



Presentation Days 2000 Program and Abstracts

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Monday, April 24

8:00 a.m.-11:00 a.m.

Research Presentations

Biology - Beckman 126

9:00 a.m. **Angela Fusello: *Tyrosine Phosphorylation of a B-G Protein Family Member in a Chicken B Lymphoma Cell Line***

Gil1 is one member of a large polymorphic family of cell-surface proteins encoded in the chicken major histocompatibility complex, and is distantly related to the B7 costimulatory molecules for T cell activation. While the function of gil1 is unknown, the cytoplasmic domain contains several tyrosine residues in sequence motifs that suggest gil1 may be tyrosine phosphorylated under certain conditions, forming binding sites for intracellular signaling proteins. To determine whether these tyrosines are phosphorylated, gil1 was stably transfected into a B lymphoma cell line. Membrane proteins were extracted from stimulated and unstimulated cells, and immunoprecipitation and Western blotting were used to look for phosphorylation of gil1.

9:15 a.m. **Cynthia Tech: *Chemical Detection of Snake and Lizard Predators by the Desert Night Lizard, *Xantusia vigilis****

I examined whether the desert night lizard, *Xantusia vigilis*, can chemically detect snake and lizard predators by conducting habitat choice experiments and behavioral observations in clean and predator-marked environments. Although *X. vigilis* did not avoid predator-marked substrate, they did alter their behavior when exposed to predator scents. *X. vigilis* tongue-flicked significantly less often and spent significantly more time motionless when placed on predator-marked substrate than when on clean or cologne-scented substrate.

9:30 a.m. **Charlie Addison: *Characterizing the Temperature Dependence of Feeding, Digestion, and Growth in *Sceloporus occidentalis* and *Sceloporus magister****

In these studies I attempted to further define the temperature-growth relationship in two lizard species: *Sceloporus occidentalis* and *Sceloporus magister*. I used a temperature regimen experiment to test the results of metabolic experiments by Perkins

(1998) indicating the optimal temperature for growth of *S. occidentalis* was between 25 and 30°C. My results argue that growth rate increases with time spent at 35°C, indicating alternative advantages to maintaining an elevated body temperature. I also studied the temperature dependence of prey capture ability and post-feeding temperature selection patterns of these species.

9:45 a.m. **Katherine Winner: *Re-examining the Genus-level Taxonomy of Alcyoniid Soft Corals Using Mitochondrial DNA Sequencing***

Although soft corals are ecologically important members of marine environments, their current taxonomy, based primarily on morphological characteristics, provides little information about their evolutionary relationships. I used molecular systematics to re-examine the current soft coral taxonomy. DNA was extracted from 20 individual soft coral specimens of the family Alcyoniidae. PCR primers were used to amplify and sequence 731 bp of the NADH dehydrogenase subunit 2 (ND2) gene. Comparison of gene sequences found nucleotide substitutions, evidence of evolutionary divergence, that were used to separate species into appropriate taxonomic groups.

10:00 a.m. Break

Engineering - Galileo Foyer

9:00 a.m. **Engineering 189, "Manufacturing Principles in Metallurgy,"** is an introduction to the theory of current industrial operation emphasizing basic scientific principles. The students in this course will be displaying their finished products. The displayed items will be for sale at the discretion of the student presenters. Students: Benjamin Batres, Richard Bell, Daylan Benner, Peter Gutierrez, Jonathan Hebreo, Jason Milne, Leslie Nadeau, Anton Nausieda, Doojin Park, Steven Shepherd, Jacob Walker.

Humanities and Social Sciences - Sprague Library Ground Floor

On-Going **American Studies 179, "Print and America Culture,"** explores the ways in which print and literacy have influenced the development of American culture. As the final project for this course, six students have mounted exhibits featuring a variety of American print artifacts. These exhibits can be found on the ground floor of Sprague Library; one in each of the foyers, two near the elevator, and two in the study area just south of the elevator. The student curators are Charles Hastings, Kathryn Lain, Matthew Mattozzi, Michelle McGraw, Michael Sakasegawa, Sage Weil.

Physics - Galileo-Edwards

9:00 a.m. **Jennifer Chalfan: *Design and Construction of a Broadband Force-Feedback Seismometer***

Historically, measurements of seismic motion have been made using instruments that collect only timing information and are accurate over a narrow bandwidth. New technology allows for the creation of a more sensitive, broadband seismometer that is quantitative with respect to both time and amplitude. This presentation focuses on the trade-off between analysis and design optimization in order to optimize the broadband frequency response for an existing mechanical hardware system.

9:15 a.m. **Jason Brudvik: *Extinction Map of the Rho-Ophiuchi Cloud Core from Near Infrared Star Counts and Colors***

The beginning of stellar evolution is a very heavily studied area in modern astronomy. The life of a star begins within dense, dark clouds that inhibit view of the processes occurring within, but information can be indirectly obtained through study of the clouds themselves. By comparison of star counts and colors of the target region with an assumed dust free region, a map of the cloud and an estimation of its mass may be made. These techniques are applied to the rho-Ophiuchi cloud core.

9:30 a.m. **Christian L. Baude: *Mid-IR Investigation of Embedded Sources in the Rho-Ophiuchi Dark Clouds***

Observations in the mid-IR N-band were taken of many embedded sources in the rho-Ophiuchi dark cloud by a team from JPL. The resulting data was reduced and calibrated in order to add important 10 mm flux data to existing smaller wavelength data to produce spectral energy distributions or SED's for the embedded sources. These SED's provide observers with important information concerning the nature of the young embedded sources as a function of associated circumstellar material and as a result provide clues as to the earliest stages of evolution of pre-main sequence stellar objects.

9:45 a.m. **Chris Simpson: *Spectral Classification of Stars in the Draco Cloud***

We present here the results of an attempt to classify a program of stars in the Draco Cloud, located in the galactic halo above the plain of our own galaxy. Using a method built upon metric-based techniques of classification pioneered by Kurtz and La Sala, we developed an automated program of classifying observed stars according to their temperatures. We then compared and integrated our results with an independent, luminosity based metric classification system to verify and support our results.

10:00 a.m. Break

Mathematics - Beckman 126

10:15 a.m. **Bryan Tysinger, Carl Yu, Ben Hulse and John Kodumal**
ODEToolkit Version 2.3: Development of an Online ODE Solver

Differential equations are an integral part of the work and research of most scientists, engineers, and mathematicians. With the ODEToolkit project we seek to provide students and professionals convenient access to a robust, hands-on tool for mathematical modeling with ordinary differential equations. ODEToolkit is a web-based Java client-server application that uses the powerful LSODA solving engine to solve ordinary differential equations on most platforms. Ultimately, the team seeks to promote greater understanding of differential equations and modeling applications by the public, students, and professionals through a robust solver with an intuitive interface that is accessible to all via the World Wide Web.

a.m.

Presentation Days Address
Galileo-McAlister

Welcome and Introduction: F. Sheldon Wettack, Vice President and Dean of Faculty, and Professor of Chemistry
Keynote Speaker: "Nanoengineering" Dr. Michael J. Sailor '83, Professor of Chemistry, University of California, San Diego

In the last several years, tools to build complex structures of near-molecular dimensions have been developed. Microscopic laboratories to perform analyses at a patient's bedside or in the field; computers based on molecules that can recognize and repair mistakes in their own circuitry; and devices whose nanometer-scale structures allow them to be interfaced with human tissue for controlled delivery of drugs or as replacement body parts are being developed. This talk will review some of the advances in the area of nanotechnology, with emphasis on the interdisciplinary nature of the field and how the diverse education provided at Harvey Mudd College is an ideal preparation for researchers in this field.

Michael J. Sailor was born on May 18, 1961 in Redwood City, Calif. He received a B.S. in chemistry from Harvey Mudd College in 1983 and a Ph.D. in chemistry from Northwestern University in 1988 for work on the synthesis of organometallic metal clusters, in the laboratory of Prof. Duward R. He then did postdoctoral research studying semiconductor photoelectrochemistry with Prof. Nathan S. Lewis at Stanford and Caltech. He began his faculty appointment in the department of chemistry and biochemistry at the University of California at San Diego in July 1990, becoming associate

or in 1994 and full professor in 1996.

Is and Recognition

ailor has been an Alfred P. Sloan research fellow (1994-1995), a Camille Dreyfus Teacher-Scholar (1994), and he has been awarded the Arnold and Beckman Young Investigator Award (1993), National Science Foundation Young Investigator Award (1993-1998), and the University of California Presidential Award for Excellence in Undergraduate Research (1995). He is a world-recognized expert on nanophase materials and sensor technologies. He has served on several federal and state government advisory panels, consults to the Department of Defense and a variety of high-tech and other companies. He has made numerous television and radio appearances and has been the subject of feature articles in the Los Angeles Times, Newsweek magazine, Science News, and The Associated Press wire service.

Research

ailor's research group focuses on the chemistry of nanophase semiconductors and phosphor materials, with emphasis on molecular sensors. His group has invented detectors for explosives (TNT and dinitrotoluene detected at the ppb level) and nerve warfare agents in a project sponsored by the Defense Advanced Research Projects Agency. Demonstration of detection of physisorbed molecules by luminescence quenching led to a general purpose detector ("electronic nose") that is being developed in conjunction with the company AlphaMOS America under sponsorship of a grant from the Department of Commerce. Studies of thin films of nanocrystalline silicon led to discovery of a sensitive biosensor that is currently being developed in collaboration with TREX industries. This work was funded under a MURI grant, administered by the Office of Naval Research. Attempts to determine the mechanism of luminescence in oxidized silicate ester layers on silicon led to the discovery of luminescent silicates and silicone phosphors. These materials are attractive for their white color, ease of synthesis, low toxicity and high efficiency. A demonstration of the use of these materials in domestic lighting applications was awarded the 1999 Research Innovation Award from Architecture Magazine (in collaboration with Professor of Architecture Steven Sandford). This work is supported by the National Science Foundation.

ailor is a member of the Executive Steering Committee of the UCSD Materials Science division, and he is on the editorial boards of *Advanced Materials*, *Inorganic Chemistry Communications*, and *Chemtracts-Inorganic Chemistry*. He is the author of 5 patents and more than 70 research publications in subjects related to materials chemistry, sensors and electrochemistry. He has supervised more than 60 graduate, undergraduate and doctoral students.

noon

Lunch Break

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1:30 p.m.-4:00 p.m.

Research Presentations

Chemistry - Galileo-Pryne

1:30 p.m.

Derik A. Larson: *Synthesis of a Symmetric Photoreversible Calcium Chelator*

Biological signals are propagated through oscillations in calcium ion concentration. Controlling these oscillations could elucidate their effects on biomolecules. A symmetric photoreversible calcium chelator that would allow oscillations to be induced has been synthesized through a four step process. A Claisen-Schmidt condensation creates a symmetric nitrospirobenzopyran which is then reduced by tin(II) chloride, esterified, and hydrolyzed. The resulting tetracarboxylate has been isolated and submitted for mass spectral analysis.

1:45 p.m. Megan Hall: *Development and Testing of a Modified Bk Perturbation Theory*

A variety of methods exist to approximate ground and excited state solutions to the Schrodinger Equation. One computationally attractive method is the Bk perturbation theory, which partitions the Hamiltonian into a reference space and correlation space. Neglecting all off-diagonal elements in the second, larger block yields a method which is fast but not sufficiently accurate in its treatment of excited states. We modified this procedure using second-order perturbation theory to fully correlate certain configurations in the correlation space. This new method has the potential to be much faster than CI while retaining accuracy. Results from test calculations on ethylene are presented and compared with results from SDCI and QDVPT for this system.

2:00 p.m. Brett Anthony: *Synthesis and Characterization of Asymmetric Photoreversible Calcium Chelators*

Recent reports identifying Ca^{2+} as a second messenger have focused on its role in sustaining cellular responses to transient hormone signals. While both $[\text{Ca}^{2+}]$ pulses and oscillations are involved in cellular response mechanisms, only the former has been emulated in vivo. As the lack of compounds capable of oscillatory $[\text{Ca}^{2+}]$ control poses challenges to the elucidation of cellular response mechanisms, we have constructed a small library of photoreversible calcium chelators suitable for in vivo applications. The binding cavity, modeled after known calcium selective chelators, is incorporated into a larger photochromic spirobis (benzopyran) superstructure that confers reversibility.

2:15 p.m. Carolyn Meyers: *Synthesis and Examination of a Symmetric Alpha-Branched Carboxylic Acid and Its Copper (II) Metallomesogen*

An alpha-branched carboxylic acid, 2-decyldodecanoic acid, was synthesized via a malonic ester synthesis. The acid was reacted by metathesis with copper (II) acetate to form tetrakis-(μ -(2,2-(didecyl(acetato))-O,O) bis-[copper(II)] (copper (II) didecyl acetate). Copper (II) didecyl acetate exhibits at least one mesophase. By contrast to the dioctyl acetate analog, which exhibits only a metastable D(ho) phase, the didecyl compound appears to have an enantiotropic mesophase and possibly another metastable mesophase. Interestingly, the 2-decyldodecanoic acid also appears to exhibit an enantiotropic liquid crystalline phase.

2:30 p.m. Break

Chemistry Poster Session - Galileo Foyer

2:30 p.m. Chemistry Research Posters Presented at the American Chemical Society Meeting

Student Presenters are:

Sara Avrantinis: *Transition State Topologies of the Amide-Acetal Claisen Rearrangement for Acetals of Cyclic Amides*

(please see abstract Wednesday, April 26 at 9:30 a.m.)

Jeanie Noelle Connor: *Spectroscopic Characterization of Cyclodextrin Host-Guest Complexes*

(please see abstract Wednesday, April 26 at 10:30 a.m.)

Jennifer Godwin: *Piezo-Optic Coefficients Measured by a Michelson Interferometric Technique for Binary Mixtures of Water and Miscible Alcohols*

Piezo-optic coefficients, $(dn/dP)_T$, the change in refractive index with pressure at constant temperature, were determined for

binary mixtures of methanol, ethanol, propanol, iso-propanol, and tert-butanol in water at several mole fractions using Michelson interferometric techniques. Refractive indices of the solutions were measured to one part in 10^5 at temperatures from 10C to 45C. Little dependence on temperature was found for $(dn/dP)_T$ values, but they monotonically increased with mole fraction of alcohol. Descriptions of the excess $(dn/dP)_T$ functions show negative values for methanol compositions at 25C, and methanol and ethanol at 45C. As temperature decreased and density increased, the changes in refractive index with composition were larger. Refractive indices of the solutions showed a maximum above the refractive index of either of the pure materials that shifted towards the alcohol-rich compositions as the size of the alcohol molecule increased. Excess refractive indices showed a positive maximum moving towards water-rich compositions as the size of the alcohol increased.

Brett Anthony Helms: *Synthesis and Characterization of Asymmetric Photoreversible Calcium Chelators*

(please see [abstract](#) Monday, April 24 at 2:00 p.m.)

Mark Edward Huberty: *Synthesis of Novel N-Ribohydrolase Mimics*

(please see [abstract](#) Wednesday, April 26 at 9:00 a.m.)

Jason Wesley Lappe: *Theoretical Studies of the 2_1A_g State of Trans-1,3-Butadiene*

The excitation energy of the 2_1A_g state of trans-1,3-butadiene is examined using a variety of ab initio electronic structure techniques. While analogous states have been shown to be the lowest singlet excited states for all longer polyenes, for butadiene the position of the 2_1A_g state relative to the HOMO LUMO excitation (1_1B_u) has been difficult to establish theoretically. We employ a variety of methods (CASSCF, CASPT2, MRSDCI, QDVPT) to examine both the vertical and adiabatic excitation energies for this state. At the ground state geometry the vertical excitation energies obtained by CASPT2 and Davidson-corrected MRSDCI for the 2_1A_g state differ by approximately 0.15eV, but all of the methods predict that the 2_1A_g has a lower 0-0 excitation energy than the 1_1B_u state. Possible reasons for the discrepancies between the various methods for the vertical excitation energy are discussed.

Carolyn Meyers: *Synthesis and Examinations of a Symmetric Alpha-Branched Carboxylic Acid and Its Copper (II) Metallomesogen*

(please see [abstract](#) Monday, April 24 at 2:15 p.m.)

Elizabeth Schoene: *Density-Temperature Studies of Two Analogous and Homologous Series of Calametic Mesogens: Trans-4-Ethoxy-4'-Alkanecarbonyloxyazobenzenes and Trans-4-Ethoxy-4'-Cycloalkanecarbonyloxy Azobenzenes*

Volume data for the nematic and isotropic phases for the series of trans-4-ethoxy-4'- alkanecarbonyloxyazobenzene, for the alkane chain carbon # = 5 to 14 and trans-4-ethoxy-4'- cycloalkanecarbonyloxyazobenzene for ring carbon # = 3 to 9, were fit to a specially derived power law in T. A packing fraction was calculated for values of T. The packing fraction which depended on a modeled volume was calculated using the program Physical Properties Pro and increased as the carbon # increased at fixed T but decreased as T increased. Volume at fixed T for the linear series increases linearly with carbon # while for the cyclic series, the increase is less than expected suggesting the rings assume an elliptical shape as the ring carbon # increases.

Martin Smith-Martinez: *Monte Carlo Simulations Using a Gay-Berne Potential Seeking Liquid Crystalline Behavior in Binary Mixtures of Ellipsoids and Spheres*

Mesogenic behavior is observed in simple systems of ellipsoidal particles subject to a Gay-Berne potential. To further understand the behavior of mesogens, mixtures of ellipsoidal and spherical particles were modeled using the Gay-Berne potential. The same procedure used by Gay and Berne to derive the energies of interaction of ellipsoidal particles was used to calculate the parameters required in the new type of interaction represented by ellipse-sphere as well as sphere-sphere and ellipse-ellipse interactions. Existing computer code was modified to accommodate the presence of spherical particles. [1] The simulations were run at constant pressures and temperatures, for varying relative concentrations of ellipses and spheres in orde

to discover the binary phase diagrams.

[1] M.A. Bates Ph.D. Thesis, University of Southampton, 1996.

Stacey Thonstad: *Spectroscopic Characterization of Microdomains within Dendrimer-Surfactant Supramolecular Assemblies*

We have constructed supramolecular structures via electrostatic interactions of Starburst poly(amidoamine) dendrimer macromolecules with anionic surfactants in aqueous solution. Varying the dendrimer generation and surfactant chemical structure creates microenvironments within the dendrimer-ligand complex that enhance encapsulation of small guest molecules. Domains of varied architecture, dimension, and hydrophobicity have been generated with surfactants of different alkyl chain length and structure. We detect the creation of these microenvironments with a neutral fluorescent probe that exhibits an emission wavelength sensitive to the polarity of its surroundings. Populations of probe molecules within the microregions of the dendrimer-surfactant supramolecular complex are distinguished by the characteristic emission wavelengths of the overlapping Gaussian functions comprising the overall fluorescence spectrum.

Eric Vinson: *Theoretical Studies of Correlation Effects on the Electronic Coupling Element for Electron Transfer Reactions*

Basis set and electron correlation effects are examined on the electronic coupling element using Hartree-Fock and Coupled Cluster theory. Initial investigation of IPs of water are used to determine adequate basis sets and level of electron correlation. The electron transfer matrix element of $1 e^-$ transfer in Be^{2+} was then calculated using the same methods. The dependence of the coupling element on distance, basis set, and electron correlation is examined. The Be^{2+} system is further investigated with one or more intervening waters. The dependence of $1 e^-$ transfer on distance, basis set, and electron correlation is shown over varying distance with a single water and with the insertion of multiple waters between the Be's. The coupling element for Be^{2+} with intervening water is shown to be sensitive to the level of e^- correlation used.

Wun K. Wong: *Orientation of Azo Dyes on Cationic Dendrimer Surfaces*

(please see [abstract](#) Wednesday, April 26 at 10:45 a.m.)

Humanities and Social Sciences - Galileo-Edwards

1:30 p.m. **Humanities 2b, "The Book in Western Culture,"** examines the history of books as aesthetic objects, symbols of political and economic status, and disseminators of cultures and ideas. In the second half of the semester, students working in groups were assigned an artifact (one of two illuminated manuscripts, an early printed book, or a set of three nineteenth- and twentieth-century illustrated books), which they subsequently researched, wrote about, and described in a series of web pages. Their presentations today will detail their research by displaying those pages. Each group will make a separate, ten-minute presentation. Questions about the presentations will be taken at the end of the session.

Group 1: Jonathan Faul, Daniel Gianotti, Dmitriy Kogan, Carl Larsen, Nathaniel Stern

Group 2: Melissa Chase, John Cloutier, Joseph Friesen, Ross Richardson, Jeffrey Werbin

Group 3: Daniel Beutel, Charles Bradford, Anna Olsen, Michael Price, Knut Strom-Jensen

Group 4: Micah Garside-White, Amanda Parmelee, Brett Rosen, Christopher Toms, Norimasa Yoshimizu

Mathematics Senior Thesis Presentations - - Beckman 126

1:30 p.m. **Philip L. Martin: *Optimal Expected Values for Cribbage Hands***

The game of Cribbage has a complex way of counting points in the hands that are dealt to each player. Each player has a choice of what cards to keep and what cards to throw into an extra hand, called the crib, that one of the players gets to count towards his score. Ideally, you could keep the most points possible in your hand and your crib, or, conversely, the most points in your hand with the fewest points in your opponent's crib. To add to the fun, a final card is randomly chosen that all three hands share. This thesis deals with finding optimal expected values for each player's hand and the crib.

2:00 p.m. **Joel Miller: *Rates of Convergence to Self-Similar Solutions of Burgers' Equation***

Burgers' Equation, $u_t + uu_x = \nu u_{xx}$, is a nonlinear partial differential equation which arises in some models of fluid or traffic flow. It is one of the simplest such equations. We consider the long-time behavior of solutions to exponentially localized initial conditions, analyzing the rate of convergence to a known self-similar, single hump solution. We use the Cole-Hopf transformation to convert the problem into a heat equation problem with exponentially localized initial conditions. The solution to this problem converges to a gaussian. We then find the optimal gaussian approximation which is accurate to order $1/t^2$. Transforming back to Burgers' Equation again yields an approximation accurate to order $1/t^2$. This improves on previously published results by a factor of $1/t$.

2:30 p.m. **Break**

2:45 p.m. **Yinan Song: *Lattices and Their Rotational Symmetries***

A planar lattice can be visualized as a way of tiling the plane by identical parallelograms. A planar lattice can also be defined as the set of all integer linear combinations of two linearly independent vectors and n -dimensional lattices can be defined similarly. Some lattices are invariant under rotations, i.e. the lattice after a rotation coincides with the original lattice. Based on the results by H.S.M. Coxeter, we can give a complete description of all the lattices that are invariant under some rotations.

3:15 p.m. **Ryan Haskett: *Examples of Volume-Preserving Great Circle Fibrations of S^3 Kafka's Geometric Nightmare***

This summer Herman Gluck and Weiqing Gu proved the last step in a process that took conformal maps between two complex spaces and related them to Volume-Preserving Great Circle Fibrations of S^3 . Fibrations are flows that do not self-intersect. The purpose of the research was to look at how these fibrations break down. We obtained the fibrations by applying the process to different conformal maps then calculated the angles where they intersect. This talk centers around the developments in the method for converting the conformal maps and finding the critical angles. Finally, it will take a look at the problems with the visualizations that plague the final step of this thesis.

3:45 p.m. **Michael Lauzon: *Reconstruction of Convex Bodies from Three Point Source X-Rays***

It has been shown that a convex body in the plane is uniquely determined by X-rays from three points. Several methods of reconstructing a convex body from X-ray data are discussed. Proofs that the methods given completely reconstruct the convex body are given for some special cases.

Computer Science - Galileo-Edwards

2:45 p.m. **Seth Heidkamp: *Self-Organization and the Appearance of Emergent Behavior***

The creation of complex, flexible, and robust behaviors is a desirable goal in many fields. We will examine multi-agent systems where complexity arises through undirected interactions and systems where desired group behavior is specified, but little or no constraints are placed on how the goal is achieved.

3:00 p.m. Greg Rae: *The Shortest Superstring Problem*

Given a set of strings, the Shortest Superstring Problem asks to find the shortest possible string that contains all strings in the set. This problem is known to be NP-complete, and there are two heuristics in common usage. Both of these heuristics were conjectured to find a solution no longer than twice the optimal solution. We have found a counterexample to this conjecture for one of these heuristics. We are looking into tightening the performance bounds for these heuristics.

**3:15 p.m. Dave Beydler, Nathan Field (Team Leader), Josh Hoyt, Dave Meyer (Team Leader), Roy Shea:
*DAVE - Distributed Asynchronous Virtual Environment***

We created a library to support all functions necessary to create a networked, real time, distributed virtual environment. To do this we wrote a set of libraries to support asynchronous network communication, methods of representing virtual 3D objects, client side prediction of object position in a virtual world, and methods of dealing with user input. We will also have a demonstration of an application of our project at the end of the talk.

3:45 p.m. Computer Science 155, "Computer Graphics." In this class we implement many of the fundamental algorithms used in computer graphics. We also use OpenGL to create 3D interactive graphics programs. The students will give 5-minute demonstrations of their final projects for the course.

Students: Hans Hagberg, Jared Jackson, Star Roth, Mike Samuels, Michelle Velea, Matthew Wong, Carl Yu, Levi Scoggins, Todd Southworth.

.m.-5:30 p.m.

Clinic Presentations

Classrooms, Galileo Halls, and Labs

10:00 a.m. Break

10:15 a.m. Marja M. Fox: *Synthesis of a Tridentate, Aspartic Acid Derived Ligand for Use in the Study of Chiral Transition Metal Complexes*

Transition metal complexes which contain four differentiated donor atoms are chiral in a fundamentally different way than the well-studied C_2 -symmetric complexes. These compounds may prove invaluable in their ability to promote highly-selective stereospecific reactions. Prior to catalytic studies, however, a fundamental question regarding the stability of such complexes must be addressed. In order to measure the rate of racemization of a chiral metal, a convenient, tridentate ligand has been developed. Design criteria and synthetic methods will be presented.

10:30 a.m. Jeanie Noelle Conner: *Spectroscopic Characterization of Cyclodextrin Host-Guest Complexes*

Cyclodextrins are water-soluble macromolecules composed of glucopyranose units. The fluorescent probe Prodan is a molecule with an affinity for the hydrophobic cavity of cyclodextrins and a sensitivity to the polarity of its microenvironment. Deconvoluting the emission spectra of Prodan suggests the formation of a 1:1 host-guest complex and dimerization of this complex. Using temperature-dependent studies we have characterized the thermodynamics of complex formation to suggest cyclodextrin substitution patterns that enhance Prodan encapsulation and favor dimerization of 1:1 inclusion complexes.

10:45 a.m. Wun K. Wong: *Orientation of Azo Dyes on Cationic Dendrimer Surfaces*

The goal of this research is to examine how azo dyes aggregate on the surface groups of Starburst Dendrimers. The method used is the attachment of anionic azo dyes to the protonated primary amine groups at the Dendrimer surface. The proximity of the aromatic rings on the dyes causes changes in absorbance spectra. Blueshifts in the absorption spectrum can be explained by H-aggregate formation (aromatic rings stacked like pancakes), redshifts by J-aggregation (aromatic rings side by side in orientation). Our hypothesis for the way the dyes stack is that hydrophobic groups on the dye encourage H-aggregation, while hydrophilic groups encourage J-aggregation.

11:00 a.m. Jody Hamilton: *An Investigation of the Role of the Cation- π Interaction in Protein Folding*

The cation- π interaction is an electrostatic attraction between a cation and the electron-rich π face of an aromatic ring. Because cationic and aromatic side groups are found in natural amino acids, the interaction should influence protein folding. The goal of our research is to characterize the cation- π interaction in the protein BPTI. To do so, we must synthesize BPTI mutants via solid-phase peptide synthesis and native chemical ligation, and assess their thermal stability.

11:15 a.m. Derek Shon: *Synthesis of an Intercalating Chaperone Molecule for Primitive RNA Replication*

Phthalocyanine-like structures found in nature possess important biological applications: photosynthesis (chlorophyll) and metabolism (cytochrome c). A recent theory in molecular evolution proposes that a phthalocyanine may function as a nucleic acid "midwife" in a primitive form of RNA replication under prebiotic conditions. Methylated forms of multisubstituted 2,3-pyridinoporphrazine were synthesized by a 5 step synthetic procedure from 2,3-pyridinedicarboxylic acid: formation of the methyl ester, ammonolysis of the esters to form the bis-amide compound, dehydration of the amides to form the dicyanopyridine, which was then used in a high-temperature cyclization reaction to form the phthalocyanine, which was subsequently methylated to yield a cationic species (30% yield overall). All compounds were characterized by ^1H NMR, ^{13}C NMR, and IR spectroscopy. Separation of mono-, di-, tri- and tetra-substituted cationic species was explored using gel electrophoresis and reverse-phase chromatography techniques.

Humanities and Social Sciences - Galileo-Edwards

9:00 a.m. **Jason Brudvik: *A "Girl" is Less Than a "Woman" Effects of Female Terms on Impressions of an Individual***

This study investigated how the use of the term "girl" versus "woman" to refer to an individual affects how people perceive individual. College students read a sentence, in which the actor was referred to either as a girl or a woman. Then they wrote brief paragraph about the actor and rated her on a number of adjective dimensions. Results showed that subjects perceived t girl as being younger, more likely to be a student, and possessing less positive qualities than the woman.

9:15 a.m. **Megan Hall: *Perceptions About and Experiences of Women in Science***

Two studies investigated factors that might affect women's representation in science. In the first study, freshmen and seniors Harvey Mudd rated their impressions of men, women, and scientists, attributions for their own successes and failures, their experiences in college, and their goals for the future. The second study involved observations of professor-student interactio in the classroom.

9:30 a.m. **Ryan Haskett: *Differences in Teaching Toward Remedial and Advanced Students of Mathematics***

Theory on teaching students of different mathematical ability describes well the problems teachers face when working with these two extreme groups. However, the authors often provide only vague and simplistic solutions to the problems educator face. This presentation examines these problems and their possible solutions using observational anecdotes from mathemati classes at Claremont High School.

9:45 a.m. **Philip Martin: *J.R.R. Tolkien - The Man, The Myth, The Half-Course***

J.R.R. Tolkien is widely considered to be the founder of modern fantasy literature. Given the popularity of his works and th impact on other authors, Tolkien's writings deserve concentrated critical attention. I exercised the Humanities and Social Sciences senior experience option to organize and teach a half-course (under the supervision of Professor Groves) on Tolkien. In this talk, I will discuss my senior experience and some of the major critical discussions that developed in the course.

Mathematics Senior Thesis Presentations - Beckman 126

9:00 a.m. **Elisha Peterson: *Generalizing Sperner's Lemma***

In this talk, we demonstrate a proof of a generalization of Sperner's Lemma, a well-known combinatorial theorem. The Lem states that in a triangle subdivided into several smaller triangles and labeled according to a specific set of rules, there will be odd number of triangles with a certain special labeling, known as "fully-labeled triangles." The generalization expands this t polytopes, which are the equivalent of polygons in an arbitrary dimension. In this case, if the polytope has n vertices and is k dimensional object, there will be at least $(n-k)$ fully labeled simplices.

9:30 a.m. **Otto Cortez: *Brownian Motion and Planar Regions - Constructing Boundaries from h-Functions***

The "h-function" of a planar region captures some geometric information about the shape of the region. Given a region in th complex plane and a basepoint z_0 in this region, we define its h-function by letting $h(r)$ be the probability that a Brownian particle wandering randomly away from z_0 first hits the boundary of the region within distance r of z_0 . Conversely, given a suitable function $f(r)$, can one construct a region whose h-function is $f(r)$? We outline a method for constructing bounded, simply connected regions from their h-functions using converging sequences of simpler regions. We also give an example o

sequence of regions, converging to a limit region - the "Artichoke Theorem."

10:00 a.m. Break

Mathematics and Interdisciplinary Competitions in Modeling Presentations - Beckman 126

10:15 a.m. LNathan Cappallo, Daniel Osborn and Timothy Prescott
Elephant Population Control
Outstanding Citation Interdisciplinary Competition in Modeling

A national park wants to maintain a stable population of elephants; previously this was accomplished by removing whole herds which is now infeasible. The park is interested in how a newly developed contraceptive dart might be used for population control. We used a matrix to model the effects of darting on the elephant population in an easily generalized approach. We found that removal was a cheaper solution, as elephants need to be redarted every few years.

10:45 a.m. Deborah A. Chun, Colin E. Little and Cameron W. McLeman
A Study of Aircraft Complexity: A Salute to Tin Pushers Around the World
Meritorious Citation - Mathematical Competition in Modeling

In order to simplify management of air traffic controllers we present a method to analyze the complexity of the job and how it relates to stress factors. We designed an algorithm to determine the complexity of an air sector at any given time. Multiplying this by a workspace stress component and integrating over time indicates how much stress a controller has endured. In this way a radar controller can determine when a member of her team should be relieved for the day, before a potentially dangerous event occurs.

11:15 a.m. Gregory Rae, Peter Boothe and Josiah Hoy
A Model for Improving Wireless Frequency Utilization
Meritorious Citation - Mathematical Competition in Modeling

In order for a cellular network to function, the devices connected must know which transceiver to contact. If each cell of the network used the same frequency, there would be no division between cells. Thus, for a cellular network to be effective, no adjacent cells can use the same frequency. This presents a problem because the company must then obtain a larger range of spectrum in order to service an area. We present a model that optimally utilizes the spectrum subject to multiple constraints and then extend that model to cover some common cases that arise in practice.

Physics - Galileo-Edwards

10:15 a.m. Aaron Edens: *Second Harmonic Generation in Silicon - A Separation of the Bulk from the Surface*

The direct experimental separation of surface and bulk contributions to second harmonic generation (SHG) in centrosymmetric materials is difficult. The SHG from a silicon layer of smoothly varying thickness exhibits a dip with increasing layer thickness, from which we deduce the relative strength and phase of surface and bulk contributions.

10:30 a.m. Charles Hellings: *Second Harmonic Generation in the Non-slowly-varying-amplitude Regime*

We numerically solve the nonlinear field equations to simulate second harmonic generation by laser pulses in a nonlinear medium without making the usual slowly-varying-amplitude approximation, an approximation which fails when either ultrashort laser pulses or laser pulses of moderate intensity are used to drive a nonlinear process. We show that the generative

of forward propagating second harmonic light is significantly affected under these conditions, and that a backward travelling second harmonic wave is created. The backward travelling second harmonic wave is large enough to be detected, and can therefore be used to quantify the breakdown of the slowly varying amplitude approximation in a nonlinear interaction.

10:45 a.m. Jason A. Berry: *Examining Magnetic Domains in Silicon/Cobalt Structures with Magnetic Force Microscopy*

I will present the magnetic domain structures of cobalt pads deposited on silicon, and discuss the effect of these domains on spin-polarized electrons moving through the samples. I investigated the magnetic domain structures through the use of Magnetic Force Microscopy, and present a thorough explanation of the principles that underlie the function of a Magnetic Force Microscope.

11:00 a.m. Tiffany Arnal: *Schottky Barriers: When Metal and Semiconductor Meet*

I will present some background theory on the potential barrier which arises at a metal-semiconductor interface, in particular the cases of chromium on intrinsic silicon and cobalt on doped silicon. I will discuss how this affects current traveling across combination of these interfaces.

11:15 a.m. Justin Radick: *Oscillation Motion: Patterns in the Sand*

An oscillation is a stable, localized excitation in a vibrating layer of granular material. A driven layer of sand can host many these excitations, resulting in interference between oscillations and very distinct vibrating patterns. This project focuses on the relation of these patterns to such parameters as driving frequency and amplitude, the shape of the vibrating surface and material type. The results are visually appealing.

Lunch Break

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2:00 p.m.-4:00 p.m.

Research Presentations

Biology - Beckman 126

1:30 p.m. Katherine Parker: *Characterization and Genetic Mapping of a Lateral Root Mutant in Arabidopsis thaliana*

We have identified a single recessive mutation affecting lateral root development in *Arabidopsis thaliana*. Plants with this mutation have fewer lateral roots, but also a shorter primary root than wild-type plants. However, mutant plants also have a reduced number of lateral roots per centimeter of primary root length. The plant hormone auxin is needed for lateral root initiation. This mutant resembles known mutants that are deficient in their auxin response by having fewer lateral roots than wild-type plants and small, curled-under (epinastic) leaves. When treated with exogenous auxin, this mutant dramatically increased its number of lateral roots, demonstrating its ability to respond to auxin. Our results suggest that this mutant may underproduce auxin. To better define this mutant we are examining its response to different forms of auxin and using PCR to map the location of the mutant gene.

1:45 p.m. **Elise Lawson: *The Role of merE in Mercury Resistance Conferred by the mer Operon of the Transposon Tn21***

The mer operon of the transposon Tn21 confers mercury resistance in bacteria. Six genes in this operon are well characterized but the function of a recently discovered seventh gene, merE, remains unknown. Plasmids containing the Tn21 operon with and without the merE gene were constructed to assess the importance of merE in mercury resistance in Escherichia coli.

2:00 p.m. **Houston Gilbert: *Characterization of Mercury Resistance in Bacillus sp. Marine Environmental Isolates***

The mer operon confers bacterial mercury resistance by encoding an enzyme, mercuric reductase, that reduces Hg(II) to volatile Hg(0). While several mer operons from terrestrial bacteria are well-characterized, DNA from marine species shows little homology with terrestrial mer genes. A modified X-ray film volatilization assay was used to detect mercuric reductase activity in fifty marine isolates. DNA from nine Bacillus isolates displaying volatilization activity was used in PCR reaction to amplify a mercury resistance determinant.

2:15 p.m. **Filip Vanevski: *Yeast 2-Hybrid Screening for Chromosomal Factors Interacting with Bacterial Mercury Resistance Proteins MerA and MerR***

The roles of plasmid-encoded mer proteins in bacterial mercury resistance are reasonably well understood, but little is known about the role of chromosomally encoded proteins. I used the yeast 2-hybrid system to detect E. coli chromosomal proteins that interact with the mer proteins MerA and MerR. In this system two test proteins are linked to two domains of a yeast regulatory protein so a reporter gene will be activated if the test proteins interact.

2:30 p.m. **Break**

2:45 p.m. **Kim Espinoza: *Theoretical Studies of the Electronic Coupling Element for Electron Transfer Through Flexible Amino Acid Chains***

This study was undertaken to investigate the distance dependence of electron transfer through flexible amino acid chains. The electronic coupling element (H_{ab}) for electron transfer was examined for the model system Pyr-(Ala) $_n$ -DMPD. Thermally accessible conformations of the molecule were determined using molecular dynamics simulations at 300K for approximately 100 ps for each system. Individual frames from the simulations were chosen and H_{ab} was calculated using the INDO/S method of Zerner and coworkers and the Generalized Mulliken Hush Method. The electronic coupling element showed significant variation with conformation but yielded an overall exponential decay rate with distance. This decay was greater than has been estimated experimentally by Jones and coworkers (J. Phys. Chem. B. Vol 103: 572-581, 1999).

3:00 p.m. **Jerry Tolzman: *Modification of a Plasmid Containing a Glyceraldehyde-3-Phosphate Dehydrogenase (GAPDH) Sequence for Facilitated Isolation and Analysis of the GAPDH Enzyme***

A plasmid which contained the GAPDH sequence from Escherichia coli was modified to include a 6xHistidine tag and TEV protease site in order to simplify isolation and analysis. The plasmid can be further modified using site-directed mutagenesis to alter Cys³¹⁷, an amino acid near the active site that may play a role in the enzymatic activity.

Computer Science - Galileo-Edwards

2:00 p.m. **The Harvey Mudd College Robotics Design Team: *Semi-Autonomous, Six-Legged Robot***
Team Members: Dave Beydler, Shantanu Bhattacharyya, James Brooks, Andrew Cosand, Ross Luengen, Eric Ong, Kevin

Ota, Carl Russell, Pete Scheidler, Chuck Schied, Ben Schmidel, Jeff Stoll (Team Leader), Eugene Tsimberg

The Harvey Mudd College Robotics Design Team has designed and is building a semi-autonomous robot capable of real-world interaction. The robot will be controlled through a Java simulator and be capable of interacting with its environment. In April the team will compete in the SAE Walking Machine Decathlon.

Humanities and Social Sciences Photography Exhibit and Poster Session - Galileo Foyer

2:00 p.m.

Art 198: "Independent Study in Black and White Photography Exhibition"

Tiffany Arnal, Jason Berry, Jennifer Chalfan, Otto Cortez, Christopher Moore

These students will exhibit a selection of their best black and white photographic work from this semester. They have been using personal camera equipment and the ASHMC darkroom in conjunction with a graded assignment schedule, meeting every other week to critique their work. Assignments have covered black and white contrasts across the gray scale, spatial depth, elements of composition, lines and textures, and portrait concepts. Each exhibit will include a statement of personal interest and objectives.

Psychology 165: "Topics in Child Social Policy"

The students in Psychology 165, "Topics in Child Social Policy," will present empirical and/or literature research on current issues about education, violence, and other societal issues pertaining to children and youth. The following posters will be presented:

Sahana Baker: *Do Race, Class, and Gender Play a Role in Career Aspirations? A Study of Elementary School Children in Claremont*

Amy Bentow: *A Review of Bilingual Education*

David Herman: *How You Can Help Volunteer Opportunities Available to College Students*

David Park: *An Evaluation of the LA Unified School District's Magnet Program*

Greg Mulert: *A Statistical Survey of Media Coverage of Youth Crime and Child/Youth Social Problems*

Michael Ragudo: *How College and High School Students Rank the Importance of Current Social Problems*

Bobu Uche: *An Investigation of the Retention of Under-represented Students at HMC and Other Claremont Colleges*

Psychology 108: "Social Psychology"

Small Group Research Projects

Social psychology is concerned with how social situations influence an individual, and how an individual's perceptions of other people affect their social behavior and interactions. In this class, students generated specific research hypotheses about social behavior. Then, they worked in small groups to design and conduct experiments to test their hypotheses. Students: Lucas Baker, David Beydler, Aaron Boyer, Adam Bush, Zai Chang, Lance Curry, Caitlin Devereaux, Katherine Drew, Adi Drost, Brad Forrest, Matthew Gay, Glenn Gebhart, Jordan Goulette, Megan Hall, Courtney Hoshibata, Thomas Johnson, Neel Joshi, Alvin Kou, Malinee Krailas, Christopher Lee, Drew Levin, David Levitt, Eric Lin, Justin Lyon, Moh Malek, Amanda Malo, Katherine Marlink, Ben Martin, Matthew Mattozzi, Richard McKnight, Antonio Medrano, Tina Meftah, Elizabeth Millan, / Moradi, Tadashi Nagao, Carman Ng, Ari Nieh, Justin Okano, Seema Patel, Loren Perelman, Myya Perez, James Perry, Kat

Ray, Ben Schmidel, Daniel Smith, Michael Tapper, Cynthia Tech, Richard Trinh, Andrew Walker, Carissa Wecker, Emily Williams, Katherine Winner.

Engineering Design Presentations - Galileo Hall

1:30 p.m.
Pryne

Design of Lighting for Art Glass in a Museum

Sponsor: Redlands Historical Glass Museum

Liaison: Loretta Beres

Faculty Advisors: Mary Cardenas, Patrick Little, James Rosenberg

Original Problem Statement: The Historical Glass Museum in Redlands, California is looking for new lighting for the display cabinets that were made for the museum. They presently have strip lighting. The strip lights are burning out and are expensive to replace, requiring an electrician to install them. The new lighting should be economical and provide for easy replacement. The lighting should also be cool so as not to damage the exhibit pieces of glass on display. The lighting intensity should be adjustable for the different types of glass on display. For instance, the cut crystal reflects light beautifully, while the opaque glass like the chocolate glass does not. We are seeking a design that addresses all these concerns.

Team 1: Brie Finger, Trevor Gile, Brett Rosen, Aaron Stratton

Team 2: Morgan Cross, Joe Friesen, Carl Larsen, Ivan Samuels

Team 3: Matt Keller, Adam Lutchansky, Trevor Oliver, Galway O'Mahony

Team 4: Keith Buerger, David Diaz, Daniel Vaughan

1:30 p.m.
McAlister

Design of a "Visual Stethoscope"

Sponsor: Western University

Liaison: Brenda Premo

Faculty Advisors: Mary Cardenas, Patrick Little, James Rosenberg

Original Problem Statement: A doctor has recently begun to lose her hearing capability. She needs a stethoscope which will visually display the signals currently transmitted as sounds so that she can continue to diagnose patients.

Team 1: Jordan Kwan, Adam Mills, Florence Shaffer, Naomi Tomimatsu

Team 2: Gigi Au, Claire Edwards, Donald Lawton, Jason Norman

Team 3: Colin Choi, Ryan Crie, Raymond Fong, Peter Lamb

Team 4: Erica Halpern, Erin Koos, Michael Linderman, Karen Studarus

2:30 p.m.

Break

3:15 p.m.
Pryne

Design of a Ventilation System for an Art Gallery

Sponsor: dA Center for the Arts

Liaison: Joanie Weldon

Faculty Advisors: Patrick Little, James Rosenberg

Original Problem Statement: dA Center for the Arts is a site that is used by groups of adults and children. The space is used for exhibits, classes, performances, and poetry readings. The problem with the space is that there is no adequate ventilation. The only fresh intake is to open the front double doors. The space is enclosed on three sides and the ceiling by other building. There is no a.c. or heat. There are windows and double doors in the front of the building. There is a series of small sealed windows over the large windows. The dA Center for the Arts needs an inexpensive procedure to provide fresh air throughout the space.

Team 1: Micah Garside-White, Knut Strom-Jensen, Gautam Thatte, Chris Zarzana

Team 2: Nils Napp, Mark Phair, Kristal Pollack, Jennifer Sherman

3:15 p.m.
McAlister

LDesign a Method to Reduce Tremor in Laryngeal Surgery

Sponsor: Beckman Laser Institute

Liaison: Brian Wong

Faculty Advisors: Mary Cardenas, Patrick Little, James Rosenberg

Original Problem Statement: Surgeons who perform vocal cord surgery currently use microlaryngeal instruments, which must be performed at a distance of some 12-14 inches to operate on surfaces with very small structure (1-2 mm). The tremor of the surgeon's hand can become quite problematic at this scale. A mechanical system to stabilize the surgical instruments is required. The stabilization system must not compromise the visualization of the vocal cords.

Team 1: Thomas Both, Genevieve Breed, Chris Stratton, Kristen Van Horn

Team 2: Stephanie Chan, Ryan Ellis, Micah Hanada, Judy Hsu

Team 3: Yannos Saravanos, Justin Schauer, Clifford Wassman

Team 4: Lance Feagan, Tom Galvani, Shannon Kelley, Markus Ong

Humanities and Social Sciences - Garrett House

7:00 p.m. Music Recital at the Garrett House Featuring New Compositions:

Quartet with Alap by Masashi Ito

Clusters by Bryan Tysinger

Perspectives on The People vs. Senator Guhl by Justin Radick

Music performances by Eric Huang, Jon Erickson and Mika Waller.

Dessert reception will follow the recital.

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