

exotic neutron-rich nuclei near the neutron dripline. In the LISA commissioning experiment, designed to study neutron unstable  $^{24}\text{O}$  excited states, decay energy calculations require careful determination of charged fragment and neutron trajectories following breakup. Tracking of charged particles through the Sweeper Chamber is accomplished using two Cathode Readout Drift Chamber (CRDC) detectors separated by 1.8 m. During analysis of individual charged fragment passages through both CRDCs we recognized a majority of events had incomplete charge collection in the center pads. Without correction, standard peak location algorithms incorrectly determined the individual event centroids thereby reducing trajectory resolution. We developed a method and algorithm for correctly determining the centroids to restore trajectory resolution, critical for neutron breakup event reconstruction and decay energy determination. *Alyson Barker '15, Sierra Garrett '14, Nathaniel Taylor '15 and Warren Rogers, Professor of Physics*

#### Precise timing calibration for MoNA and LISA detectors

The Modular Neutron Array (MoNA) and the Large multi-Institutional Scintillator Array (LISA), working in conjunction with the Sweeper Magnet and Detector Chamber at the NSCL, MSU, are used to determine the properties of neutron-unbound ground and excited states of neutron-rich nuclei. In order to determine the decay energy, precise energy and trajectory for both the charged fragment and the neutron need to be determined. This requires very precise time calibration for each of the 288 scintillator detectors in the two neutron arrays. Initial timing calibrations for all bars in a vertical layer are achieved using muons passing through all 16 detectors, taking into account the muon transit time from bar to bar. Vertical layers are then "tied" to one another using the arrival times of gamma rays originating from the target during production runs. In the LISA commissioning experiment, prompt gamma rays from the contaminant beam  $^{29}\text{Na}$  were used instead of those from the  $^{26}\text{F}$  production beam since they constituted 98% of the beam intensity (compared with the  $^{26}\text{F}$  production beam). Results for the LISA commissioning experiment will be presented. *Alyson Barker '15, Sierra Garrett '14, Nathaniel Taylor '15 and Warren Rogers, Professor of Physics*

#### Isotope Separation and Decay Energy Calculation for LISA Commissioning Experiment

The commissioning experiment for the Large multi-Institutional Scintillator Array (LISA) was designed to investigate properties of neutron-unstable excited states of  $^{24}\text{O}$ . The array is located at the NSCL, MSU and is used in conjunction with the Modular Neutron Array (MoNA) and the Sweeper Magnet. Oxygen fragments produced by the  $^{26}\text{F}$  secondary beam incident on a Be target are directed through the Sweeper Chamber which includes two tracking CRDC detectors, an ion chamber, and a thin and thick scintillator. Plotting the fragment's trajectory position vs. angle vs. time of flight allows for separation of the individual  $^{22}$ ,  $^{23}$ , and  $^{24}\text{O}$  isotopes, necessary for the calculation of the decay properties of individual states. Anomalous features in the fragments' emittance distribution, believed to result from little understood issues with the tracking detectors, required that we adopt a slightly different approach than that developed recently by the collaboration. Once the isotopes are successfully separated, decay energies are calculated by applying mass-invariant decay spectroscopy by associating the fragment's precise trajectory (determined by inverse-

tracking through the Sweeper Magnet) and energy with those of the emitted neutron. *Alyson Barker '15, Sierra Garrett '14, Nathaniel Taylor '15 and Warren Rogers, Professor of Physics*

#### Distinguishing Best Neutral Prime

In the current research on biculturalism, much has been done relating to priming individuals to act in accordance with one cultural identity or the other. However, little to no research has of yet investigated—or even determined—the best comparative neutral prime that would have no effect on priming any cultural identity. Our study sets out to determine the effects of several primes (some cultural, some neutral, some neutral with an imaginary culture) on several measures sensitive to cultural frame-switching, so that in future studies the best primes and control conditions will be used to ensure validity and accuracy of results. Keywords: biculturalism, cultural frame-switching, cultural identity, neutral, priming. *Abby Lombardo '15, Melissa Caputo '15, Carmel Saad, Assistant Professor of Psychology*

#### Preparation of Chiral Cinnamoyl Esters from Cyclic Carbonates

Many biological molecules are chiral, and therefore, many pharmaceuticals are required to be chiral in order to be effective. An ester with a chiral auxiliary attached can be used in stereoselective synthesis. Chiral esters can be synthesized using Wittig reagents that are prepared from cyclic carbonates containing one or more chirality centers. The Wittig reagent is then reacted with benzaldehyde to form the chiral cinnamoyl ester. However, this method has not been found to produce high yields of the trans isomer of the ester. Significant amounts of the cis isomer and the acetate are also produced. Future work will involve testing a shorter method using cinnamoyl chloride to see if it is more selective for the trans isomer and produces a larger yield. *Becky Winchenbaugh '15, David Marten, Professor of Chemistry*

#### Synthesis and Separation of Sub-stoichiometric Ru-functionalized PAMAM Dendrimers

In hopes of breaking down pollutants in water systems, Generation 2.0 PAMAM Ru(bpy) $_2$ (dcbpy) dendrimers were previously synthesized and roughly characterized by taking the ratio of Ruthenium:Dendrimer from UV spectrum. It was shown, however, that all the resulting reaction mixtures were heterogenous mixtures Ru:Dend ratio, and could not be accurately characterized until separated. A FPLC (fast protein liquid chromatography) method was developed in order to separate dendrimers by charge using an ion-exchange column. Resulting fractions were analyzed by NMR to determine Ru:dend ratio, and showed the developed

method successfully separated a reaction mixture. Further research will pursue photophysically characterizing the separated G2.0 dendrimers and developing a FPLC method to separate G1.5 PAMAM Ru(bpy) $_2$ (dcbpy) dendrimers. *Garrett Johnson '12, Jeffrey Kuwahara '11, Anneka Rienstra '15, Tamara Sparks '13, Michelle Haas '11, Elizabeth Grossman '14, Jonas Marks '12, Stephen Contakes, Assistant Professor of Chemistry*

#### Revelation Exegesis

The study of Revelation benefits from a variety of exegetical methods in the process of interpretation and translation. The goal of my research was to examine the Greek text of Revelation and provide a grammatically-focused commentary with emphasis on the original language for use in both academic and ecclesial contexts. To this end, I worked carefully with a range of Greek grammars and lexical aids. In addition to preliminary readings and interpretation, I surveyed a wide selection of commentaries from a multiplicity of ecclesial settings and disciplines in order to assess an array of possible interpretations. *Tanner Lowe '14, Bruce Fisk, Professor of New Testament*

#### Generation of Novel Plasmids through Lambda-Mediated recombination for use in DNA and subunit vaccination against HSV-1.

Although recombination by restriction digestion and ligation has traditionally been used to create recombinant DNA, lambda-phage recombination offers a more efficient method. Here we use lambda-phage recombination to create a recombinant mammalian expression vector encoding the Herpes Simplex Virus-1 Glycoprotein B (HSVgB) and a Ca protein purification tag. This recombinant plasmid can be used as a DNA vaccine against HSV-1, and the purified recombinant protein can be used for soluble subunit vaccines. The experimental procedure relies on successive rounds of recombination mediated by enzymes encoded by the plasmid pRED/ET. Restriction digests and PCR screenings confirmed that pRED/ET recombination successfully produced the recombinant plasmid encoding HSVgB and the Ca tag. Initial trials in mice immunized with anti-CD40 and Poly I:C adjuvant suggest that the HSVgB is translated and secreted and induces T-Cell proliferation. Collectively, our experiments provide a novel, adept, and competent method of creating recombinant plasmids and protein for DNA and subunit vaccines. *Aaron Wilk '16<sup>1,2,3</sup>, N.D. Pennock<sup>2</sup>, J.A. Kedl<sup>2,3</sup>, and R.M. Kedl<sup>2</sup>. <sup>1</sup>Department of Biology, Westmont College, Santa Barbara, CA 93108. <sup>2</sup>Integrated Department of Immunology, University of Colorado, Denver, CO 80206. <sup>3</sup>National Jewish Health, Denver, CO 80206.*

#### OPPORTUNITIES TO PARTNER WITH WESTMONT'S SCIENCE PROGRAM

- Provide internships or employment for Westmont science students/graduates.
- Sponsor the next summer science research event (with promotional materials bearing your name).
- Sponsor a summer science research student.
- Contribute resources to Roger John Voksuy Library.
- Donate an employee's time and company resources to service and maintain certain pieces of science equipment.
- Contribute equipment to our natural and behavioral sciences departments.
- Help us build our science equipment endowment funds for new acquisitions and maintenance.
- Host an event in your home or at your company with your local acquaintances to hear from one of our research students and faculty members.
- Check with your company to see if it would match your cash gift to the sciences at Westmont.



# WESTMONT

## CELEBRATION OF SUMMER RESEARCH

THURSDAY, SEPT. 5, 2013

Reception and Poster Display, 3:30–4:15 p.m.  
Winter Hall for Science and Mathematics, Rotunda

Plenary Session and Student Panel, 4:15–5 p.m.  
Darling Foundation Lecture Hall, Room 210

#### PROGRAM

Welcome and Recognition of Students  
*Patti Hunter, Professor of Mathematics and Vice Provost*

Panel Discussion with Students  
*Dr. Mark L. Sargent, Provost*

*Sierra Garrett '14, Physics*  
*Elizabeth Grossman '14, Chemistry*  
*Jennifer Sanchez '13, Education*  
*Jake West '14, Biology*  
*Eric Zuidema '13, Psychology*

Celebrating Allan Nishimura  
*Dr. Niva Tro, Professor of Chemistry*

# 2013 SUMMER RESEARCH ABSTRACTS

Researchers have worked over the summer in the fields of Biology, Chemistry, Economics and Business, Education, English, Physics, Psychology, and Religious Studies. The following abstracts detail their work and collaboration with faculty members.

## Effects of n-Propanol on Excimers of 2-Methylnaphthalene on $\alpha$ -Alumina

The thin film interactions of n-Propanol (n-PrOH) and 2-Methylnaphthalene (2-MN) during excimer formation were observed on  $\alpha$ -alumina by monitoring laser-induced fluorescence (LIF) decay rate constants, intercepts, and wavelength-resolved spectra during temperature programmed desorption (TPD). *Brandon Driver '14, Marcus Anthony (Point Loma) '14, Nicole Grabe '13, Allan Nishimura, Professor Emeritus of Chemistry, K.A. Martin*

## Effects of Simple Aliphatic Alcohols on Naphthalene Excimers on $\alpha$ -Alumina

Temperature programmed desorption (TPD) experiments were run on bilayers of various simple aliphatic alcohols and naphthalene, both of which were amorphously deposited in a high vacuum chamber on the surface of an  $\alpha$ -alumina crystal. The excimer fluorescence of naphthalene was induced by either a pulse laser or a mercury lamp. Laser induced fluorescence (LIF) decay rate constants show the presence of an alcohol causes a minimum in the rate constant to occur during the temperature range of the alcohol's desorption. Annealing the alcohol-naphthalene bilayer showed an irreversible character resulting from lower energy excimer conformations forming; the naphthalene multilayer was reversible as a result of its inability to rearrange into a lower energy excimer. The methanol-naphthalene bilayer was representative of this effect. *Nicole Grabe '13\*, Marcus Anthony'14\*‡, Brandon Driver '14\*, K.A. Martin‡ and Allan Nishimura, Professor Emeritus of Chemistry, Westmont College, Santa Barbara, CA 93108 ‡Department of Chemistry, Point Loma Nazarene University, San Diego, CA 92106*

## N-Substituted Oxazolidinones and Amino Alcohols in the Preparation of Functionalized Chiral Auxiliaries

Wittig reagents with chiral auxiliaries can be used to stereoselectively synthesize useful organic compounds. Wittig reagents are used in a reaction with aldehydes or ketones to form carbon-carbon double bonds. The resulting alkenes can be transformed in stereoselective ways using organometallic reagents to produce useful organic compounds. N-substituted oxazolidinones were used to produce Wittig reagents with an ester linkage to a chiral auxiliary. Two novel chiral N-substituted oxazolidinones and one previously synthesized oxazolidinone were used. When an N-tosyl substituted oxazolidinone was used, the Wittig reaction occurred as expected to yield a chiral enoate with a 95:5 E/Z ratio. Using the N-mesitoyl substituted oxazolidinone, the Wittig olefination occurred with a 99:1 E/Z ratio. An alternative method was also employed, by first directly protecting the nitrogen of an amino alcohol and then forming the chiral enoate. This alternate procedure was seen to produce a better product yield in a shorter synthetic process. *Aleah Bond '14 and David Marten, Professor of Chemistry*

## Turn Sequence Requirements for the Self-assembly of Helix-turn-helix Peptides into $\alpha$ -Helical Fibrils

Apolipoprotein A-I (apo A-I) is the main component of high density lipoprotein (HDL) and is essential in the reverse transport of cholesterol and in the anti-inflammatory properties of HDL. Peptides modeled after apo A-I have been shown to mimic the physical and the functional properties of the full-length protein. Previously, peptide 1, a helix-turn-helix peptide with two identical 18-residue, amphiphilic  $\alpha$ -helical segments joined by a turn from apo A-I, was synthesized. This peptide readily formed  $\alpha$ -helical fibrils in solution. To investigate the driving forces behind fibril formation, modifications were made to the turn sequence of peptide 1. The effects of these modifications will be explored. The kinetics of fibril formation will also be revealed using intrinsic tryptophan fluorescence. *Harmeet Takhar '14, Tjitske Veldstra '14, Aaron Barnes'11, Kristi Lazar Cantrell, Assistant Professor of Chemistry*

## Overcoming Obstacles: Empowering students through growth and grit

This study examines the intersection of three areas of research: executive function, growth mindset, and the character strength of grit. After examining the literature, the researchers conducted a descriptive case study in a first grade classroom gathering data from lesson transcripts, interviews, photographs, and videotapes. The school chosen has exceeded the state's academic performance index and serves over 90% English learners and low-income students. The teacher chosen for this study is an America Achieves Fellow, recognized for her transformative approach to education. The researchers compiled examples of instructional strategies and teacher discourse that guide students to develop growth mindset and grit in order to persevere through challenges and overcome obstacles in learning. This paper presents a review of the research literature, an example of its application to the classroom, and significant themes that compel students to work with focused attention and sustained efforts while overcoming challenging obstacles in learning. *Jennifer Sanchez '13, Jane Wilson, Associate Professor of Education*

**Life-history strategy and blood glucose response to stress in the garter snake *Thamnophis elegans***  
Distinct populations of garter snake *Thamnophis elegans* exhibit contrasting life-history strategies which may indicate an energetic tradeoff between long-term survival and current reproduction. Previous work suggests that snakes using a slow life-history strategy have higher baseline and elevated levels of the stress hormone corticosterone than snakes using a fast strategy. We hypothesized that slow-living snakes would respond to capture-induced stress with higher levels of circulating blood glucose than fast-living snakes. Snakes were captured from populations exhibiting either a fast or slow strategy. Blood samples were drawn at three time points and tested for glucose concentration. Slow-living snakes

showed a trend for greater blood glucose response to stress than fast-living snakes. These results support the hypothesis that slow-living animals are more likely to mobilize energy to survive a stressor, while fast-living animals redirect energy towards immediate reproduction. *Nicole Carver '13\*, Kiera Kauffman '14\*, Eric Gangloff\*\* , Anne Bronikowski\*\*Professor of Ecology, Evolution and Organismal Biology, Amanda Sparkman\*, Assistant Professor of Biology \*Westmont College, Santa Barbara, CA \*\*Iowa State University, Ames, IA*

## The Mirror Neuron System and Empathy: Implicit Gender Bias

The Mirror Neuron System (MNS) is presumed to be the neural basis of empathy. Previous research has shown decreased MNS activity while observing racial out-groups, suggesting decreased empathy towards out-groups. This project tests whether the a similar reduction in MNS activity and empathy is seen with gender out-groups (males observing a female actor), if a decrease in MNS activity is related to implicit gender bias, and if increasing the engagement of the MNS (and therefore empathy) can reduce bias. Implicit gender bias was measured using two Implicit Association Tests (IATs), developed to measure attitudes towards gender. MNS was measured during observation of a female actor before and after engaging in synchronous movements with her, aimed at increasing engagement of the MNS and identification with her. The IATs were then repeated to test whether increased identification (and empathy) with a female had reduced overall gender bias. The results Of this pilot study suggest that synchronous movement increases MNS activity (especially in the parietal lobe), and IATs were inconclusive regarding gender bias. *Megan Seymour '14, Jessica Konopoliv '13, and Tom Fikes, Professor of Psychology and Director of the Center for Social Neuroscience*

## Lymphopenia and T cell homeostatic expansion, potential drivers of autoimmunity, occur in Inherited Inflamed Joints (IJ) mice

In several mouse models of disease, a depleted T cell compartment ("lymphopenia") triggers abnormal expansion of autoreactive T cells, ("homeostatic proliferation"), and induces autoimmunity. This study examines lymphopenia and homeostatic expansion in IJ mice. It was determined from flow cytometric peripheral lymphocyte profiles that pre-clinical IJ mice (pAR) and arthritic IJ mice (AR) are lymphopenic compared to non-arthritic IJ mice (NAR) and SJL controls. Cell transplants were then carried out by injecting NAR splenocytes and lymphocytes into IJ recipients. The transplanted cells readily proliferated in the spleens and lymph nodes of AR and pAR IJ mice, but not in NAR IJ mice showing a correlation between lymphopenia and disease. Furthermore, these proliferating cells were mainly CD25-, a hallmark of homeostatic expansion. These results show that lymphopenia and homeostatic expansion of T cells occur in IJ mice and suggests that these events may play a role in the development of arthritis. *Jacob West '14 and Eileen McQuade, Associate Professor of Biology*

## Business Case Studies

Working under the direction of David L. Anderson, Associate Professor of Business, the following students have completed case studies on various companies. The case studies have been submitted to Ivey Publishing, a subsidiary of The Ivey Business School which is the business school of Western University in London, Ontario, Canada. *Richie Graffeo '14: Luxottica Sunglasses, Electronic Arts Games, Nintendo Games;*

*Davis Vanderhorst '16: Victoria's Secret, JC Penny, Forever 21; Ryan Sullivan '14: Spotify; Cameron Mahi '12 served as a consultant*

## Attachment Anxiety and Parasympathetic Nervous Activity

The purpose of this pilot study was to explore the possible connections between attachment anxiety, attachment avoidance, and parasympathetic nervous activity as indexed by respiratory sinus arrhythmia (RSA). RSA is a phenomenon in which the heart rate increases during inhalation and decreases during exhalation. These changes may be seen in how well the inter-beat interval of the heart rate and respiration rate track with each other. A series of anxiety and attachment surveys were given to a class of PSY 001 students and the highest and lowest indexed subjects were invited to the study. The three responding participants (two with higher self reported anxiety and one with lower self reported anxiety) completed four different phases including a habituation, a first baseline measure, a stressor period, a recovery period, and a second baseline measure. They were hooked up to equipment measuring their EKG and respiration rate. Using MATLAB, these rates were converted into single RSA estimates for each condition. The participants fell into three categories: low RSA with a low stressor to recovery difference, high RSA with a high stressor to recovery difference, and high RSA with a low stressor to recovery difference. The lowest anxiety participant exhibited the biggest change in RSA from stressor to recovery suggesting that their parasympathetic nervous system was able to modulate physiological symptoms of anxiety. This finding is supported by the Polyvagal Theory. *Jessica Konopliv '13, Megan Seymour '14, Tom Fikes, Professor of Psychology and Director of the Center for Social Neuroscience*

## plrS-dependent CO2 sensing in Bordetella bronchiseptica

In this work, we identify and characterize a CO2 responsive gene regulon in multiple Bordetella bronchiseptica strains. Genes identified by microarray to be responsive to CO2 were also found to be responsive to pIR5 regulation in separate microarray experiments, strongly suggesting pIR5 is involved in bacterial sensing of CO2. In several Bordetella strains, it was found that pIR5 mutants fail to induce the production of CO2-dependent adenylate cyclase toxin. Transcriptional fusions were constructed in several more putative CO2-responsive genes, and in several, pIR5 was required for their proper expression. In one particular CO2-responsive strain, JC100, it was determined that pIR5 is necessary for the bacteria to colonize the lower respiratory tracts of rats, and mutant strains show differential immune-recognized protein production when compared to wild-type JC100. Because pIR5 is required for colonization of the lower respiratory tract in mice and rats in both JC100 and other strains, it is hypothesized that CO2 sensing by pIR5 is used as a general mechanism for Bordetella virulence. *Brittany McHargue '14, Steve Julio, Associate Professor of Biology*

## Impulse and Connoisseurship: Selections from the Forde Collection

This summer I have been working alongside Dr. Judy Larson and the Westmont Ridley-Tree Museum of Art staff (Brandon Waybright, Chris Rupp, and Alisha Paulsen) in preparation for the upcoming show Impulse and Connoisseurship: Selections from the Forde Collection. Due to the diversity of the artists and artworks found in the Forde collection, my research has taken me across the art historical spectrum of the past century. Throughout the summer I have engaged

in extensive research on specific artworks from this collection, and have written explications on these particular pieces that will be featured in the show's catalog. As a rising senior and an art history major, this research opportunity has been an enriching and instructive exercise in scholarship, and I'm thankful for the student-professor partnerships I have been able to build this summer. *Rachel Urbano '14, Dr. Judy Larson, Professor of Art History*

## Project Persist

Cultural psychologists have demonstrated that East Asians persist longer on a subsequent task after they have failed that same task compared to North Americans, who persist longer only after they have succeeded on the task. This is because East Asians engage in self-improvement, whereas North Americans engage in self-enhancement. Given that East Asians are more collectivist and North Americans are more individualistic, the current study examined whether East Asians would engage in more self-improvement (as evidence by greater persistence on the subsequent task) following group versus individual failure feedback. The study also reveals whether North Americans would engage in self-enhancement motivation by persisting longer on the task following individual versus group success feedback. The current study unites two bodies of work, persistence after failure and individualism/collectivism, to determine cultural differences in motivation. *Abby Lombardo '15, Melissa Caputo '15, Carmel Saad, Assistant Professor of Psychology*

## Learning to Slow Down, Slowing Down to Learn: How Leisure Activities Relate to Neuropsychological Functioning in Older Adults

This study explores the specific cognitive functions correlated with the leisure activities of older adults. Sixty-one older adults completed a comprehensive battery of neuropsychological tests. On an additional questionnaire, participants indicated how many times they engaged in leisure activities each week. The results suggest that the frequency of older adults' leisure activities is associated with stronger executive functions, visuospatial abilities, and learning, particularly learning visual relative to verbal material. This prominence of nonverbal rather than verbal aspects of cognition implicates more leisure-related activation of the right relative to left hemisphere. Frontal lobe functions also appear to be activated or potentially strengthened by leisure activity. Recent research on the relationship between exercise and cognitive health has revealed beneficial trends in left hemisphere functions, and leisure seems to mirror those benefits with right hemisphere functions. Exercise and leisure, taken together, may provide a comprehensive program for cognitive wellbeing. *Eric Zuidema '13, Dr. Steven Rogers, Associate Professor of Psychology*

## The Relationship Between Subtypes of Anxiety and Executive Functioning in Older Adults

The current study explored the differential relationships between the factorial dimensions underlying the Beck Anxiety Inventory (BAI) and the executive functioning of older adults. Eighty-five older adults completed a battery of extended neuropsychological measures, as well as the BAI, which was subdivided into two factors, somatic and cognitive. The findings suggest that older adults with greater overall anxiety exhibited weaker simple auditory attention, visual processing speed, verbal and nonverbal learning, divided attention, and verbal abstract reasoning, but not verbal processing speed, response inhibition, or working memory. The cognitive symptoms impacted more areas of frontal-executive functioning, but the somatic symptoms had

a unique connection to verbal abstract reasoning. These results demonstrate that the subtypes of anxiety appear to impact different areas of frontal-executive functioning. This can assist in the diagnosis, conceptualization, and treatment of older adults with anxiety and frontal-executive deficits. *Brittany Allen '14, Dr. Steve Rogers, Associate Professor of Psychology*

## Mitigating time and search space for exponentially large data sets

Modern computational efforts to mitigate time and search-space for large data sets has shown to be a problem that parallel programming can address. As a machine traverses very large data sets, the search space grows exponentially as the depth of the search increases. This research on parallel programming specifically targets that exponential explosion and distributes the task inherent in very large problems, across Westmont's 32-node Beowulf-class cluster computer. To study this problem, we selected a class of sliding block puzzles as our testbed; the goal of which being ClimbPro24, with a search space on the order of 9.9\*1035 distinct puzzle position sets. To find the optimal solution in such a large search space, we use fringe search to expand each set of positions present in each search depth, and split these sets evenly among the compute nodes. Each machine can then expand their respective fringes, merge their findings back into a complete fringe (while deleting any duplicate positions), and repeating this process using the new fringe until the goal state is found. *Adam Hess '14, Austin Raidaud-Owens '14, John Neal '15, Wayne Iba, Professor of Computer Science*

## EW-CRDS and Spatial Investigation of Adsorption on a Fused Silica Prism

The interfacial interactions of methyl red dye and silanized fused-silica prism faces were studied through evanescent-wave cavity-ringdown spectroscopy (EW-CRDS). The spatial adsorptivity of methyl red on gradients and concentrated circles of (3-aminopropyl)-trimethoxysilane (APTMS) were investigated through loss and pH studies with a Nd:YAG laser. Spatially specific adsorption was observed, but APTMS must cover a threshold fraction of the glass before significant adsorption occurs. *Elizabeth Grossman '14, Michael Everest, Professor of Chemistry*

## Synthesis and Characterization of Ru(bpy)2-4-(2-phthalimidyl ethyl)-1-10-phenanthroline

This project was inspired by the study of dendrimers and their use in removing waste water contaminants such as perchlorates and nitrates. Dendrimers are large branches molecules and are capable of binding and reducing these contaminants to less harmful substances with the aid of a Ruthenium metal complex. However, attaching the Ruthenium complex to the dendrimer proved difficult because the Ruthenium complex's reactive amine group (R-NH2) was stabilized from the aromatic ring. An ethyl group was placed between the amine and the aromatic ring to enhance reactivity and coupling to the dendrimer, resulting in Ru(bpy)2-4-(2-phthalimidyl ethyl)-1-10-phenanthroline. The goal of this project was to clean up the synthesis of this molecule, increase the yield, decrease time required for synthesis, and to characterize its reaction intermediates. *Jeremy Kubiak '15, Stephen Contakes, Assistant Professor of Chemistry*

## Charged Particle Trajectories in Sweeper Magnet for LISA Commissioning Run

The Large multi-Institutional Scintillator Array (LISA) located at NSCL, MSU, is used in conjunction with the Modular Neutron Array (MoNA) and the Sweeper Magnet for experiments investigating the properties of