using ImpactX to optimize transverse focusing and longitudinal bunching under space-charge effects. These studies are important for Ultrafast Electron Diffraction research and development. Together, these experiments demonstrate how high-power lasers, magnetic focusing, and opto-electronics integrate to power next-generation light sources and accelerator infrastructure.

63.

Particle Accelerators at the Junction of Artificial Intelligence (AI), Optics, Superconducting Magnets (SCM), and Ultrafast Electron Diffraction (UED)

Anita Nam¹, Viviana Vladutescu², Mikhail Polyanskiy³, Vikas Teotia³, William Li³, Marcus Babzien³, Dismas Choge³, Li Geng², Giovanni Ossola², Raul Barajas Vargas², Christopher Chow², Aldane Duncan², Axel Lojas¹, Efrain Luna², Sheikh Tusher², Avanti Williston², Henry Ye², and Tianyi Zhao²

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The study of advanced accelerators is essential to the growth of technological innovation. This paper explores how artificial intelligence (AI) can improve the performance of accelerator physics at Brookhaven National Laboratory's (BNL) Accelerator Test Facility (ATF). This was done through four modules: AI in materials discovery, optics, superconducting magnets (SCM), and ultrafast electron diffraction (UED).

Aligning optical systems involves fiber optics, timing synchronization, and mirror alignment. Concurrently, we present an AI module that can predict the performance of an optical material from its chemical formula and crystal structure. This was done by combining feature engineering with embeddings to predict a material's refractive index. The third module focuses on core magnetic profiling with SCM to maintain beam focus. We designed and examined two quadrupole magnets with SIMULIA Opera and MATLAB. We finally have UED which encompasses simulations of accelerators. ImpactX enabled particle tracking and space charge effects.

64.

Integrated Accelerator Research at BNL: Automatic Laser Alignment, Quadrupole Magnet Design, and UED Beam Dynamics

Sheikh Tusher¹, Mikhail Polyanskiy², Viviana Vladutescu¹, William Li², Li Geng¹, Vikas Teotia², Lufeng Leng¹, Marcus Babzien¹, Giovanni Ossola¹, Dismas Choge², Aldane Duncan¹, Axel Lojas¹, Henry Ye¹, Raul Barajas Vargas¹, Efrain Luna¹, Avanti Williston¹, Christopher Chow¹, Tianyi Zhao¹, and Anita Nam¹

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This research was conducted at the Accelerator Test Facility at Brookhaven National Laboratory through the Science and Engineering Student Apprenticeship Program in Accelerator Research and Development. The work focused on three areas of accelerator science: automated laser alignment, superconducting quadrupole magnet design, and Ultrafast Electron Diffraction beam dynamics. The laser alignment project used Basler cameras, Python image processing, a Newport 8742 controller, and Picomotor-driven mirrors to monitor and correct beam position. The quadrupole project used SIMULIA OPERA for three-dimensional modeling and electromagnetic analysis, with MATLAB and Excel used to analyze magnetic-field harmonics. The UED project used ImpactX to study electron-beam transport, focusing, phase-space evolution, acceleration, bunch compression, emittance, and space-charge effects. Together, these projects provided practical experience in automation, electromagnetic simulation, numerical analysis, and particle-beam modeling.

65.

Automation, Simulation, and Instrumentation Used in Particle Accelerators: Automated Laser Alignment, 3D Magnet Design, IQ Modulation Replacement, Particle Simulation

Avanti Williston¹, Viviana Vladutescu¹, Mikhail Polyanskiy², Dismas Choge², Li Geng¹, Marcus Babzien², Vikas Teotia², Lufeng Leng¹, William Li², Giovanni Ossola¹, Jhair Alzamora, Sheikh Tusher¹, Tianyi Zhao¹, Henry Ye¹, Efrain Luna¹, Raul Barajas Vargas¹, Aldane Duncan¹, Anita Nam¹, and Christopher Chow¹

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This work focused on laser beam alignment, quadrupole magnet design, and electron beam dynamics. A remote-control and automated laser alignment system was developed using motorized mirror mounts and two beam-monitoring cameras. A graphical user interface (GUI) was created to provide centralized control of the cameras and motorized components, improving the efficiency and usability of the alignment process. Quadrupole magnets were designed and analyzed using the finite-element software SIMULIA Opera 3D. COMI scripts were used to evaluate key performance characteristics, including magnetic field gradient, integrated gradient, and B-H curves, providing quantitative insight into magnet performance. Electron beam dynamics were investigated using the ImpactX simulation software to examine the effects of Courant-Snyder beam parameters on electron beam quality and energy. The simulations provided insight into the relationship between beam parameters and beam behavior and contributed to a better understanding of electron beam dynamics. Overall, the work demonstrated the application of optical alignment, electromagnetic modeling, and beam dynamics simulations to the development and analysis of accelerator technologies.

66.

Computational Modeling and Application in Accelerator Science at BNL

Henry Ye¹, Viviana Vladutescu^{1,3}, Vikas Teotia³, Mikhail Polyanskiy³, William Li³, Marcus Babzien³, Dismas Choge³, Sheikh Tusher¹, Axel Lojas², Christopher Chow¹, Anita Nam², Efrain Luna¹, Raul Barajas Vargas¹, Aldane Duncan¹, Avanti Williston¹, Li Geng¹, Giovanni Ossola¹, Tianyi Zhao¹, and Lufeng Leng¹

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This work presents research experience focused on accelerator operations and foundational studies in accelerator physics. The primary operational contribution consisted of implementing an automated laser alignment system to improve efficiency and assist diagnostic operations at the Accelerator Test Facility. To build practical familiarity with core accelerator concepts, additional exploratory projects were undertaken in magnetic design and beam dynamics. This included designing and simulating a quadrupole magnet to understand electron beam focusing mechanisms, as well as utilizing ImpactX to model and evaluate electron beam behavior under varying test parameters. Together, these experiences bridge hands-on facility instrumentation with theoretical beamline modeling.

HEALTH CARE POLICY AND MANAGEMENT

67.

Barriers to Community Board Participation in New York City: Strengthening Civic Engagement to Advance Community Health

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New York City's 59 community boards advise municipal decision-making on land use, housing, transportation, public safety, parks, and neighborhood services that shape community health. Yet participation remains uneven, limiting those whose experiences, needs, and priorities are reflected in local decisions. This narrative review examined barriers to community board participation and identified strategies to support more equitable civic engagement. Peer-reviewed literature and public-sector reports were selected for relevance and synthesized. Five interconnected barriers emerged: limited awareness and civic knowledge, language barriers, time and scheduling constraints, limited resources and community networks, and institutional mistrust. The literature supports targeted strategies, including plain-language outreach through trusted organizations, multilingual materials and interpretation, flexible or hybrid participation options, and transparent feedback loops. Equitable community board participation is therefore both a civic and public health imperative. Future research should evaluate whether redesigned engagement practices meaningfully expand representation, resident influence, and health equity.

68.

Rethinking How We Prepare the Public Health Workforce

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Shortfalls in the public health workforce are commonly related to recruitment issues. Yet, future practitioners are already enrolled at minority-serving institutions, viable public health professional pipelines. We present a model for a paid, 10-week community health policy internship designed to connect didactic instruction with applied public health work during the undergraduate academic trajectory. This experiential approach supplements the undergraduate academic experience. Interns applied public health theory and policy frameworks while examining their neighborhood's community boards, which included analyses of board structures and priorities and the synthesis of 12 sources on barriers to participating in community boards. Concurrently, the interns engaged directly in local civic processes. The four-intern summer 2026 pilot cohort allowed for close mentorship and a detailed account of the model in practice. We recommend commencing workforce development before graduation through compensated, locally anchored, consequential in-the-field activities that integrate health policy academic program learning objectives and public health competencies.

COMPUTER ENGINEERING TECHNOLOGY

69.

Adaptive Virtual Infrastructure: Observability, Reconfiguration, and Changing Operations Conditions

Emmanuel Akpona, Eduardo Alcala, Anthony Delarosa, Binay Ghimire, and Aparicio Carranza /
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Virtualization allows computing, storage, and network resources to be reconfigured without permanently tying workloads to one physical arrangement. We investigate and report how adaptive virtual infrastructure can use observed workload, hardware, and network conditions to determine when reconfiguration is justified. Furthermore, we examine the measurements that inform adaptation, the resource overhead and constraints of actions such as migration and resource reallocation, and the risk of instability caused by repeated changes. We also consider how reconfiguration priorities may shift under different operating conditions.

70.

Wireless Networking Technologies

Victor Baez, Ethan Cyrus, Jose Palacios, Diego Reyes, and Aparicio Carranza /
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This experiment examines wireless roaming and interference within mobile devices as their wireless networks overlap. Wireless roaming is an important function in mobile devices as they allow for constant connectivity through their ability to seamlessly switch between access points. The wireless roaming experiment examines this feature inside a virtual environment where a mobile client moves between one access point to another.

71.

The Hidden Threat Within AI Systems

Faridjon Jamshidov, Christopher Guttierrez, Jaiden Sampilo, Aisha Ayub, and Aparicio Carranza /
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Prompt injection is a cybersecurity attack in which malicious instructions attempt to override the original rules of an Artificial Intelligence (AI) system. We examine prompt injection attacks in a controlled virtual lab environment. Virtualization technology, Virtual Operating System, Python, and AI models are used to perform a series of normal and malicious prompt tests. The testing measures how the AI responds to prompt-injection attempts under different conditions. Security controls and stronger instructions are applied, and the same tests repeated. Results are recorded and compared to evaluate how effectively the protections reduce successful prompt-injection attacks. We demonstrate how prompt injection affects AI systems and how security methods help reduce this threat.

72.

Analysis of Suspicious Login Activity Using Machine Learning for Cybersecurity

Mehedul Khan, Ruitao Xiong, Samuel Ajeleti, and Aparicio Carranza /
Department of Computer Engineering Technology, New York City College of Technology, CUNY

Unusual login patterns may indicate suspicious activity and may require further investigation. We analyze a publicly available authentication dataset and study user login behavior using basic data analysis and Machine Learning (ML). Our approach was to examine login frequency, login time, and authentication results to find unusual patterns in user activity. A basic ML algorithm has been used to identify potentially unusual authentication activity. We compare the patterns found through basic data analysis with the anomalies identified by the ML model. Furthermore, we discuss the limitations of using authentication data and ML for cybersecurity monitoring. The outcome provides us a basic understanding of how login data and machine learning help identify potentially unusual user activity.

73.

Low-Overhead Flow-Level Performance Tracing in Multi-Tenant OpenStack Clouds Using eBPF and Programmable Virtual Switches

Jamie Labriel, Kyle Huang, and Aparicio Carranza /
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The primary purpose of Cloud Computing is to dedicate its compute, storage and network resources across a public or private sector. OpenStack an open-source Cloud Operating System is used by the public sector or private companies to distribute computing resources across itself (privately) or clients (publicly). OpenStack consists of several segments: Nova (Compute), Keystone (Identity), Glance (Image), Cinder (Block Storage), Swift (Object Storage), and Horizon (Dashboard), Manila (Shared File System), Neutron (Networking), Heat (Orchestration) and Ironi (Bare Metal). Our main focus is on Neutron to track down network degradation using Extended Berkeley Packet Filter (eBPF) to determine packet loss, micro-burst latency spikes and asymmetric routing.

74.

CloudTransit: Distributed Transit Monitoring and Passenger Information System

Kimberly McLauring and Aparicio Carranza /
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Modern transit systems depend on the continuous exchange of information between stations, centralized operations, and passengers. Inspired by the Metropolitan Transportation Authority (MTA) and its Operations Control Center (OCC), CloudTransit explores how cloud and edge computing can support a distributed transit network. Raspberry Pi-based station nodes simulate train, passenger, and equipment data, while a Raspberry Pi 5 serves as an edge server for local processing and communication. Cloud-based services provide centralized data storage and monitoring, demonstrating how distributed, edge, and cloud technologies support operational awareness and real-time passenger information.

75.

Integrating Data and AI Into Cybersecurity

Karl Richards and Aparicio Carranza /
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Technology, CUNY

As cyber threats continue to grow in complexity, organizations are increasingly turning to Artificial Intelligence (AI) to strengthen the way threats are identified and addressed. We examine how AI and Machine Learning (ML) are used to analyze network traffic and identify potential threats. Network traffic data containing normal and malicious activity were collected and analyzed. A ML model were trained using patterns within the data to classify network activity as normal or potentially malicious. The process consists of collecting and preparing the data, training and testing the model, analyzing its detections, and evaluating the results. The model's performance, effectiveness, benefits, and limitations were analyzed based on its ability to correctly identify malicious activity while distinguishing it from legitimate network traffic.

76.

Access Control and Security for AI Systems

Angel Sanchez, Rizwan Chowdhury, Shomik Islam, and Aparicio Carranza /
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Companies use cloud storage services to protect their important files. With the rise of Artificial Intelligence (AI), there is a need to regulate the access to the data of AI. We have simulated the environment of AI related data in Google Drive using training data, systems settings and activity logs. Using an script and OpenAI API, we validated the file name and permissions to access files against access rules, removed unnecessary access to test files, and documented all actions in Google Sheets. Testing covered viewing and editing permissions, restricted access, and removal of access.

77.

Understanding GitHub and Cloud Concepts

Maisey Khaimov, Tavarae Thomas, Pavel Perz, Randy Landaverde, and
Aparicio Carranza /
Department of Computer Engineering Technology, New York City College of
Technology, CUNY

Cloud computing is computation performed on a server away from a physical computer. Servers are accessed across the Internet with no need of downloading or physical hardware. Cloud data centers are located worldwide with most prominent areas being in the Americas, Europe, Asia, Middle East, and Africa. This allows anyone with an Internet connection to access these data centers online and stay connected. Cloud computing allows businesses to store data, access applications and compute via cloud. GitHub provides a platform for storing, editing, and collaborating software with other developers via the cloud. In this project, we demonstrate how GitHub is used to store programming information and how to connect various GitHub coding sets together.

78.

Building and Exploring Networks with Raspberry PI

Jose Velez, Nathaniel Bruce, Yasser Mohajiry, Javon Ane, and Aparicio Carranza /
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Technology, CUNY

The purpose of our project is to explore the application of Raspberry Pi in building and connecting computer systems. We explain how Raspberry Pi communicates with other devices using wired and wireless connections. The topics covered includes basic networking concepts such as IP addresses, Ethernet, Wi-Fi, and data sharing. We also detail how Raspberry PIs are used for monitoring a network, hosting a website, and connecting smart devices.

79.

A High-Accuracy Detection Scheme for VM Escape Attacks

Zhuofan Zheng, Ivan Wu, Weibo Zhou, and Aparicio Carranza /
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Virtualization technology serves as a cornerstone for cloud computing and malware isolation, significantly reducing the risk of host infection. However, the emergence of advanced malware and Trojan viruses capable of hypervisor escape poses a severe threat to virtualized environments. Traditional detection mechanisms often fail to intercept these Virtual Machine (VM) escape attacks due to their sophisticated exploitation of shared hardware resources and hypervisor vulnerabilities. To address this challenge, we experimented several detection schemes to enhance the accuracy rate and identify hypervisor escape attempts.

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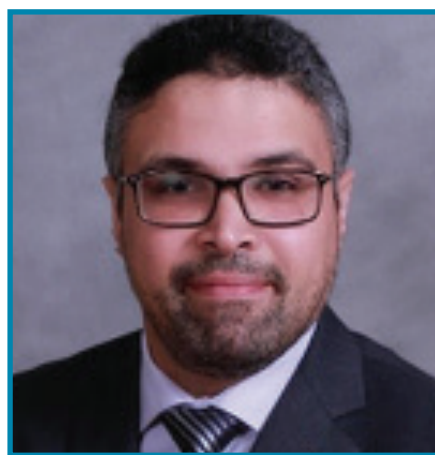
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