



Mission: Provide a stimulating, intellectual environment for the discovery, integration, application, and communication of physics.

Inside this issue:

Introduction	1
Physics and Astronomy Club	2
Student Recognitions	3
Meet your Faculty	4-6
Faculty Research	7
Call for Support	8

Welcome from the Chair

We are delighted to have an opportunity to share some recent developments within the physics programs at St. Cloud State University. We have been approved to become a new academic unit entitled **The Department of Physics and Astronomy** starting fall semester 2014. The new department name communicates and focuses our renewed commitment to provide outstanding preparation for students to enter the scientific workforce with a physics skill set or move on from SCSU into advanced academic preparation in graduate school. The faculty, staff and students within the new academic unit are thrilled with the confidence in us that the administration has communicated through this approval and we will strive to continue the long tradition of offering exceptional classroom and research experiences to SCSU students. *(continued on next page)*



Wick Science Building's 3rd floor is the home of the Department of Physics and Astronomy. We also have facilities to support classes and research in electronics, optics and nuclear sciences in Brown Hall and ISELF.



ISELF, the Integrated Science and Engineering Laboratory Facility is a new, 100,000 ft² structure for science and engineering. It encompasses several rooms for physics use, including nuclear and optics teaching and research facilities, as well as general facilities for meetings and tutoring. ISELF is intended to encourage collaborations with industry and opportunities for students to engage with technology and applied research.

More information can be found at: <http://www.stcloudstate.edu/iself/>





Welcome from the Chair *(continued from page 1)*

The physics faculty has received a new tenure-track faculty member with the hiring of Dr. John Sinko. John has a PhD from University of Alabama, Huntsville and has previous university teaching experiences at OSU Newark and St. Cloud State University. Dr. Sinko's experiences position him very well to be a strong contributor to the optics curriculum at SCSU as well as a leader in optics research for our students and for industrial partners in the region.

We have hired Dr. Elisha Polomski on a fixed-term basis this year to help us out by teaching several introductory courses within the department. Elisha has a PhD from University of Florida at Gainesville with post-doctoral research experience at the University of Minnesota and several years of teaching experience within the University of Wisconsin system. We are pleased to have Dr. Polomski on board this year to help with teaching, research, and outreach.

Dr. Gary Bohannon has also been hired into a fixed-term appointment for 2014-2015. Gary's PhD is from Montana State University—Bozeman. Gary has had a wealth of experience in the US Navy, work in the electronics industry as well as teaching experience at St. Cloud State University. Gary's research efforts are in condensed matter physics with applications in electronics (materials) characterization and device physics. Dr. Bohannon has previously worked with mathematics and physics students at SCSU and continues to inspire research as part of the basic learning process.

We also welcome back fixed-term faculty member Dr. Todd Vaccaro to teach various astronomy courses (while Maria Womack is on a professional reassignment to serve as a program manager at the National Science Foundation in Arlington, VA). Todd's PhD is from University of Florida and he has teaching experience at Francis Marion University and St. Cloud State University. Todd's research efforts involve observational astronomy and have included collaborators at other institutions as well as SCSU undergraduate students.

Russell Lidberg is back in the department as the Director of the Imaging Center and Clean Room in ISELF. Russ also serves as a liaison between SCSU and regional industry and provides a communication portal and support role in the NanoVox endeavors to develop and provide support for academic institutions, as well as regional industrial entities, to share information, share resources when appropriate and come together when common interests seek efficient solutions to problems in materials science and nano-technology.

The permanent faculty in the Department of Physics and Astronomy are eager get back to work for fall semester, to teach a full complement of physics and astronomy courses, and especially to engage with students in research projects. In terms of scholarship and research activities, we are particularly pleased to mention Annette Lee's scholarly project Native Skywatchers which involves collecting and archiving Native sky knowledge and developing eventual curriculum modules appropriate for K-12, for university courses and seminars, and for public outreach. John Harlander's team of collaborators continues to design and test ground-based optics equipment for sensitive measurements of outer-atmospheric composition and dynamics. John's work involves scientists at other academic research institutions, senior scientists at national research laboratories, as well as a few very fortunate St. Cloud State University undergraduate students. John Liu is making progress with his open-source physics laboratory concept and recently offered a workshop for interested participants at the American Association of Physics Teachers' Meeting in Minneapolis, MN, in June 2014.

We look forward to another stimulating year with Astronomy public nights in the fall and spring semesters, Science Rocks in the winter, as well as participation in the STEM Summit, Horizons Conference encouraging young women in science and active participation in the Central Minnesota Regional Science Fair. Faculty also participate in various clubs and organizations on campus (e.g. India Heritage Club, Physics and Astronomy Club) and are eager to support activity devoted to enrichment for students and faculty alike.

If you would like further information about academic opportunities, research opportunities and activities, or outreach activities, please contact the (Physics and Astronomy) Department Office at 320-208-2011.

Let's have a rewarding school year full of enthusiasm, hard work, and especially full of impressive accomplishments!

Best wishes to All,

Kevin

K. Haglin, Professor and Chairperson, Department of Physics and Astronomy, SCSU

The Physics and Astronomy Club

Old Officers (2013-2014)

President	Jennifer Neu
Vice President	Anthony Kunkel
Secretary	Brenda Knauber
Treasurer	Travis Hislop

New Officers (2014-2015)

President	Anthony Kunkel
Vice President	Alexis Corbett
Secretary	Brenda Knauber
Treasurer	Rita Schwieters
Advertising	Travis Hislop

Advisors

Dr. John Sinko and Dr. Zenqiang (John) Liu

Members

Sutapa Biswas, Alexis Corbett, Joseph Harter, Travis Hislop, Brenda Knauber, Anthony Kunkel, Jennifer Neu, Rita Schwieters, Joseph Sperling, Anthony Walz, and Jeff Witthuhn

Activities (2013-2014)

10/10-11/2013	Field trip to Soudan Mine and MINOS neutrino detector (Corbett, Harter, Hislop, Knauber, Kunkel, Neu, Schwieters, Sperling, Witthuhn, Dr. Bohannon, Dr. Sinko)
12/17/2013	Cookie decorating and science games at Dr. Sinko's house (Prof. Lee, Prof. Sinko)
1/30/2014	STEM Summit (Brinkman, Hislop, Knauber, Kunkel, Neu, Walz, Dr. Liu, Dr. Sinko)
2/22/2014	Science & Engineering Fair (Biswas, Harter, Kunkel, Neu, Schwieters, Witthuhn, Dr. Sinko)
3/22/2014	Horizons Conference (Corbett, Hislop, Kunkel, Neu, Schwieters, Witthuhn, Dr. Sinko)
4/2/2014	Student Awards Banquet "Most Outstanding Student Organization" (Corbett, Hislop, Knauber, Neu, Dr. Sinko)



Contact

Would you like to join the Physics and Astronomy Club? Contact the club on Facebook, use the club email phy_astr@stcloudstate.edu, or contact Anthony Kunkel, the current President: kuan0902@stcloudstate.edu. The Physics and Astronomy Club meets on the 3rd floor of Wick Science Building Thursdays at 4 pm.

Student Recognitions

Dean's List, Fall 2013

Nicholas Lewellyn, Justin Ruud

Dean's List, Spring 2014

Alex Griswold, Nicholas Lewellyn

Student Research Activities for Credit during the 2013-2014 Academic Year

Tyler Baxter	Spring 2014	Prof. Sinko	Photon Propulsion for Interplanetary Travel
Intana Chanthirath	Spring 2014	Prof. Haglin	Modelling Diatom Properties
Mitch Gagne	Fall 2013	Prof. Ratliff	Radiation Measurements
Alex Griswold	Fall 2013	Prof. Haglin	Topics in Nuclear Radiation
Joseph Harter	Fall 2013	Prof. Lidberg	Surface Mobility Measurements of Organic Semiconductor Crystals
Joseph Harter	Spring 2014	Prof. Lidberg	Lateral Field Studies of Organic Semi-Conductor Crystals
Travis Hislop	Summer 2014	Prof. Sinko	Nontoxic Ammonium Iron Citrate Holography
Travis Ingvarsson	Fall 2013	Prof. Vaccaro	CCD Imaging and Stellar Photometry
Anthony Kunkel	Fall 2013	Prof. Haglin	Topics in Nuclear Radiation
Frank Leo	Fall 2013	Prof. Vaccaro	CCD Imaging and Stellar Photometry
Casey Rowe	Spring 2014	Prof. Lidberg	Optical Instrumentation and Analysis of Semiconductor Materials
Justin Ruud	Spring 2014	Prof. Ratliff	Radiation Transport Calculations
Brian Sapp	Fall 2013	Prof. Vaccaro	CCD Imaging and Stellar Photometry
Daniel Sapp	Spring 2014	Prof. Haglin	Gravitational Effects of Compact Objects

Students are strongly encouraged to get engaged in an applied research activity.

Summer 2014 REUs

Brenda Knauber University of Minnesota – Twin Cities Nanophysics

Graduates 2013-2014

James Brinkman
Mitch Gagne
Nicholas Newellyn
Jennifer Neu
Joel Nowitzke
Joseph Palmerston
Casey Rowe
Justin Ruud
Daniel Sapp
Frank Scherer

NEW PHYSICS & ASTRONOMY SCHOLARSHIPS

The Department of Physics & Astronomy is developing a competitive, \$ 1000.00 per year student scholarship. The scholarship could be renewed up to 4 years with maintenance of a 2.5 GPA and sufficient progress towards completing a physics major. If you are seeking a physics major, you may be eligible! Please direct inquiries about this opportunity to Prof. Kevin Haglin.

Tenured Faculty (2013-2015)

Prof. and Chair, Kevin Haglin



Prof. and Chair Kevin Haglin earned his B.A. from Hamline University in 1985 and his Ph.D. from the University of Minnesota-Twin Cities in 1990. Recent research projects include calculating the thermal conductivity of subatomic (nuclear) fluid, estimating electromagnetic energy from subatomic furnaces and exploring Virial-theorem features in spiral galaxies. He enjoys supporting his daughters academically and sometimes gets fanatical about their competitive dance activities.

Prof. John Harlander



Prof. has been awarded a grant for research and development of the Michelson Interferometer for Global High-resolution Thermospheric Imaging (MIGHTI). Prof. Harlander is emphasizing student involvement in the project, including active research with a prototype instrument. MIGHTI will be part of an Explorer satellite mission to be launched by NASA in 2017. Prof. Harlander is on reassignment and is dividing his time between teaching and research.

SCSU News Release, Monday, Apr. 15, 2013, <http://www.stcloudstate.edu/news/newsrelease/default.asp?pubID=3&issueID=34410&storyID=40568&slimageID=15174>

Prof. Sneha Kalia



Prof. Sneha Kalia earned her B.S. and M.S. degrees from Delhi University and her Ph.D. from Lucknow University. She teaches all courses from the 100 to 400 level. This year, she attended the American Association of Physics Teachers summer meeting in Portland, Oregon in July 2013 including events on use of tablets in classroom and on measuring learning in astronomy classrooms. She has been the advisor to the India Heritage Club for 20 years.

Prof. Annette Lee



Prof. Annette Lee earned a B.S. from the University of California-Berkeley, a B.A. from the University of Illinois-Urbana, an M.S. in astrophysics from Washington University in St. Louis, and a M.F.A. in painting from Yale. Her physics outreach includes STEM programs focused on serving women and Native American populations. Activities include planetarium shows, SCSU Public Nights, Native Skywatchers research and middle school workshops, Chemistry and Physics Teachers' Night, Girls Best, Teen/Community Star Party, NASA Sci 4 Girls, ENGAGE, EMARE, the Pipeline summer science camp, astronomy presentations at Oglala Lakota College, and more. Her work will be featured in the Astronomy and Arts show at the Duluth Art Institute. In promoting SCSU physics & astronomy, she authored news articles in the *St. Cloud Times* and in *Central Minnesota Woman*. Her research is supported by SCSU, NASA, the Bush Foundation, Minnesota Space Grant, NSF Northstar STEM Alliance, Minnesota Womens' Foundation, and Fon du Lac Tribal and Community College.

Prof. John Liu



Prof. John Liu earned his B.S. from Nankai University and his Ph.D. from the University of Minnesota. As an experimental physicist, he works on structures and phase transitions in liquid crystals and conducts collaborative research with UMN and Brookhaven National Laboratory, NY. His expertise is in electronics and computer programming as it relates to experimental physics. He is developing an open source physics laboratory platform to display and log sensors wirelessly for introductory labs. It earned 1st place at the 2013 American Association of Physics Teachers Apparatus Competition and also won twice under low cost category.

Prof. Steve Ratliff



Professor Ratliff earned his BS, MS, and Ph.D. degrees in Physics from the University of California, Los Angeles (UCLA). He also completed a medical physics residency at the Mayo Clinic in Rochester, Minnesota. His current research interests include ionizing radiation, radiation detectors, radiation-induced thermo-luminescence, and physics education research. He directs the Nuclear Medicine Technology and Radiologic Technology programs here at SCSU. He is planning to teach a special topics course in Spring 2015: Physics 452 (Introduction to Radiation Protection). The course is open to all interested students who have successfully completed either Physics 234 and 235 or Physics 231 and 232. According to current plans, this course would be equivalent to a required course for the Nuclear Engineering minor that we are developing (Physics 462, Introduction to Radiation Protection).

Prof. Maria Womack

Professor Womack earned her B.S. in physics from Florida State University and Ph.D. in physics from Arizona State University. She has taught a wide variety of astronomy and physics courses, and is the SCSU Observatory Director. Her research specialty is observing comets and exoplanets in order to better understand how planets form and the habitable conditions for life. She's worked with over 60 undergraduate students in research, and was funded by NASA and the National Science Foundation (NSF), including the NSF CAREER scholar teacher award. Currently, she is on assignment to the NSF Division of Astronomical Sciences, near Washington, DC as the lead program director for the Planetary Astronomy and Stellar Astronomy grant programs.

Fixed Term Faculty (2013-2015)**Prof. Gary Bohannon**

Prof. Gary Bohannon earned his B.S. in Physics at Washington State University-Pullman, his M.S. at the Naval Post Graduate School in Monterey, CA, and his Ph.D. in Physics at Montana State University-Bozeman. His passion is application of the calculus of arbitrary order (known as the fractional calculus) to model dynamical properties of materials. His immediate focus is in developing electronic devices he calls "fractors". He has organized a research group of Physics, Chemistry, and Mathematics students to work together to tackle 300 year old questions in mathematics while potentially creating highly stable, robust control systems.

Prof. Russ Lidberg

Prof. Russ Lidberg earned his B.S. in Chemistry from University of Nebraska-Omaha, a B.S. in Electrical Engineering from University of Wisconsin-Platteville, a M.S. in Chemistry from University of Nevada-Las Vegas, and is completing his Ph.D. in Chemical Physics at the University of Minnesota-Twin Cities. He manages the Center for Microscopic Imaging and Analysis which houses AFM, SEM and XRD instrumentation. Russ is one of the core developers at SCSU working on developing specialties in material science and nano-materials. Russ has spent over 30 years in academic and industrial fields of science and engineering, including positions at Lockheed and the U.S. Army Corps of Engineers. His research efforts are centered on the optical and electrical properties of materials focusing on organic semiconductor materials.

Prof. Elisha Polomski (2014-2015)

Elisha is from an ancient (350 yr old) picturesque fishing village in the northeast. After obtaining her PhD in astronomy from the University of Florida, she fled giant flying cockroaches, banana spiders, and daily severe thunderstorms for the relatively tranquil weather and friendly inhabitants of Minnesota. She spent 7 years at UMN helping to guide the Spitzer Space Telescope to its targets and studying infrared emission from all sorts of objects. After her postdoc at Minnesota ended, Elisha became a professor at the University of Wisconsin where she became acquainted with a wide variety of cheeses and learned the lore of the fabled tennis team the Green Bay Packers. Elisha is very happy to return to Minnesota and is excited to be at St Cloud State!

Prof. John Sinko (2013-2014; Tenure-track 2014-2015)

Prof. John Sinko earned his B.S. in Mathematics and Chemistry at Furman University, and M.S. and Ph.D. in Physics at the University of Alabama in Huntsville with a specialty in plasma physics. He previously worked as a Visiting Professor at Ohio State University-Newark, as a Researcher at The Global Center of Excellence in Micro-Nano Mechatronics in Nagoya, Japan, and as an Optical Engineer for Kratos Defense & Security Solutions performing R&D at MSFC/Redstone Arsenal in Huntsville, AL. His hobbies include playing the violin, winemaking and western martial arts. Prof. Sinko researches laser ablation, laser propulsion, tractor beams, optical sensors, and holography.

**Prof. Todd Vaccaro**

Prof. Vaccaro comes to SCSU from Florence, SC where he was an Asst. Prof of Physics at Francis Marion University. Prior to that he held postdocs at LSU, UF, and FL Tech – all dealing with astronomical research involving stellar photometry and spectroscopy. His main field of research is eclipsing binary stars, and one of his projects involves the observation and analysis of red dwarf binaries. Prof. Vaccaro also serves as a consultant on a NASA project dealing with Kepler satellite data. He frequently observes at Kitt Peak National Observatory using the large 4m telescope, including in May 2013. He holds a B.S. in Physics/Astronomy from Vanderbilt University, an M.S. in Astronomy from San Diego State University, and a Ph.D. in Astronomy from the University of Florida.

Adjunct Faculty (2013-2015)

Prof. Cliff Grosberg (2013-2014)

Prof. Grosberg earned his B.S. at University of Wisconsin – River Falls and M.S. from St. Mary's University. He has 42 years of physics education experience, and previously taught in the SCSU chemistry department as well as at Apollo HS in St. Cloud and Montgomery–Lonsdale HS in New Prague. He is a big game archery and rifle instructor for the DNR. He lives in Sauk Rapids, and loves hunting, fishing, and riding his motorcycle.

Prof. Dave Williams

Prof. Dave Williams earned his B.S. at the University of Minnesota, and his M.S. at the University of North Dakota. He recently organized a local group of St. Cloud observers to start the Astronomy Club of Central Minnesota. Assistant professors Gary Bohannon and Todd Vaccaro are participating, and Assistant Professor Annette Lee is collaborating with the group. Prof. Williams is also writing a monthly column on Astronomy that is published in the St. Cloud Times. (Photo courtesy of St. Cloud Times)

Staff (2013-2015)

Kim Gregory (Summer 2014)

Kim Gregory joined the Physics & Astronomy Department during part of Summer 2014 during Ann Hudson's absence.

Ann Hudson

Ann Hudson is the Office Manager for the physics unit. She earned her B.E.S. degree in elective studies from SCSU, specializing in college counseling and student development. She was formerly an HR director in the healthcare industry. She is married to SCSU professor of finance Bill Hudson, has two children (Peter and Emily), and loves traveling and watching her kids play hockey.

Steve Zinsli

A graduate of SCSU with a B.S. in physics, Steve Zinsli is the ever-present backbone of the physics department's lab activities. He manages the lab supply room, and handles setup and takedown of student laboratories for the introductory classes. He works part-time in Physics and part-time as a technician in the Electrical Engineering Department. He is the local armchair expert on all matters involving the Mississippi River, and is an experienced canoeer.

STEM Service Opportunities

The Physics & Astronomy Department is active in promoting and supporting STEM (science, technology, engineering and math) service activities. Below is a brief glimpse of activities conducted in the 2013-14 year. Get involved!

Chemistry and Physics Teachers' Night

The Chemistry Department and Physics & Astronomy Department host a Teachers' Night in the Fall, where local high school and college teachers meet in the evening to share stories, discuss interesting science demonstrations and activities, and talk about the latest teaching and learning methods.

Horizons

The Horizons Conference is an activity day geared towards leading middle school girls to become scientists. A gender gap persists in most science fields, including physics. Some theories point to girls being turned off to STEM early in their lives. Horizons attempts to recruit some of those by giving them an engaged experience on campus, with exposure to female scientist student and professor mentors.



Student participation is vital if we are going to give our young colleagues relevant role models.

Science Rocks

Science Rocks is an activity day where students from local elementary and middle schools come to SCSU to engage in several interactive laboratory experiences throughout the day. Our past involvement included pendulums, electronics, and even lasers. We may note that physics activities (lasers and pendulum worm) have dominated the front cover of their magazine for 2 years. Student assistants are needed each year in the laboratory activities to make things run smoothly.

Regional Science and Engineering Fair

The Science and Engineering Fair is a chance for middle and high school students from various towns near St. Cloud to present and get feedback on science projects. SCSU students often help out as judges and choose which projects and students best succeeded.



Senior to Sophomore Program

Many of the SCSU Physics and Astronomy professors participate in Senior to Sophomore ('S2S') programs, which allow high school students to earn college credit at SCSU while taking an advanced class in high school. Professors work closely with high school teachers to deliver engaging, college level content to students.

STEM Summit

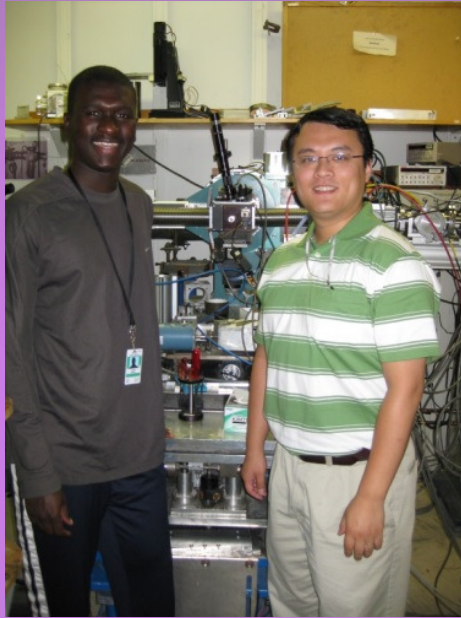
The STEM Summit is a kind of free-for-all carnival of science. In 2013-14, the Physics and Astronomy Club mostly ran the department's table with Dr. Liu and Dr. Sinko, demonstrating physics magic tricks, the interactive 'torque chair', and a pendulum worm.



Physics Research Opportunities

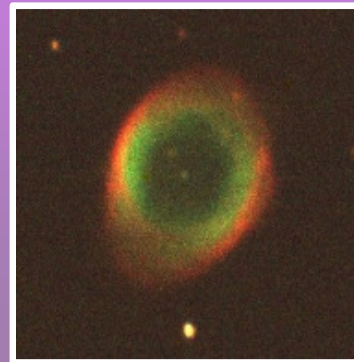
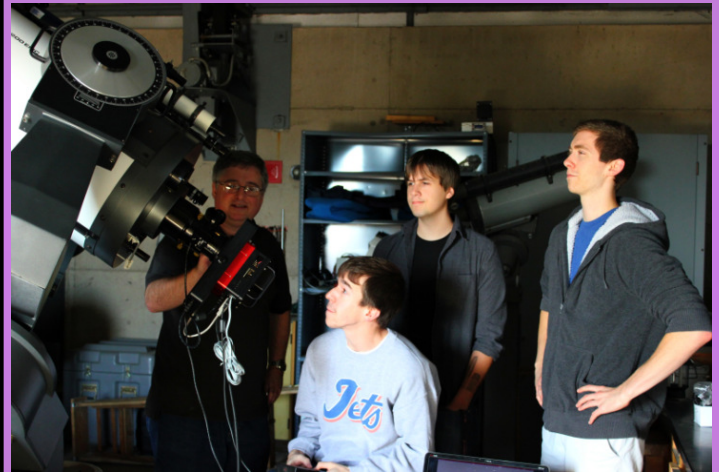
Dr. Liu Electronics

Dr. Liu studies condensed matter physics, specifically x-ray and laser probes of liquid crystals, as well as award-winning open-source laboratory apparatus for physics.



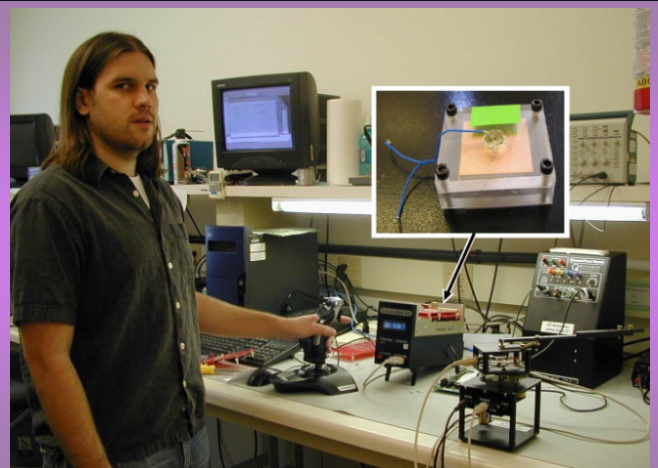
Dr. Vaccaro Astronomy and Astrophysics

Dr. Vaccaro's main field of research is eclipsing binary stars. In addition, he is involved with the 'Radio Jove' project, which uses portable, ground-based antennas to intercept radio frequency electromagnetic waves from Jupiter. Dr. Vaccaro is currently also involved with new telescopes on campus for observing astrophysical objects. Brian Sapp, Frank Leo, and Travis Ingvarsson (below, right, respectively) worked with Dr. Vaccaro in 2013-14 to assemble the colorful image below of the ring nebula, using a composite of three RGB filter images.



Dr. Bohannan Fractional Calculus, Electronics

Dr. Bohannan studies 'anomalous' fractional order kinetics in solids (described by power laws rather than exponentials). The experimental research goal is creating materials with both conduction and charge storage properties; *i.e.*, with 'pure' power-law impedance spectra. Such materials exhibit a memory effect useful in signal processing and control system applications. Theoretical research involves the mathematics of fractional calculus and development of efficient computational techniques to analyze fractional kinetics.

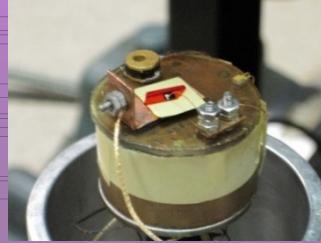
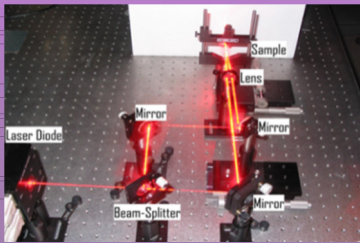
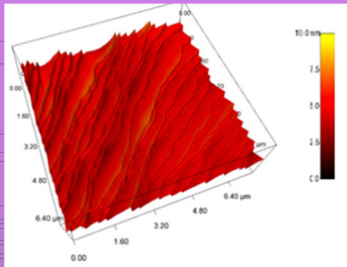




Physics Research Opportunities

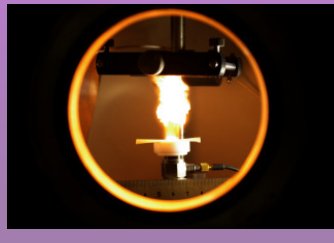
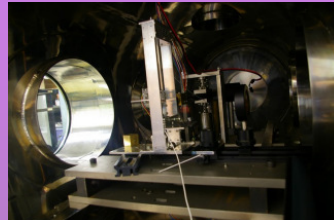
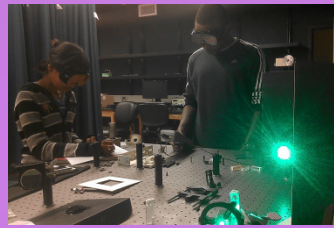
Russ Lidberg Spectroscopy, Molecular Electronic and Optical Materials and Devices

Russ Lidberg's research interests focus on understanding the optical and electrical properties of organic semiconductor materials. The relationship between the molecular structure, solid-state molecular packing and the effect on charge carrier transport and energy transfer is fundamental in the design of electronic and electro optic devices such as organic solar cells, light emitting diodes, transistors and sensors. Laser based spectroscopic and electrical techniques are employed in the study of single crystals, thin films and material interfaces. Surface structure and reactivity can play a major role in device performance. Atomic force microscopy (AFM) is used to study the surface. Projects combine physics, chemistry, materials science and electrical engineering to provide students with a real world interdisciplinary research environment.



Dr. Sinko Lasers, Optics and Sensors

Dr. Sinko studies optics and plasma physics, with interests in renewable energy, sensors, and aerospace applications. Current opportunities for student research include developing a prototype high power pulsed laser tractor beam to retrieve incapacitated astronauts, exploring new types of solar sails, creating patentable laser-based sensors for aerospace and safety applications, multidisciplinary research in renewable energy, and holography with iron ammonium citrate (recording 3D information into a 2D film). Contact Dr. Sinko to get involved!



Dr. Ratliff Medical/Radiation Physics

Past SCSU student research projects have included projects in radiation-induced thermo-luminescence, retrospective dosimetry, radiation measurements, and radiation transport calculations. Please contact Dr. Ratliff for more information if you are interested in doing research with him.



Radiation-Induced Thermoluminescence Dosimetry

Bryce Gustafson, Sponsor Dr. Steven T. Ratliff
Department of Physics, Astronomy, and Engineering Science, St. Cloud State University

<h4>Thermoluminescence</h4> <p>The thermoluminescence (TL) is a luminescence phenomenon. All forms of ionizing radiation (alpha, beta, gamma, x-rays, neutrons, and heavy ions) will induce TL in certain materials. The TL signal is a function of the dose of radiation to which the material is exposed. The TL signal is a function of the dose of radiation to which the material is exposed. The TL signal is a function of the dose of radiation to which the material is exposed.</p>	<h4>Abstract</h4> <p>Radiation induced thermoluminescence is a process in which energy from radiation is stored in a material and then released as light or luminescence. The amount of light given off is proportional to the radiation dose to which the material is exposed. This process can be used to measure the amount of ionizing radiation to which a material is exposed. In a dosimeter, a known amount of ionizing radiation is used to create a known amount of TL signal. The amount of TL signal is then measured and compared to the known amount of TL signal to determine the amount of radiation to which the material is exposed.</p>	<h4>Results</h4> <p>In this experiment, the TL signal was measured for a range of radiation doses. The TL signal was found to be proportional to the radiation dose. The TL signal was found to be proportional to the radiation dose. The TL signal was found to be proportional to the radiation dose.</p>
<h4>Equipment</h4> <p>The equipment used in this experiment includes a radiation source, a TL detector, and a TL reader. The radiation source is a ⁶⁰Co source. The TL detector is a LiF detector. The TL reader is a TL reader.</p>	<h4>Future Research</h4> <p>Future research includes the development of a TL detector for use in a dosimeter. The development of a TL detector for use in a dosimeter is a goal of this research.</p>	<h4>References</h4> <p>1. J. C. Van den Brink, <i>Thermoluminescence Dosimetry</i>, Wiley, 1998. 2. J. C. Van den Brink, <i>Thermoluminescence Dosimetry</i>, Wiley, 1998.</p>



We Welcome Assistance!

Supporting students is our number one goal and we owe it to them to provide the resources necessary if we want to continue to be at the forefront of applied research in the state and region. The cost of providing these real world opportunities continues to rise. With your generosity and support we will be able to recruit and retain our students with scholarship assistance, we will give them enhanced experiences on the most up-to-date technology and instrumentation and we will be able to assist them in guiding and presenting their research through student professional development funds. Please consider helping our students with your gift today!

Name _____

Address _____

City _____ State _____ Zip _____

Email address _____

_____ I would like to support the Physics General Fund

Please make check out to St. Cloud State Foundation (or Department of Physics & Astronomy if you prefer)
720 4th Ave. South
St. Cloud, MN 56301-4498

THE STUDENTS OF THE CHEMISTRY AND PHYSICS DEPARTMENT THANK YOU FOR YOUR SUPPORT!