

Oregon State University Department of Physics
SENIOR THESIS PRESENTATIONS
Part I: Tuesday, June 4, 2013
WENIGER 304
Refreshments will be served!

STUDENTS are especially welcome!

3:00 – 3:15

Novela Auparay: Room Temperature Seebeck Coefficient Measurement of Metals and Semiconductors.

Advised by Janet Tate

3:15 – 3:30

Mo Brethower: Implementing the Autocorrelation Transform for Nanosecond-Scale Optical Pulse Resolution

Advised by William Hetherington

3:30 – 3:45

Ben Howorth: Detecting ZnS Thin Films on Si Substrates Using X-ray Diffraction

Advised by Janet Tate

3:45 – 4:00

Ben Norford: Acoustic Backscatter Surveys over Methane Vents along the Cascadia Continental Margin

Advised by Anne Trehu, CEOAS

4:00 – 4:15

Casey Hines: Practical Implementation of a Physical Vapor Deposition System in a Research Environment: An in-depth look at the implementation of a thermal evaporator system

Advised by Janet Tate

4:15 – 4:30

Sean Van Hatten: Calibration Methods for an Aerolab 375 Sting Balance to be used in Wind Tunnel Testing

Advised by Roberto Albertani, MIME

4:30 – 4:45

Afina Neunzert: Exploration of charge-transfer exciton formation in organic semiconductors through transient photoconductivity measurements

Advised by Oksana Ostroverkhova

4:45 – 5:00

Thomas Ferron & Thomas Windom: Surface Polarization Reflection

Advised by William Hetherington

SENIOR THESIS PRESENTATIONS

Part II: Monday, June 10, 2013

WENIGER 304

Refreshments will be served!

STUDENTS are especially welcome!

3:00 – 3:15

Alex Abelson: V-I Characterization of μ -Scale Plasma Devices with Comparison to Theoretical Performance

Advised by Henri Jansen (REU Northrop Grumman)

3:15 – 3:30

Will Bramblett & Ky Hale: Solar Radiation in the 70-cm band measured through a Yagi-Uda Antenna

Advised by William Hetherington

3:30 – 3:45

John Elliott: Design and Implementation of Next Generation Digital Scientific Instrumentation

Advised by William Hetherington

3:45 – 4:00

Kyle Peters: Optical Tweezer Trapping of Colloidal Polystyrene and Silica Microspheres

Advised by Oksana Ostroverkhova

4:00 – 4:15

Jenna Wardini: Characterization of graphene grown by chemical vapor deposition

Advised by Ethan Minot

4:15 – 4:40

Chaelim Reed Coffman: Graphene

Advised by Ethan Minot

4:40 – 5:00

Justin Schepige & Eric Stringer: A weathering balloon program at Western Oregon University

Advised by William Schonfeld, WOU

Earlier thesis presentations by the class of 2013

River Wiedle (Honors College) Thermal conductivity measurements of amorphous thin films on silicon via the 3ω method

Advised by Janet Tate

Bethany Matthews (Honors College): Building a Basic Computational Model of Surface and Impurity States in a One-dimensional Solid

Advised by Henri Jansen

Andy Svesko (Honors College) Writing *A Detailed Introduction to String Theory*

Advised by Albert Stetz

Nicholas Coyle: TBA (summer 2013)

Advised by Ethan Minot

Abstracts and Biographies:

Alex Abelson: V-I Characterization of μ -Scale Plasma Devices with Comparison to Theoretical Performance

This experiment serves to test the validity of macro-scale plasma relationships on a micro-scale and to investigate device-materials performance for a variety of device configurations. Theoretical plasma device performance will be compared with experimental results. The devices under testing were deposited on thin semiconductor wafers produced using conventional semiconductor processing techniques. They consist of an anode, cathode and gap of free-space in between the two electrodes.

Surrounding the electrodes is passivating material. The varied device parameters include electrode geometry (parallel plate, axial and trigger configurations), electrode metal composition and device-gap distance. V-I curves of micro-scale plasma devices were measured to investigate electrical stability and determine breakdown voltages. This was done using a DC-excitation current-ramp in an argon medium for a range of pressures.

Devices showed greatest stability (least noise) at low pressure. At increasing pressure, instability made precise readings of key voltages unreliable. Based on post-test visual inspection, Met 3 exhibited the greatest resiliency to ion impingement, showing no degradation. Gap size variations showed no direct proportionality to breakdown voltage.

Bio: Alex Abelson grew up in Los Angeles, CA and was first introduced to Physics by his grandfather, Arnold Silver. Arnold received a PhD in physics from RPI and with his team at Ford Motor Company went on to invent the SQUID. Alex's mother, Lynn, gave him his first glimpse into science industry at TRW, an aerospace research firm in Redondo Beach, CA. After beginning his career at OSU as an engineer, he eventually decided to pursue a degree in Physics. Four years later, Alex is graduating with a B.S. in Physics with an option in Applied Physics, and will begin work at Intel in Hillsboro, OR beginning in July, 2013. In his free time, he enjoys downhill mountain biking and playing pick-up basketball.

Novela Auparay: Room Temperature Seebeck Coefficient Measurement of Metals and Semiconductors.

When two dissimilar metals are connected with different temperature in each end of the joints, an electrical potential is present due to the flow of excited electrons from the hot joint to the cold joint. The ratio of the induced potential to the difference in temperature of between both joints is called Seebeck coefficient. Semiconductors are known to have high Seebeck coefficient values (200-300 $\mu\text{V/K}$). Unlike semiconductors, metals have low Seebeck coefficient (1-3 $\mu\text{V/K}$). Seebeck coefficient of metals, such as aluminum and niobium, and semiconductor, such as tin sulfide is measured at room temperature. These measurements show that our system is capable to measure Seebeck coefficient in range of (1-300 $\mu\text{V/K}$) with 0.14 $\mu\text{V/K}$ error.

Bio: Novela graduated from SMA Negeri 3 Jayapura, Indonesia in 2009. She is interested in Physics since the first time she learned it in the 7th grade. She originally wanted to pursue Physics degree in Indonesia. She changed her mind after being offered a full-ride scholarship to study in the US by BP SDM Papua, a new established government agency of Papua Province, Indonesia. Her career goal is to teach physics at college level. She enjoys traveling and playing guitar.

Will Bramlett: Solar Radiation in the 70-cm band measured through a Yagi-Uda Antenna

Mo Brethower: Implementing the Autocorrelation Transform for Time-Domain Optical Pulse Resolution

Optical fluorescence measurements require a detector sensitive enough to register very low intensity emissions (often bursts of two to three photons [1]). The photodetector's susceptibility coupled with the very brief (2-3 nanosecond) duration of each pulse requires data-recording equipment that can not only record when the pulse arrived, but also perform digital signal processing on the input signal to recover pulses from system noise. This experiment's goal is to produce hardware capable of recovering the time interval between photon bursts emitted from a sample of material.

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Hardware for this experiment starts at the photodetector's output (the Hamamatsu HPD R10467U-40 was chosen prior to this experiment's inception [1]). The autocorrelation transform was implemented on a Field-Programmable Gate Array (FPGA) for flexibility, speed and future re-use in different contexts. The final product is able to resolve the arrival of an incident photon to within 2.5ns. The resulting implementation may be incorporated with additional signal-processing elements in future work and offers a highly adaptable, less-expensive solution to removing system noise from fluorescence experiments and other situations with noisy data.

Bio: Mo finished high school in Yamhill, Oregon, and enrolled at OSU in the Engineering Physics program. After a summer internship with the US Air Force, his focus shifted to optics and scientific instrumentation, prompting a change in major. Mo's hobbies extend to amateur radio (call sign KD7ZLL), cycling, swimming and backpacking.

Chaelim Reed Coffman: Graphene

Nicholas Coyle: TBA

John Elliott: Design and Implementation of Next Generation Digital Scientific Instrumentation

Thomas Ferron: Measuring Low Intensity Light Reflections of High Temperature CO₂ Adsorbed on SiO₂ Near Brewster's Angle

This investigation expands on earlier methods of using surface polarization reflection (SPR) to characterize the first few monolayers of a surface. P-polarized light is reflected at Brewster's angle to measure low intensity reflections. Using an SBIG 8300 CCD camera intensities are measured in an open air environment and compared to that of applied CO₂ by the use of a gas jet. SPR theory predicts that higher polarizabilities will cause a larger reflection. Temperature of the applied gas was increased in order to quantify a difference in reflections based on this change in temperature. Removing ambient particles from the open air by use of a heated gas stream was thought to change the signal to a more consistent level of measurement. The intensity was found to change at higher temperatures but no trend was quantified. Increasing the temperature beyond 323K caused signal fluctuation and was found not to be beneficial in SPR analysis. Overall SPR was found to not have been improved by heating the applied gas.

Bio: Thomas Ferron grew up in Gresham, Oregon graduating from Sam Barlow High School. His early college career was spent performing with the Oregon State University percussion department in ensembles including the OSU Wind Ensemble, OSU Marimba Quartet, OSU Steel Band, and the Corvallis Repertoire Singers. Thomas joined Dr. Hetherington working on the radio telescope before changing to work on SPR research.

Ky Hale: Solar Radiation in the 70-cm band measured through a Yagi-Uda Antenna

Geomagnetic Storms from the sun produce strong amounts of radiation with frequencies as low as 300MHz. This project is designed to observe the radiation and strength of these geomagnetic storms over time at low frequencies, specifically the 70-cm band.

During periods of intense activity on the sun, signals have been detected by the Yagi-Uda antenna. These signals represent solar activity within the 430MHz-438MHz frequency bandwidth. Yagi-Uda antenna has been programmed to allow data collection over long periods by tracking the sun. With a signal averaging program, signals can be construed more clearly from the spectrum analyzer. This would allow for more precise signal measurement and analysis such as strength, periodicity and causes of these signals.

Bio: Ky Hale, 20 years old, graduated from Corvallis High School in Corvallis, Oregon in 2010. He has been working for Media Services at Oregon State University for the last three years. He will be graduating from OSU with B.S. in Physics and a minor in Mathematics. After graduation he will be attending Western Oregon University to pursue a M.A. in teaching.

Casey Hines: Practical Implementation of a Physical Vapor Deposition System in a Research Environment: An in-depth look at the implementation of a thermal evaporator system

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Even small physical vapor deposition (PVD) systems typically found in research environments can cost hundreds of thousands of dollars, making them unattainable for independent research groups and small startup companies. This work demonstrates the implementation of a low cost thermal evaporation system commissioned for less than \$5,000, while maintaining advanced features and capabilities, and not sacrificing functionality. The thermal evaporation system is capable of closed-loop-feedback thickness control of multiple sources, a low-base pressure of 3×10^{-7} Torr, and capable of growing films with resolutions of less than 10nm. The system is also equipped with an extensive interlock subsystem to protect both the hardware and the user. This document contains a discussion of how each of these capabilities were implemented, along with the obstacles that were overcome.

In addition to the discussion about the thermal evaporator, an introductory overview of other PVD systems such as sputter deposition, electron beam PVD, and pulsed laser deposition is presented. There is also a general discussion about vacuum systems and the relevant physical concepts. Because the PVD systems examined share many attributes, namely aspects of their vacuum system, much of the information covered here can be directly ported to many PVD systems.

Bio: Casey grew up and attended high school in Pendleton, Oregon. Following graduation from high school in 2001, he joined the United States Marine Corps where he served two enlistments. One as an infantry mortarman with First Battalion Third Marines, and another as a tank crewman with the Fourth Tank Battalion.

In 2007, he began attending Oregon State University, studying mechanical engineering. In 2008 his studies were interrupted when his reserve unit was activated to deploy to Iraq. After his return to the university in 2010, he switched majors to physics. Upon graduation, he plans to pursue a career in material science and has been offered a job with a local startup company.

Ben Howorth: Detecting ZnS Thin Films on Si Substrates Using X-ray Diffraction

The goal of this research is to determine whether x-ray diffraction (XRD) is a viable method for resolving ZnS thin films on Si substrates. The samples are ZnS thin films of thickness between 50nm and 100nm, on Si substrates that are 0.5mm thick.

ZnS and Si have nearly identical lattice parameters and can be interfaced well. They also absorb different ranges of light wavelengths. Graduate student Christopher Reidy is researching more efficient solar cells and methods of ZnS thin films on Si substrate production. This is a good quality for solar cells, which can increase the efficiency considerably. Tunneling electron microscopy (TEM) is a method that directly images the interface, and provides all the needed information about the interface and quality of a sample. However, it is both costly and time consuming compared to XRD. It is hoped that XRD will be able to resolve information about the ZnS thin film, and produce the same information in a matter of hours rather than days.

The scope of this paper includes an introduction to Bragg's law and crystal lattice structure, sample and process descriptions, and conclusions drawn from the results. There is a large amount of previously published work on experiments that use XRD, but none was found pertaining to the process itself. Ultimately, ZnS intensity peaks were not observed in the XRD measurements on the Si intensity background. This is likely due to the fact that the thin film is 5000 times smaller than the Si substrate.

Bio: Ben Howorth graduated from South Eugene High School in 2010 and entered OSU as a physics undergraduate. His senior thesis work was conducted in the lab of Dr. Janet Tate, on thin film materials and x-ray diffraction. He will be graduating in spring 2014 with a BS in physics with an optics option, and a minor in aerospace studies. He will then apply to Air Force Officer Training School, with the hope of doing astronomy research in the future.

Bethany Matthews (Honors College): Building a Basic Computational Model of Surface and Impurity States in a One-dimensional Solid

Learning about periodic and oscillatory systems is a huge step in an undergraduate's understanding of physics and complex systems. However, understanding how specific changes affect aspects of the entire system can be difficult. The goal of this study is to create a learning tool to see how changes to the system alter its characteristics using a simple one-dimensional solid of length N . In order to compare how the energy, a reference chain was established and its ground state energy and wave function were

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calculated. The allowed states and energies of the solid were studied as on-site energies and coupling terms were modified. Surface states and impurity states were observed to localize for potentials below -1 and 0, respectively. Relationships were found between the ground-state energy and the change to the system. The deviation ΔE in energy from the energy of the reference matrix was found to be inversely proportional to the change in the chain length: $\Delta E \propto N^{-2}$; inversely proportional to the decay length d as the edge potentials were varied: $\Delta E \propto d^{-2}$; and quadratically related to the decrease in nearest-neighbor coupling p in the chain: $\Delta E = 1.5p^2 + 0.0454p$. Complex systems display a similar behavior; that they should be reproduced here indicates that this program is a powerful instructional tool.

Bio: Bethany was born in Grants Pass, Oregon, and graduated from New Hope Christian Schools in Grants Pass. After attending the community college for two years, although having no physics background whatsoever, she declared physics her major. She will graduate this spring and be entering OSU's Graduate Program in the Fall. She was a member of the Lindey and Swing Club as well as Intersarsity Christian Fellowship at OSU for three years. Bethany participated in the Oregon Theatre Dance 2013, and enjoyed theater dance through high school. She also likes remodeling houses.

Afina Neunzert: Exploration of charge-transfer exciton formation in organic semiconductors through transient photoconductivity measurements

This project investigated transient photoconductivity in organic donor-acceptor (D-A) systems, where a fluorinated anthradithiophene acted as the donor. Thin film composites of donor and acceptor materials were excited with sub-nanosecond laser pulses, and the photoconductivity of the sample was measured up to several microseconds after excitation. Comparing the response of acceptor molecules with different packing properties and energy level offsets allowed insight into the generation and dynamics of charge carriers in the sample, including the formation of CT (charge-transfer) excitons. We found that in systems with larger D-A spatial separation, CT exciton dissociation made a larger contribution to the photocurrent.

Bio: Afina grew up and attended high school in Tigard, Oregon, graduating in 2009. She has been a member of Dr. Oksana Ostroverkhova's research group since 2010, and conducted her thesis research with that group. After graduation, she plans to study astrophysics and high energy theory at University of Michigan, Ann Arbor.

Ben Norford: Acoustic Backscatter Surveys over Methane Vents along the Cascadia Continental Margin

In this study, 12 acoustic backscatter surveys were taken over a group of methane vents off the coast of Washington state, along the Cascadia continental margin.

These data indicate that the flux of the methane vents generally decreased as tidal pressure increased and vice versa. Methane exited primarily from the larger, southeastern vent when total flux was high, regardless of the tide. Larger bubbles with radii near 1.5 cm exited from three distinct sources, while smaller bubbles with radii near 0.5 cm exited from only two, one of which contained two of the vents expelling larger bubbles.

Behavior of life near the surface above the methane vents was also analyzed. Above the vents, the biological layer (containing primarily plankton which feed off of methane) became denser and spread out over a wider depth range. They also followed a diurnal cycle, moving to lesser depths in the middle of the night and greater depths at night's beginning and end.

These results may promote a better understanding of the behavior of methane vents and the plant and animal life which depends upon them. These vents are a small but relevant source of global methane emissions to be considered when analyzing global climate change.

Bio: Ben Norford came to OSU in 2009, planning to double-major in physics and education. Corvallis' close proximity to the outdoors and Ben's taste for adventure quickly convinced him to pursue a more outdoorsy major, so he switched gears to a physics degree with a geophysics option. He has happily performed research, data analysis and field work in the area. He plans on spending the next summer bicycling across the country, and the following year working as a volunteer for the NCCC before applying to graduate school.

Kyle Peters: Optical Tweezer Trapping of Colloidal Polystyrene and Silica Microspheres with Preliminary Surface Charge Experiments

Optical trapping is a tool used throughout a wide variety of disciplines, ranging from precisely probing and manipulating sub-micron organisms in biology to analyzing fundamental charge transfer in colloidal physics. My thesis presents research involving optical tweezer force measurements of polystyrene and silica microspheres with preliminary work in tweezer-based surface charge measurements.

The optical tweezer related research provides information pertaining to the construction and calibration methods of a single-beam optical tweezer trap equipped with an independent back focal-plane laser position detection system. Calibration methods and experimental power dependence for 1 μm -diameter polystyrene and silica microspheres provide proof-of-principle results that exhibit expected linear power dependence to within an experimental error of 10.5%.

Preliminary work involving optical tweezer-based electrophoretic experiments is developed to investigate surface charge at the solid-liquid interface of single colloidal microspheres in water. Adopted methods are employed to examine the electric field dependence for surface charge.

Bio: Kyle is from Bend, Oregon and graduated from Southridge High School in Kennewick, WA where he played semi-professional ice hockey. After high school, he continued to play in upstate New York, eventually returning to Bend and attending Central Oregon Community College for two years. He originally came to OSU in 2010 to study engineering, but instead pursued physics. In 2011 he joined the Organic Photonics and Electronics group under the advisement of Assoc. Prof. Oksana Ostroverkhova, where he has been implementing optical tweezer trapping to study single charge carrier dynamics. Kyle will be graduating from OSU in the spring and attending graduate school at Case Western Reserve University in the fall.

Justin Schepige: A weathering balloon program at Western Oregon University

The addition of a weathering balloon program at Western Oregon University allows research opportunities for the education department, projects in professional development for inservice teachers, a partnership with Oregon Space Grant, and another option for participation in the Program for Undergraduate Research Experiences. As the ballooning program is successfully constructed a launch will be performed to assess functionality. The primary goal of the launch is to demonstrate effectiveness of the ballooning program by taking data on cosmic ray flux as a function of altitude, temperature, pressure, and humidity. The design and implementation of the GPS tracking system, heating circuitry and balloon filling procedure are explained from conceptualization to utilization during launch. These systems function to allow for a successful launch, data acquisition, and recovery. All systems performed well enough to allow for a successful launch and for a successful recovery of the payload after flight. The successful establishment of the ballooning program will allow more balloon launches to occur with less preparation and overall less cost. The data sensing equipment can be modified to sample a large variety of different quantities for various projects, and further improvements to the program could also be good research opportunities for undergraduates.

Bio: Justin Schepige came to Oregon State in 2009 and, with the help of course catalogue and a freshly sharpened dart, chose to pursue a bachelors in physics. By using his newly acquired skills from the physics program, Justin was not only able to finish building a fully functional bat cave, but was also able to kind of use separation of variables, sometimes. Justin will continue to pursue his love for the stage by learning magic, after which he will disappear from reality entirely.

Eric Stringer: A weathering balloon program at Western Oregon University

Andy Svesko (Honors College): Writing *A Detailed Introduction to String Theory*

String theory, one of the more popular approaches to quantizing gravity, is a highly complex theory, involving high level mathematics and physics. But the basic ideas of string theory are not inaccessible, even to the undergraduate. This document acts as a supplemental report to my thesis project, the writing of *A Detailed Introduction to String Theory*, an undergraduate themed text intended to demystify the basics of string theory. In this report the motivation for, and process of, writing are thoroughly discussed. Excerpts from the text are included. This present document is should viewed as the thesis itself, while

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the text should be viewed as the 'thesis project'. For a PDF copy of the complete text, visit <http://people.oregonstate.edu/~sveskoa/>.

Bio: Andy was raised in Corbett, Oregon, a small country town by the Columbia River Gorge. He graduated from Corbett High School in 2009 and enrolled in the Honors College at Oregon State University double majoring in mathematics and physics. On his free time, if there is any, Andy enjoys a variety activities including kayaking, hiking, ultimate Frisbee, playing the guitar, writing, reading, and pretending to be a film critic. Andy plans on receiving his Master's in Physics from Oregon State University next year, after which he will attempt an academic life elsewhere.

Sean Van Hatten: Calibration Methods for an Aerolab 375 Sting Balance to be used in Wind Tunnel Testing

Internal force, or sting, balances are used in wind tunnel testing to measure the total force and moment imposed on an aerodynamic structure. A sting balance operates through strain gauges converting strain from externally applied loads to voltage signals. An accurate measuring device is of paramount importance in wind tunnel testing, and this thesis concerns itself with calibrating such measurement device for use with micro air vehicles in a wind tunnel. A calibration matrix was found to convert the voltage output of the balance to force and moment data. Known loads were applied to the different channels of the sting balance and a custom made program was used to read and post process the voltages produced by the strain gauges in the balance under load. A relationship between voltage and load was then found and used to produce the calibration matrix. The calibration matrix was then inputted into a different program to test the accuracy and resolution of the balance by applying known loads, as a reference, and comparing the measured forces to the reference.

Bio: Sean started out as a child in Redmond, Oregon flying remote control airplanes. This led him to attend Central Oregon Community College for an Associate's in Aviation as well as a passionate interest in all things aerospace. While attending Oregon State University, he helped start the American Institute for Aeronautics and Astronautics club on campus. His primary function was as lead engineer and pilot for the club's Design/Build/Fly team, which placed 14th out of 80 universities in an international competition this spring. During college, he has worked as a flight instructor and professional pilot, and after graduating with a B.S. in Physics, he is planning on working as a pilot in the aerospace industry. Sean is also a semi-professional musician playing bassoon with OSU's Symphony and Wind Ensemble among many other music ensembles in the state.

Jenna Wardini: Characterization of graphene grown by chemical vapor deposition

The work presented in this talk began with the installation of a custom-designed, chemical vapor deposition system, for the growth of graphene on the wafer scale. I will briefly discuss the components of this CVD system, and the tunability it provides over growth parameters. While CVD produced graphene is the preferred method of large-scale production today, the quality can be seriously degraded from that of exfoliated graphene samples. The focus of this talk will then be to discuss some of these undesirable features that can degrade graphene's electrical performance, and to share a series of characterization techniques used to speculate on the performance of graphene samples without undergoing the lengthy fabrication processes necessary to test them directly. These characterization techniques include optical microscopy, Raman spectroscopy, as well as scanning and transmission electron microscopy. This information is then used to adjust CVD growth parameters with the goal of producing single-layer graphene that rivals the performance of exfoliated samples for integration into high-performance electrical devices for the Minot research group and collaborators.

River Wiedle (Honors College): Thermal conductivity measurements of amorphous thin films on silicon via the 3ω method

Thermal transport properties of a material are often difficult to measure, especially for thin films, but they are important for materials that have applications in modern devices, such as nano-scale electronics, thermoelectrics, and thermally resistive coatings. In this thesis, we describe an apparatus developed to measure the thermal conductivity of bulk and thin film materials via the 3ω method and a procedure to construct the high quality microheaters needed for the measurement process. The theoretical basis of

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the 3ω method is derived and we demonstrate how thermal properties are extracted from experimental data. We measure bulk Corning 1737 glass; results indicate that the thermal conductivity is $0.90 \text{ W m}^{-1} \text{ K}^{-1}$, consistent with the known value to within 2%. We also test bulk silicon and show that the thermal conductivity is strongly dependent on doping concentration. In addition, we present novel measurements on amorphous aluminum phosphate (AIPO) films with thickness 50-200 nm and show that these films have a thermal conductivity of $0.94(3) \text{ W m}^{-1} \text{ K}^{-1}$, comparable to other dielectrics used in the microelectronics industry.

Bio: River is originally from Grants Pass, Oregon. He came to OSU in 2008 and began research in the laboratory of Dr. Janet Tate in late 2010. River has also worked as a teaching assistant for both the mathematics and physics departments. After graduation, he will begin work at Intel's Ronler Acres campus in Hillsboro. In his spare time, River enjoys playing disc golf, car racing, watching movies, and cooking.

Thomas Windom: Surface Polarization Reflection of Few-Monolayer Adsorbates on SiO_2

The reflection of P-polarized light from a polished SiO_2 surface is examined at the Brewster angle for evidence of surface polarization reflection (SPR). Gases of different polarizability are introduced to the surface in an open environment, and a change in intensity of the reflected light is detected with a CCD camera. Results suggest a linear relationship between intensity and polarizability, but more data is needed to confirm it is truly linear. Gases with higher polarizability produce a more intense reflection than those with lower polarizability; this result is in agreement with prior experiments and with theory. It is evident that surface interactions play a role at the Brewster angle.

CO_2 produced an increase in reflectivity of $1.11 \pm 0.56\%$ when compared to air. N_2 showed an increase of $0.07 \pm 0.07\%$. O_2 and H_2 yielded decreases of $0.45 \pm 0.22\%$ and $1.43 \pm 0.30\%$ respectively. Reported errors are standard deviation.

Bio: Thomas grew up in Redmond, Oregon where he learned to fly during high school. While completing an A.A.S. in Aviation at Central Oregon Community College, earning a commercial pilot certificate, and working on the ramp at the local airport, he took a general physics class which sparked his interest. Since coming to OSU, tinkering with electronics has joined his ever-growing list of hobbies, including hunting, working on cars, and playing guitar. After graduation, he plans to shift his focus back to building a career in aviation.