



COLLEGE OF SCIENCE

2008 Student Project Showcase

COS-1 to COS-32

BIOLOGICAL SCIENCES (8)

COS – 1

The Relationships of Temperature, Salinity, and Size on Percent Coral Cover in the Dry Tortugas National Park

Cheryl Caldwell and John Majoris

QEP Faculty Adviser: Dr. Mark Bush

A synthesis of archived data revealed trends in bleaching of corals in the Dry Tortugas National Park. Large corals were found to bleach more than small ones, and bleaching was most extreme not only where temperatures were highest but also at high salinity.

COS – 2

Protein Self Assembly and Colloidal Aggregation in Alzheimer's Disease

Lisa Cole^{1,4}, J. Paraway^{2,4}, B. Burnett^{3,4}, M. McKuen^{2,4}, D. Woodard^{4,5}, S. Durrance^{3,4}, and S. Xu^{2,4}

Departments of ¹Chemical Engineering, ²Biological Sciences, and ³Physics, Florida Institute of Technology; ⁴Space Life Sciences Laboratory, Kennedy Space Center; ⁵Bionetics Corporation, Kennedy Space Center.

Florida Tech Faculty Advisers: Drs. Sam Durrance and S. Xu

Protein aggregation and formation of amyloid fibers is responsible for numerous human diseases, including Alzheimer's disease and Parkinson's disease. Using AFM, TEM and biochemical methods, we have recently analyzed the aggregation of numerous proteins and found that amyloid fiber formation is a three-step process. (1) Molecules of the protein first cluster together into spheres that are all approximately the same size. (2) The spheres join together in linear chains like beads on a string. (3) The beaded chain transforms itself into a filament. This process closely resembles the formation of colloids, mixtures like milk or ink, in which tiny particles are suspended in a fluid. A new theory, explaining every step of the fiber formation process, based on principles of colloid science is presented. If this new theory is correct, then it is very likely that amyloid diseases can be halted by drugs, which hinder the aggregation of the spherical colloidal particles into linear chains. (Support: Florida Space Research Institute, Space Florida, NASA)

COS – 3

Functional Architecture of Retinal Photoreceptor Arrays in the African Spurred Tortoise, *Geochelone sulcata*

Andrea Cross

Faculty Adviser: Dr. Michael Grace

Vision in tortoises plays a critical role in food acquisition, predator avoidance, and reproductive behavior; however, vision is very poorly studied in tortoises. Previous studies of the tortoise retina (morphology based only) found a cone-dominated retina, with no rods present. With the development of immunohistochemical labeling, the photoreceptor classes of tortoise retinas can be explored. The African Spurred Tortoise, *Geochelone sulcata*, was chosen as a model for the genus as it reproduces readily in captivity. Captive-hatched *G. sulcata* were overdosed with halothane, and eyecups (retina, choroid, sclera) prepared. For light microscopy, eyecups were fixed in glutaraldehyde/paraformaldehyde, embedded in resin, 1 μ m sections cut, and sections stained with azure II and methylene blue. Eyecups for immunofluorescence were fixed in Zamboni's, infiltrated with sucrose and sectioned. Frozen 10 μ m sections thaw-mounted onto slides were incubated with antisera against rod and cone opsins (anti-cone CERN-906, anti-rod CERN-922 and anti-rod MAB5136). Sections were then incubated with labeled goat-anti-rabbit IgG-Alexa-488 (green) and goat-anti-mouse IgG-Alexa-555 (red), coverslipped with DAPI, and viewed by fluorescence microscopy. Negative controls included omission of primary antisera buffer, but performing all other steps as above. All procedures approved by Florida Tech's IACUC. Light microscopy showed morphologically similar and cone-like photoreceptor cells, as described in previous literature. Immunofluorescence showed the presence of rod opsin and cone opsin in distinct cells throughout the retina, suggesting greater spectral sensitivity and greater absolute sensitivity than previously thought. This research provides the first biochemical analysis of visual function in a group of turtles that includes some of the most endangered species on earth. This work may have important implications for conservation of endangered species, and will be used as a foundation for analyzing developmental plasticity in the nervous system.

COS – 4

Dynamics and Stasis of Coral Populations in the Western Pacific Ocean

Lynn Holem

Faculty Adviser: Dr. Rob van Woesik

This study sought to understand the dynamics of coral populations by examining a long-term photograph record from the western Pacific Ocean. Coral recruitment, growth and mortality were examined through time, and before and after a major physical disturbance (a typhoon), to determine 1) the vital rates of the processes, and 2) whether the vital rates vary because of the disturbance, and if so which processes are responsible for reef recovery and population resilience. Photos were taken at 2 different sites on Akajima Island, southern Japan, each of which supported 2 stations. Sampling was depth stratified at 1 m, 3 m and 6 m. At each depth, 2 x 2 m quadrats were repeatedly sampled, at least once a year, from 1996 to 2001. Here I target *Acropora* corymbose colonies. Each colony was tracked through time to determine growth and mortality rates. Each colony was binned into one of 10 size classes, which revealed consistent right-skewed, log-normal size-frequency distributions over time. Kolmogorov-Smirnov tests showed that most of the coral size-frequency distributions did not change significantly over time, indicating relative stasis. The physical disturbance generated available space through differential mortality, which allowed for recovery through recruitment and re-growth. Using this information, discrete population growth models were constructed using Lefkovich probability matrices, which in turn were used to predict future coral population abundances. The transitions were calculated from 1996-97 for each size class, using information on recruitment, growth, stasis and mortality to predict population density for 1998; model predictions were compared with actual data. The study shows that the coral assemblages at the two sites had clearly different dynamics, on the one hand the more exposed site (Kushibaru) showed relative stasis, with punctuated regrowth and recruitment following a physical disturbance, while the more leeward site showed a higher turnover of *Acropora* colonies, driven primarily by high, but constant levels of mortality.

COS – 5

A Search for PLCgamma Binding Proteins Active in Calcium Release at Fertilization in Starfish Eggs

Stephen Jones

Faculty Adviser: Dr. David Carroll

One of the most important processes involved in the activation of the egg during fertilization is a transient increase in intracellular free Ca^{2+} . This Ca^{2+} release is regulated by the enzyme phospholipase C (PLC). However, the initial steps of the PLC signaling pathway are unknown. In this study, a PLC SH2 domain recombinant fusion protein was produced for use as an affinity matrix to screen for proteins from the starfish egg or sperm that may be involved in the regulation of PLC. The SH2 domains are the protein-protein binding region of PLC. Numerous proteins bind to the PLC fusion protein and many of these proteins are phosphorylated on tyrosine residues, which strongly suggests they are regulated by standard signaling mechanisms.

COS – 6

Linking Form and Function in *Amphiprion frenatus* Fish Larvae

John Majoris

Faculty Adviser: Dr. Ralph Turingan

The ability of marine fish larvae to capture food has profound consequences for their survival and growth. The design of the feeding mechanism and the coordinated activities of cranial bones and muscles underlie feeding success in fishes. This study is designed to determine the relationship between the development of the feeding mechanism and the ontogeny of feeding selectivity in *Amphiprion frenatus*, fish larvae. Different size-sorted planktons were fed to *A. frenatus* through different developmental stages of its feeding mechanism. One to 5/6 days post-hatch (DPH) fish have less developed feeding mechanism and fed on small, non-elusive prey. In contrast, older fish (6-14 DPH) have highly developed feeding mechanism and feed on larger, more elusive prey. It is conceivable that state of development of the feeding mechanism (FORM) influences the ability of fish larvae to capture prey (FUNCTION).

COS – 7

A Comparative Microscopic Structural Analysis of Bovine and Rat Tibia

Christine A. Muns, Y.A. Lin, O. Okpobrisi

Faculty Advisor: Dr. Shaohua Xu

Rat has been a popular animal model for NASA's biomedical study of astronauts' mineral loss over the last four decades. However, it remains unclear how accurately rat bone simulates human's in its structure and microfluidics. Bovine compact bone on the other hand has been reported to closely resemble human bone. In this study we compared the similarities and differences between the microstructure of bovine and rat tibia. Bone samples were demineralized in EDTA, embedded in epoxy, ultratome sectioned, and analyzed by use of AFM and SEM. Our results showed that differences in the structure of osteons, lacunae, canaliculi, and lamella exist between the two samples. Embedding epoxy appeared to penetrate into the vascular and lacunar-canalicular pores, which could help us to assess the microfluidics of bone tissue. Knowledge gained from this study will aid in the evaluation of rat as an animal model for our research toward a countermeasure against astronauts' bone loss and osteoporosis. (Project supported in part by Space Florida, NASA, and Florida Space Grant Consortium).

COS – 8

Surface Changes Associated with Maturation of Starfish Eggs and Oocytes as Observed Using Scanning Electron Microscopy (SEM)

Philina Richardson

Faculty Adviser: Dr. David Carroll

There are known surface structure changes that occur in eggs and oocytes at various times during development (Schroeder 1978, Schroeder 1979 and Schroeder and Stricker, 1988). Cell surface changes in the eggs and oocytes of starfish were visualized using scanning electron microscopy; the preparation for SEM imaging presented many obstacles that needed to be overcome for imaging to take place. Oocytes underwent 3 separate treatments (removal of follicle cells, removal of jelly coat and vitelline envelope, and maturation) before being imaged. Differences in surface structure were found between mature eggs and immature oocytes as well as between eggs with and without the vitelline envelope and jelly coat. Pores measuring ~1 μm in diameter were found on the surfaces of eggs matured with 1-methyladenine (1-MA) and were lacking on eggs that spontaneously matured during Pronase treatment. Eggs matured with 1-MA also lacked microvilli as found on immature and spontaneously matured eggs.

CHEMISTRY (5)

COS – 9

A Two Step Synthesis of a Fish Pheromone from Cortexolone

Karissa Albin, Yannick Ouedraogo, Longchuan Huang, Mariana Plazas-Mayorca

Faculty Advisors: Drs. Nasri Nesnas and Rudolf Wehmschulte

A steroidal fish pheromone was synthesized in two steps. The reported work aims at confirming the stereochemistry of the pheromone. To verify the coupling of the fish pheromone (17 α ,20 β -Dihydroxy-4-Pregnen-3-one) with the bis-boc carrier (protected diamino propane), the model reaction of Boc protected Glycine and cholesterol was performed. This reaction was done using simple techniques and verified by TLC, NMR, and DART Mass Spec.

COS – 10

Scanning Tunneling Microscopy of Indolo[2,1-b]quinazolin-6,12-dione (tryptanthrin) On HOPG: Evidence Of Adsorption-Induced Enantioisomerization

Jerry W. Buhrow

Faculty Advisors: Dr. M. J. Novak, Dr. J. C. Baum, and Dr. J. A. Olson

Scanning tunneling microscopy was used to observe 2-dimensional liquid crystals of indolo[2,1-b]quinazolin-6,12-dione (tryptanthrin, an anti-malarial agent) at the solution-graphite interface. The liquid crystals were formed via physisorption from a saturated solution in 1-phenyloctane. Sub-molecular resolution was achieved allowing elucidation of the primary electronic features of the molecule. The molecule's appearance is attributed to the molecular HOMO or LUMO, calculated using density functional theory, with contrast attributed to differences between the molecular moieties. The lamellae form rows that alternate in contrast (light/dark), from row to row. The contrast variation between the rows is attributed to adsorption-induced stereoisomerization of the individual molecules, with each row comprised of one enantiomeric configuration. This example is the first-ever observation of physisorption-induced stereoisomerization of individual molecules.

COS – 11

Detection of Organic Leachates in Sea Water from Suspended Plastics

Kelly L. Reda

Faculty Adviser: Dr. Mary L. Sohn

The effects of bisphenol-A (BPA) on human populations have been researched extensively and it has been discovered that BPA may cause a variety of commonly known diseases and illnesses. Currently, to the best of our knowledge, there are no reports in the literature of studies on possible BPA leaching into marine waters in spite of world-wide littering of beaches with plastics. Determination of BPA or other plastic additives, leaching into seawater from suspended plastics, can be determined through liquid-liquid extraction and analysis of the extractant by Gas Chromatography-Mass Spectrometry (GC-MS).

COS – 12

Design of, and Approaches to, 2,18-Dithia [3] (1,8)carbazolo [3](3,5) pyridinophane

Tycho Spadaro

Faculty Advisor: Dr. Alan Brown

The fluorescence quenching mechanism of carbazole by pyridine has been proposed to be that of a hydrogen bond between the nitrogen atoms of the carbazole and pyridine ring. A unique phane molecule has been proposed to hold a carbazole and pyridine ring in proximity by sulfur bridging units such that there can be no internal hydrogen bonding. This molecule should not quench the fluorescence of the internal carbazole.

COS – 13

Preparation of Chemically Etched Au Tips for Ambient Instructional Scanning Tunneling Microscopy

Margot Zaccardi

Faculty Advisor: Dr. Joel Olson

A laboratory experiment designed for undergraduate students, which utilizes concepts of electrochemical tip etching and scanning tunneling microscopy (STM) is described. The students electrochemically etch gold STM tips using a time efficient method, to later be used in an instructional grade STM that operates under ambient conditions. Since the most common materials used to fabricate electrochemically etched tips cannot be used in ambient STM's, this experiment is a way to integrate the importance of tip etching (as opposed to mechanically prepared tips) into an STM laboratory experiment. Undergraduate students in a Nanotechnology Laboratory course (CHM 1091) were able to successfully etch Au tips with a reasonably small radius of curvature, and achieve atomic resolution on HOPG with the Instructional STM.

MATHEMATICAL SCIENCES (2)

COS – 14

Implementation and Analysis of Image Inpainting Algorithms

James Branam-Lefkove

Faculty Advisor: Dr. Gnana Tenali

Inpainting (the process of restoring damaged or missing portions of images) has applications in image compression and transmission, art restoration, special effects, and other areas. This project implements and analyzes an algorithm that uses third-order partial differential equations for smooth structural inpainting. Damaged pixels are automatically repaired using surrounding information; the user is required only to specify the inpainting domain. The implementation was tested on a variety of images and inpainting domains, with impressive results. We are currently making efforts to improve this implementation via the incorporation of texture synthesis.

COS – 15

Variational Inequalities in Hilbert Spaces with Application to Particle Acceleration Phenomena in Plasma Physics

Jessica Cunningham

Faculty Advisors: U. Abdulla, V. Lakshmikantham, M. Zhang, and H. Rassoul

Shock waves are believed to be capable of accelerating charged particles to very high energies. Scattering, both upstream and downstream of the shock, causes certain particles to cross a shock front many times. This is called diffusive shock acceleration. The Parker transport equation describes this acceleration and can be written as a parabolic variational inequality. The obstacle problem, a specific type of variational inequality, will be used to find an analytic solution to the Parker transport equation. The obstacle problem will be considered within a Hilbert space that allows conditions to ensure monotone, hemicontinuous, and coercive operators. Under these conditions, the existence, uniqueness, and stability of the solution can be proved.

PHYSICS & SPACE SCIENCES (15)

COS – 16

Galactic Formation and Evolution

Felix J. Arroyo

QEP Faculty Advisor: Dr. Joseph Dwyer

The purpose of this research project is to look into the various methods that are used in order to both detect and classify the various types of galaxies. The first step was to understand the history of galactic classification and the natural place to start was with Hubble's classification scheme, the "Tuning Fork." Upon understanding the initial purpose of the shape of his diagram, one can begin to understand the method used in classifying a galaxy as well as how much information is needed so that it can be classified properly. The second step in this research project was to understand the various models for galactic formation and detection. Under detection methods, it is typical to use the Lyman alpha Break Method in order to detect very distant objects, though regular observations, as well as spectroscopic observations, can be used to detect near-by objects.

COS – 17

Development of a High-throughput Computing Cluster at Florida Tech

Patrick Ford, R. Pena, J. Helsby, and R. Hoch

Faculty Adviser: Dr. Marcus Hohlmann

Since the first concept and implementation of the computing cluster at Florida Tech, we have increased its size and developed the cluster software significantly. We have implemented the Linux-based ROCKS OS as the central controller of all cluster resources. The cluster now uses the Condor high-throughput batch-job system and has been fully integrated into the Open Science Grid test-bed. In addition to contributing to the data-handling capabilities of worldwide scientific grids, the cluster is being used to process and model high-energy particle simulations such as in Muon radiography. The development, usage, and future expansion of the cluster will be discussed.

COS – 18

Article I. Identification and Analysis of Magnetic Substorms

Patricia Gavin, Brogl S, and R Lopez

Faculty Advisor: Dr. Hamid Rassoul

Using AE data, we have identified 218 isolated substorms whose initial onset is over North America (between 0300UT and 0800UT). We constructed a data table that contains each substorms' onset time, strength in AE, duration, and whether or not the event was a multiple- or single-onset substorm. We have examined the statistics of these events, in particular comparing single-onset and multiple-onset substorms. Preliminary results indicate that the strengths of both single- and multiple-onset substorms are very similar. The investigations done here determined the weak relationships between aspects of the substorms, such as substorm's maximum strength and duration. We have collected data about the substorms from satellites orbiting Earth and hope to put this data into a computer model to help further understand these events.

COS – 19

Article II. Effects of Heating and Impact on the Spectral Properties of Clays on Mars

Patricia Gavin, Chevrier V, and K Ninagawa

Faculty Advisor: Dr. Vincent Chevrier, University of Arkansas

CRISM/MRO has confirmed observations made by OMEGA/Mars Express of the existence of clay minerals on Mars [Bibring, *et al.*, 2005; Poulet, *et al.*, 2005]. Naumov, 2005, proposed that these clays were formed post-impact, but we suggest that they formed in the Noachian period and were later affected by impact shock and volcanism [Chevrier, *et al.*, 2007; Gavin, *et al.*, 2007]. Previous studies showed that impacted clays undergo various structural and mineralogical transitions making them possibly responsible for the layer of red dust on the Martian surface [Boslough, *et al.*, 1986; Hviid, *et al.*, 1994; Weldon, 1982]. However, in this study we focus on the spectral properties of shocked / heated clays to decipher how they were affected during impact. We heated and impacted nontronite and montmorillonite and used X-ray diffraction (XRD), an electron microscope (ESEM) and near-infrared reflectance to analyze the treated clays. Our results showed that the layered structure of clays is destroyed at relatively low temperatures ($T < 750^{\circ}\text{C}$) due to the loss of interlayer water. Secondary phases start to form at intermediate temperatures ($800^{\circ}\text{C} < T < 1000^{\circ}\text{C}$). At high temperatures ($T > 1100^{\circ}\text{C}$) we see melting and recrystallization of the minerals on a molecular level into secondary phases, including hematite, sillimanite, and cristoballite. We also found that clays are resistant to shock treatment of up to about 50 GPa. This tells us that the unaltered clays detected in crater ejecta on Mars were not formed by the impact, rather they were present pre-impact and were excavated from under younger material.

COS – 20

Sky Survey of the Cygnus Region of the Galactic Plane Using the VERITAS Imaging Cherenkov Telescope Array

Jennifer Helsby

Faculty Advisers: Drs. Joseph Dwyer (FIT) and Rene Ong (UCLA)

The sky survey of the Cygnus region in the galactic plane is one of the key science projects of the VERITAS (Very Energetic Radiation Imaging Telescope Array System) gamma-ray telescope. In this work, a preliminary sky survey map has been generated using the Ring Background Model (RBM) using data from VERITAS. Several source catalogs are used to examine the possible sources of TeV gamma rays in this region.

COS – 21

Detection of High Energetic Radiation from Lightning

Andrea Hughes

Faculty Advisers: Drs. Joseph Dwyer and Hamid Rassoul

The Thunderstorm Energetic Radiation Array (TERA) Research Project (aka the “Lightning Box” Research Project) measures energetic electromagnetic radiation (i.e. x-rays and gamma rays) from rocket triggered and natural lightning in thunderstorms. The results of this research project have been beneficial in solving the mystery behind the physics of lightning. For the last 2 years, the author has worked closely with PIs of the project (Drs. Dwyer and Rassoul) in testing and calibration of the TERA boxes before shipping them in the field. This paper gives an overview of the project and focuses on the construction and calibration of detectors.

COS – 22

Performance Study of Ground-Based IR-VLBI for Direct Exoplanet Imaging

Scott Johnson

Faculty Adviser: Dr. Sam Durrance

To this day, we do not have a single direct image of a planet around another star. In fact, we cannot even detect Earth-like planets using our current indirect methods. This is certain to change with the future launch of TPF and Darwin by NASA and the ESA respectively. However, such missions are rare and limited by their great expense and difficulty. Fortunately, it is possible to achieve the angular resolution and contrast ratio within the desired infrared band currently offered by space-based observatories using existing observing facilities on the ground. By combining a multi-aperture interferometer with baselines on the order of hundreds of kilometers with an adaptive optics coronagraph at each site, enough on-axis light from the parent star can be nulled to allow for direct imaging of orbiting planets. Because of the minuscule angular separation between the planet and star, such enormous baselines are necessary to resolve the system adequately for independent imaging of the planet and even the extraction of spectroscopic data that might give us clues regarding the possibility of these planets harboring life. Unfortunately, this system cannot be implemented as it requires simultaneous measurement of the phase and amplitude of the incident IR photons. But in the future, we hope that this system might be used once the technology to do so is developed.

COS – 23

Physics Behind the Waves: Tsunamis

Burcu Kosar

QEP Faculty Adviser: Dr. Joseph Dwyer

A tsunami is a very special water wave generated by a disturbance in the ocean bottom. Such disturbances in the ocean be caused by earthquakes (~95%), landslides, volcanic eruptions, and meteorite impacts. Tsunami waves are sometimes referred to as tidal waves but this is a misleading term because tsunami waves have no connection with tidal waves. This project looked for the well established characteristics of these waves observed in recent events in order to understand the underlying physics that is manifested in Tsunami's behaviors. Compared to other water waves main features that make tsunamis distinct and more powerful than any other water waves are: (1) great wavelengths (~200km as compared with 100m for normal wave); (2) very rapid movement (500 to 900 km/hr as compared with 90 km/hr for normal wave that is generated by wind); (3) a chain of waves rather than a single wave. Tsunamis slow down in shallow water but their amplitude increases up to 30m as they reach to the coastline (in open water ~1m). As the tsunami waves approach the shore, the water at the coastline drawdown. These and other characteristic features (relation between their seed energy and impacted energy) will be discussed.

COS – 24

Nuclear Fusion: Alternative Energy via Magnetic Confinement

Alicia Moss

QEP Faculty Adviser: Dr. Joseph Dwyer

Particles following open field lines in a toroidal field within a tokamak may essentially pollute the plasma gas and cause an increase in the number of runoff particles. To counter this problem, diverters may be introduced to the plasma edge where the open field lines are diverted into a region where runoff particles can collide with the chamber wall or with gas, which allow these particles to collect in the same area, avoiding collisions with other particles, and thereby decreasing the number of runoff particles. The by-product of the particle-wall collision (He) may also be contained and discarded.

COS – 25

The Cluster Space Weather Anomalies

Mike Paniccia

Faculty Advisors (LASP): Drs. S. Elkington, S. Kanekal, X. Li

As spacecraft orbit Earth they are subject to bombardment from particles from the sun and other space weather effects. This bombardment can cause an anomaly, which is an interruption of data flow to Earth caused by the particle's interference. There are three main types of anomalies caused by space weather: surface charge, deep dielectric discharge, and single event upset. The goal of this project was to analyze the 131 anomalies that occurred on the Cluster Spacecraft from August 2000 through March 2005, and determine how many were the result of space weather, which type of anomalies they were, and if possible predict when more anomalies will occur. There were 86 anomalies that were the result of space weather, with 37 surface charging, 31 single event upsets, and 18 deep dielectric discharging. Also, anomalies are more likely to occur as space weather indices read large spikes, and that as time goes on, more and more anomalies due to space weather are occurring. Lastly, the prediction of future anomalies was correct with a margin of 12% error.

COS – 26

Muon Tomography for Detection of Nuclear Contraband in a Low or Medium Z Background Using High Performance Computing Infrastructure

Rafael Pena, Patrick Ford, Kondo Gnanvo, Jennifer Helsby, Richard Hoch, Debasis Mitra

Faculty Advisor: Dr. Marcus Hohlmann

Using Geant4, a toolkit for simulating particles passing through matter, and CRY (Cosmic Ray), a cosmic ray generator, we ran Monte Carlo simulations of cosmic ray muons as they traverse high Z elements in a low and medium Z background. Using this data we analyzed the scattering angle and found the positions of the heavier elements. We were able to properly identify high Z materials in air and Uranium when placed next to Aluminum.

COS – 27

Modeling Diffuse Gamma Ray Emission from Starburst Galaxies

Keri Salvador

Faculty Adviser: Dr. Tim Paglione, American Museum of Natural History

Cosmic rays are infinitesimal particles in our universe that we know little about. A dominant source of cosmic rays would be shock fronts of supernovae (Ginzburg, Stravotski). Because these objects are difficult to directly detect, the properties and behavior of cosmic rays can be traced and analyzed through gamma ray radiation emitted from interactions with interstellar clouds and subatomic particles. Paglione et al. (1996) hypothesized that starburst galaxies, which have high supernova rates and cloud densities, would be ideal beacons for gamma ray and cosmic ray activity. We re-analyze energy processes that occur in starburst galaxies in order to determine which ones are caused by cosmic rays.

COS – 28

Pixelization of the Extrasolar Planetary Disk for Spectral Analysis: Gliese 581c Case Study

Don Schumacher, Jr.

Faculty Advisor: Dr. Samuel T. Durrance

As of this month, 277 extrasolar planets have been discovered since the first one was detected back in 1988, and 61 were discovered last year alone! There are many current projects dedicated to detecting extrasolar planets, and a few more are due to start within the next couple of years including the NASA TPF and the ESA Darwin space telescopes. The goal of this project was to develop a code using IDL that would model the simulated spectrum for an extrasolar planet given specific input parameters. For our model, we used the information from the recently discovered planet Gl 581c (Udry et. al.). These types of models will be used in the future to help analyze extrasolar planetary spectra obtained by next-generation telescopes and to develop methods for cataloging the wide variety of planetary environments that will surely be discovered.

COS – 29

Shedding Light on Anomalous Galactic Properties

Jason Seiler

Faculty Advisor: Dr. Hakeem M Oluseyi

For many years, the mystery of the orbital velocities of luminous baryonic matter has been a nagging problem. Many have postulated reasons as to why the orbital velocities of stars in any galaxy we observe appear to be nearly constant outside of a certain distance from the galactic center. This fairly constant orbital velocity distribution usually begins within 10 kiloparsecs from the center of the galaxy, and, in many cases, much nearer than that. Some of the hypotheses attempting to explain this phenomenon include the classic Dark Matter argument, MOND (Modified Newtonian Dynamics) Theory, and the idea that perhaps gravity works in an entirely different way than we have come to expect. This research focuses on calculating a value we refer to as an “effective moment of inertia” (EMOI henceforth), which will represent the mass distribution of luminous, baryonic matter in a galaxy. This will allow a qualitative comparison of each galaxy’s EMOI with its mass-to-light ratio in an effort to explain the discrepancy between observations (i.e. high velocities at extended distances from galactic centers) and what we expect to see.

COS – 30

Detection Methods of Extrasolar Planets

Alberto Sierra

QEP Faculty Adviser: Dr. Joseph Dwyer

Extrasolar planets were only a thing of science fiction until the first one was discovered in 1998. After the initial discovery of the first extrasolar planet, a new age of discovery has spawned that spans the sky. In the last decade, the search for extrasolar planets has been one of the fastest growing fields of study in the scientific community. As the field grows, old methods have been made better, and new methods of finding planets have made it possible. With the advances in technology and human ingenuity, we have been able to find around 277 planets. The main methods used to find planets today are the Radial Velocity of Doppler Shift method, the Transit Method, Micro Lensing, and the Direct Imaging Method. While all these methods are different, they all have proven themselves in being able to find planets. Not only that, but as progress made in instrumentation used to find these planets, we can get closer into finding planets that are similar to Earth, which is the ultimate goal of the extrasolar planet research.

SCIENCE & MATHEMATICS EDUCATION (2)

COS – 31

Class Scheduling in College Algebra: An Examination of the Spacing Effect on Student Achievement

Michael Odu

Faculty Adviser: Dr. Michael A. Gallo

The purpose of this study was to examine the relationship between class scheduling in college algebra and student achievement. The study was an application of the spacing effect and involved three schedules: 3 days per week [Monday-Wednesday-Friday, 50 minutes per session], 2 days per week [Monday-Wednesday or Tuesday-Thursday; 75 minutes per session], and 1 day per week (Saturday, 165 minutes with a 15-minute break). The research factors included class schedules and targeted student and teacher attributes. The study was implemented as a modified quasi-experimental design involving intact classes of 116 students during the Spring 2007 term at a west central Florida community college. All students were taught using the same Florida-mandated college algebra curriculum, used the same textbook, completed the same assessment protocols, and met for the same number of hours before each unit exam and final exam. Study protocols included a college algebra prerequisite knowledge exam, an attitudes toward mathematics inventory, a learning styles inventory, four unit exams, and a comprehensive final exam, which served as the dependent measure. Data were analyzed via hierarchical multiple regression in which the dependent measure was regressed on three sets of variables: class schedules, student attributes, and teacher attributes. Results showed (1) the 1-day per week group's mean exam score was 17 points lower than the 3-day per week group's mean score ($p < .01$) and 12.7 points lower than the 2-day per week group's mean score ($p < .01$), (2) the 2-day per week group's mean final exam score was 4.4 points lower than the 3-day per week group's mean score ($p = .28$), (3) prerequisite knowledge had a direct relationship with final exam scores ($p < .10$), and (4) students of female teachers mean final exam score was 11.5 units lower than students of male teachers ($p < .01$). Findings suggest (1) college algebra should not be offered on a 1-day per week schedule, (2) students whose prerequisite knowledge is less than 70% should be placed in a 3-day per week schedule, and (3) students with an Accommodator learning style (Kolb, 2005) should not be placed in 1-day per week schedule.

COS – 32

Examining the Relationship between Computerized Testing Conditions and Test Anxiety: A Comparison of Computer-Based, Pseudo Computerized-Adaptive, and Pseudo Self-Adapted Tests

Chi-jung Huang

Faculty Advisor: Dr. Michael A. Gallo

The purpose of this study was to examine the relationship between computerized test conditions and targeted student attributes relative to test anxiety involving Taiwanese undergraduate students. The test conditions were computer-based (CBT), pseudo computerized-adaptive (Pseudo CAT), and pseudo self-adaptive (Pseudo SAT); test anxiety was measured using Spielberger et al.'s (1980) Test Anxiety Inventory (TAI). A 34-item researcher-prepared English language proficiency exam was administered under the test conditions; items were selected from the Language Training and Testing Center's (1999) General English Proficiency Test, which assesses English proficiency of non-English native speakers. The pseudo test conditions were computer interfaces that gave examinees the perception the English exam was administered under authentic CAT or SAT conditions; in actuality, the exam was administered as a CBT. The sample consisted of 189 freshmen from eight intact sections at a private university in Southern Taiwan during Spring 2007. Test conditions were implemented in the school's IBM PC classroom. At login, students were randomly assigned to a test condition; they then installed the program interface that corresponded to their assigned condition. The exam item database was resident on the teacher's computer and captured all student input. The test conditions were implemented at the same time in each of the eight sections, and the exam terminated after 34 items were administered or after 40 minutes expired, whichever occurred first. At the end of the session, students were administered the TAI. Data were analyzed using ANCOVA, which was performed via hierarchical regression; the covariate was students' pre-anxiety scores, which were collected 7 weeks prior to study implementation. Results showed that test conditions' incremental knowledge in explaining anxiety or English exam scores' variability was not significant. Students' locus of control and years of informal English language training, however, were significant relative to English exam scores, and there was a significant self-efficacy-test condition interaction. Findings suggest that CBT, CAT, and SAT have the same influence on test anxiety, and that the perception of control over item difficulty and answer feedback, which are features of SATs, have no impact on test anxiety when compared to CBT or CAT.

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