

Physics & Astronomy Department Newsletter

Vol. 5, No. 1 (Fall 2017-Summer 2018)



ST. CLOUD STATE
UNIVERSITY

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Mission: Apply theoretical, computational, observational, and experimental methods to explore and understand the natural world.

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Editors: Dr. John E. Sinko, Dr. Ka-Wah Wong

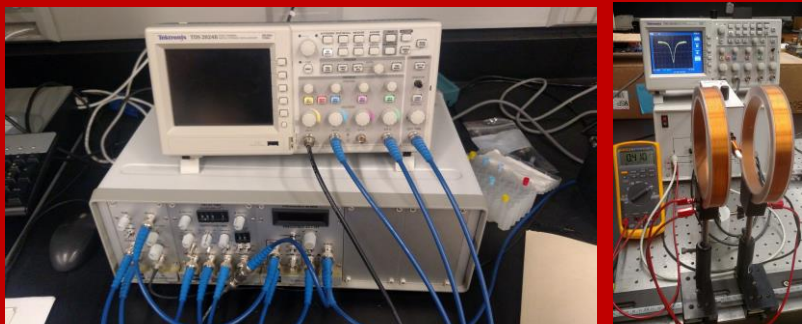
Send news to jesinko@stcloudstate.edu
or

Physics Department Newsletter
309 Wick Science Building, SCSU
720 4th Ave. South, St. Cloud, MN 56301

Physics & Astronomy Facilities Updates (2017-2018)

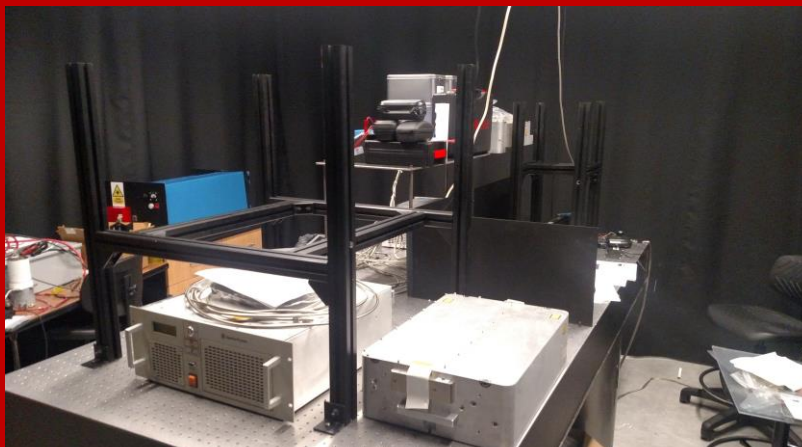
Revitalized Advanced Laboratory Apparatus **BROWN HALL 318**

Dr. Liu (and to a lesser extent, Dr. Sinko) have been hard at work organizing Brown Hall 318. Dr. Liu revived the NMR apparatus (below left), and Dr. Sinko rehabilitated the ESR apparatus (below right) for the PHYS 430 + 432 Advanced Laboratory courses. The rehabilitated equipment will provide interesting and relevant student laboratory experiences and support the official course learning outcomes.



Donation of Femtosecond Titanium Sapphire Lasers **ISELF 20**

Dr. Sinko coordinated a donation from Rudolph Technologies (Bloomington, MN) of two Spectra-Physics Mai Tai 800nm, 100-fs titanium-sapphire laser systems, and three scientific chillers. Many thanks are owed to Dr. Curt Fiedler at Rudolph for arranging this donation. Software, cooling, and safety must be addressed before the lasers can be brought online.



18" Spherical Vacuum Chamber **ISELF 21**

The physics department successfully requested an 18" vacuum chamber in the DAC COSE equipment budget. Dr. Sinko installed the chamber in ISELF 21 and with students, outfitted the chamber supported by an Early Career Award and several Student Research Grants. With installation of a safety valve, the chamber will reach 10^{-2} Torr pressures. Future improvements will improve the vacuum capability to around 10^{-8} Torr, enabling high vacuum materials science experiments and simulation of space conditions for aerospace experiments.



Flammables Cabinet **ISELF 21**

In compliance with OSHA regulations, a flammables cabinet was installed in ISELF 21 to store optical solvents.



Physics & Astronomy Club News

MainStreet

Physics majors and faculty worked to recruit new club members for the 2017-2018 year during the SCSU MainStreet event.



Halloween Pumpkin Drop!

The Physics & Astronomy Club's annual test of gravity commenced October 31st, 2017 from a position of enhanced potential energy atop Wick Science Building. According to a student spokesperson, gravity is still operational and several pumpkins were reliably accelerated under its influence.

(Below: pumpkin acceleration under 1.000 g load)



Community Engagement and Active Learning

Tech Savvy

This event seeks to recruit young women into STEM fields. Dr. Sinko worked with senior physics major Meredith Rupp to deliver a workshop on solar energy and electricity.



Horizons

This event seeks to recruit young women into STEM fields. Dr. Sinko supervised a workshop on solar energy and electricity.



Regional Science Fair

This event evaluates middle and high school student science project presentations in a "poster session" format. Dr. Kevin Haglin participated as the International Fair Director, managing special awards and providing award decisions to move exceptional projects forward to the International Science Fair. Physics faculty Dr. Christofer Nelson and Dr. John Sinko also participated in the event as regular table judges, providing feedback on presentations.

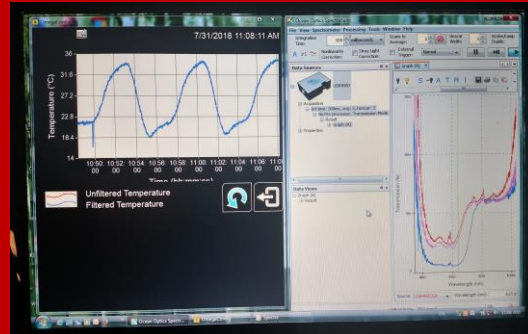
Science Fest

This event seeks to recruit young people into STEM fields. Dr. Sinko traveled to St. John's University to present on light and electricity on behalf of St. Cloud State University.



'Advanced Program in Technology and Science' Summer Camp

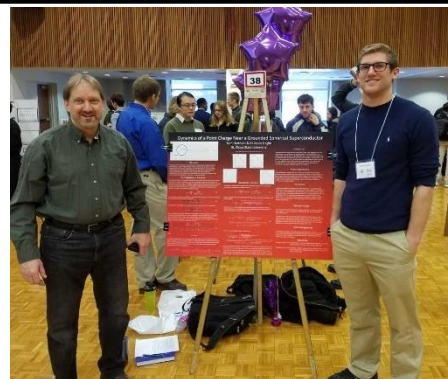
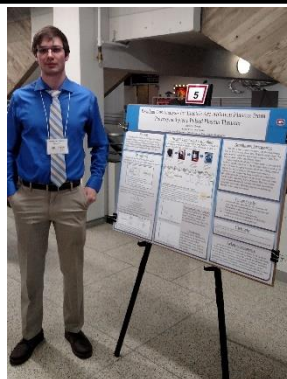
This program engages international and underrepresented high school students in summer STEM research. Along with physics majors Donovan Bassett, Alexis Corbett, Sam Hartman, and Chase Negen, Dr. Sinko worked with high school students Ezana Demmessie, Ava Masse, Alexandria Robertson, and Maasia Si-Asar to explore research topics related to color-changing coatings.



Physics & Astronomy in the 2018 Student Research Colloquium

AWARDS AT THE 2018 SRC

2018 SCSU SRC Best Poster Finalist AND **Alexis Corbett and Danielle Hall** Faculty Sponsor: Dr. John Sinko
2018 SCSU SRC Dimension of the Year Runner-Up "Variable Temperature Thermochromic Switching Under Varying Illumination"
2018 SCSU SRC Dimension of the Year Finalist **Matthew Thomas** Faculty Sponsor: Dr. John Sinko
 "Residual Gas Analysis of Electric Arc Ablatants from Polyoxymethylene Pulsed Plasma Thruster Propellant"



SCSU Student Research Colloquium, 4/11/2018

ORAL PRESENTATIONS

<u>Student</u>	<u>Faculty Sponsor(s)</u>	<u>Title of Project</u>
Tyler Baxter	John Sinko	"Laser-Induced Carbon-Doped Carbonate Propellant Thermal Decomposition For Use In Beamed Energy Propulsion"

POSTERS

<u>Student</u>	<u>Faculty Sponsor(s)</u>	<u>Title of Project</u>
William Blanzeisky, Eu Ee Chung, Michael Free, Nicholas Hiltner, and Sailesh Timilsena	Zengqiang Liu	"Quantum Random Number Generation and Applications"
Alexis Corbett and Danielle Hall	John Sinko	"Variable Temperature Thermochromic Switching Under Varying Illumination"
Christopher Crawford	Elisha Polomski, John Sinko	"Supernova Shock Waves Through a Nebula-Like Plasma"
Maichael Free	Zengqiang Liu	"Laser Safety and Control System"
Danielle Hall and Alexis Corbett	John Sinko	"Variable Temperature Thermochromic Switching Under Varying Illumination"
Sam Hartman	Kevin Haglin	"Dynamics of a Point Charge near a Grounded Conducting Sphere"
Elizabeth Rossman	John Sinko	"Laser Ablation of Aluminum Alloy Sheets and Determination of Byproducts by Mass Spectroscopy"
Alexander Sigstad	John Sinko	"Laser Propulsion Analysis and Crater Metrology"
Matthew Thomas	John Sinko	"Residual Gas Analysis of Electric Arc Ablatants from Polyoxymethylene Pulsed Plasma Thruster Propellant"

Physics & Astronomy Student Awards, Fa 2017-Sp 2018

St. Cloud State University – College of Science & Engineering – Dean's List

SCSU COSE Dean's List Fall 2017

William Julius
Tanner Maehren
Neil Nienaber
Meredith Rupp
Hyun Seo

SCSU COSE Dean's List Spring 2018

Michael Free
William Julius
Meredith Rupp
Hyun Seo

Physics & Astronomy Department Scholarships

2017-2018 Academic Year

Tyler Baxter
Jocelyn Christopherson
Chase Negen

Additional Student Highlights

- Physics majors **Tyler Baxter** and **Alexis Corbett** presented research posters at Posters in St. Paul in St. Paul, MN (photos below).
- Physics major **Tyler Baxter** presented at the Minnesota Undergraduate Scholars Conference at Rochester Technical & Community College in Rochester, MN, and was awarded Best Oral Presentation (photo at right).
- Physics major **Tyler Baxter** presented his work at the National Council on Undergraduate Research (NCUR) conference.
- Materials Science graduate student **Danielle Hall** (PSM Program in Materials Science) presented her work at the Spring meeting of the Materials Research Society in AZ.



Physics & Astronomy Student Research Awards, Fa 2017-Sp 2018

Physics & Astronomy competed strongly in the 2017-2018 SCSU Student Research Awards. Eleven proposals were awarded and accepted including 11 individual students (some with multiple awards) for a total of \$ 3628.89 awarded in Fall 2017, and \$ 5,172.34 awarded in Spring 2018. The award success rate (proposals awarded per submitted) was 86%, with all but one award accepted by the proposer. Physics student research awardees were mentored by three faculty in this academic year: Dr. Polomski, Dr. Liu, and Dr. Sinko. By participating, students gain valuable skills in persuasive writing, research planning, and research methods, and get experience using scientific equipment and applying classroom learning in a hands-on environment with a professional mentor.

Fall 2017 Student Research Awards

➤ Tyler Baxter	Faculty Sponsor: John Sinko	\$ 1000
“Microlens Ablation of Plastic Propellants for Beamed Energy Propulsion”		
➤ Christopher Crawford, Travis Mathwig	Faculty Sponsors: Elisha Polomski and John Sinko	\$ 860.91
“Supernova Shockwave Propagation through a Nebula like Plasma”		
➤ Danielle Hall, Alexis Corbett	Faculty Sponsor: John Sinko	\$ 999
“Variable Temperature Thermochromic Switching Under Varying Illumination”		
➤ Matthew Thomas	Faculty Sponsor: John Sinko	\$ 768.98
“Residual Gas Analysis for Electric Arc Ablation Plasma from Polyoxymethylene”		

Spring 2018 Student Research Awards

➤ Tyler Baxter	Faculty Sponsor: John Sinko	\$ 1000
“Lens Comparison Study for Laser Astronaut Retrieval”		
➤ Alexis Corbett and Danielle Hall	Faculty Sponsor: John Sinko	\$ 184.08
“Thermochromic Material Temperature and Durability Limits”		
➤ Michael Free	Faculty Sponsor: Zengqiang Liu	\$ 900
“Laser Safety Control, and Rail System”		
➤ Danielle Hall	Faculty Sponsor: John Sinko	\$ 493.60
“Measurement and Modeling of Temperature Rise in Thermochromic Coatings”		
➤ Nicholas Hiltner, William Blanzeisky, Michael Free	Faculty Sponsor: Zengqiang Liu	\$ 1000
“Quantum Random Number Generations and Applications”		
➤ Elizabeth Rossman	Faculty Sponsor: John Sinko	\$ 618.46
“Laser Ablation of Aluminum Alloy Sheets and Determination of Byproducts with Mass Spectrometry”		
➤ Alexander Sigstad	Faculty Sponsor: John Sinko	\$ 976.20
“Laser Propulsion Analysis & Crater Metrology”		

Student Research in Physics & Astronomy 2017-2018

Lens Arrays in Laser Propulsion

Student Tyler Baxter worked with Dr. Sinko to investigate whether a high-power laser could be applied to tractor beams to rescue astronauts and deorbit space debris.

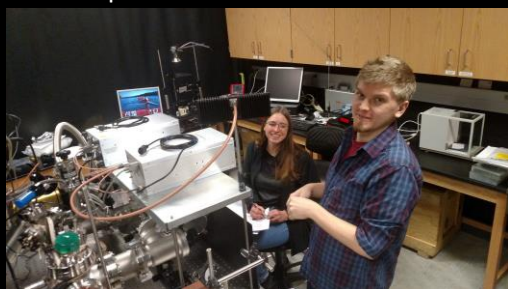


Interdisciplinary STEM Astronomy Research

Prof. Annette Lee works with the American Astronomical Society (AAS) bringing together cultural and scientific knowledge of the stars. If you are interested in learning more about the connections between modern and ancient astronomical ideas and techniques, contact Prof. Lee!

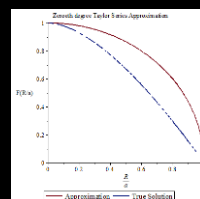
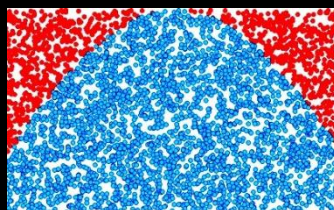
RF for Supernova Shock Waves

SCSU student Christopher Crawford worked with Dr. Polomski and Dr. Sinko on setting up laser experiments to simulate supernova shock waves in a stellar nebula.



Generating Random Numbers

True random numbers are difficult to generate for applications like encryption. SCSU student Nicholas Hiltner worked with Dr. Liu to improve on the random number generator seeded by radiation counts, using an Arduino Uno and Raspberry Pi 3+.



Radiation Physics and Medical Physics

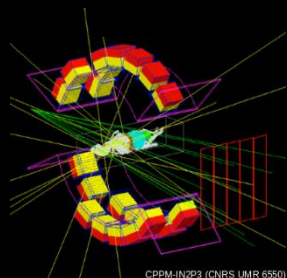
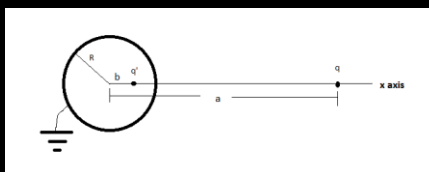


Image source:
<http://www.opengatecollaboration.org/>

Student research project topics in radiation physics have included: radiation-induced thermoluminescence, retrospective dosimetry, radiation measurements, and radiation transport calculations. Please contact Dr. Ratliff for more information if you are interested in doing research with him.

Theoretical Particle Physics

Physics student Sam Hartman worked with Dr. Haglin to study a point charge near a grounded spherical superconductor. If you are interested in theoretical physics research or in learning more about particles, contact Dr. Haglin!



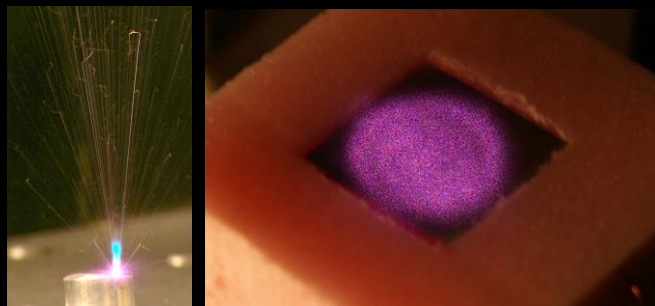
$$v = \frac{dx}{dt} = -c \sqrt{1 + \frac{8\pi\epsilon_0 mc^2 (a^2 - R^2)}{q^2 R} \left(\frac{x^2 - R^2}{a^2 - x^2} \right)^2}$$



Student Research in Physics & Astronomy 2017-2018 (2/2)

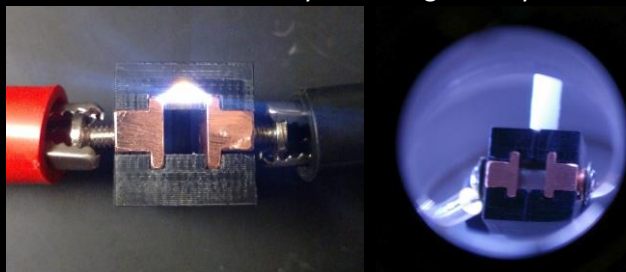
Space Debris Elimination

Space debris accumulation in orbit threatens our continued use of satellites. Students Chase Negen and Beth Rossman studied laser ablation of aluminum.



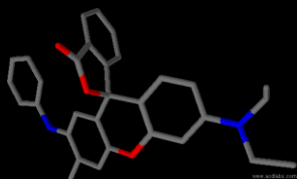
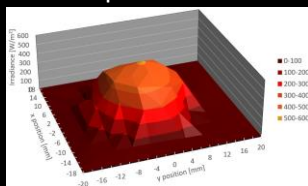
Pulsed Plasma Thruster Development

Physics student Matthew Thomas worked on development of a pulsed plasma thruster. Chemical ablatants were studied by residual gas analysis.



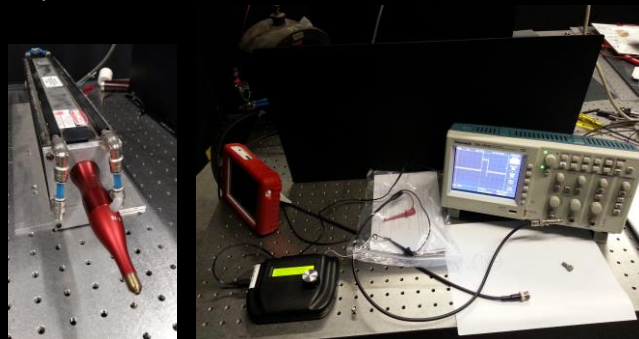
Analyzing Color Changing Solar Materials

SCSU graduate student Danielle Hall, + undergraduate students Donovan Bassett, Alexis Corbett, and Binit Sthapit worked with Dr. Sinko to characterize temperature rise in color-changing materials under simulated sunlight. Dr. Sinko is looking for a chemistry major to research leuco dye synthesis and microencapsulation.



Laser CNC Construction & Control

Physics major Michael Free worked with Dr. Liu to complete a controller for a donated CO₂ laser.



Ask a professor how to join a research project!

Physics & Astronomy Faculty 2017-2018

Dr. Kevin Haglin

Professor, Physics
Department Chair



Theoretical Physics

Dr. Sneha Kalia

Professor, Physics



Physics

Prof. Annette Lee

Associate Professor, Astronomy
SCSU Planetarium Director



Astronomy

Dr. Zengqiang (John) Liu

Associate Professor, Physics



Experimental Physics

Dr. Christofer Nelson

Assistant Professor, Physics



Structural Glass, Theoretical Materials

Dr. Elisha Polomski

Assistant Professor, Physics
WE-STEM Coordinator



Astrophysics, Women Engaged in STEM

Dr. Steven Ratliff

Professor, Physics
Director of Rad Tech, Nuc Med Tech Programs



Medical Physics, Radiation Transport

Dr. John Sinko

Assistant Professor, Physics
SCSU Laser Safety Officer



Experimental Physics, Optics, Materials

Dr. Todd Vaccaro

Adjunct Professor, Physics



Astrophysics, Astronomy

Physics & Astronomy Faculty and Staff News 2017-2018

Dr. Sneh Kalia will be on sabbatical for the Spring 2018 term.

In Spring 2018, Dr. Chris Kvaal assumed the role of Building Coordinator for Wick Science Building, taking over the position vacated by Dr Kurt Helgeson.

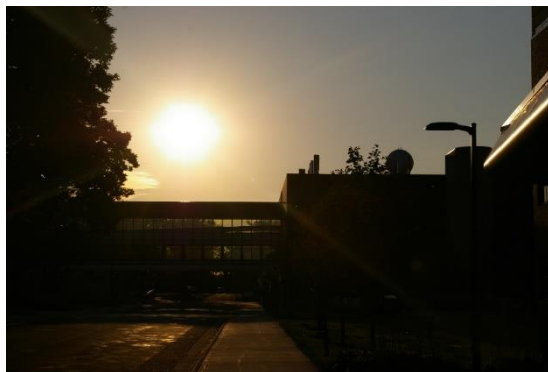
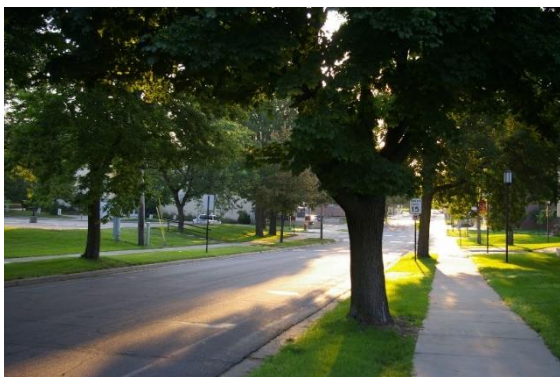
Dr. Chris Nelson's position with the department was renewed for another year. Dr. Nelson, a theoretical physicist and topical expert on applied quantum mechanics and glass models, continues to teach courses across the curriculum including support for the Professional Science Masters program in Materials & Instrumentation. Dr. Nelson is also actively involved in materials science research with both external and internal collaborators.

Dr. Elisha Polomski has accepted a tenure-track position with the College of San Mateo in San Mateo, California, beginning in Fall 2018. Dr. Polomski completed four years at SCSU from Fall 2014-Spring 2018, and throughout her time at SCSU, demonstrated an excellent record of teaching and student engagement. We wish her well on her new academic journey!

Dr. Todd Vaccaro will be assisting the department by teaching in the role of Adjunct Professor during the 2017-2018 academic year.

Dr. Kah-Wah Wong will join the department as Fixed-Term Non-Probationary faculty beginning in Fall 2018. Dr. Wong is an expert in x-ray astronomy and astrophysics. The most rewarding teaching experience he has is when many students said "thank you" in person after classes and have expressed how interesting and excited they got when they listened to his lectures. He particularly remembers meeting some students in grocery stores and gas stations, who expressed how much they learned during his class.

Kari Kinney will serve in Fall 2018 as interim Department OAS following Ann Hudson's retirement.



Faculty Scholarly Achievements

Papers

- **S. T. Ratliff** and K. Barry, "Characterization of Ivoclar Vivadent Dental Restoration Material for ^{137}Cs Retrospective Radiation Dosimetry," *Health Physics*, Vol. 115, No. 2, pp. 212-220 (August 2018).
- **A. S. Lee**, "Celestial Calendar-Paintings and Culture-Based Digital Storytelling: Cross-Cultural, Interdisciplinary, STEM/STEAM Resources for Authentic Astronomy Education Engagement", *EPJ Conference Proceedings in Physics and Astronomy*, International Symposium on Education in Astronomy and Astrobiology" (ISE2A-IAU), Utrecht, Netherlands (2018)
- **A. S. Lee**, "The Cosmos as Viewed Through the Lens of a Native-American Astronomer-Artist, pg. 203-220, *Imagining Other Worlds*", edited by N. Campion and C. Impey, *Inspiration of Astronomical Phenomena (INSAP) IX*, Gresham College, London, Sophia Centre Press (2018)
- **C. B. Nelson**, "On the co-operative formation of frustration fields and ground states in As_2Se_3 glass," *Journal of Non-Crystalline Solids*, Vol. 481, pp. 627-633 (2018).
- **C. B. Nelson**, T. Zubkov, J. D. Adair, and M. Subir, "A synergistic combination of local tight binding theory and second harmonic generation elucidating surface properties of ZnO nanoparticles," *Physical Chemistry Chemical Physics* (Oct. 27, 2017).

Professional Presentations

- 9/2017 **Annette Lee** "Interdisciplinary, Intercultural, Community-Based Education Practices at the Intersection of Art-Science-Culture": INSAP-OXFORD-SEAC, Spain
- 11/2017 **Kevin Haglin** "Teachable Surprises in Classical Physics", Minnesota Conference for Science Educators, River's Edge Convention Center, St. Cloud, MN
- 1/2018 **Kevin Haglin** "Quantum Mechanics Lessons from ", American Association of Physics Teacher's Winter Meeting 2018, San Diego, CA (student co-authors Benjamin Boe, Joseph Harter, Sutapa Biswas)
- 4/2018 **Annette Lee** Invited Colloquium Speaker, University of Toronto, Department of Astronomy

Awards

- 2018-2019 **Annette Lee** Distinguished Lecture, Archaeological Institute of America (IAI), Webster Lecturer

Faculty Grant Proposals

Submitted (Not Awarded)

8/2017 Kannan Sivaprakasam (PI), **John Sinko (Co-PI)**, and Christina Cama (Co-PI)
NSF Site REU \$350,000
"REU Site: Research, Education and Workforce Preparation in Nanomaterials"

Awarded

10/2017 John Sinko (PI)
SCSU Proposal Enhancement Grant \$5,200
"Heating Analysis and Crater Metrology for Laser Ablation"

11/2017 John Sinko (PI)
Industrial Donation (Negotiated Contract, In-Kind) \$100,000
"Femtosecond Lasers Supporting Academic Experiences"

2018 Annette Lee (PI)
American Astronomical Society (AAS) Education and Professional Development Grant
"Skywatchers: Bringing Together Cultural and Scientific Knowledge of the Stars"

1/2018 John Sinko (PI), Adel Ali (co-PI), Kannan Sivaprakasam (co-PI), Russ Lidberg (co-PI), & Matthew Julius (co-PI) \$263,825
MnSCU Leveraged Equipment + \$29,995
"Equipment for the Expansion and Enhancement of Materials Characterization"
(Profilometer, EDS and backscatter upgrades for SEM, Smart Classroom for COSE, and annealing furnaces)

2/2018 Kannan Sivaprakasam (PI), **John Sinko (co-PI)**, and Plamen Miltenoff (co-PI)
Minnesota State Multi-Campus Collaborations Grant \$65,295
"Multi-campus Partnership to Advance Sustainability in Chemistry Education, Research and Workforce Development"

5/2018 John Sinko (PI)
SCSU Early Career Award \$8,000
"Removal of Aluminum Space Debris by Laser Vaporization"

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OUR STUDENTS NEED YOUR SUPPORT!

Supporting students is our number one goal.

We owe it to them to provide the resources necessary to continue to be at the forefront of applied research in the state and region.

The costs of providing real-world experiential opportunities continue to rise.

With your generosity and support we will recruit and retain students with scholarship assistance, we will engage them in enhanced experiences using the most up-to-date technology and instrumentation, and we will assist them in building and presenting research through student professional development funds.

Please consider helping our students with your gift today!



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THANK YOU FOR YOUR SUPPORT!