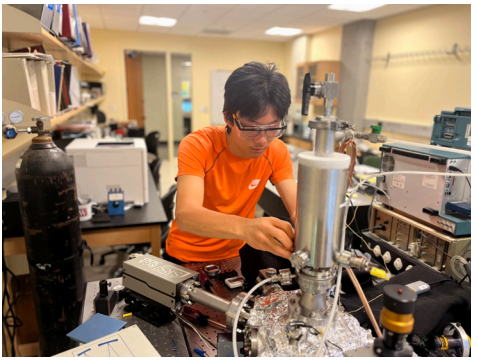
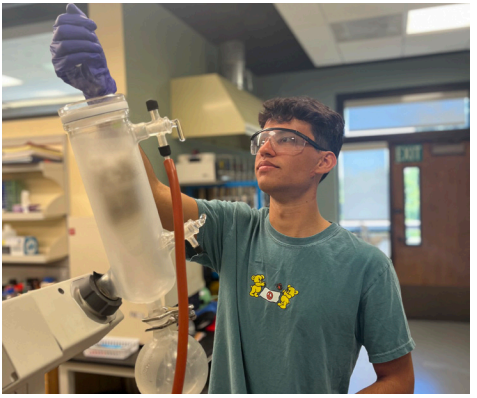


WESTMONT

2023 CELEBRATION OF SUMMER RESEARCH

October 13, 3:30-5:00pm

Winter Hall 3rd Floor Atrium



WELCOME TO THE 2023 CELEBRATION OF SUMMER RESEARCH

A hallmark of Westmont's outstanding undergraduate liberal arts education is providing opportunities for students to conduct significant research with faculty.

Approximately 1,300 undergraduates enjoy a student-to-faculty ratio of 11 to 1 and an average class size of 18, which allows them to develop close relationships with outstanding faculty who are committed to teaching, scholarship, research, service and involving undergraduates in research.

Westmont's faculty place high value on research. Each summer, over 30 students from many disciplines work as full-time research assistants, collaborating closely with professors on cutting-edge projects.

This past summer, faculty and students were very busy conducting research with a record 45 students from seven departments participating in the summer research program, including all the natural and behavioral science departments.

Many of these research projects extend into the school year. Some students even co-author scholarly papers with their faculty. These are extraordinary opportunities that advance and make significant contributions to research.

Congratulations to all the summer research students and the great work they have accomplished with their professors and academic disciplines. **We celebrate you!**

FOR MORE INFORMATION ON WESTMONT'S RESEARCH, GO TO
WESTMONT.EDU/RESEARCH

SUMMER RESEARCH PARTICIPANTS

Poster #16
Kari Anema
Biology

Poster #11
Chandler Baker
Physics

Poster #4
Curtis Barnhart
Mathematics

Poster #23
Mya Brushey
Chemistry

Poster #1
Ben Buskirk
Biology

Poster #17
Jan Carne
Kinesiology

Poster #19
Sophia Chan
Chemistry

Poster #27
Elijah Cicileo
Engineering

Poster #25
Junia Coe-Renner
Chemistry

Poster #8
Natalie Fogg
Physics

Poster #14
Michael Hemmett
Physics

Poster #25
Briana Herrera
Chemistry

Poster #3
Richie Hibbs
Engineering

Poster #16
Ainsley Hosley
Biology

Poster #29
Logan Jackson
Chemistry

Poster #20
Joshua Jang
Chemistry

Poster #9 & 10
Olivia Knapp
Biology

Poster #2
Todd Knight
Engineering

Poster #24
Reed Kulberg
Chemistry

Poster #22
Michael Lew
Physics

Poster #5
Tasha Loh
Engineering

Poster #15
Berit Lunstad
Physics

Poster #18
Jane Nakamura
Kinesiology

Poster #22
Jacob Nelson
Physics

Poster #19
Jordan Ogawa
Chemistry

Poster #6
Em Oneale
Psychology

Poster #26
Mariyan Popov
Chemistry

Poster #9 & 10
Eric Reyes
Biology

Poster #12
Sean Ryan
Physics

Poster #13
Naomi Siragusa
Physics

Poster #28
Isaac Song
Chemistry

Poster #5
Jonah Swanson
Engineering

Poster #4
Sam Tang
Mathematics

Poster #7
Reese Toepfer
Physics

Poster #1
Noah Tseng
Biology

Poster #21
Isaiah Underwood
Biology

Poster #28
Samie Watanabe
Chemistry

Poster #27
Josh Wozniak
Engineering

RESEARCH PROJECT SUMMARIES

POSTER #1

Me and My Broken Heart: A Rough History with COVID-19

Noah Tseng, Ben Buskirk, *and Yi-Fan Lu*

SARS-CoV-2, the virus responsible for the COVID-19 pandemic, produces a two-fold increased mortality rate for those with pre-existing heart failure. We investigated the interaction between SARS-CoV-2 and heart cells by exposing P1 mice cardiomyocytes to the virus' receptor-binding domain (RBD). The RBD is responsible for binding to the host cell, the first step to viral entry. After extracting and isolating P1 mice cardiomyocytes, we cultured the cells on a specialized plate made for a micro-electrode array (MEA). The MEA measured and recorded electrical activity. Our results demonstrate that RBD exposure is sufficient to inhibit cardiac activity regarding amplitude and frequency. In other words, the RBD alone is effective in hindering electrical activity of the heart, not the entire virus. Additionally, this experiment could explain the increased rate of myocarditis and pericarditis in patients following COVID-19 vaccination administration, as the vaccination catalyzes the synthesis of the spike protein that contains the RBD.

POSTER #2

Plume Surface Interaction with Mars Heavy Lander

Todd Knight *and Douglas Fontes*

Landing on a foreign planet like Mars can kick up a lot of dust as well as generate a crater due to the rocket plume touching down on the surface. Under the right circumstances, these dust particles can be dangerous to any human infrastructure on Mars. This research project uses computational fluid dynamics (CFD) to simulate a Martian landing in order to analyze the crater formed by the rocket plume and the interaction of the rocket plume with all the dust and debris kicked up during landing.

POSTER #3

"Where Does it Go?": An Investigation of Pesticide Spray Deposition

Richard N. Hibbs *and Douglas Fontes*

Over the last several decades, dramatic food demands have forced farmers to pursue higher efficiency in several areas of agriculture. One particularly exciting advancement has recently been the introduction of drones equipped with pesticide-spraying nozzles as a replacement for crop-dusting airplanes. By virtue of their small size the machines are known to be easily maneuverable, but their worth as accurate depositors of pesticide is not yet fully known. As many pesticides in current use are known to be toxic for humans, it is critical to understand on a deeper level those factors in the agricultural environment which cause deposition and drift of such chemicals to occur in a manner that is computationally predictable. In this paper, we approximate this environment as a multiphase flow case which we then use Computational Fluid Dynamics (CFD) to evaluate, incorporating several different combinations of drone and wind speeds and crossflow directions in our calculations.

POSTER #4

What are the Odds?—Flip a Coin, Get an Annular Function?

Curtis Barnhart, Samuel Tang, *Isaac Jessop, and Russell Howell*

Every number between 0 and 1 can be written as a decimal. For example, ⅓ = 0.33333 … . These numbers can also be expressed using "base-two" notation. For example, in base-two notation we have ⅓ = 0.010101 … . With this scheme, each number between 0 and 1 can be associated with an infinite sequence of plus or minus signs, with +1 and -1 corresponding to a zero or one in the base-two notation of that number (after the decimal). For example, with the representation ⅓ = 0.010101 … we get the sequence +1, -1, +1, -1, +1, -1, … . That sequence can then be turned

into an "infinite" polynomial: $1 - x + x^2 - x^3 + x^4 - x^5 + \ldots$. This association can be thought of as generating an infinite polynomial by means of flipping a coin, with a sign of +1 or -1 determined by whether the flip is heads or tails. These protocols are the basis for the title of this research project, with the question marks serving as indicators to an interesting question we address: what is the probability of picking a number that gives an infinite polynomial with a "special property," which is known in the guild as being "strongly annular"? We prove that the odds are either 0 or 1, and exhibit specific numbers having this property.

POSTER #5

A Weighted Design Matrix Approach for Informing—Digital vs. Physical Prototyping Options

Tasha Loh, Jonah Swanson, *Elijah Cicileo, Josh Wozniak, Dan Jensen, and Greg Reich*

Engineering product design teams must decide if they will create digital or physical prototypes (or both). This decision can radically impact the success of the product's development. Our research indicates that most designers make this decision based on historical precedent or intuition. We have created a weighted design matrix to enhance that decision making process. The matrix requires the design team to input information in the areas of cost, schedule and performance. The method is easy to use and has been shown to significantly enhance the design team's decision regarding the use of physics vs digital prototypes.

POSTER #6

Cigarettes and Parkinson's Disease: The Effect of Smoking on Cognition

Emery L. Oneale *and Steven A. Rogers*

This study explores the effect of smoking cigarettes on the cognitive abilities of those with Parkinson's disease (PD). A total of 141 patients (44 women, *M* age = 74.19, *M* education = 15.42 years) diagnosed with PD participated in comprehensive neuropsychological assessment. The findings of this study suggest that a history of smoking may have a positive impact on the verbal delayed recall and phonemic fluency of those with PD, likely related to the alteration of dopamine activity caused by nicotine. However, a longer history of smoking seems to have a deleterious influence on patients' performance in several other cognitive domains. These findings may help clinicians appreciate the beneficial effect of dopamine-inducing chemicals on the cognitive functioning of patients with PD. Further research can investigate the interaction between length of smoking history and amount of nicotine intake on the cognitive abilities of PD patients.

POSTER #7

Quenching the Octuple Rotational Band in ^{71}Ge

Reese Toepfer, *R.A. Haring-Kaye, J. Döring, S.L. Tabor, B. Abromeit, R. Lubna, P.-L. Tai, Vandana Tripathi, A. Volya, J.M. VonMoss, D.C. Vengas-Vargas, C.L. Tan, M.J. Heeschen, K.Q. Le, and B.L. Harbin.*

Static octupole deformation, having pearlike shapes, has been observed in several even-even nuclei with mass $A \approx 70$. Experimental evidence for an octupole rotational band was observed in an odd-*A* isotope (^{71}Ge). An experiment at Florida State University using the ^{62}Ni reaction at 50 MeV was used to produce ^{71}Ge at high spin. Ten Compton-suppressed Ge detectors were used to measure the gamma decays in coincidence. An analysis of the resulting coincidence spectra resulted in adding six transitions to the ^{71}Ge level scheme, one of which (1092 keV) extends the octupole band to a $(35/2^-)$ state at 8208 keV. Calculations of the octupole band's kinematic moment of inertia and aligned angular momentum show that the 1092-keV transition disrupts the smooth rotational pattern and may point to a band crossing, potentially quenching the octupole deformation. Comparisons between the ^{71}Ge octupole band and those of other neighboring even-even nuclei show similar behaviors.

POSTER #8

Searching for an Octupole Rotational Band in ^{71}Ga

Natalie Fogg, *R.A. Haring-Kaye, J. Döring, S.L. Tabor, B. Abromeit, R. Lubna, P.-L. Tai, Vandana Tripathi, A. Volya, J.M. VonMoss, D.C. Vengas-Vargas, C.L. Tan, M.J. Heeschen, K.Q. Le, and B.L. Harbin.*

Recently, a rotational band with static octupole deformation was observed in ^{71}Ge, the first odd-mass isotope in the mass $A \approx 70$ region to show evidence of this behavior. Systematic experimental and theoretical studies of nuclei in this region indicate that octupole deformation might be enhanced for isotopes with $N = 40$. The goal of this work was to search for an octupole rotational band in the $N = 40$ isotope of gallium (^{71}Ga) while enhancing the existing level scheme. A ^{62}Ni(^{14}C, αp) reaction at 50 MeV was performed at Florida State University to populate high-spin states in ^{71}Ga, and their decays were measured in coincidence using an array of Ge detectors. Gating was used to confirm recently observed transitions and cranked shell model calculations as well as total Routhian surface calculations were used to compare rotational behaviors. No conclusive evidence was found for a possible octupole rotational band, however.

POSTER #9

Acorn woodpecker aggression across the urban gradient: Rare but influenced by group composition and species identity

Olivia Knapp, Eric Reyes, *Peter Schramm, and Amanda Sparkman*

Urbanization can drive changes in social behavior as animals adapt to the challenges of heavily modified environments. Past studies have explored aggression in wild acorn woodpecker populations, but little is known regarding the impact of urbanization on their aggressive interactions. We observed 141 acorn woodpecker families across Santa Barbara county over three years and documented interspecific and intraspecific aggressive interactions. We found that aggressive behavior was rare across the study population. While family groups with more males were more likely to engage in interspecific aggression, this did not differ across the urban gradient. In contrast, intraspecific aggression decreased with greater urbanization, was higher in larger family groups, and lower for those with nestlings present. Further study is required to determine what factors, such as changes in resource availability or population density, might cause urban woodpeckers to exhibit less intra- and/or inter-group conflict.

POSTER #10

Island dwarf reptiles' capture rates correlated with each other and climatic changes

Eric Reyes, Olivia Knapp, *Peter Schramm, and Amanda Sparkman*

Past studies have shown that drought can be an important factor in shaping population trends. An inverse correlation between wildlife adult survival rates and drought has been documented in coastal California. Our data from Santa Cruz Island between 2015-2023 investigated the correlation between reptile capture rates, Spring temperature, and annual precipitation. Gopher snakes, western yellow-bellied racers, and alligator lizards were captured using coverboards; thus capture rates can reflect population trends and/or reptiles' tendency to seek cover. We observed a significant correlation between racer and gopher snake capture, but no correlation between alligator lizards and racers. However there was a marginally significant inverse relationship between alligator lizards and gopher snake capture, indicating a predator-prey relationship, or divergent responses to another factor. Gopher snake capture rates were correlated with higher seasonal temperatures and higher rainfall the previous year. We hypothesize that greater grass biomass may reduce the need for artificial cover.

POSTER #11

Search for Higgs boson decays to muons and missing transverse momentum at ATLAS

Chandler Baker *and Ben Carlson*

There are exotic decays of the Higgs boson not predicted in the Standard Model (SM) that are well-motivated by dark matter. Dark matter does not interact with the detector, and is therefore "invisible." However, such non-interacting particles can be reconstructed using the law of conservation of momentum resulting in missing transverse energy (MET). In this study, we search for a specific model that is partially visible, decaying to muons reconstructed in the detector and MET.

POSTER #12

Journey to the Dark Side: Fusing Gluons, Fleeting Bosons, and Elusive Photons

Sean Ryan *and Ben Carlson*

Higgs boson decays to a photon and missing transverse momentum are motivated by beyond the Standard Model (BSM) theories. Past searches for dark photons at ATLAS and CMS have used the associated production and vector boson fusion production modes. This poster discusses a new approach that relies on the gluon-gluon fusion production mode using the new Monte Carlo simulation.

POSTER #13

Outlier removal of online dark matter trigger rate data using machine learning

Naomi Siragusa *and Ben Carlson*

The number of events saved per second, or trigger rate, are often used for rapid decisions as experimental conditions evolve. Typically, these decisions are based on detector conditions information, which is subject to noise that leads to significant outliers. The goal of this project was to develop a method that would remove these unnecessary outliers. The method implemented combines Isolation Forest and Local Outlier Factor from Sci-kit Learn we were able to remove noise from online trigger rate data.

POSTER #14

Jet Calibration: A Regression Model for the ATLAS Global Event Processor

Michael Hemmett, *Ben Carlson, and Elham E Khoda (University of Washington)*

Measurement of the Higgs self-coupling is one of the core objectives for the High Luminosity LHC (2029-2045). The di-Higgs process is sensitive to the jet momentum threshold available from the trigger system. One possible solution for lowering the threshold is to implement machine learning algorithms in the ATLAS Global Event Processor, part of the FPGA hardware trigger. This project uses a regression model to implement a calibration using simulated events of the ATLAS detector.

POSTER #15

Machine learning models for the ATLAS dark matter trigger

Berit Lunstad *and Ben Carlson*

Dark matter is invisible and therefore does not interact with the ATLAS detector. To detect and save these events with the trigger system, the missing transverse momentum (MET) can be reconstructed. This project explores a variation on a neural network to optimize the ability of the network to differentiate between background and signal data and to estimate the MET in the event using a regression.

POSTER #16

Purposeful Planting—An Introduction to Becoming Firewise

Ainsley Hosley, Kari Anema, *Isabella Garcia, and Laura Drake Schultheis*

In areas at high-risk for wildfire, a thorough understanding of plant traits and their relationship to flammability is essential for predicting behavior patterns of future fires. In our research, we measured 16 plant traits across 23 species of various life forms (shrubs, sub-shrubs, grasses, and forbs)

and foliar persistence (deciduous and evergreen) and analyzed these data to provide easily evaluated metrics as indicators of plant flammability. Using a nonparametric one-way ANOVA, both growth form and foliar persistence were found to be predictors of leaf thickness, and live and dead fuel moisture. Additionally, analysis of rank correlation coefficients revealed basal trunk diameter was a strong predictor of both plant volume and branching architecture, and branching architecture and stem specific density were highly correlated. This study provides a variety of simple plant assessments that may be used by individuals as guidance for home landscaping to evaluate and reduce overall vegetation flammability risk.

POSTER #17

Delay Period Duration Influences Reaction TIme during a Maximum Jump Task

Jan Carne *and Isaac N. Gomez*

On your marks. Get set. Go! The interval between a preparatory cue and a go cue, known as the delay period, is a widely used feature in human and animal behavioral studies. Although the delay period is thought to be important for preparing actions, the influence of delay period duration on human performance has not been explored. Our study investigated the effect of short (0.5s), medium (1.0s) and long (1.5s) intervals between two audible beeps on the reaction time and force output of healthy young adults (n = 11) during a maximum sit-to-jump movement. We used electromyography (EMG) to measure muscle activity, and force platforms to measure ground reaction forces. Reaction time was calculated as the time between the second beep (go cue) and the onset of muscle activity. Preliminary results suggest a significant effect of delay period duration ($F(1,5) = 4.2$, $p = .047$) on reaction times, with shorter delay periods producing faster response times.

POSTER #18

The Mind's Playground: Mental Training and Discovering the Science Underlying the Art of Outperforming Fatigue

Jane Nakamura, *Jong Min Park, Stephen Gonzalez, Sten Kajitani, Emma Gabriano, Gavin Hoiosen, Karly Kingsley, and Timothy Van Haitsma*

This study examines the effects of mental training on performance when individuals are in a physically fatigued state, and looks into some of the physiological mechanisms underpinning how mental training enhances performance.

POSTER #19

Novel Approaches to the Ortho-Olefination of Aryl Carbonates

Jordan Ogawa, Mariyan Popov, Sophia Chan, *Braden Chaffin and Amanda Silberstein*

The formation of carbon-carbon (C-C) bonds is critical for the synthesis of pharmaceuticals and other big organic molecules. However, reactions that produce C-C bonds are limited and require specific reaction parameters. Of additional concern is forming bonds with predictable and specific geometry. One way of forming these specific C-C bonds is through carbon-hydrogen (C-H) activation reactions. These reaction conditions are preferable to other methods of C-C bond formation due to being more eco-friendly, efficient, and cost-effective. Through C-H activation, an olefin (a carbon-carbon double bond) can be installed on an aryl starting material. This research focuses on using carbonates as a directing group, to both facilitate C-H activation and control the geometry of installation in the ortho position. The primary goals of this research are to synthesize various aryl carbonates as starting material and to use these aryl carbonates to generate ortho-olefinated products.

POSTER #20

Can we use small molecule therapeutic agents to deter aggregation of TDP-43(307–319) peptides?

Joshua Jang, *Nicole Marsh, Ethan Walker, Xikun Liu, Kristi Cantrell, and Michael Bowers*

TAR DNA-binding protein (TDP-43) is an RNA processing protein that is located in the nucleus of nerve cells. However, the relocation of TDP-43 to the cytoplasm and the aggregation of TDP-43 into oligomers and fibrils is associated with the neurodegenerative disease amyotrophic lateral sclerosis (ALS). The aggregation and translocation of TDP-43 is often accelerated by mutations found in the carboxyl terminal, glycine rich region of TDP-43. Three peptide fragments consisting of residues 307 through 319, including one wild type and two mutant peptides, were synthesized to study the aggregation of the TDP-43 glycine rich region. Moreover, two molecular inhibitors made with computational methods by the biotechnology company Acelot were studied with the TDP-43(307-319) peptides. Circular dichroism was used to determine the conformations of the peptides in solution with and without the inhibitors. Fibril assays were performed and imaged using electron microscopy.

POSTER #21

Bacteria Bulking Season: Bordetella Need Amino Acids Too

Isaiah Underwood *and Steve Julio*

Bordetella is a bacterial respiratory pathogen that causes the human disease whooping cough. Two component systems (TCS), which consist of two proteins that sense environmental changes and trigger the appropriate gene expression, coordinate bacterial disease. The PlrSR TCS was discovered at Westmont, and because it is similar to other bacterial TCS that are involved with nitrogen use and glutamate metabolism, we asked if PlrSR plays the same role in Bordetella. We found that when grown in a glutamate-deficient environment, the wild type bacteria would autoaggregate (clump together) at the bottom of the culture tubes, while the PlrS mutant did not. We suspected that the mutant strain lacked FHA, since FHA is a long surface protein that allows cells to stick together. This hypothesis was supported by both SDS-PAGE gels and Western Blots. Finally, we show that PlrSR controls expression of two genes that are involved with maintaining proper glutamate levels in the cell.

POSTER #22

Microwave Telescope Assembly and Troubleshooting for Studying the Beginning of the Universe

Michael Lew, Jacob Nelson, *and Jennifer Ito with the Simons Array Collaboration*

Simons Array consists of three telescopes, located in the Chilean Andes. Our focus was on the Paul Simons telescope which houses the POLARBEAR-2b receiver (camera). Our research this summer revolved around working towards bringing the telescope to regular scientific observations and to protect the instrument from the elements of Cerro Toco. While in Chile, we completed or made progress on the following tasks to achieve our goal: stimulator maintenance, readout noise analysis, and installing the receiver enclosure. The completion of each task brought the telescope closer to normal operations. The maintenance on the stimulator allowed the telescope to have a working thermal calibration device that is operated before and after observation scans. The readout noise analysis determined whether or not to double shield our readout cables. We continued the receiver enclosure assembly by installing some of the bottom panels of the enclosure.

POSTER #23

Towards Photoactive Nanoparticle Catalysts that use Light Energy to Convert Inorganic Endocrine Disruptors to Harmless Products

Mya Brushey, *Anneka E. Rienstra, Nicholas M. Choi, Madison J. Foster, Taylor Cheung-Damonte, and Stephen M. Contakes*

As part of efforts to prepare nanocatalysts that photodegrade endocrine-disrupting inorganic ions, nanoparticles were prepared and tested for photoreactivity towards perchlorate. First, methyl 2-phenyl-5-pyridinecarboxylate-bis-(2-(2-pyridinyl) phenyl)diiridium(III), Irppy2cmppy2, was synthesized and chromatographically purified. Then its methyl ester was hydrolyzed using NaOH in a 9:1 mixture of dichloromethane and methanol. The resulting 2-phenyl-5-pyridinecarboxylate-bis-(2-(2-pyridinyl)phenyl) diiridium(III), Ir(ppy)$_2$cppy, was covalently coupled to G2.0 PAMAM dendrimer nanoparticles using DCC and HOBt in dry DMF, giving nanoparticle mixtures with 1H NMR-determined Ir:drendrimer ratios between 2 and 8. The nanoparticles exhibit photophysical properties typical for Ir-diimine complexes, with a MLCT absorption band that appears as a shoulder around 350 nm that produces emission at 560 nm when irradiated. This emission is quenched when perchlorate is added, consistent with either energy transfer or electron transfer between photoexcited Irppy$_2$cppy group and perchlorate. In contrast, Ir-diimine emission in physical mixtures of Irppy$_2$cppy and G2.0 PAMAM dendrimers and in Irppy$_2$cppy alone is not quenched by perchlorate.

POSTER #24

A Computational Study of C–H Insertion by Aryloxenium Ions

Reed Kulberg, *Kevin G. M. Kou, and Brandon E. Haines*

What are oxenium ions? They are oxygen atoms with a positive charge, which is due to the atom having less than a full octet of electrons. This makes them very reactive. The goal of studying oxenium ions is to develop stable yet reactive intermediates to open new pathways for chemical synthesis. My research uses computational chemistry methods investigating the mechanism of the C-H functionalization of coordination-stabilized oxenium ions with different substrates. C–H insertion accomplishes the formation of a C–O bond between a carbon of the substrate and the oxenium ion. My goal was to determine which substrates have the lowest energy barrier of reacting with the oxenium ion, as well as analyze the physical mechanism of the C–H insertion. We found that barriers to C–H insertion are in the range of 30–40 kcal mol^{-1} with pyridine as the coordinating group.

POSTER #25

Vibrational Overtones Measured with CRDS

Briana Herrera, Junia Coe-Renner, *and Michael A. Everest*

We used cavity ring down spectroscopy to detect the absorption of visible light by water and methane molecules in the gas phase. When molecules absorb light their bonds vibrate, exciting the molecule from the lowest to a higher energy level. The rules of quantum mechanics for springs allow only a single step in energy level, however, since bonds are not perfect springs, transitions to even higher energy levels are allowed. These transitions, called vibrational overtones, are very weak. We are interested in methane because it is a main component of the atmosphere of Titan, a moon of Saturn. We compared our spectrum of water with a published database to calibrate and characterize the laser. A significant achievement for our team this summer was designing and 3D printing new optical mounts that greatly facilitate alignment of the laser system.

POSTER #26

Activation of the C-H Bond for Ortho-Arylation of Aryl Carbonates

Mariyan Popov, Sophia Chan, Jordan Ogawa, *Braden Chaffin, and Amanda Silberstein*

Carbon-carbon (C-C) bonds are one of the most prevalent bond types in blockbuster drug synthesis. The common approaches for C-C bond formation rely on harsh conditions and multi-step reactions. Approaching C-C bond formation through carbon-hydrogen (C-H) activation allows for lower temperatures, safer solvents, and a one-step reaction. Also of interest is control of the regiochemistry of bond formation (geometry of bond formation). This research investigates C-H activation reactions that generate *ortho*-arylation products on aryl carbonates. (Arylation refers to installing an aromatic ring on the starting substrate and *ortho* refers to the desired regiochemistry/geometry.) In this research, we use carbonates as the *ortho* directing group to control regiochemistry and synthesize *ortho*-arylated products from aryl carbonates. Optimization of reaction parameters for successful *ortho*-arylation is ongoing.

POSTER #27

Research and development of 3D Printing Machines

Elijah Cicileo, Joshua Wozniak, *and Will Allison*

For our summer research, we looked into developing a 3D printer which would take advantage of a process known as electrophotography. Due to the nature of the topic, some details must be withheld, as a patent is currently being processed. With that being said, the process of our printer focuses more on printing by layers instead of one continuous line. This is different from resin printers as well since, even though the resin printer seems to go layer by layer, the resin printer still goes by sections when printing the layer. Our printer uses an electrostatic belt that will have a very specific pattern of electrons applied by a laser in order to pick up the fine plastic particles. These particles are then heated uniformly to mesh into a singular layer, which is then adhered to the main piece being printed. This process is very similar to laser paper printers.

POSTER #28

Dishrack Theory: The Effects of Alkanes in Parallel Orientations on Biphenyl

Isaac Z Song, Samie Watanabe, *and A.M Nishimura.*

Vapor deposited biphenyl overlayer is extremely sensitive to its molecular conditions. In these experiments, the effects of *n*-hexane, *n*-heptane, *n*-octane, and *n*-decane on the dihedral angle of biphenyl and disorder to order transformation are studied. All molecules were vapor deposited at 120 K onto an Al_2O_3 crystal and were allowed to desorb using temperature programmed desorption (TPD). It was found that *n*-hexane and *n*-octane underlayers caused biphenyl to exhibit more planar dihedral angles and to form excimers. Additionally. *n*-hexane and *n*-decane were found to create high defect site densities, likely due to the inability to form correlated molecular orientations (CMO), in the same way that *n*-octane and *n*-heptane did.

POSTER #29

A Computational Study of C-H insertion by Cationic Transition Metal-Alkyne Complexes Using Distortion Interaction Analysis and Model Systems

Logan Jackson, *Lilia Allen, Harrison Bruggeman, Rachel Lorson, and Brandon E. Haines*

The earliest known experimental precedent of gold and silver mediated C-H insertion on cyclooctyne yields two possible fused bicyclic alkenes. Reactivity for both products using IPr-Au(I) was observed, but the selectivity flipped with $AgNTf_2$. Our research used a Distortion Interaction Analysis to investigate trends in reactivity and selectivity and a series of model systems to investigate the effect of the substrate on the reaction. We found that the gold catalyst has a stronger interaction energy than the silver catalyst, and it gets stronger as the reaction progresses. An explanation for the switch in selectivity is that the silver-mediated reaction is under kinetic control while the gold-mediated reaction is under thermodynamic control. In addition, model studies suggest that the cyclooctyne reaction is favorable because of a decrease in the activation entropy as opposed to release of ring strain.

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