

Cosmic Pathways Chicago
Lewis University
October 17, 2026

PROGRAM

A. Cosmic Pathways Program Schedule

9:00-10:00 **Conference Registration and Exhibit Space Open**
Location: First floor and ground floor lobby, Academic Science Center (AS)

10:00 **Conference introduction**
Location: UDR / FDR (AS-103C / AS-104C)
Dr. Joseph Kozminski, *Lewis University*

10:10-10:25 **Be A Shark**
Location: UDR / FDR (AS-103C / AS-104C)
Dr. Matthew Wright, *Adelphi University*

Abstract: In this workshop, congress participants will channel their inner shark to explore taking control over their career pathways and how to overcome hurdles. Participants will learn how to actually network and how to use their own sharkiness to innovate, have fun, and take their physics career to the next level.

10:25-10:45 **From Physics to Nuclear: Finding Your Path in STEM**
Location: UDR / FDR (AS-103C / AS-104C)
Introduction by **Amanda Anderson**, *Lewis University*
Autumn Crisafulli, *Westinghouse Electric Company*

Abstract: A physics degree can take you a lot of places, including careers you may not know exist yet. I'll share how I went from studying physics at Lewis to working in nuclear safety and computational modeling, what my job actually looks like, and how physics prepared me for work I never expected to be doing. Along the way, I'll talk about the different backgrounds and roles I work with every day and some of what I've learned about gaining experience, trying things outside your original plan, and figuring out where your own interests and strengths can take you.

10:45-11:05 **At the Interface of Innovation: CMP and the Future of Semiconductor Manufacturing**
Location: UDR / FDR (AS-103C / AS-104C)
Introduction by **Kyle Bledsoe**, *Lewis University*
Dr. Jason Keleher, *Lewis University*

Abstract: As modern technologies demand ever-increasing electronic performance and processing power, the semiconductor industry faces a critical challenge extending beyond technological innovation – developing the skilled workforce needed to solve tomorrow's manufacturing challenges. Semiconductor manufacturing is inherently interdisciplinary, requiring professionals who can integrate chemistry, physics, materials science, engineering, data science, and machine learning to understand increasingly complex materials and processes. This convergence of disciplines is particularly evident in chemical mechanical planarization (CMP), one of the most critical processes in advanced semiconductor manufacturing. CMP combines chemical reactions, surface and interfacial science, materials behavior, fluid dynamics, and mechanical interactions to selectively remove material and produce the highly uniform, planar surfaces required for device fabrication. As device architectures become more complex, feature dimensions continue to shrink, and new materials are introduced, CMP becomes increasingly important for controlling surface quality, defectivity, material selectivity, and successful integration across multiple device layers. This presentation will explore the evolution and importance of CMP within semiconductor manufacturing while highlighting the interdisciplinary science that enables continued innovation. Emphasis will be placed on how expertise from traditionally distinct academic disciplines converges to address emerging manufacturing challenges. Finally, the discussion will connect these technical advances to the growing range of career opportunities within the semiconductor industry, illustrating how the next generation of scientists, engineers, and data-driven problem solvers will help shape the future of semiconductor manufacturing.

11:05-11:15 Break

11:15-11:45 Physical Science Career Panel

Location: UDR / FDR (AS-103C / AS-104C)
Introduction by **Sarah Lauss**, *Lewis University*
Moderated by **Dr. Joseph Kozminski,** *Lewis University*
Panelists: **Zeenat Biag,** *JPMorgan Chase & Co.***; Harvey Campos-Chavez,** *Panduit;* **Micheal Morrow,** *Northrop Grumman;* **Marybeth Senser,** *Downers Grove South High School*; **Dr. Keith Taddei,** *Argonne National Laboratory*

Abstract: This panel discussion will inform conference goers about divergent career paths for students who study physics. This panel features engineers, industry experts, and leaders at national labs.

11:45-12:15 Graduate School in Physical Sciences

Location: UDR / FDR (AS-103C / AS-104C)
Introduction by **Adam Makhlouf**, *Lewis University*
Moderated by **Katie Gifford,** *University of Illinois Urbana-Champaign*
Panelists **Jasper Bradford, David Imig, Miles Knudtson, Io Kovach, and Suhas Sheikh**, *University of Illinois Urbana-Champaign*
Ziana Benjiman and David Rodriguez, *Lewis University*

Abstract: This panel discussion will inform conference goers about opportunities to attend graduate school, many of the benefits of obtaining an M.S. or Ph.D. and some of the perils.

12:15-1:30 Lunch

Location: UDR / FDR (AS-103C / AS-104C)

Ask an expert! Career, College, and Industry Floor Show
Location: Ground floor lobby

Poster Session
Location: Ground floor lobby
Odd Posters 12-12:45
Even Poster 12:45 - 1:30
For poster assignments see E. Poster Abstracts

1:30-4:00 Workshops and Research Presentations

Location: Various locations
See: B. Research Presentation Sessions, C. Research Presentation Abstracts, and D. Workshop Schedules for further information

1:30 - 2:10 Workshop Session I
Research Talks I

	Parent Discussion I
2:20 - 3:00	Workshop Session II
	Research Talks II
	Parent Discussion II
3:10 - 3:50	Workshop Session III
	Research Talks III
	Parent Discussion III

4:00-5:00 **Keynote: How Do We Know What We Know in Science?**
Location: UDR / FDR (AS-103C / AS-104C)
Introduction by **Rose Reitz**, *Lewis University*
Dr. Rhett Allain, *Southeastern Louisiana University*

Abstract: Suppose you had to build the scientific base of knowledge from scratch. Could you do it? Where would you begin? Think about all the stuff in your science textbook—how did people actually figure this out? How do we know about Newton's laws (other than just taking Isaac Newton's word for it)? What about the size of the Earth or the speed of light? And how did Avogadro figure out Avogadro's number? (Hint: he didn't.) In this talk, we'll explore some of the clever and surprising ways you can rediscover the things we already know.

B. Research Presentation Sessions (1:30pm - 4:00pm)

Refer to C. Research Presentation Abstracts for further information about each talk.

Session A1 (Room AS-150A) – Light and Bio Physics
Chair: Dr. Mel Sabella, *Chicago State University*

Reading the light produced by krypton
Alondra Azpeitia, *Joliet Junior College*

Designing & Simulating a TD-UHD Micro-DOT System to Predict Image Resolution Improvement Upon Existing Systems
Cemantha Hearing, *Oswego High School*

Impact of Epigenetic Modifications on DNA Structure Formation
Daniela Avramovich, *Loyola University Chicago*

Session B1 (Room AS-150A) – Particle Physics
Chair: Dr. Ryan Hooper, *Lewis University*

NuMI Off-axis ve Appearance (NOvA) Experiment
Ava Berios, *Loyola University Chicago*

How the Electron-Ion Collider will Explore the Physical Nature of the Universe
Leonardo D'Andrea, *University of Illinois Chicago*

Session C1 (Room AS-150A) – Astrophysics
Chair: Dr. Rick Jesik, *Elgin Community College*

Modeling the Formation of Quasi-Stars from Supermassive Stars
Claire Campbell, *Illinois State University*

A Geometric Pathway to Lorentz Spinors
Zachary Gunther. *Illinois State University*

Session A2 (Room AS-156A) – Condensed Matter Physics
Chair: Dr. Brian Cannon, *Loyola University Chicago*

Structural investigation of Redox-Active Metal-Organic Frameworks in Electrochemical Capacitors
Adam Makhlouf, *Lewis University*

Converging diffusion coefficient analysis in molten salts
Amanda Anderson, *Lewis University*

Engineering Novel Si-MOF Hybrid Photocapacitors for Green Energy Storage
Javier Romero, *Lewis University*

C. Research Presentation Abstracts (1:30pm - 4:00pm)

Session A1 (Room AS-150A) – Light and Bio Physics (1:30-2:10)

Reading the light produced by krypton
Alondra Azpeitia, *Joliet Junior College*

At the Argonne National Laboratory Trace Radioisotope Analysis CentER (TRACER), Atom Trap Trace Analysis (ATTA) uses krypton dating to determine the age of water samples ranging from 10 to 230,000 years old using laser cooling and trapping techniques. This requires understanding how to interact with the atoms. As part of the Argonne summer Bridge internship, I analyzed the fluorescence spectrum of krypton to learn about isotope shifts. Using AI-coding tools, I analyzed collected krypton fluorescence data and created a graphic user interface (GUI) to connect directly to the lab system. This GUI enabled the collection of new Magneto Optical Trap (MOT) fluorescence data from both a photodiode and a camera simultaneously. The data extracted isotope shift measurements were then compared to literature values.

Designing & Simulating a TD-UHD Micro-DOT System to Predict Image Resolution Improvement Upon Existing Systems
Cemantha Hearing, *Oswego High School*

Brain activation imaging is an essential component of developing effective treatments for patients affected by neurological conditions. A biomedical imaging system that is currently being used to image brain activation is that of diffuse optical tomography (DOT). DOT, a biophotonic imaging system, has the unique ability to preserve naturalistic environments due to its lightweight structure, but fails at producing high-quality images. To supplement this issue, ultra-high density (UHD) DOT and time-domain (TD) DOT systems have been created with the ability to improve the quality of brain activation images. Although components from both TD-DOT and UHD-DOT systems combined with the use of microtechnology would theoretically allow for a DOT system with optimized image quality, such a system has not yet been designed. Thus, a TD-UHD Micro-DOT was simulated for imaging metrics using NeuroDOT in order to determine whether or not the system's predicted metrics improved upon current systems. In this study, predicted mean full width at half maximum (FWHM) and localization error values of the hypothetical system were compared to existing values of high-density (HD) DOT and time-domain (TD) DOT systems to place the hypothetical system within the context of existing technology. It was found that the hypothetical system was

predicted to possibly improve in areas of image resolution upon both HD-DOT and TD-DOT systems but was not predicted to improve upon the HD-DOT system in terms of localization error. These findings imply that the TD-UHD Micro-DOT system design must be improved in order to reduce localization error before it is built.

Impact of Epigenetic Modifications on DNA Structure Formation
Daniela Avramovich, *Loyola University Chicago*

Single-molecule imaging provides a powerful approach for the biophysical characterization of DNA molecules. The human genome contains domains of repetitive DNA content. A particular repeat motif, termed the CAG trinucleotide, exhibits a propensity for expansion that can induce neurodegenerative diseases. Under certain conditions, these CAG repeat domains can form non-helical structures, such as hairpins, that disrupt normal DNA processing. Epigenetic modification of DNA is a natural biological process that alters the DNA composition without disrupting the underlying sequence, and higher methylation levels are observed for CAG disease states. The effect of methylation on the structure-forming capabilities of the CAG repeats remains unknown. Using single-molecule, total internal reflection fluorescence microscopy, imaging of individual CAG-rich, DNA molecules in real time show the stochastic formation of the hairpin structure. The systematic incorporation of methylated cytosines throughout the hairpin reveals how the location of this epigenetic modification within a hairpin-forming sequence can alter the energetic stability and kinetic behavior to promote formation of these aberrant DNA structures and potentially the disease state.

Session B1 (Room AS-150A) – Particle Physics (2:20-3:00)

NuMI Off-axis ve Appearance (NOvA) Experiment
Ava Berios, *Loyola University Chicago*

Neutrinos are among the most abundant particles in the universe, a billion times more abundant than the particles that make up stars, planets and people. Unimaginably large numbers of neutrinos from the first moments of the universe are still present today. Though a trillion naturally occurring neutrinos from the sun and other bodies in the galaxy pass through us each second, they interact so rarely with other particles that they are very difficult to detect.

That is why researchers strive to create intense beams packed with as many neutrinos as they can produce and to build large, precise detectors that can spot them when they interact. The goal of the Experimental Neutrino Detector (END) project is to develop a complete baseline system capable of detecting and distinguishing a beam of neutrinos generated at Fermi

National Accelerator Laboratory (Fermilab) from the cosmic background neutrinos and other noise sources in shallow bodies of water. END will place underwater neutrino detectors on the lakebed in the path of the Fermilab neutrino beamline as it passes through Lake Superior near Two Harbors, Minnesota, on its way north to previously established neutrino detector sites at Soudan (Lake Vermilion) and Ash River, Minnesota.

How the Electron-Ion Collider will Explore the Physical Nature of the Universe
Leonardo D'Andrea, *University of Illinois Chicago*

Protons and Neutrons make up nearly all visible matter in the universe, yet the internal force dynamics holding them together remain incompletely understood. Scientists probe these atomic structures using Deep Inelastic Scattering (DIS), a process where high-speed electrons break up atomic nuclei, producing directional sprays of particles known as jets. These experiments will take place at the Electron-Ion Collider, a next generation facility under construction at Brookhaven National Laboratory. The Electron Proton/Ion Collider (ePIC) collaboration is currently simulating and building an experiment that will operate in the mid 2030s. Our study analyzes Transverse Energy-Energy correlators (TEECs) to track how energy is transferred between particles during these collisions to map out forces between particles. These studies allow for the establishment of essential baseline models for future Electron-Ion Collider Measurements.

Session C1 (Room AS-150A) – Astrophysics (3:10-3:50)

Modeling the Formation of Quasi-Stars from Supermassive Stars
Claire Campbell, *Illinois State University*

Recent James Webb Space Telescope observations of early-universe supermassive black holes (SMBHs), such as little red dots (LRDs) like the 10^6.3 solar mass MoM-BH*-1, motivate work studying their early-time growth pathways. As typical stellar core collapse and subsequent accretion is too limited to form an SMBH within a Hubble time, direct collapse of supermassive stars (SMSs) into quasi-stars has been proposed as an alternative formation mechanism. We model the growth and transition of SMSs to SMBH seed-forming quasi-stars using the stellar evolution code MESA. Following observations by V. Kokorev et al. (2026) of enhanced aluminum in LRDs, we use a 52-isotope network to study the nucleosynthesis of 27Al in SMSs and its subsequent presence in quasi-star atmospheres. Our results place reasonable constraints on SMBH seeds formed via direct collapse. We also find significant aluminum formation in the SMS core, which is transported to the surface via convection after the central collapse and during the quasi-star phase.

A Geometric Pathway to Lorentz Spinors
Zachary Gunther. *Illinois State University*

Geometric algebra provides a natural extension of vector geometry that unifies rotations, boosts, and spinors within a single geometric framework. Starting from rotations in physical space, rotors emerge as the fundamental objects encoding orientation and transformation.

This structure extends seamlessly to spacetime, where Lorentz boosts appear on equal geometric footing with spatial rotations. Within this language, spinors arise as concrete geometric entities associated with mass and motion rather than abstract algebraic constructs. The Lorentz spinor is introduced to establish the geometric foundation for a constructive formulation of relativistic quantum theory and, ultimately, particle physics.

Session 2A (Room AS-156A) – Condensed Matter Physics

Structural investigation of Redox-Active Metal-Organic Frameworks in Electrochemical Capacitors
Adam Makhlouf, *Lewis University*

Electrochemical capacitors have gained popularity in recent years for their potential to increase the competitiveness of green energy. The energy storage devices, also known as supercapacitors, store energy by mobilization of polarized charges at the electrochemical double layer, surface bound faradaic interactions, or through both electrochemical double layer and faradaic interactions. It is important to incorporate redox active materials with high surface areas to maximize both electrochemical double-layer capacitance and faradaic charge storage. Metal-organic Frameworks (MOFs) are porous coordination networks that are comprised of metal oxide clusters coordinated with organic linkers. Though MOFs are highly porous materials, the metal oxide nodes inhibit the ability of the MOF to efficiently transfer charges at the metal centers. Conductive polymers, like polyaniline (PANI), are often introduced to MOFs to increase conductivity. It has previously been reported that PANI can be covalently bonded to MOFs to increase charge transfer efficiency. Redox-active MOFs of the same organic ligand were covalently anchored onto graphite-PANI electrodes. The procedure was repeated for several different MOFs, including NH2-MiL-101(Fe), NH2-MiL-101(Cr), and NH2-MiL-53(Fe). The resulting composite materials were characterized using XRD analysis, BET surface area analysis, and FTIR-ATR spectroscopy. The electrochemical activity of each electrode was investigated using Cyclic Voltammetry and Galvanostatic charge-discharge

techniques. The structure and morphology of the electrodes were determined with SEM imaging, EDS analysis, and FTIR spectroscopy.

Converging diffusion coefficient analysis in molten salts
Amanda Anderson, *Lewis University*

Molten salts enable efficient operations of industrial-scale pyroprocessing, molten salt reactor, and electrometallurgical systems due to their thermal stability, wide electrochemical windows, and energy storage capabilities. However, in situ monitoring of the evolving salt composition in these systems is needed to ensure that the salt does not corrode its containment system or accumulate impurities over time. While the inherent electrolytic nature of these salts readily allows for characterization using electroanalytical methods, precise knowledge of the diffusion coefficients of dissolved analyte species is needed to ensure accurate measurements. A variety of techniques within the literature can be used to determine diffusion coefficients, such as cyclic voltammetry, chronoamperometry, and chronopotentiometry. Although these techniques should produce identical values, technique-dependent factors have led to a surplus of contradicting and unreliable datasets. To resolve these discrepancies, we have augmented these experimental approaches with updated models that properly account for non-idealities that are typically ignored in molten salt systems. Using this approach, we have confirmed the efficacy of the electroanalytical techniques to measure consistent diffusion coefficients in molten salts using the model system of LiCl-KCl containing FeCl2. These results will help to enable optimized operations of molten salt systems and provide the backbone for future multimodal monitoring tools.

Engineering Novel Si-MOF Hybrid Photocapacitors for Green Energy Storage
Javier Romero, *Lewis University*

The integration of energy harvesting and storage into a single monolithic device represents a critical frontier in sustainable electronics. The photocapacitor is a new type of device that integrates light-harvesting components (such as silicon-based solar cells) with capacitive materials (such as supercapacitors) to enable highly efficient, self-powered energy storage. This proposal focuses on developing a novel class of silicon-MOF hybrid photocapacitors designed to overcome current limitations in energy density and interfacial charge transfer. Specifically, it will explore integrating silicon-based materials with Metal-Organic Frameworks (MOF) hybrid electrodes, leveraging previous results showing that polyaniline (PANI) can covalently anchor high surface area MOF to graphite, generating high-performance supercapacitor electrodes. The porous MOF architecture serves as a high-capacity medium for effective charge storage, while the silicon provides efficient light harvesting capabilities. To

characterize device performance, an experimental platform was developed to measure photovoltage and photocurrent under controlled illumination. Instrumentation was optimized using an optical chopper and a cooling stage to minimize thermal effects and improve measurement accuracy. A cooling stage and optical chopper were added to eliminate heat in the system to best receive data. This research provides a robust framework for developing the next generation of self-charging power units.

D. Workshop Schedules (1:30pm-4:00pm)

Student Presentations (See B. Research Presentation Sessions, C. Research Presentation Abstracts)
Location: Room AS-150A and Room AS-156A

The Wolfram Language for Mathematics
Location: AS-112S
Adam Copeland
Session B: 2:20 - 3:00
Session C: 3:10 - 3:50

Abstract: The Wolfram Language is a powerful environment for exploring, teaching, and doing mathematics. This talk provides an introduction to its core capabilities, including symbolic computation, numerical methods, visualization, and interactive programming. Through a selection of mathematical examples, participants will see how the Wolfram Language can streamline calculations, support mathematical discovery, and create engaging computational demonstrations for research, education, and problem solving.

Purposeful Affirmations—Building a Supportive Classroom with STEP UP Everyday Actions
Location: AS-118S
Red Lhota
Session B: 2:20 - 3:00

Abstract:The workshop will introduce participants to the STEP UP Everyday Actions Guide for building classroom and community spaces that include all students, and focus on Purposeful Affirmations, using videos of a high school physics teacher's classroom as case studies for the workshop participants to discuss both what they observe in the video and their own experiences in teaching. Teachers will develop their toolkit for recognizing students both inside and outside of class, supporting them in taking on new opportunities, and nurturing relationships through one-on-one interactions. We will be talking about strategies from the Everyday Actions Guide that can be implemented across different levels of teaching, experience, topics, and classroom sizes, so come discuss no matter your level of experience or where you are teaching.

Learning Outcomes: After this workshop, you should be able to:

- Identify the impact of purposeful affirmations in a classroom
- Discuss the role of the instructor in building a supportive classroom environment
- Implement one or more components of purposeful affirmation in your teaching setting

Lewis University Airport Tours
Location: Outside of AS-155A
Session B: 2:20 - 3:00
Session C: 3:10 - 3:50

Abstract : Lewis University Airport, in Romeoville, Illinois, sits next to Lewis University's well-known aviation program. These tours give visitors a behind-the-scenes look at a working general aviation airport. Guests see how pilots train and how aircraft are maintained and operated. They also learn how air traffic is managed at a busy airfield southwest of Chicago.

Additional Discussion with Physics Graduate Student
Location: Room AS-156A
Session B: 2:20 - 3:00

Abstract: In this panel, students will meet graduate school students in engineering, physics, and astronomy. Students will learn the secret sauce to getting into graduate school, what graduate school is like in various fields, and available opportunities

Creating a Mentorship Network
Location: AS-110S
Eduardo Alejandro
Session B: 2:20 - 3:00
Session C: 3:10 - 3:50

Abstract: Mentorship is an essential component of success and perseverance in many fields, including STEM careers. This interactive workshop will equip participants with a practical framework for building a “mentorship network” rather than relying on a single mentor. Participants will learn where to find mentors, how to initiate and sustain productive mentoring relationships, and how to navigate common challenges. Through hands-on activities, participants will leave with an actionable plan and ready-to-use scripts for building the mentorship network they need to thrive in the sciences.

The Music and Physics Connection
Location: AS-157A
Gordon Ramsey
Session A: 1:30 - 2:10 [For Students]
Session B: 2:20 - 3:00 [For Parents]
Session C: 3:10 - 3:50 [For Educators]

Abstract: There is a wonderful connection between music, physics and mathematics. All three elements are required to make the music we all love. This workshop will help you understand this connection at a fundamental level, while seeing some of these elements at work. As a bonus, I will discuss some of the careers that physics graduates can pursue, both in general and specifically, in relation to music and acoustics.

Exploring Cosmic Rays
Location: AS-119S
Kenneth Cecire and Jeremy Wegner
Session A: 1:30 - 2:10
Session C: 3:10 - 3:50

Abstract: Students will explore cosmic rays by working in groups with small, portable cosmic ray detectors. They will explore a suite of activities that includes measurement of beta radiation, determination of the direction from which cosmic rays come, and relating the angle of acceptance to the cosmic ray rate.

QuarkNet Teacher Workshop
Location: AS-119S
Kenneth Cecire and Jeremy Wegner
Session B: 2:20 - 3:00

Abstract: Teachers will explore QuarkNet activities they can use to introduce particle physics concepts to high school students at almost any level. With “Shuffling the Particle Deck”, teachers can make a basic introduction to the particles that comprise the Standard Model. In “Rolling with Rutherford”, students learn how indirect evidence, probability, and statistics are used by particle physicists to make measurements of the tiniest particles. They will also be able to explore the QuarkNet Data Activities Portfolio to find other useful and interesting ways to connect the physics students learn in school to the forefront of research.

Quantum Computing and the Quantum Workforce
Location: AS-113S
Russell Ceballos and Valerie Goss
Session A: 1:30 - 2:10 [For Educators]
Session B: 2:20 - 3:00 [For Students]
Session C: 3:10 - 3:50 [For Students]

Abstract: This will be an engaging workshop about quantum education, key quantum concepts, and common misconceptions. Quantum workforce needs and how to prepare for jobs in the quantum workforce will also be discussed.

Pathways into Materials Science
Location: AS-108S
Colton Ginter
Session B: 2:20 - 3:00
Session C: 3:10 - 3:50

Abstract: We interact with engineered materials every day: from the chips powering our computers to the concrete in our walls and fibers in our clothes. This talk will provide an introduction to materials science as a field, focusing on examples of ceramic, metallic, and polymeric materials in our day-to-day lives. We will then hold an informal discussion on pathways into materials engineering.

E. Poster Abstracts (12:00 pm - 1:30pm)

Poster 1

Observation of a Downward Terrestrial Gamma-Ray Flash Associated With Dart Leaders of a Negative Cloud-to-Ground Lightning Flash

Wayne Hopple, *Loyola University Chicago*

We report the observation of a downward terrestrial gamma-ray flash (TGF) during the dart-leader stage of a negative cloud-to-ground lightning flash. The event was recorded by the Telescope Array Surface Detector (TASD), together with a Lightning Mapping Array, a broadband radio interferometer, a fast antenna, and a high-speed camera. The TGF was associated with the fifth of nine return strokes in a multistroke flash with three distinct ground-strike points. This stroke had the largest peak current of the flash and was preceded by its fastest dart leader. The final TGF emission was detected within 4 μs of the return stroke, placing it in the final stage of leader development immediately before ground attachment. Interferometric observations also revealed branching above the cloud base, suggesting nonuniform electrical conditions around the leader. The combination of residual charge from previous strokes and complex electrical conditions near the dart-leader tip may have contributed to TGF production. This observation establishes that downward TGFs can occur during negative dart-leader development and supports the interpretation that leader-associated X-rays and downward TGFs may represent different manifestations of a common lightning-driven energetic-radiation process.

Poster 2

Titanium–Based Oxide Nanopatterning by Block Copolymer Templated Sequential Infiltration Synthesis

Tylon Kondowe, *Illinois State University*

Recent advancements in microelectronics and memory technologies have created a strong need for scalable methods of fabricating inorganic nanopatterns that can offer fine control over both size and scale. Sequential Infiltration Synthesis(SIS) is a vapor deposition technique that allows inorganic materials of interest to be grown inside polymer environments. SIS encourages precursor division and chemical binding at specific polymer domains through a process of alternating exposures of reactive precursors, effectively hardening those regions and converting soft polymer features into robust inorganic structures. SIS preserves nanoscale morphology. In this work, polystyrene block poly(methyl methacrylate) (Ps-b-PMMA) BCP films were spin coated onto silicon substrates and thermally annealed to form nanoscale

morphologies. SIS was then performed using titanium tetrachloride and deionized water to infiltrate the PMMA domains, resulting in feature size and spacing invariant titanium dioxide nanopatterns.

Poster 3

Converging diffusion coefficient analysis in molten salts

Amanda Anderson, *Lewis University*

Molten salts enable efficient operations of industrial-scale pyroprocessing, molten salt reactor, and electrometallurgical systems due to their thermal stability, wide electrochemical windows, and energy storage capabilities. However, in situ monitoring of the evolving salt composition in these systems is needed to ensure that the salt does not corrode its containment system or accumulate impurities over time. While the inherent electrolytic nature of these salts readily allows for characterization using electroanalytical methods, precise knowledge of the diffusion coefficients of dissolved analyte species is needed to ensure accurate measurements. A variety of techniques within the literature can be used to determine diffusion coefficients, such as cyclic voltammetry, chronoamperometry, and chronopotentiometry. Although these techniques should produce identical values, technique-dependent factors have led to a surplus of contradicting and unreliable datasets. To resolve these discrepancies, we have augmented these experimental approaches with updated models that properly account for non-idealities that are typically ignored in molten salt systems. Using this approach, we have confirmed the efficacy of the electroanalytical techniques to measure consistent diffusion coefficients in molten salts using the model system of LiCl-KCl containing FeCl2. These results will help to enable optimized operations of molten salt systems and provide the backbone for future multimodal monitoring tools.

Poster 4

Commissioning and Characterization of Micro-Channel Plate Detectors for Use in St. Benedict and BEARTrap experiments

Akira Clark, *Indiana University South Bend*

The commissioning and characterization of Micro-Channel Plate (MCP) detectors for use in a variety of beta-decay experiments is integral for providing precise and accurate determinations of decay daughter ion properties. A set of position-sensitive, 80x100mm2 MCPs is under commissioning for use in both the BEtA Recoil ion trap (BEARtrap) at Argonne National Laboratory for beta-delayed neutron emission spectroscopy and the Superallowed Transition Beta-Neutrino Decay Ion Coincidence Trap (St. Benedict) facility at the University of Notre Dame. Characterization of these MCPs, including evaluating timing resolution, spatial

responses, and systematic uncertainties affecting time-of-flight measurements, is ongoing, and the status and results of these tests will be presented. In particular, applications for measurements at BEARtrap for beta-delayed neutron spectroscopy and at St. Benedict for beta-neutrino angular correlation parameter determination will be discussed.

Poster 5

Designing Enhanced Embedded Systems for Wireless Environmental Datalogging Using Bluetooth Low Energy

Ryleigh Jebson, *Indiana University*

The Tree Canopy Project is an effort to reduce dangerous urban heat islands in the city of South Bend by planting 100,000 trees over 10 years in the least green areas of the city. At the request of the city of South Bend, the IUSB Physics Department is designing and fabricating 75 data logging systems to measure the effectiveness of these trees at reducing the temperature of hot spots. Developing a cost-effective method of gathering environmental data, using widely available sensors and microcontrollers, is important for this decade-long experiment. This project was conducted during the Summers of 2025-2026 by physics major Ryleigh Jebson who developed code and hardware the server dataloggers. These dataloggers can communicate wirelessly with a centralized hub or other microcontrollers using Bluetooth Low Energy (BLE) to avoid having to manually collect data from potentially dozens of loggers in the field.

Poster 6

Asteroid Surface Observation Mission

David Rodriguez, *Lewis University*

The Asteroid Surface Observation Mission (ASOM) is a small spacecraft flyby mission intended to characterize the physical properties of near-Earth objects (NEOs). ASOM targets small (10 - 100 m diameter) NEOs and will perform close-approach (~50 km) observations, complemented by ground-based astrometry data. A major scientific motivation is to improve constraints on the parameters governing non-gravitational forces such as the Yarkovsky effect. The Yarkovsky effect is a phase-delayed thermal-recoil force which contributes to the secular time-evolution of the semi-major axis of NEOs. Currently, the Yarkovsky effect is inferred primarily through astrometric drift measurements. Predictive modeling requires assumptions regarding surface temperature distributions, thermal inertia, spin state, and surface morphology and composition.

This work investigates the extent to which these properties, particularly spin state, could be constrained by an in-situ mission concept, and develops detection models linking equipment limitations to achievable science return.

Ground-based lightcurve observations of 10-100 m NEOs are typically obtained in V-band using 1-4 m aperture telescopes during close-Earth approaches (0.01-0.1 AU). Small NEOs (H>22) generally have a photometric uncertainty of 0.1-0.5 magnitude, corresponding to signal-to-noise ratios < 50, depending on telescope aperture and atmospheric conditions. ASOM flybys will occur at distances four to five orders of magnitude closer, which will result in a ten order of magnitude increase in photon flux. Combined with the absence of atmospheric noise, though with a smaller aperture, this will enable an uncertainty two orders of magnitude better than ground-based observations which corresponds to a signal-to-noise ratio > 1000.

Poster 7
Characterization of In1-xMnxAs(111) Thin Films
Rose Reitz, *Lewis University*

A Dilute Magnetic Semiconductor (DMS) is formed when a non-magnetic semiconductor is doped with a magnetic material. Combining a DMS with a topological material gives us a platform to tune time-reversal symmetry, and this potentially opens a pathway to topological qubits for quantum computing. Though many III-V DMS materials have been extensively studied over the past few decades, the (111) direction of Mn doped InAs has remained largely unexplored. In this study, we investigate the structural and ferromagnetic properties of InMnAs(111) as a function of Mn doping levels. Using molecular beam epitaxy (MBE), we grow In1-xMnxAs on a GaSb buffer layer grown on GaAs(111)B wafers to optimize growth conditions through an iterative process. We characterize our material with Atomic Force Microscopy (AFM), X-ray Diffraction (XRD), and X-ray Reflectivity (XRR). Through magnetotransport measurements, we were able to observe the Anomalous Hall Effect (AHE). Further studies will be conducted to investigate the magnetic anisotropy by measuring the AHE.

Poster 8
Single-molecule Imaging of RNA Hairpins with CAG Repeats
Ella Bricker, *Loyola University Chicago*

Using single-molecule fluorescence imaging, transient structure formation by biomolecules can be observed in real time. A key step in processing genetic information is the formation of single-stranded RNA molecules that serve as the template for protein formation. The human genome contains domains of repetitive DNA sequences, such as the CAG trinucleotide, and these repeat sequences can be conserved in the resulting RNA sequence. Single-stranded RNA molecules, enriched with these repeat sequences, may be prone to fold into structures that interfere with protein formation. In particular, CAG repeats are associated with numerous neurodegenerative diseases, and this mechanism may contribute to the disease state. Here, using single-molecule, total internal reflection microscopy, we report on the imaging of single RNA molecules containing CAG repeat domain that reversibly form hairpins. Through measurements of the relative lifetimes for the observed hairpin structures, their energetic stabilities are calculated. The hairpins are sensitive to environmental conditions, such as increasing concentrations of monovalent and divalent cations, which promote their formation.

Poster 9

The Power of Tiny

Sheila Kuria, *Illinois State University*

Phones, Tv's and electronics in general have gotten smaller over the years. This phenomenon is in part due to the ongoing development of nanomaterials. Nanomaterials have revolutionized the ways we can use technology in fields such as medicine, computing, energy and even agriculture. The enhanced properties that nanomaterials demonstrate allow for a wide range of applications. How are these tiny yet powerful structures formed? Sequential Infiltration Synthesis is one method of nanopatterning. This presentation will delve into this method of synthesizing nanomaterials, how it is performed and how the results can be used in industry.

Poster 10

Enhancing CeO2 Particle–Surface Interactions via Megasonic Energy for Improved Shallow Trench Isolation (STI) Chemical Mechanical Planarization (CMP) Performance

Cesar D. Alvarado Orellana* and Jason J. Keleher, *Lewis University*

Shallow trench isolation (STI) is essential in semiconductor manufacturing for electrically isolating adjacent devices and enabling high-density device integration. During STI fabrication, dielectric-filled trenches produce a layer of silicon dioxide (SiO2) that requires precise planarization, hence the need for chemical mechanical planarization (CMP). In STI CMP, ceria (CeO2) slurries are used due to their high affinity through active surface sites (O2 vacancies) that can promote strong interactions with oxide, including the formation of Ce–O–Si bond. Although strategies to provide an improved oxide material removal rate (MRR) rely on surface modification and higher adsorption through additives, they can lead

to additional contamination and make the post-CMP processes harder. An alternative strategy is the use of megasonic energy to boost interfacial interactions by chemically activating the particle-dispersion-wafer interface without requiring additional surface modifying additives. The megasonic energy can provide a catalytic cycle of formation of redox environment by generating reactive oxygen species (ROS) through release of energy from cavitation events. By modifying the flux and flow rate, the interface can greatly improve. The particle dispersion and interfacial transport is compared by the estimation of surface sites through Ce3+/Ce4+ using UV-VIS. The changes in interfacial interaction were correlated with oxidation-reduction potential (ORP) and dissolved oxygen (DO) over time. Furthermore, the concentration of 1O2 by using fluorescein as fluorescence probe to support the mechanism of catalytic cycle and formation of ROS. Contact angle measurements were taken to evaluate changes in surface wettability and correlate with the CMP performance. The results have shown that megasonic energy assisted increases the slurry wettability supporting the change in interface interactions. DO and ORP measurements increase in time and as greater flux is induced, the greater the boost is. Finally, a discussion of defectivity is presented by suggesting increase in surface quality and reduced defects post polish.

Poster 11

Enhancing CeO2 Particle–Surface Interactions through Synergistic Chemistry to Chemical Mechanical Planarization (CMP) Performance

Ziana Benjiman* and Jason J. Keleher, Lewis University

One key step in semiconductor wafer production is Chemical Mechanical Polishing (CMP). This is the process by which a wafer is flattened and planarized with both chemical and mechanical forces. Metal oxides are one of the most common polishing agents added to CMP slurries. These metal oxides (i.e. Ceria [CeO2]) act as mechanically abrasive nanoparticles that, when combined with chemical and fluid components, can remove layers of substrate (in this case Tetraethyl Orthosilicate or TEOS), effectively polishing its surface. In commercial slurry alone, nanoparticles do not always work at their full potential. With increasing demand for improved material removal rates (MRR), the need for additives that enhance interfacial interactions between the substrate and nanoparticles has become vital. The purpose of this study was to determine which chemical behaviors were most significant in improving MRR. Four additives were selected and evaluated using UV/VIS Spectroscopy, contact angle, and an oxidation-reduction potential test (ORP), and the coefficient of friction (COF). Some additives were chosen because of their ability to reduce Ce^{4+} to Ce^{3+}, increasing O_2 vacancies on the surface of ceria while others, surface adsorbers, increase the amount of contact the chemistry has with the TEOS surface both of which improve MRR. This work reveals how the synergistic connection between Ce^{4+}/Ce^{3+} ratio, wettability, and oxidation reduction potential allows additives to play a key role in modulating substrate-nanoparticle interactions, consequently increasing MRR. This work will provide insight into the foundational synergistic mechanisms for utilizing additives in metal oxide-based slurries to improve the CMP process. Future works could examine the use of a mixture of additives to optimize material removal rates.

Poster 12

Conductive Polymer Functionalization of Cellulose-Derived Hydrogels for Bio-

Sensing Applications
Jadyn C. Dominguez*, Luca M. Fisher, Sarah E. Powers, and Jason J. Keleher

There is a critical need for real-time, efficient, and environmentally sustainable biosensors for monitoring water conditions. Conventional approaches rely on off-site, static measurements that require costly materials and introduce delays between sample collection and analysis. Cellulose- based hydrogels offer an attractive alternative due to their porous structure, tunable conductivity, and biodegradability. Two cellulose derivatives, carboxymethyl cellulose (CMC) and hydroxyethyl cellulose (HEC), contain reactive functional groups, including hydroxyl, carboxyl, and hydroxyethyl substituents, that enable chemical modification. These polymers can form alternating chains (CMC–HEC–CMC) and be crosslinked using a dicarboxylic acid such as citric acid, producing a functionalized hydrogel scaffold suitable for prolonged submersion with minimal structural degradation. Previous studies employed photoinitiated polymerization using Fe(III)–carboxylate complexes to incorporate polyaniline (PANI) into the hydrogel matrix, followed by hydrochloric acid doping to generate an electrochemically active polymer network. Although this approach enhanced current output, the environmental impact of PANI motivated exploration of more sustainable conductive polymers. Integration of alternative polymers is evaluated using cyclic voltammetry to characterize redox behavior and guide organic electrode design. The hydrogel scaffold can be further customized by embedding molecular probes, such as IgG antibodies, to enable selective detection of target analytes. Binding events between probes and specific molecules induce measurable electrochemical shifts that are amplified by the surrounding conductive network. This strategy demonstrates strong potential for developing an aqueous biosensor capable of providing rapid, on-site analysis while maintaining environmental compatibility.

Poster 13
Brush Design Variation Effects on P-CMP Mechanics and Performance
Angelina S. Martinez*, Andrew C. Murphy and Jason J. Keleher

As the semiconductor manufacturing industry approaches the production of single nanometer to angstrom scale chip production, enabling technologies like Chemical Mechanical Planarization (CMP) become increasingly important. CMP is the process by which atomic planarity of semiconductor substrates is met through a combination of chemically active slurries and mechanical abrasion by polishing and nanoparticles. In the process, defects like organic residues and nanoparticle aggregates are left on wafer surfaces and require a cleaning step to be removed. The post CMP Cleaning (P-CMP) process uses polymer-based brushes and cleaning chemistries to gently remove organic residues and nanoparticles without further damaging the integrity of the wafer. The efficiency of P-CMP is dependent on numerous variables like chemistry flow rate, pressure, contact area, and brush design. This work will explore how brush material properties, nodule-level contact mechanics, and operating conditions control P-CMP cleaning performance. Connecting brush-wafer friction, shear forces, pressure distribution and efficiency of the removal of adhered particles, several brushes of different compositions/designs will be compared.

Poster 14
Connecting Organic Defect Models and Metal Oxide Surface Chemistry to Understand

Contaminant Adhesion in Post-Chemical Mechanical Planarization (CMP) Cleaning
Andrew C. Murphy*, Robert M. Mueller, Austin J. Rockaitis, and Jason J. Keleher

Integrated circuits are manufactured by building successive layers of metals and insulating materials, each requiring exceptionally flat and clean surfaces. Chemical mechanical planarization (CMP) combines chemical reactions with mechanical polishing to achieve this flatness, but it can leave behind particles and chemical residues that interfere with device performance. As device features shrink, controlling these contaminants requires understanding of both how residues adhere and how the underlying surface changes chemically. This work connects controlled modeling of organic contamination with the investigation of metal oxide films to better understand defect formation and surface stability following CMP. Organic residues associated with benzotriazole (BTA), a corrosion inhibitor used during copper polishing, present a persistent cleaning challenge. Because these residues form dynamically during polishing, reproducing them consistently for laboratory studies is difficult. To address this limitation, a BTA defect mimic was developed to represent organic contamination associated with copper CMP. This controlled model provides a platform for investigating residue adhesion and evaluating removal strategies under reproducible conditions. Complementing this approach, molybdenum (an emerging material for electrical connections) is investigated to understand how changes in the underlying metal surface influence contamination and cleaning response. Molybdenum forms oxide films whose stability depends on the surrounding chemical environment. Changes in pH, dissolved oxygen, and oxidant concentration can affect oxide formation and dissolution, altering corrosion behavior and interactions with residual contaminants. Electrochemical measurements are combined with contact angle, surface energy, and particle removal measurements to examine relationships among oxide-film evolution, surface wettability, and contaminant adhesion. Together, these studies examine two connected aspects of post-polishing contamination. By combining reproducible defect models with mechanistic studies of metal surface transformations, it provides a foundation for improving contamination control while preserving materials used in semiconductor manufacturing.

Poster 15
Developing Photocatalytic Biopolymer Scaffolds for Cu CMP Wastewater Reclamation
Rebecca S. Ratajczyk*, Isabella B. Johnson, and Jason J. Keleher,

As stricter standards for more sustainable approaches in the semiconductor manufacturing industry are taken into effect, reducing pollutants and conserving resources like water is essential in chemical mechanical planarization (CMP). CMP is critical step in wafer planarization that couples mechanical and chemical forces; however, it also generates large volumes of wastewater containing abrasive nanoparticles, organic chemical additives, and substrate byproduct species (e.g., Cu, W, TEOS, SiC, and Mo). These waste streams are also very complex due to the interactions between nanoparticles, molecular species, surface charges, and dissolved ions. As a result, traditional treatment methods like filtration and coagulation often generate secondary waste products, such as copper (Cu) sludge and nanoparticle agglomerates, limiting possible water recovery. In addition, commonly used chemical additives, such as corrosion inhibitors like benzotriazole (BTA), are persistent and poorly biodegradable. This work focuses on developing a reusable, photo-redox-active biopolymeric media as

an enabler for CMP wastewater remediation and water reclamation. Cellulosic media can be modified during synthesis with additives such as glycine to tune pore structure, accessible surface area, and interfacial adsorption, thereby influencing the transport and capture of contaminants within the porous network. Titania (TiO2) nanoparticles (NPs) were incorporated into the media to introduce a photoactive pathway for degradation of persistent organic pollutants. Upon ultraviolet (UV) excitation, electrons move from the valence band to the conduction band, generating an electron–hole pair that produces reactive oxygen species (ROS) from H2O and O2. These ROS drive oxidative degradation and eventual mineralization of adsorbed organic contaminants to carbon diozide (CO_2) and H_2O. Integration of TiO2 NPs into the biopolymeric media enabled the removal and degradation of up to 70% of CMP contaminants under UV irradiation. Residual Cu was subsequently recovered through electrowinning. The reclaimed water was then used to formulate recycled CMP slurries. Initial polishing studies demonstrate material removal rates, surface defectivity, and electrochemical behavior comparable to slurries prepared using conventional water sources.

Poster 16

Megasonic Activation of Slurry Chemistry to Modulate the Tribochemical Interface for "Low-Stress" Copper Chemical Mechanical Planarization (CMP)

Kiersten M. Smith*, Cesar D. Alvarado-Orellana, Robert M. Mueller, Jason J. Keleher

Chemical mechanical planarization (CMP) relies on coupled chemical and mechanical interactions at the wafer surface where the tribochemical interface governs material removal, corrosion, defect formation, and overall process stability. This work investigates the megasonic activation of slurry formulations as a strategy for low-stress modulation of the tribochemical interface during copper (Cu) CMP without altering the fundamental slurry composition. Focused acoustic energy generates reactive oxygen species (ROS) through acoustic cavitation, creating a more oxidizing environment and enhancing chemical reactivity at the Cu-slurry interface. The increased oxidative strength promotes the rapid conversion of Cu0 through intermediate Cu^{+} species toward Cu^{2+}, therefore minimizing the lifetime and availability of Cu^{+}. This limits the Cu^{+} availability for interaction with benzotriazole (BTA). Reducing the persistence of this intermediate suppresses the formation of dense, polymeric Cu(I)-BTA passivation networks and instead promotes a more chemically active surface film that can be more readily removed under reduced mechanical stress. Electrochemical characterization, oxidation-reduction potential (ORP), dissolved oxygen (DO) and ROS measurements, surface chemistry analysis, and friction measurements are correlated with changes in Cu oxidation, passivation behavior, material removal rate, and surface quality. Furthermore, engineering different reactor configurations designed to minimize radical residence time and ROS decay are examines as a means of delivering a greater concentration of reactive species to the tribochemical interface.

Poster 17

Influence of Poly(vinyl alcohol) Brush Surface Morphology and Mechanical Properties on Post-CMP Cleaning Efficiency

Sydney A. Tremblay*, Jadyn C. Dominguez, and Jason J. Keleher

Chemical Mechanical Planarization (CMP) is a crucial step in the semiconductor manufacturing process, enabling the formation of ultra-flat surfaces essential for the integration and scaling of semiconductor devices. Post-Chemical Mechanical Planarization (p-CMP) cleaning involves the removal of nanoparticle residues, stains, or aggregates on the semiconductor substrate surface after polishing to ensure flatness at the atomic level. Polyvinyl alcohol (PVA) brushes are widely used in p-CMP cleaning to remove residual slurry particles and organic contaminants from wafer surfaces due to their softer mechanical forces and fluid transport abilities. On the surface of the PVA brushes, there are two specific locale; brush nodules and land areas, which may come in contact with the wafer substrate under an applied load. Effective brush performance depends on a complex combination of mechanical effects, pore structure, surface chemistry, and fluid transport within the porous matrix. This work focuses on creating a small-scale brush scrubber to examine the effects of brush surface on the coefficient of friction values (CoF), particle removal efficiency (PRE), and brush performance. Pencil PVA brushes were created out of typical CMP roller brushes, and they were used to correlate pore architecture and brush shape with mechanical parameters, revealing their combined influence on contact mechanics and cleaning efficiency. Young's modulus and Poisson's ratio tests were performed to determine brush characteristics under loads relevant to CMP and understand the material response of the porous polymer. Through scanning electron microscopy (SEM) and energy-dispersive spectroscopy (EDS), the elemental interaction between the slurry and the pore matrix was understood. The results demonstrate that brush cleaning efficiency correlates strongly with pore structure and mechanical stiffness, which govern particle entrapment and release during wafer contact. These structure-property relationships provide quantitative metrics for predicting brush lifetime and guiding the optimization of PVA brush design and conditioning for improved post-CMP defect reduction in advanced semiconductor manufacturing.

F. Parent Discussion (1:30pm-4:00pm)

1:30 - 2:10 Parent Discussion I
Discussion of Physics Careers
Location: AS-155A
Chris White

2:20 - 3:00 Parent Discussion II
The Music and Physics Connection
Location: AS-157A
Gordon Ramsey

3:10 - 3:40 Parent Discussion II
Lab Tours and Q/A with Lewis University Faculty
Location: AS-155A
Joseph Kozminski

G. Educator Sessions (1:30pm-4:00pm)

1:30 - 2:10 Educator Session
Quantum Computing and the Quantum Workforce
Location: AS-113S
Russell Ceballos and Valerie Goss

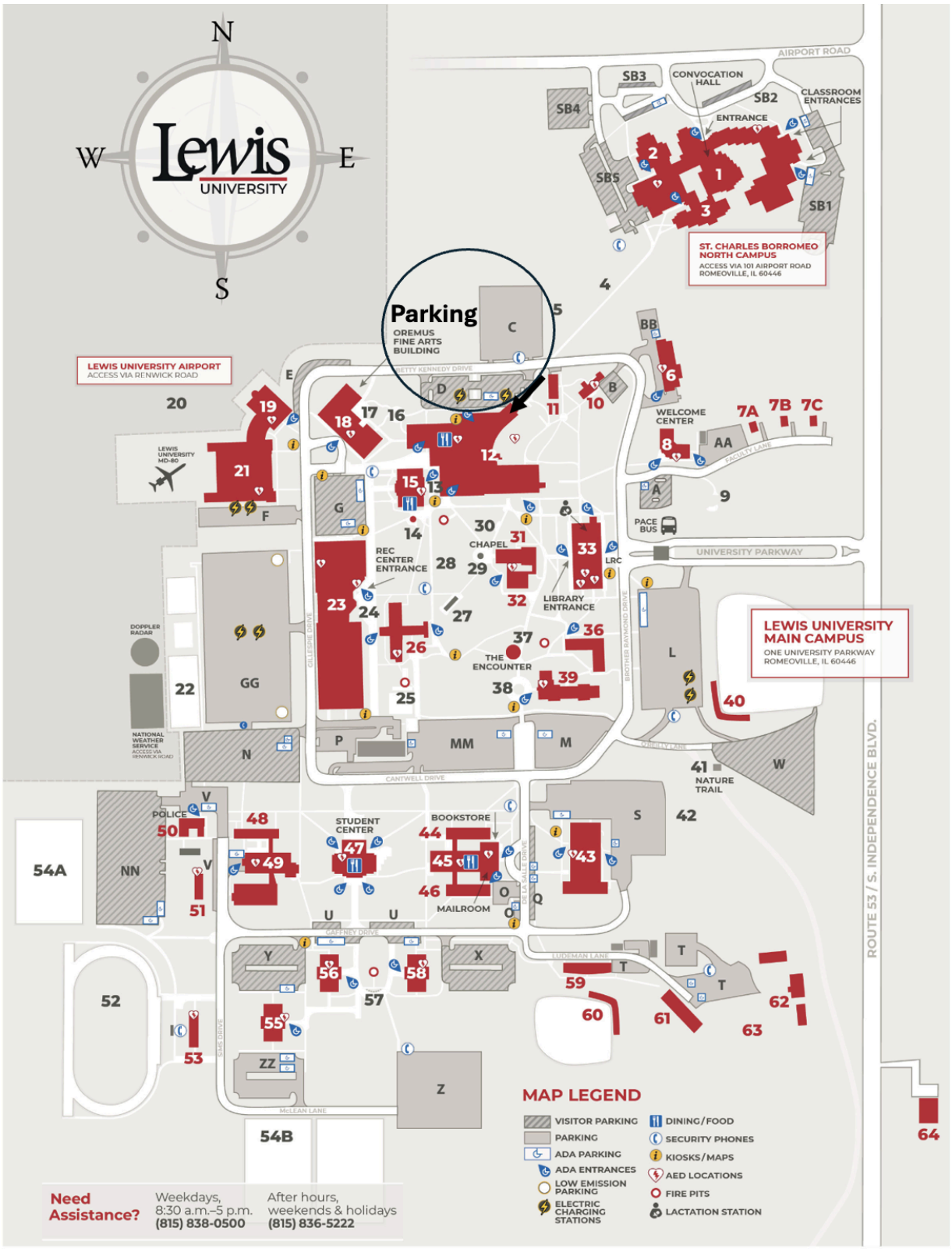
2:20 - 3:00 Educator Session
Purposeful Affirmations—Building a Supportive Classroom with STEP UP Everyday Actions
Location: AS-118S
Red Lhota

2:20 - 3:00 Educator Session
QuarkNet Teacher Workshop
Location: AS-119S
Kenneth Cecire and Jeremy Wegner

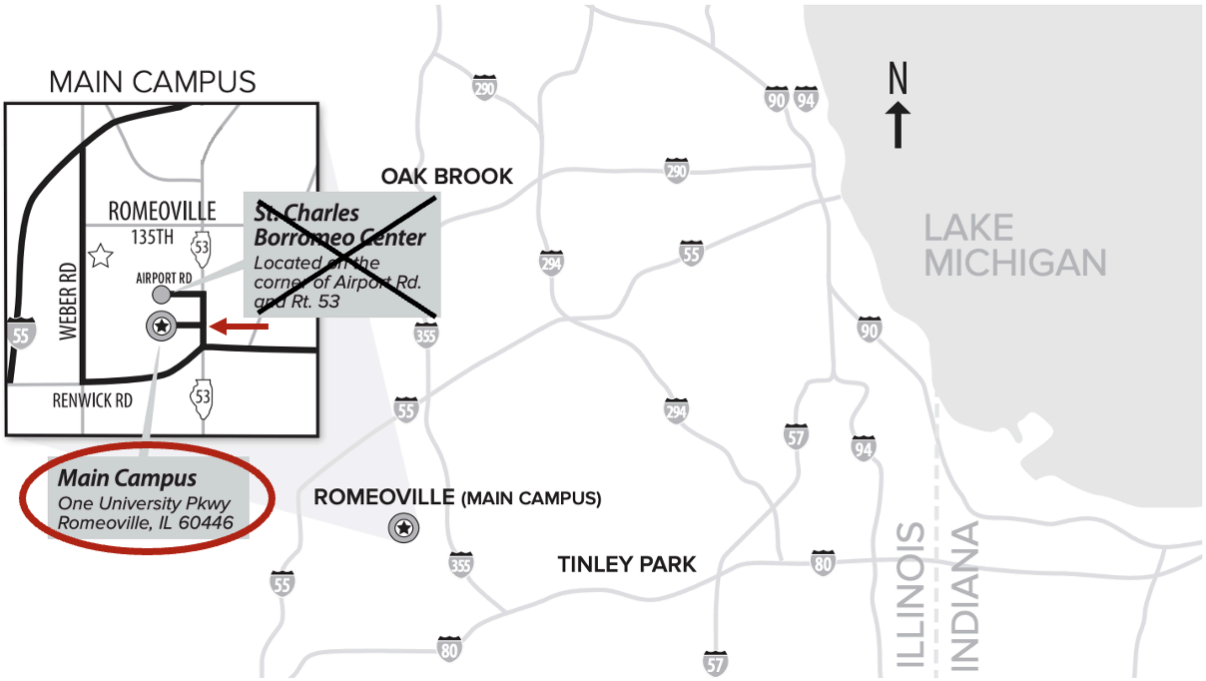
3:10 - 3:40 Educator Session
The Music and Physics Connection
Location: AS-157A
Gordon Ramsey

H. Lewis University Map/Directions

The conference is held at the Academic Science Center (AS), building 12. Park in Lot C or D, and enter on the North East side of the building.



GPS: Use **1 University Pkwy, Romeoville, IL 60446**



From South of Campus

- From IL-53 Northbound, turn left onto the main campus at University Parkway (1st stoplight after Renwick).
- To access the Academic Science Center (12 on the map), turn right onto the circle drive at the T-intersection and park in Lot C or D.
- Enter glass atrium on the NE side of the building (arrow on the campus map)

From North of Campus

- From IL-53 Southbound, turn right onto the main campus at University Parkway (1st stoplight after Airport Rd).
- To access the Academic Science Center (12 on the map), turn right onto the circle drive at the T-intersection and park in Lot C or D.
- Enter glass atrium on the NE side of the building (arrow on the campus map)

I. Speaker Bios

Keynote Speaker
Rhett Allain, Ph.D.
Rhett Allain is an Associate Professor of Physics at Southeastern Louisiana University, where he teaches undergraduate physics courses. As an active science communicator, he creates content for social media and YouTube, writes regularly for WIRED, and ponders the everyday applications of physics.

He has authored several books, including Geek Physics and Angry Birds: Furious Forces, and served as the technical consultant for both MythBusters and CBS's MacGyver. In his spare time, he enjoys spending time with his family and taking things apart—though he can't always put them back together.

Co-chair of Cosmic Pathways and Introduction Speaker
Joseph Kozminski, Ph.D.
Joseph Kozminski, Ph.D. is a Professor of Physics and Chair of Physics and Chemistry at Lewis University. He earned his B.S. from the University of Notre Dame and his M.S. and Ph.D. in Physics from Michigan State University. He is a high energy experimental physicist by training and worked on the D-Zero and Mu2e experiments at Fermilab; however, his research interests have shifted to community-based science around climate vulnerability and air quality. Professionally, Dr. Kozminski has served on various committees, task forces, and Boards within the Advanced Laboratory Physics Association (ALPhA) and the American Association of Physics Teachers (AAPT) and led the writing of the *AAPT Recommendations for the Undergraduate Laboratory Curriculum*. He has also forayed into public service, being elected (twice) to the Board of Education of his local public school district.

Co-chair of Cosmic Pathways and Be a Shark Speaker
Matthew Wright, Ph.D.
Matthew Wright, Ph.D. is the chair of the physics department at Adelphi University, where he holds the rank of Professor of Physics. He obtained his Ph.D. from the University of Connecticut as an experimental atomic physicist. He has held research positions as an atomic physicist at the University of Innsbruck as a Marie Curie Fellow and Harvard University. He also held a position at Princeton Consultants, Inc where as a management consultant focused on the logistics and technology industries. Professor Wright has focused on helping the students make the transition from high school to college and then beyond. His recent book, "Sustaining Colleges and Universities through Community" discusses how members of the

academic leaders can improve our current situation by connecting more deeply with the community. Another recent book he authored “Be A Shark: The Secret Sauce to Winning in Life after High School” helps students navigate college. He has also written over 21 op-eds on this topic and many others.

Autumn Crisafulli
Autumn Crisafulli graduated from Lewis University with a B.S. in Physics and has spent the past three years working as a nuclear safety engineer and physicist at Fauske & Associates (a Westinghouse company). Her day to day work focuses on severe accident modeling, probabilistic risk assessment, and nuclear safety for both existing and new advanced reactor designs where I use a mix of physics, engineering, and computational modeling.

Jason Keleher, Ph.D.
Dr. Jason J. Keleher is Professor of Chemistry at Lewis University, where he brings a dynamic and holistic approach to teaching, research, and mentorship. A proud graduate of Christian Brothers Academy (’94) and Clarkson University, he earned his B.S. and Ph.D. in Chemistry under the guidance of the late Dr. Yuzhuo Li, pioneering “Next-Generation Consumable Technologies for Chemical Mechanical Planarization (CMP) of Cu/Low-K Devices.” Before joining academia, Dr. Keleher served as a Senior Research Scientist at Cabot Microelectronics Corporation, where his groundbreaking work on interfacial reaction mechanisms earned him the 2007–2008 Inventor of the Year award. Since arriving at Lewis University in 2009, Dr. Keleher has built an energetic research and teaching culture that spans traditional chemistry and interdisciplinary frontiers—from Organic and Supramolecular Chemistry to Fluid Mechanics, Electrochemistry, and Composite Materials. As Principal Investigator (PI) of the Keleher Research Group (KRG), he leads a vibrant team exploring the design, synthesis, and characterization of nanoparticles and nanocomposite systems for semiconductor manufacturing, health safety, sensing, and sustainability initiatives. His group’s work has generated more than 45 peer-reviewed publications, two book chapters, and over 20 patents, with findings showcased in over 500 presentations worldwide. Supported by over $5 million in external funding from organizations such as the NIST, NSF, EPA, and industry leaders, including Applied Materials, DuPont, and Araca Corporation, his research bridges academic innovation with real-world impact. Along with teaching and mentoring, he highlights the importance of giving back to the community and has impacted over 20,000 kids in the past 10 years by hosting STEM nights, summer camps and other educational events. A passionate educator and advocate for student research, Dr. Keleher has been honored with the Distinguished Lasallian Educator Award (2015) and the Brother Louis Seiler Ministry of Teaching Award (2021). Recently, he was by the Illinois Science and Technology Coalition as one of the 2026 Researchers to Know. He continues to serve the Lewis community as President of the Faculty

Senate and Faculty Representative to the Board of Trustees, while actively contributing to the American Chemical Society, Materials Research Society, and Electrochemical Society. Blending creativity, collaboration, and curiosity, Dr. Keleher embodies the spirit of discovery—both in the classroom and at the cutting edge of modern materials science.

Gordon Ramsey, Ph.D.
Gordon Ramsey is Emeritus Professor of Physics at Loyola University in Chicago, where he has been for forty-four years. He has done research in particle physics, physics education research and musical acoustics. He is a Past President of the American Association of Physics Teachers (AAPT).
Gordon grew up in a musical household. His involvement in music began when his mother gave him piano lessons while his father taught him chord structures (experimental and theoretical music). This paralleled his interest in mathematics and physics. Gordon has played in numerous theater orchestras and jazz bands in Chicago. He enjoys doing physics and still having the pleasure of music without worrying about where the next “gig” is going to be. Gordon teaches a course in the Physics of Music and does musical acoustics research at Loyola. He has published a textbook on the subject, “Physics of Music: Integrating the technical and artistic aspects of creating music”, ©2024, Springer.

Russell Ceballos, Ph.D.
Dr. Ceballos has a background in the theory of open quantum systems and is currently serving as Assistant Professor of (Quantum) Physics. He has a profound interest in the mathematical and philosophical foundations of quantum theory and a deep passion for understanding how to best teach the fundamental principles of quantum information science through the development of quantum games for pedagogy. Dr. Ceballos leads research projects centered around quantum optimization of noisy and open quantum systems, particularly investigating how quantum game theory can be leveraged in noisy quantum networks for quantum cybersecurity, quantum robotics, and enhanced metrological applications, as well as in designing novel quantum metamaterials and qubit platforms.

Kenneth Cecire
Kenneth Cecire received a B.S. in Physics in 1979 from the University at Albany and an M.A. in Physics from City College of New York in 1981. He taught physics for twenty years in both independent and public schools in New York and Virginia. In 1999, Cecire joined the staff of QuarkNet, working first at Hampton University and then moving to the University of Notre

Dame in 2009. Cecire was a founding member of the AAPT Contemporary Physics Committee and is co-Coordinator of International Masterclasses.

Jeremy Wegner
Jeremy Wegner received a B.S. in Physics Education from Purdue University in 1999 and has been teaching H.S. Physics and Math in his hometown of Winamac, IN ever since. He more recently received an M.S. in Mathematics from Indiana State University in 2025. He has been a member of QuarkNet since 2013 and an LHC fellow since 2016.

Physical Science Career Panelists

Zeenat Baig
Zeenat Baig is a software engineer with more than five years of experience building full stack applications. As a physics undergraduate, she was introduced to programming, which she used for data modeling and physics work. She went on to work at Ames National Laboratory as part of a Department of Energy internship. That internship turned into a career, one built on the same analytical thinking she developed studying physics. She's excited to share how a physics or STEM background can lead to unexpected paths in technology.

Harvey Campos-Chavez
Harvey Campos-Chavez is an Optical Test System Engineer at Panduit, where he builds automated test and analysis systems for optical-fiber connectivity. He earned his M.S. in Physics from the University of Illinois Urbana-Champaign in 2025 as an NSF Graduate Research Fellow and GEM Fellow, and holds a B.S. in Physics and a B.A. in Mathematics from Lewis University. His research experience has been in experimental atomic, molecular, and optical (AMO) physics, designing and validating UHV-integrated optical systems for the laser cooling, slowing, and trapping of cesium for quantum computing and of radium in a search for physics beyond the Standard Model.

Michael Morrow, Ph.D.
Dr. Michael Morrow, a native of Chicago and the surrounding area, attended Homewood-Flossmoor High School and started his college career at Knox College, where he received a B.A. in Physics and minor in Mathematics. He transferred to Washington University in St. Louis as a dual-degree student, and earned a B.S., M.S., and Ph.D. in Mechanical Engineering. After school, he worked as adjunct faculty for Lewis University and Benedictine University, teaching undergraduate students fundamental engineering and physics through courses and labs. He was also a teaching assistant for aerospace courses at WashU during this time. Currently, he is starting a new role as a Principal Systems Engineer at Northrop Grumman (Rolling Meadows, IL), working on developing and improving algorithms for state-of-the-art hardware to protect U.S. servicemen and women.

Marybeth Senser
Marybeth Senser is in her 11th year teaching physics at Downers Grove South High School. Marybeth is passionate about inclusive physics education. She serves as a STEP UP ambassador to increase female representation in physics. After school, Marybeth and her Research Club students perform original particle physics research through QuarkNet.

Marybeth joined QuarkNet in 2014 and was named a Cosmic Ray Fellow in May 2025. QuarkNet has brought her on many adventures, including performing an experiment in a tunnel 100 meters underground on the Fermilab campus, presenting to the International Particle Physics Outreach Group, and leading professional development workshops. When she's not at work, Marybeth enjoys spending time with her spouse and 2 kids (ages 3 and 5), playing board games, and singing in her synagogue's band.

Keith Taddei, Ph.D.

Dr. Keith Taddei is the lead instrument scientist for the 11-ID-D beamline, a high-energy x-ray diffraction and scattering instrument at the Advanced Photon Source at Argonne National Laboratory. His research uses x-ray and neutron scattering to study quantum materials, including superconductors, magnetic systems, topological phases, and low-dimensional materials. Before joining Argonne in 2023, he was a neutron diffraction instrument scientist at Oak Ridge National Laboratory's High Flux Isotope Reactor. In addition to his work at Argonne, he teaches physics at Dominican University. He earned his Ph.D. in physics from Northern Illinois University and his B.S. in physics from Lewis University.

Graduate Student Panelists

Ziana Benjiman
Ziana Benjiman is a first-year master's student in Chemistry at Lewis University in Romeoville, IL. She completed a B.A. in Biochemistry and Spanish at Grinnell College in Grinnell, IA. Her post-baccalaureate journey led her to working as a Residential Coordinator and STEMM TA for the CPASS Foundation Summer Scholars Academy in 2025. After her time spent working at the Academy on Lewis's campus, she decided to come back as a student with the Keleher Research Group. The group is currently conducting research in the semiconductor field, focusing heavily on CMP and pCMP. Her work examines how modulation of the surface chemistry of nanoparticles impacts substrate-slurry-pad interactions both during and after polishing.

Jasper Bradford
Jasper Bradford is a 4th year grad student in physics, working with Professor Wolfgang Pfaff at the University of Illinois Urbana Champaign. He works on manipulating microwave-frequency resonators with controllable interactions to store quantum information. In his free time, he enjoys injuring himself by running and rock climbing.

Katie Gifford (Moderator)
Katie Gifford is a PhD candidate in the Department of Physics at the University of Illinois Urbana-Champaign. In her work with Eric Kuo, Katie's research explores how to better support physics students. This includes developing interventions that engage with and refine students' intuitions, as well as identifying mechanisms that promote supportive and inclusive learning environments. When she is not teaching or doing research, Katie loves playing volleyball with fellow grad students.

David Imig
David Imig is a 4th year astrophysics PhD student, working under Professor Jessie Shelton at the University of Illinois. He studies dark matter, the mysterious ingredient thought to make up most of the mass in galaxies; and cosmological neutrinos, some of the most abundant yet most elusive known particles in the universe. Outside physics he can be found on the basketball court or anywhere there is salsa dancing.

Miles Knudtson
Miles is a fourth-year graduate student at the University of Illinois working in a laboratory studying a class of compounds called 'quantum materials'. He uses a technique called laser coupled scanning tunneling microscopy to study novel forms of metallicity, magnetism, and

superconductivity. Once he graduates, he hopes to continue being researcher at a national laboratory. On his free time miles enjoys cooking, writing, and haggling with people on Facebook marketplace.

Io Kovach
Io Kovach is a 4th year grad student at the University of Illinois Urbana Champaign, working with Professor Jessie Shelton. She makes N-Body simulations of exotic scenarios in the early universe, which will be tested with gravitational wave detectors such as LISA and pulsar timing arrays. In her free time, she makes lots of electronic music and plays the banjo.

David Rodriguez
David Rodriguez is a physics master's student at Lewis University and a visiting researcher at the Adler Planetarium. He earned his BA in physics with an astronomy concentration from the University of Montana, where he also worked at the Blue Mountain Observatory and was a planetarium presenter. After graduating, he taught high school Earth Science before beginning at Lewis University. His masters thesis research is on measuring the efficacy of the Yarkovsky effect on small near-Earth objects through an in-situ surface-resolution mission.

Suhas Sheikh
Suhas Sheikh is a 4th year physics graduate student, working with Prof. Smitha Vishveshwara at the University of Illinois Urbana Champaign. He likes to think about unconventional superconductivity and works on proposing theoretical schemes to detect Majorana Zero Modes (zero energy particles!) in a class of superconducting materials. He worked with Nobel Laureate Tony Leggett for a while on understanding superconductivity in a material called strontium ruthenate. His hobbies include soccer, tennis, running and thinking about physics hypotheticals.

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