College of Natural Sciences and Mathematics
Annual Student Research Symposium
Posters presented at 2:00 p.m., May 5, 2000 in Main Hall

TITLES

Department of Biology

Screening an Arkansas Plant, *Sesbania exaltata,* for Antitumor Activity Using the Crown Gall Tumor Bioassay
Alison Acott
(Faculty Mentor: John S. Choinski, Jr.)

Enterocyte Volume Regulation in Nutrient-absorbing *Aplysia* Intestine
David Moore and Robert Keeton
(Faculty Mentor: Mike Moran)

Role of Intracellular Acidification of Cultured Cells in Resistance to Dying
Sarah Holloway
(Faculty Mentor: Steven W. Runge)

A Comparison of Apoptotic Induction in Aplysia californica and the Sprague-Dawley Rat
DeLynn Holleman and Jill Jaggers
(Faculty Mentor: Steven W. Runge)

Role of jun-N-terminal kinases in Acid Induced Apoptosis
Kelly Johnson (Faculty Mentor: Steven W. Runge)

A novel mouse model for measuring macrophage cytotoxic activity during Paclitaxel-based chemotherapy.
Dru S. Dace
(Faculty Mentor: Thomas M. Walker)

Department of Chemistry

Overcoming the kinetic stability of a nickel-cysteine center by alkylation.
Andrea L. Phelps
(Faculty Mentor: Patrick J. Desrochers)

Chemical Water Quality Assessment of Tucker Creek
Tracey Daugherty, Krista Reynolds, Taimur Shaikh, Elizabeth Stafford, and Nathan Twaddle.
(Faculty Mentor: Jeffrey Draves)

Sediment Sample Analysis of Tucker Creek
Student: Mark Kottmyer, Jody May, Brendan McAuley, and Brandi Thompson.
(Faculty Mentor: Jeffrey Draves)

Cavity Ringdown Laser Absorption of the $\nu_7 + \nu_8$ Combination Band of Ethylene
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State-specific studies of gas-phase organometallic reactions involving Cu^+ and Au^+
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Department of Computer Science

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(Faculty Mentors: Harold Forbes and Amelia L. Barile)

Department of Mathematics

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(Faculty Mentors: George Bratton and Suzie Booher)

Peano Curves and Arclength
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(Faculty Mentors Larry Huff and David. Peterson)

Department of Physics and Astronomy

Mountains on the Moon
Susan Erwin
(Faculty Mentor: Tod Ramseyer)

The increasing luminosity of CI Camelopardus
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CI Camelopardus
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Acoustical and Non-Acoustical Measurement of Porous Properties
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(Faculty Mentor: Carl Frederickson)

Acoustic scattering from buried objects in shallow water environments
Brian R. Lemon
(Faculty Mentor**:** Carl Frederickson)

Study of Direct Capture in $^{26}Mg(p,\gamma)^{27}Al$
Mark Denton
(Faculty Mentor: Gaylon Ross)

ABSTRACTS

Department of Biology

Screening an Arkansas Plant, *Sesbania exaltata*, for Antitumor Activity Using the Crown Gall Tumor Bioassay

Alison Acott
Faculty Mentor: John S. Choinski, Jr.

The Crown Gall Tumor (CGT) bioassay was used to investigate the possible anti-tumor activity of plant compounds isolated from the widely distributed, leguminous plant, *Sesbania exaltata*. The isolation of plant compounds was accomplished through a modification of the National Cancer Institute's protocol used for screening biological material for antitumor activity. Briefly, *S. exaltata* seeds were acid-scarified, and then germinated for 5 days at 25°C. The germinated seeds were homogenized and extracted overnight in methylene chloride and methanol (1:1 v/v). The resulting macerate was filtered and reduced in volume using a rotary evaporator and dried to a powder with a rotary drier. Samples of the powder (0-375μg) were applied to potato discs inoculated with 48 h old cultures of *Agrobacterium tumefaciens* strain B_6 (3×10^8 cells/ml). Previous research had shown infections of *A. tumefaciens* to induce autonomous tumor cell growth on potato tissue. The infected potato discs were incubated for 14 days at 25 °C and any tumors produced were counted and weighed. It was found that 375 μg/disc of *S. exaltata* plant powder inhibited tumor initiation and growth by 80.3 and 75.7 %, respectively. Agar diffusion and tube dilution assays were run against a suite of bacteria including *A. tumefasciens*. *S. exaltata* extracts had no measurable effect on bacterial growth up to a concentration of 10 mg/ml. It is concluded that *S. exaltata* activity in the CGT bioassay is not because of general cytotoxicity against *Agrobacterium* and may be an indication of a new antitumor compound worth further study.

Enterocyte Volume Regulation in Nutrient-absorbing *Aplysia* Intestine

David Moore, and Robert Keeton
Faculty Mentor: Mike Moran

Intestinal epithelia cells (enterocytes) actively transport nutrients from the lumen of the intestine to the blood stream. Because nutrients pass through the enterocytes, increases in the concentration of intracellular osmotically active solutes occurs during nutrient absorption, and the enterocytes swell by osmosis. However, measurements of cell volume

in intact sheets of intestinal epithelia have been difficult to make. Hence, we have developed a technique called the electrical resistance method (ERM) that indirectly measures volume changes in a monolayer of cells, such as sheets of intestinal epithelia. With ERM, a 5V, 500Hz signal is passed over the tissue layer. The resistance of the layer of solution above the cells is proportional to layer thickness. Thus, increases in cell volume decrease thickness of the solution flowing over the cells and increase solution resistance. To confirm application of ERM to the study of nutrient-induced changes in *Aplysia* enterocyte volume, we have performed two experiments: 1) We assessed how changes in solution ionic strength affect solution resistance; we predicted that decreases in ionic strength increase solution resistance. 2) We changed the thickness of the layer of solution. In this case, we predicted that increases in solution layer thickness decrease resistance. Solution resistance was proportional to solution ionic strength (% artificial seawater), and increases in solution layer thickness reduced resistance. In conclusion, the results from both experiments confirm application of ERM to the study of nutrient-induced changes in enterocyte volume in *Aplysia* intestine.

A Comparison of Apoptotic Induction in Aplysia californica and the Sprague-Dawley Rat

DeLynn Holleman and Jill Jaggers
Faculty Mentor: Steven W. Runge

This study examines the role of context in apoptotic induction and compares apoptotic induction in intestinal epithelial tissue of a mollusk, Aplysia californica, and the Sprague-Dawley rat. The intestinal epithelial tissues of these organisms are incubated in aerated media. Treatments include intracellular acidification using the proton ionophore (CCCP) and exposure to the tumor promoter 12-O-tetradecanoyl-phorbol-13-acetate (TPA) and tumor inhibitors 5-(N,N-hexamethylene-amiloride) (HMA) and chelerythrine. Intestinal crypts are examined by light microscopy following hematoxylin and eosin staining of sectioned tissue. The percent apoptotic index is calculated for each sample and this is used to determine the percent change in apoptosis. Significant differences in apoptotic rates exist along the length of the snail intestine, with a trend toward decreased apoptotic indices in segments farther from the esophagus. Preliminary results indicate that apoptosis can be induced by intracellular acidification in both Aplysia californica and Sprague-Dawley rat intestinal tissues. The average difference in percent apoptotic index when apoptosis is induced by intracellular acidification is 10% for the snail and 28% for the rat. To our knowledge, Aplysia intestinal epithelium has not been used previously to study apoptosis. Thus, this study may provide a foundation for establishing a new invertebrate model for the study of cancers and drug sensitivities.

Role of Intracellular Acidification of Cultured Cells in Resistance to Dying

Sarah Holloway
Faculty Mentor: Steven W. Runge

Apoptosis is a very controlled mode of cell death to eliminate cells that are no longer needed or have arisen abnormally. Chemotherapy, ultraviolet radiation, and intracellular acidification (IA) are among the many stimuli capable of inducing apoptosis. An understanding of apoptosis is important in cancer research because most anti cancer treatments kill tumor cells by inducing apoptosis. Also, some forms of cancer are known to arise due to a defect in apoptosis.

Relative to normal tissues, solid tumors have a microenvironment that is unique. Tumor cells maintain intracellular pH that is close to normal (~7.25), while the extracellular pH is more acidic. The goal of this project is to determine if sublines of cells can be established that are resistant to IA-induced apoptosis. If apoptosis-resistant sublines can be established, then it will be determined if these cells will also resist apoptosis induction by modes other than IA.

The experiments involve the use of two cell lines, C3H10T1/2 and MCA. Both cell lines have survived for 24 hours in the acidic media (6.25, 6.75), and the goal is to continue the selection process until cells can survive a continuous IA for at least two weeks. Once selected, they will then be treated with other stimuli known to induce apoptosis in unselected cells. Selection for, and analysis of, cell lines that are resistant to apoptosis induced by intracellular acidification will help us explain how tumor cells evade apoptosis even though a component of the final cell death pathway has been triggered.

Role of jun-N-terminal kinases in Acid Induced Apoptosis

Kelly Johnson
Faculty Mentor: Steven W. Runge

Apoptosis (programmed cell death) is an important phenomenon in multicellular organisms and can be induced by many divergent stimuli including intracellular acidification. We have shown previously that cells subjected to an intracellular pH below 6.4 have a faster rate of apoptotic induction as compared to cells acidified within the pH range 6.4- 6.8. The jun -N -terminal kinases (JNK) are activated during cellular stresses and have been proposed to play an important role in cell death following intracellular acidification. A decrease in intracellular pH activates JNK in most cell lines. We assessed the role of JNK in acid-induced apoptosis by transfecting C3H-10T1/2 and MCF-7 cells with either the JNK1 gene or its dominant negative mutant form (JNK-APF). Transfected and untransfected cells were monitored for changes in apoptotic induction by clamping at intracellular pH levels of 6.25, 6.75, and 7.25, respectively. Apoptotic induction was assessed by cell counting using trypan blue exclusion. Our

results show that down-regulating JNK1 serves to protect cells from acid-induced apoptosis. In contrast to previous reports, cells overexpressing JNK showed decreased rates of apoptosis at a pH level of 6.25 and 6.75. In the current project we blocked JNK1 directly rather than an upstream activator. JNK is part of the mitogen activated protein kinase family which is associated with cell proliferation and cellular death; therefore, it is possible that JNK could serve to protect against apoptosis as well as facilitate cell death under different conditions.

A novel mouse model for measuring macrophage cytotoxic activity during paclitaxel-based chemotherapy.

Dru S. Dace
Faculty Mentor: Thomas M. Walker

Paclitaxel (Taxol™) is a potent chemotherapeutic drug used to treat many human cancer types. The clinical success of paclitaxel also may be due to its ability to activate macrophages and promote nonspecific antitumor immune responses. To determine whether tumor rejection is mediated through macrophage activation, a novel murine tumor model was developed that allows comparison between murine strains that differ solely with respect to their macrophage responsiveness to paclitaxel. Age-matched and weight-matched male C3H/HeJ (paclitaxel-hyporesponsive) and C3H/HeOuJ (paclitaxel-responsive) mice were injected intramuscularly with a single cell suspension (10^5 - 10^6 cells/host) of a nonmetastatic murine fibrosarcoma in the left hind leg. Paclitaxel (20, 40 or 60 mg/kg/dose) or placebo was administered by intraperitoneal injection to hosts using regimens that preceded, paralleled, or followed palpable tumor development. Measurements of solid tumors suggest that paclitaxel did not significantly delay tumor development between C3H/HeJ and C3H/HeOuJ mice. Results from the sulforhordamine B colorimetric cytotoxicity assay suggest that the fibrosarcoma exhibits limited resistance to paclitaxel, which may account for poor host responses *in vivo* to paclitaxel chemotherapy. The murine model will be used in future studies to elucidate the contribution of macrophage cytotoxicity *in situ* during paclitaxel chemotherapy. Current investigations are screening additional tumor types with greater paclitaxel sensitivity. These studies were supported by the National Institutes of Health (CA-74380), Arkansas Scientific Information Liaison Office, Arkansas Space Grant Consortium, and UCA Research Council.

Department of Chemistry

Overcoming the kinetic stability of a nickel-cysteine center by alkylation.

Andrea L. Phelps
Faculty Mentor: Patrick J. Desrochers

Monomeric five coordinate nickel-cysteine centers can be isolated using tris(pyrazolyl)borate ligands. These systems are a departure from the common square planar geometries that predominate in other nickel-cysteine synthetic complexes. An emerging characteristic of these complexes is a kinetic stability that precludes the binding of additional Lewis bases to nickel. Alkylation of the cysteine-sulfur center has proven to be a successful method for encouraging the nickel center to accommodate additional Lewis bases. The alkylated form readily binds coordinating solvents, yielding six coordinate nickel centers; this characteristic is absent in the un-alkylated five coordinate precursor. This "switch" induced by alkylation is reversible; de-alkylation returns the more inert five coordinate precursor. Possible extensions to metal-protein centers, and ligand modifications to test the extent of the above chemistry will be discussed.

Chemical Water Quality Assessment of Tucker Creek

Tracey Daugherty, Krista Reynolds, Taimur Shaikh, Elizabeth Stafford, and Nathan Twaddle.
Faculty Mentor: Jeffrey Draves

Students from the Environmental Chemistry Class at the University of Central Arkansas collected whole water, grab samples at fourteen sites on Tucker Creek, Conway, Arkansas. Samples were analyzed for 10 different analytes. The results are compared to the Safe Drinking Water Act (SDWA) standards and measurements made in previous years. Results of the comparisons showed that levels of all analytes, with the exception of nitrate, fall within SDWA approved levels. Comparisons with historical data indicate minor changes, possibly due to urban development, in the sampling area.

Sediment Sample Analysis of Tucker Creek

Mark Kottmyer, Jody May, Brendan McAuley, and Brandi Thompson
Faculty Mentor: Jeffrey Draves

Students from the Environmental Chemistry Class at the University of Central Arkansas collected sediment samples at fourteen sites on Tucker Creek, Conway, Arkansas. The sampling sites were chosen for their proximity to suspected point sources along the creek. Four metal species, aluminum, barium, iron, and lead were analyzed by graphite furnace-atomic absorption spectroscopy. Concentrations were in the low to mid ppm range for all of the metals tested and little site-to-site variation in metal concentration was observed. This suggests that the sources of metal species along Tucker Creek are not of the point source variety.

Cavity Ringdown Laser Absorption of the $\upsilon_7 + \upsilon_8$ Combination Band of Ethylene

Mclane Simpson
Faculty Mentor: Jeffrey Draves

Cavity Ringdown Laser Absorption Spectroscopy (CRLAS) was used to measure the $\upsilon_7 + \upsilon_8$ combination band of ethylene in the 1880 cm^{-1} region. The measurements were made with a pulsed, tunable diode laser whose output frequency was controlled using both temperature and current. This allowed the collection of high resolution spectra which have provided data on both the υ_7 and υ_8 modes along with the coupling constant. Spectroscopic parameters for each of these modes will be presented in the poster. In addition, the CRLAS technique was shown to have an estimated sensitivity of 1 in 10^7 for this experiment.

Cavity Ringdown Laser Absorption of Molecular Ions

Jason Thessing and Gary Dobbs
Faculty Mentor: Jeffrey Draves

Cavity Ringdown Laser Absorption (CRLAS) is a spectroscopic technique that has many advantages over other spectroscopic methods. The advantages of this technique are that it is 10,000 to 100,000 times more sensitive than conventional absorption methods because it is not dependent on the intensity of the light source. Using a carbon dioxide laser we have measured the absorption of ethylene ion ($C_2H_4^+$) in the υ_7 vibrational

region. We have observed two absorption features, one located at 890 cm^{-1} and the other at 889 cm^{-1}. We have assigned the feature at 889 cm^{-1} to be the fundamental and the feature at 890 cm^{-1} to be the first overtone. We have also measured the ν_4 vibration of NH_3^+ in the 945cm^{-1} region. We observed a single peak very similar to that of neutral ammonia.

Mitomycin C Binding Efficiency to Chromatin

Charity Billingsley and Shawn Kinsey
Faculty Mentor: Patricia H. Draves

Mitomycin C (MC) is a genotoxic antitumor antibiotic that is widely used in the treatment of a variety of cancers. The potency of this drug results from its covalent bonding to double stranded DNA. While the interactions of MC with DNA have been well characterized, little work has focused on the interactions of MC with chromatin. The work presented here will describe the binding efficiency of MC to three chromatin systems; chicken erythrocyte mononucleosomes, chicken erythrocyte dinucleosomes, and the *X. borealis* phased mononucleosomes. Gel electrophoresis results demonstrating changes in the binding efficiency of MC to these chromatin systems in comparison to free DNA will be presented.

State-specific studies of gas-phase organometallic reactions involving Cu^+ and Au^+

Jody C. May
Faculty Mentor: William S. Taylor

The reaction of bare gas-phase transition metal ions with small molecules yield species that serve as models for intermediates in many catalytic reactions. These reactions are also known to be state-specific. This work has investigated the reactions of Au^+ and Cu^+ with a number of small hydrocarbons. In addition to carrying out reactions with the ground state of the bare metal ions, several excited states were also examined. The reactions were carried out under near-thermal conditions using a drift cell reactor. Association is the dominant process in all of these reactions, but products consistent with C-H and C-C bond activation were also observed in several of the Au^+ reactions. In most cases, the ground state was found to react preferentially, however excited states were frequently observed to react as well. Preliminary a*b initio* and density functional calculations were also done on selected product species in order to explore the participation of more than one metal ion state. These initial calculations suggest that the initial interaction between excited metal ions and these neutrals occurs on a less attractive surface.

Department of Computer Science

3D Volume Transformation of Brain CT Datasets

Jason Gatlin
Faculty Mentor: Wayne Brown

To move or rotate a discrete volume dataset, each of the voxels in that dataset must be transformed to a new location. Specifically, the x, y, and z coordinates of each voxel change in accordance with a series of rotations or translations performed by a single transformation. This is accomplished using a single 4 x 4 transformation matrix. This method of transformation works well for data that is in a homogeneous space (the scale on each axis is identical). However, CT datasets are often not homogenous. The problem lies in how the CT data is captured. The x and y values are captured along uniform axes, but the z axis is comprised of slices that vary in thickness from 5 to 10 mm. The current algorithm treats each slice as a uniform voxel and thus, the slices are not correctly mapped when the dataset is rotated or translated. The new algorithm maps the voxel values given to each of the slices into their actual distance in mm. Then the correct transformation is applied and the new points are computed relative to the slice thickness. Next, these values are translated from mm values back into voxel values so that the newly transformed 3D dataset is the same size as the original dataset.

Segmentation of Head CT Images to Facilitate Medical Diagnosis

Bryan Hoffman and Kris Bocox
Faculty Mentor: Wayne Brown

The goal of this research is a program that analyses a standard CT image of the head and returns a mask of the image that identifies the brain tissue, skull, air, braces, and transitional areas. A mask contains one discrete value for each distinctive region within the original image. Three different algorithms are used for identifying these areas. The first method identifies the brain tissue by searching the image for areas of homogenous sample values. The second method locates the bone and surrounding air by taking advantage of the fact that these areas are represented by the maximum and minimum range of sample values. The third method identifies transitional areas by using a modified version of the brain algorithm that looks at both similarity and large differences. These three methods are executed in sequence and the results of one method constrains the results of the next method. At each stage of processing, validation of both assumptions and results are carried out to ensure that the methods performed properly.

The Effects of Computerized Versus Traditional Testing With and Without Review Capability

Amy L. Worthington
Faculty Mentors: Harold Forbes and Amelia L. Barile (Psychology)

This research was designed to determine the effects of computerized testing. Participants were randomly assigned to administration mode (computer or paper-and-pencil) X review capability (with-review or without-review) conditions. Participants were college students and were tested for academic computer knowledge. Participants in experiment one (n = 204) had at least 15 weeks of computer experience. Participants in experiment two (n = 71) had at least one week of computer experience. For both experiments, no main effects of administration mode or review capability were found, and no interaction was realized. These results suggest the acceptability of computerizing academic tests. Future studies should include participants with no prior computer experience as well as participants who are not college students.

Department of Mathematics

Attitude Toward Violence and Speed of Response as a Function of Violence Justification

Dana Goodwin
Faculty Mentors: George Bratton and Suzie Booher

Research has indicated a strong correlation between violence on television and aggressive attitudes. Further, studies suggest that viewing violence considered to be justified (retaliatory) may increase aggressive tendencies. In the present study, participants will be randomly assigned to one of three conditions, and each condition will be presented with both written stimuli and a brief film clip. The nature of the stimuli will be varied among conditions. The first group will serve as the control condition and will be provided neutral stimuli. The second group will be presented with stimuli which suggests unjustified (gratuitous) violence. The third group will be presented with stimuli which suggests justified violence. All three groups will then be given a questionnaire which evaluates general attitudes toward violence. The justified and unjustified violence groups will be given additional questions regarding the violence presented in the video clip. Responses to the questionnaires and latency of response will be compared among groups using two commonly applied statistical tests. Conclusions involve both the research question and an analysis of the statistical methodology. It is predicted that participants in the justified violence condition will have the highest latency of responses to questionnaire items and will have the most favorable attitudes toward violence among conditions.

Peano Curves and Arclength

Garth Johnson
Faculty Mentors: Lawrence Huff and David Peterson

This semester I have been studying Peano curves, which are a class of curves that, even though they are nothing more than a continuous one-dimensional curve, will fill two-dimensional space when completely graphed. I can look at several iterations of the curve and see that it becomes increasingly more complex as the iteration increases. I can also see that the arclength of the curve must increase as the complexity increases, but by how much? Is it growing linearly, exponentially, or perhaps even randomly? Also, what is the arclength of the line when the curve is completely graphed? Would it be infinite length, or would it be a limit that would converge at some value? Using evidence gathered from *Mathematica* and a C++ program, I have analyzed the graphs of several approximations to find an answer.

Department of Physics and Astronomy

Acoustical and Non-Acoustical Measurement of Porous Properties

David James
Faculty Mentor: Carl Frederickson

Different theories relating non-acoustical properties of porous samples to their acoustical properties are being tested. The parameters of interest are flow resistivity, porosity, and tortuosity. Glass beads are being used as a model porous medium. Flow resistivity is the volume flow of air across through an area per unit time given a pressure difference across the sample. Porosity is the ratio of media to air in the sample. Tortuosity is the ratio of the length of a pore to the length of the sample. A simple device has been built to measure the flow resistivity of the glass beads. This device uses a balance beam to create a pressure slightly below atmospheric pressure on the top surface of a glass bead sample. The pressure on the bottom surface is held at atmospheric pressure. The volume flow rate for air through the glass beads is measured. Coupled with the known pressure difference across the sample the flow resistivity can be calculated. The same sample is then placed in an impedance tube where acoustic measurements are taken. The flow resistivity is then calculated, using current models of the acoustic properties of porous media. The acoustical and non-acoustical values of flow resistivity are then compared.

Acoustic scattering from buried objects in shallow water environments

Brian R. Lemon
Faculty Mentor: Carl Frederickson

Measurements of acoustical scattering from a retro-reflector buried just below a water/sand interface were made. A retro-reflector reflects sound energy back in the same direction in which it originated. An acoustic line source was used to create pseudo plane waves that were incident on the interface. Different incident angles were tested, with the main angle of interest being the critical angle (28 degrees from the interface) where total reflection at the water/sand interface occurs. At the critical angle, energy passes into the sand in the form of evanescent waves. Evanescent waves travel parallel to the ocean floor decaying exponentially with depth. Locating and interpreting these waves was the particular area of interest in many of the measurements taken. Both smooth and rough sand surfaces were used at the various incident angles. A receiver was moved in circles of different radii around the retro-reflector and along a line over the top. This provides data for various scattering angles.

Mountains on the Moon

Susan Erwin
Faculty Mentor: Tod Ramseyer

The purpose of this project was to measure the height of the crater walls on the Moon. Using the UCA 16 inch telescope, pictures were taken of the Moon and the craters were identified from a lunar atlas. By using known diameters of the craters, the ratio of measurements taken from the pictures to the length of the shadows gave the actual length in meters of the shadows cast. From there, using the angle of incidence, the derived equation, and the length of the shadows, we calculated the height. Finally, these calculated values were compared to accepted values. This project may be used in the future in astronomy classes as a lab project. All pictures and data will be used in class to reduce the amount of time taken for this entire project, which will allow these concepts to be taught within time constraints.

The increasing luminosity of CI Camelopardus

Seth Cottrell
Faculty Mentor: Tod Ramseyer

CI Camelopardus is an interacting binary star, an x-ray transient, which underwent a serious eruption in 1996. Since this time, the luminosity of the star has been steadily increasing. My research with Dr. Ramseyer and Chris Melton this semester has been mainly focused on determining the period of this binary star. This will tell approximately how large the stars are that make up the system—thought to be a neutron star or black hole interacting with a giant star—and shed some light on why it erupted. My part of the project was to determine if there are any short period variations in the luminosity of the star, which would be due to either the rotation of the neutron star or black hole itself, or in the accretion disk. I did this by writing a discrete Fourier transform, DFT, in Mathematica. DFTs are used to analyze data taken unevenly in time and approximate the data as an infinite series of sines and cosines of different periods. The DFT then takes this series and determines which periods have the greatest contribution. Included in my Fourier transform are a general polynomial fitting routine and a Hanning window that allows the data to taper off at the beginning and end of the stream. This window does not affect the Fourier transforms' ability to pick out significant periods; however, it allows the ends of the data stream to taper off. Which keeps the Fourier transform from seeing the abruptly beginning and ending ends of the stream as periods themselves that should be modeled.

CI Camelopardus

Christopher Melton
Faculty Mentor: Tod Ramseyer

CI Cam is an interacting binary star which historically has exhibited irregular bursts of light. The study of CI Cam is important because most stars in the universe are multiple star systems and interacting binary stars provide appropriate opportunity to analyze current models of stellar evolution. My portion of the research on CI Cam concentrates on determining long-term trends in its variation of light output, hopefully corresponding to its orbital period. In turn, this will help to determine which of two current models of interaction are responsible for the irregular light bursts that have been observed. Once the period is determined, the combined mass of the system can be deduced, which will allow determination of what type of stars are present in the system. The current model holds that one star is a black hole. To determine the orbital period, data were taken with the university's telescopes; soon, I will begin using data taken by other professional and amateur astronomers. The data is analyzed with an original non-linear function fitting routine, written in MATLAB, which uses a Chi-Squared test to determine the best fit sine function.

Study of Direct Capture in $^{26}Mg(p,\gamma)^{27}Al$

Mark Denton
Faculty Mentor: Gaylon Ross

The study of nuclear astrophysics allows an understanding of how stars produce energy and manufacture elements. One energy production and nucleosynthesis mechanism is the Magnesium-Aluminum cycle. This experiment deals with one part of this cycle: the reaction $^{26}Mg(p,\gamma)^{27}Al$. Fusion between a proton and nucleus can occur strongly at discrete energies (resonant reaction) corresponding to excited states in the compound nucleus, but it may also occur, although weaker, at a continuum of energies via a process know as direct capture. A determination of the energy dependence of direct capture of a proton by ^{26}Mg is essential to understanding the rate of nuclear reactions in the MgAl cycle. We have made a systematic study of the direct capture process in conjunction with a group at the University of North Carolina. Proton bombarding energies between 1.5 and 2.0 MeV were achieved using a 4 MV KN accelerator at the TUNL laboratory. The proton beam was incident on an evaporated ^{26}Mg target, and reaction gamma rays were detected using a high purity germanium detector located at 55^{o} with respect to the beam. Calibrated sources and reactions of known strength were used to perform an energy calibration for the detection apparatus and to determine the energy dependent efficiency of the detector. Target characteristics such as the stoichiometry and stopping power are currently being derived from the data. The energy dependence of the cross-section from direct capture will then be determined after subtraction of the contributions from nearby resonances is performed. Funding for this project has been provided by: Department of Energy, SILO Advisory Council Undergraduate Research Fund, and UCA Research Fund.