2007

R·I·T

College of Science

2007

Summer Undergraduate Researchers

Acknowledgements

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College of Science

Mentors for the 2007 Summer Undergraduate Researcher's

Professor Jonathan Arney
Professor David Axon
Professor William Basenger
Professor Batcheldor
Professor Stefi Baum
Professor Bernard Brooks
Professor Scott Brown
Professor Larry Buckley
Professor Dawn Carter
Professor Christina Collison
Professor Christopher Collison
Professor Paul Craig
Professor Richard Doolittle
Professor Roger Easton
Professor Irene Evans
Professor Susan Farnand
Professor Maureen Ferran
Professor Maria Helguera
Professor Emmett Ientilucci
Professor Marv Illingsworth
Professor Jessa Jones
Professor Joel Kastner
Professor John Kerekes
Professor Tom Kim
Professor Karl Korfmacher
Professor Robert Kremens
Professor Andreas Langner
Professor Douglas Merrill
Professor Matt Miri
Professor Darren Narayan
Professor Dina Newman
Professor K.S.V. Santhanam
Professor John Schott
Professor Noel-Storr
Professor Chris O'Dea
Professor Suzanne O'Handley
Professor Jeff Pelz
Professor Perkins
Professor Harvey Pough
Professor Stanislaw Radisowski
Professor Andy Robinson
Professor Michael Savka
Professor Jon Schull
Professor Gary Skuse
Professor Thomas W. Smith
Professor Lei Lani Stelle
Professor Hyla Sweet
Professor George Thurston
Professor Laura Tubbs
Professor John Waud
Professor Tamas Wiandt
Professor Williams
Professor Kate Wright

"we are motivated by the excitement of discovery, and at the same time, we have acquired new skills and knowledge from our mentors..."

Russell Barkley is from a small town located outside of Watkins Glen, New York. He arrived at RIT in the fall of 2004 and enrolled in the General Science Exploration Program. Subsequent to declaring his major sophomore year as Imaging Science it was his goal to participate in numerous research projects. In the summer of 2006 he participated in a Structured Light research project with Dr. Harvey Rhody, modeling object three dimensionally. This year's summer project involves resolving host galaxies beneath quasars. Russell is also planning on doing his Senior Research Project on modeling the fluid dynamics in the alveoli. Upon completing this project he will graduate with a Bachelor's Degree in Imaging Science and then pursue a Master's Degree in either Business or Imaging Science.

The Galaxies Beneath:

Host Galaxy Quasar Deconvolution in the 0.1 < z < 0.5 Redshift Range

Abstract: A quasar is a very active young galaxy at the edge of the seen universe and they are orientated, such that we are looking down one of the jets from the black hole, into its nucleus. This orientation relative to the Hubble Space Telescope, using the Advance Camera for Survey's (ACS) imager, creates a bright blur extending over the galaxy. Accounting for this blur, using the point spread function (PSF) we can deconvolve the image, taking into account the optical distortions. Parameters can then be quantified after resolving the galaxy beneath the quasar. These parameters include the host galaxy radius, structural parameters, and the luminosity of the black holes' nucleus. Studying an array of these quasars will allow us to study and characterize the evolution of quasar host galaxies.

MENTOR: Stefi Baum, Jake Noel-Storr and Chris O'Dea

Matt Fullana, a Capricorn and a Nutmegger (he comes from Connecticut), has always loved science. He was especially fond of AP chemistry in high school and wished to learn more about the subject. After enrolling as a General Science Exploration major at RIT, he quickly switched to the Polymer Chemistry program, convinced by his current research advisor, Dr. Miri, that polymers are cool. Currently, Matt has spent well over a year with Dr. Miri's research group and enjoys the many new and exciting projects that he gets to work on. Matt has made numerous presentations on his research and is a current Chemical Sciences Research Scholar. Once he receives his BS degree from RIT, Matt hopes to earn a PhD in chemistry and pursue a career in a research-related field overseas.

Synthesis of Polymers from Polar Monomers and with Water as Solvent Using Single-Site Catalysts

Abstract: Currently all commercially available polymethyl acrylate and ethylene/acrylate copolymers are produced using radical initiator polymerization, which produces polymers with little control over polymer properties, such as crystallinity, molecular weight, and polydispersity. If typical Ziegler-Natta catalysts are used they are inactivated by the polar groups in the monomer resulting in no formation of polymer. However, some single-site catalysts offer the potential to polymerize in the presence of polar groups while providing ample control over polymer properties. Additionally, single-site catalysts, which are stable towards polar compounds make it possible to conduct polymerizations in water instead of organic solvents is possible, which provides numerous environmental and financial benefits, along with the ability to reduce dependence on foreign petroleum products. Our work involves the synthesis of new single-site catalysts, which remain stable in the presence of polar compounds, and the polymerization of polar monomers, which have not yet been successfully applied with single-site catalysts, in organic solvents and in water.

Mentor: Matt Miri

College of Science UNDERGRADUATE RESEARCH

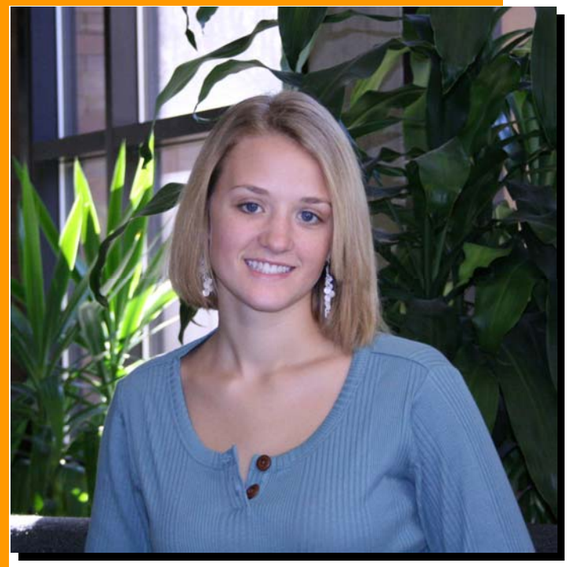
During the 10 weeks, students presented their work every Wednesday afternoons at the Undergraduate Research Seminars.

Dean Ian Gatley invited everyone to attend and lunch was served.

Fridays in the Factory

On Friday mornings, students gathered to explore interesting science topics. Fridays in the factory was coordinated by Catherine Mahrt-Washington.

Photos from video taken by Forrest Warner



"I think Undergraduate Research is one of the most important experiences you can have as an Undergraduate student. You learn so much in the classroom, but only in a certain number of classes you actually get to do what you are learning about. If you do Undergraduate Research you can apply your knowledge and see what is actually done in the real world and what is done in upper-level research or even research in industry. "

- Ashlee Benjamin
4th year - Bioinformatics

Divya Kumar was born in Charlotte North Carolina, but has lived in Rochester for most of her life. Ms. Kumar will be a sophomore in the fall, majoring in Biotechnology and minoring in International Business. She plans on attending medical school after college. She has been working with Dr. Savka for roughly half of her freshman year, and would like to continue doing research throughout her college years. She is very interested in playing the violin, playing the veena (a classical Indian instrument), and tennis.

Abstract: *Agrobacterium vitis* is a soil bacterium that has been known to cause crown gall disease on grape vines. When a grape vine is attacked by the *A. vitis* the vine is severely weakened, reducing the productivity of the grape vine in the vineyard. One hundred and thirty-eight isolates have been collected from nine crown gall tumors and have been grouped on the basis of their biochemical characteristics.

Through experiments that were based on the idea that the *A.Vitis* bacterium in grape plants utilize communication signals while transferring plasmids between each other (Burr and Otten 1999), we have come to the conclusion that cell-to-cell communication signals known as *N*-acyl-homoserine lactones (AHLs) are significant in the relationship between *A.vitis* and its host, the grape vine. We have already determined that the bacterial isolates produce AHL. The purpose of this experiment is to further screen unknown tumor bacterial isolates for AHLs. These studies will provide the insight necessary to attain the universal goal of determining the role of AHL signals in microbial communities associated with plants.

Mentor: Mike Savka

Andrea Braganza was born in Goa, India. She came to RIT in the spring of 2005 and is enrolled in the Biotechnology program. Ever since she was little she has being intrigued by science and life. She has been doing research with Dr. Newman since the spring of 2006 on the age related hearing loss project. Andrea wants to go to graduate school and then become a geneticist.

Correlation between Haplogroups and Presbycusis

Abstract: Presbycusis or age related hearing loss, is a disease that affects the elderly. It begins with the loss of hearing of high frequencies and then affects the lower frequencies, making everyday speeches difficult to follow and understand. It has been found that Presbycusis has a high mother-child correlation than a father-child correlation. We also know that mitochondrial DNA is maternally inherited and the different haplogroups are based on SNP (Single Nucleotide Polymorphisms) on the mitochondria. Therefore we are trying to see if there is a correlation between the different European haplogroups and the inheritance of Presbycusis in an individual. DNA for the experiments is obtained from ICHSR lab at NTID after the subjects have undergone phenotypic analysis.

Mentor: Dina Newman

"As Spring Quarter begins, students begin to consider their options for the summer. So what do you do? Camping in the Adirondacks? Back to the same old summer job? Or doing research in the College of Science? For those of us who decided to stay at RIT, what do we have to benefit? We benefit from our fellow researchers, who are just as interested as we are in learning about the wonders of science. We get to interact more with professors and fellow students, whether in our labs, at the seminars, or while standing outside of the stockrooms."

- Jamie Lou Mallonga
4th year - Chemistry

2007

Summer

Undergraduate

Researchers

Sarah Novotny is a mathematics major at Sacred Heart University. She will be graduating in the Spring of 2008 and plans to attend graduate school to pursue a Ph.D. in mathematics. She is participating in the NSF REU (Research Experience for Undergraduates) run through RIT this summer. She is doing research in the area of graph theory and vertex labeling.

Minimal k-rankings and the rank of the square of a path

Abstract: Given a graph G, a function f:V(G) --> {1,2,...,k} is a k-ranking of G if f(u)=f(v) implies that every u-v path contains a vertex w such that f(w)>f(u). A k-ranking is minimal if the reduction of any label greater than 1 violates the described ranking property. The rank number of a graph is the smallest k such that G has a minimal k-ranking. The a-rank number of a graph is the largest k such that G has a minimal k-ranking. We will present new results involving the rank numbers of ladders and the square of a path. We will then show that the rank number of the square of a path on n vertices is equal to the a-rank number of a path on n vertices.

Mentor: Darren Narayan

Timothy Hopper is from Princeton, WV and is a rising senior at Grove City College in Grove City, PA. He is majoring in mathematics with minors in applied physics and computer science. He was part of the RIT Department of Mathematics summer REU program sponsored by the NSF. In his free time, he enjoys running, reading, and knitting.

Computational Ramsey Theory

Abstract: We sought to find R(C4,C4,C4,C4) through various computational means. This Ramsey number is known to be either 18 or 19. We used over one year of CPU time, yet results were inconclusive.

Mentor: Stanislaw P. Radziszowski

Mudit Chaand graduated with a degree in Plant Biology from University of Delhi and joined RIT in Fall 2006 and is currently pursuing his undergraduate degree in Biotechnology. Mudit pursues his passion for research on bacteria under the able guidance and mentorship of Professor Michael Savka and is currently focused on the research initiative of Quorum Sensing in *Agrobacterium vitis.* During the course of his studies, Mudit has been an active member of the RIT Rotaract Club and serves as its Director of Community Services. Mudit's creative interests range from cooking to fashion designing and shopping. Mudit also enjoys spending time learning new activities. Mudit remains excited about his research program and is looking forward to making his mark in the field in the foreseeable near future.

Characterization of bacterial isolates from grapevine tumors.

Abstract: Crown gall tumors on grape are caused by the soil bacterium *Agrobacterium vitis*. Tumorigenic strains of *A.vitis* cause tumor formation that reduces vine vigor and productivity (Stewart and Wenner, 2004). The bacterium can survive systemically within the grapevine and tumor. One hundred and thirty-eight unknown bacterial isolates from nine different tumors have been separated and organized into groups based upon their biochemical characteristics. The bacterium has a unique ability to transfer a portion of its plasmid to the host plant (Burr *et al* 2002) which is mediated by specific bacterial communication signals (Fuqua and Greenberg, 2002). It has been shown that *N*-acyl-homoserine lactone (AHL) signals are the key cell-to-cell communication molecules in the relationship between *A.vitis* and grapevines.

Our aim is to identify if these AHL communication signals are produced by the 138 unknown grapevine tumor isolates. This will enhance our understanding of plant-microbial interactions and contribute to development of biocontrol agents to reduce dependency on pesticides.

Research Mentor: Mike Savka

Aaron Johnson, a Rochester native, was invited to participate in the Rochester Biomedical Experience while still in high school. That program, funded by the National Institutes of Health, is a collaboration between RIT and Monroe Community College and is designed to promote and enhance undergraduate education for promising students.

Aaron is completing his second year of summer research at RIT. Last year he laid the foundation for a comprehensive database of neurological diseases, spanning symptoms, implicated genes and medical literature, which will serve as a research resource for individuals interested in identifying genes responsible for coincident symptoms in a number of common diseases. This year he is continuing his application of bioinformatics tools to understand another aspect of genetics.

After earning this AAS this past spring Aaron will be entering RIT in the fall as a 3rd year student in the Biomedical Sciences program.

Environmental Effects on the Rate of Change in DNA Sequences in Complex Organisms

Abstract: Many studies have examined the long term effects of environmental factors on DNA changes in single cell organisms but few have looked at more complex plants and animals. This project takes advantage of freely available gene and genomic DNA sequences from a variety of organisms. Using common bioinformatics tools, including BLAST and databases at the National Center for Biotechnology Information, the Broad Institute at MIT and the Genome Sequencing Center at Washington University, we are comparing key genes and non-gene sequences within those genomes to determine whether there is a relationship between extreme environmental factors and long term rates of DNA sequence change. Specifically, we are comparing sequences from organisms that typically live in harsh but stable (e.g. deep ocean or desert), harsh and unstable (e.g. islands) and benign (e.g. temperate) environments. Prior studies on the nematode *C. elegans* suggest that, in a controlled laboratory setting, increased selective pressures is correlated with increased DNA stability. Our goal is to extend those findings to other organisms living in their respective natural environments.

Mentor: Gary Skuse

Paul Prue is from Sacramento, California, and is a senior majoring in Mathematics at the University of California, Davis. He is spending the summer in Rochester as a student researcher in RIT's first National Science Foundation Research Experience for Undergraduates (REU) in Mathematics, working with Professor Bill Basener, fellow student researcher Jenn Mahle, and Professor David Messinger (of the Carlson Center for Imaging Science) on Topological Anomaly Detection in Hyperspectral Images. Paul plans to pursue a graduate degree in Mathematics after graduation from UC Davis.

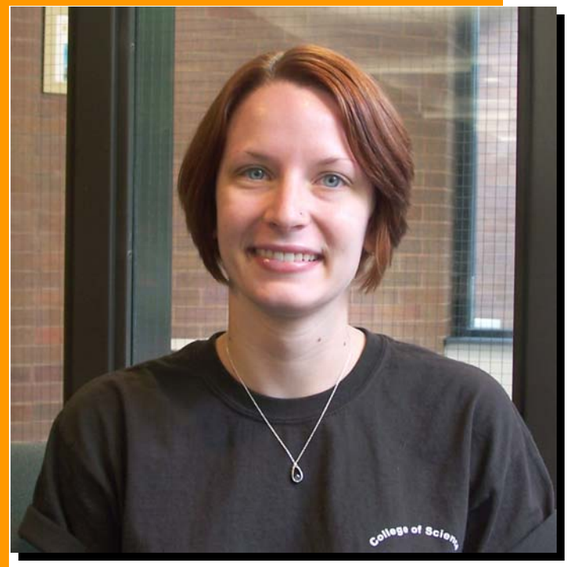
Topological Anomaly Detection in Hyperspectral Images

Abstract: Remote sensing hyperspectral imagery has the ability to provide detailed data about ground sites of considerable size. On the other hand, exploitation of these data is impractical without some tools for automated image analysis, such as materials classification and anomaly detection.

We coded in MATLAB a novel approach to materials classification, which finds the relative densities of image pixels in high-dimensional, hyperspectral color space, and outputs a greyscale image in which a darker pixel corresponds to higher local density.

Drs. David Messinger, William Basener, and Emmett Ientilucci created the Topological Anomaly Detection (TAD) algorithm to improve upon existing, statistically-based anomaly detection, which assumes normal distribution of data points. We added to TAD a method for classifying image pixels as live vegetation, using a formula based on reflectance in red and near-infrared wavelengths.

Mentor: Bill Basener



Jennifer Mahle attends the Wilkes Honors College at Florida Atlantic University in Jupiter, FL and this summer she is participating in an NSF Research Experience for Undergraduates in mathematics at RIT. Jennifer will be starting her senior year this fall at the Wilkes Honors College and is majoring in mathematics. She is the president of the photography club, vice president of the math club, and vice president of the tea club at her school. In '05-'06 and again in '06-'07, she was chosen as one of her college's named scholars.

Topological Anomaly Detection in Hyperspectral Images

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Mentor: William Basener

Kurniyati Kurniyati comes from Jakarta, Indonesia. In 2004, She entered RIT's College of Science as a biotechnology major. Kurniyati started working in Dr. Savka's lab in spring 2004. She has continued with the same research since. This summer she received an Undergraduate Research Fellowship from the American Society for Microbiology. She will be graduating in 2008 and plans on going to graduate school majoring in microbiology.

CONSTRUCTION OF A BIOLUMINESCENT PLASMID REPORTER BASED ON *PANTOEA STEWARTII* QUORUM SENSING RECEPTOR PROTEIN, *ESAR*.

Abstract: Pantoea stewartii subsp. stewartii (Pnss) is a Gram negative bacterial pathogen that causes Stewart's wilt and leaf blight diseases on sweet corn and maize, respectively. Pnss grows in the plant xylem and produces an exopolysaccharide slime layer called Stewartan that interferes with vascular transport of water. Production of Stewartan is cell density dependent and governed by the EsaI/EsaR quorum sensing (QS) system (Fig. 1). Previous work has shown that the EsaR directly interacts with promoter regions upstream of the rcsA gene to promote Stewartan synthesis. Presented here is our strategy to construct an EsaR-dependent bacterial biosensor that will detect the EsaR-cognate QS signal, 3-oxo-C6-HSL.

Progress to date includes PCR amplication and cloning of the esaR lux box sequence from promoter of rscA into luxCDABE cassette plasmid, pBS377, resulting in pBS377-rcsA. The newly constructed bioluminescent plasmid consists of the inducible EsaR binding promoter region and reporter operon, luxCDABE, that is predicted to produce light in the presence certain QS signals. This reporter plasmid will be transformed into esaI-, esaR+ Pnss strain to test the activity and functionality of the biosensor in the presence of various QS signals including EsaR cognate signal, 3-oxo-C6-HSL. This biosensor will be used in various detection assays with bioengineered corn and to characterize QS signal mimics produced by genotypes of maize that differentially respond to Pnss infections.

Mentors: Dawn Carter and Mike Savka

Janice K.N. Smith was born in Fontana, CA. and was raised mainly in the small town of Lyndborough, NH. After attending the Academy of Notre Dame from 2001 to 2005, she entered RIT in 2005 as a Biotechnology major. Ms. Smith is currently working on Terrestrial Isopoda Molecular Phylogeny. She became interested in terrestrial isopods after participating in research with Dr. Pough and Angeline Oh Abai on the Field and Laboratory Study of Terrestrial Isopods from the RIT Campus project. Currently Janice Smith is working in Dr. Buckley's lab and is pursuing a molecular biology project involving the investigation of terrestrial isopods. She plans to pursue a Masters Degree after the completion of her bachelors' of science at RIT.

Terrestrial Isopoda Molecular Phylogeny

Abstract: Terrestrial isopods (commonly called as pill bugs, sow bugs, or woodlice) are inhabitants of both natural and human-altered landscapes. Their social and reproductive behaviors are responsive to natural and anthropogenic changes in environmental conditions (Takeda 1980, Paoletti and Cantarino 2002, Kight and Nevo 2004, Lardies et al. 2004). Isopods contribute to the flow of energy and nutrients in ecosystems, and are bioindicator species that reflect changes in habitat quality (Alikhan 1995, Zimmer 2002). Terrestrial Isopods have been studied at length in Europe, while in North America they have been only studied sparingly and many of the species bear the names of European forms, although it is unknown if they are in fact the same species. Until recently the evolutionary history was based mainly on morphology alone, which can correlate unrelated groups in the same taxonomic group. Historically all the US species are simply assumed to be the same as those in Europe. To date our lab has focused on the species *Philoscia muscorum, Porcellio dilataus,* and *Oniscus asellus,* and begun to sequence the mitochondrial genes 12s and 16s.Once multiple independent molecular data sets are obtained, the goal is to further test the morphological phylogeny.

Mentor: Larry Buckley

Stanley Snelson is a rising junior at Columbia University. He is at RIT this summer for the NSF REU Program in Mathematics. He is working with Sara Reynolds and Dr. Tamas Wiandt in the field of Dynamical Systems.

The Lang-Kobayashi Equations

Abstract: We investigate the Lang-Kobayashi equations, a nonlinear delay differential equation system in three variables that describes the behavior of semiconductor lasers. Delay differential equations (DDE's)are similar to ordinary differential equations, except that the rates of change of the state variables depend on both the state at the present time and at some time in the past. Our research focuses on a family of periodic solutions of this system known as External Cavity Modes (ECM's). We use a combination of analytical and numerical techniques to study the qualitative behavior of the ECM's. The analytic investigation is supplemented by a thorough numerical study using the cutting-edge MATLAB package DDE-BIFTOOL.

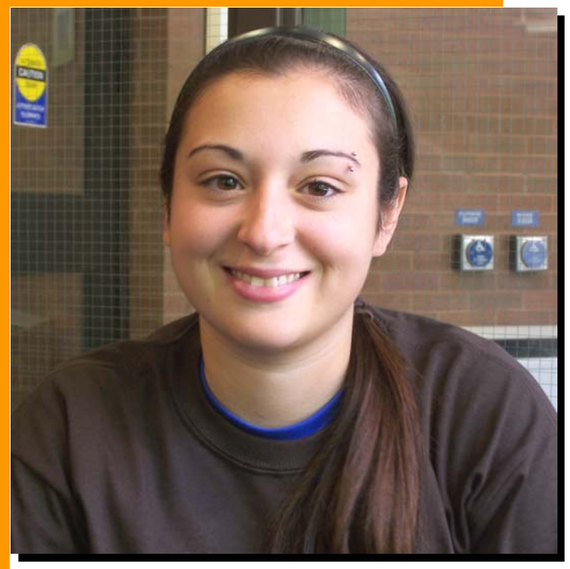
Mentor: Tamas Wiandt

Evan Heidtmann is from Portland, Oregon and attends the College of Wooster in Wooster, OH. He will be a junior double major in Mathematics and Physics in the fall. He spent this summer at RIT under the Department of Mathematics summer NSF-REU. In his free time, he enjoys cycling, hiking, and playing bluegrass banjo. Evan would also like to thank the Red Barn for their awesome climbing wall.

Computational Ramsey Theory

Abstract: We sought to find the multicolor Ramsey number R(C4,C4,C4,C4) through various computational means. This Ramsey number is known to be either 18 or 19. We used over one year of CPU time, yet results were inconclusive.

Mentor: Stanislaw P. Radziszowski



Amanda Souza is originally from Dighton, Massachusetts and came to RIT in the fall of 2005. She is entering her third year in the Biology program. Amanda was interested immediately in Dr. Newman's project and joined the lab in the spring of 2007, working on the age related hearing loss project. She has always been interested in Biology, especially genetics and evolution. Amanda decided on Biology as a major after taking a course in high school and hopes to go to graduate school and further study genetics.

Examination of the Mitochondrial Genome for the Cause of Presbycusis

Abstract: Presbycusis, or age-related hearing loss, is fast becoming a problem in the United States. As people age, their natural ability to hear high pitches begins to decline, followed by the lower frequencies. The degree of severity of the loss is partially genetic, and partially enviornmentally related. Overall, men tend to be more affected by presbycusis then women. The average age in America is growing, and many more people are facing this problem. Previous research has shown a correlation between hearing ability and maternal ancestry (mitochondrial haplogroup). The aim of this project is to identify the specific genetic difference(s) responsible. We will be sequencing the entire mitochondrial genome of 12 selected subjects, and look for any polymorphisms (differences in the DNA sequence between individuals). These loci will then be examined for functionality and association with hearing ability.

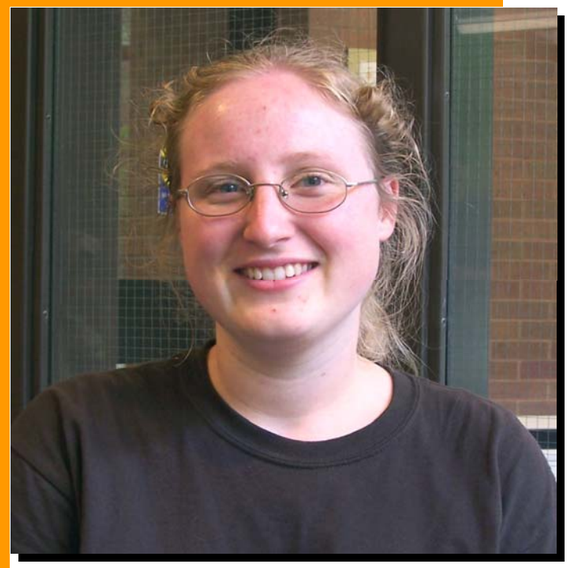
Mentor: Dina Newman

Kim Rafferty

MULTIMODAL DISPLAY TECHNIQUES WITH APPLICATION TO BREAST IMAGING. *K.*

Abstract: Breast cancer is the most frequently diagnosed cancer in women, and is second among deaths behind lung cancer. It would be to our advantage to have a non-invasive technique, instead of biopsies, as a standard follow-up diagnostic treatment after an abnormal mammography. Multimodal imaging is the approach that is currently being investigated to use as an alternate procedure to examine suspicious tissue prior to a biopsy, with the hopes to decrease the number of unnecessary biopsies being performed. Traditionally, radiologists are shown PET/MRI images on a side-by-side display. However, humans have difficulty judging spatial relationships when they are observed side-by-side, proving the need for ways to display volumes from multiple modalities as a single volume. The study conducted included eight different fusion techniques that were used by four radiologists at the Upstate Medical Hospital in Syracuse, NY. From this study we were able to obtain valuable information. For example, the distance between the location the subject selected in the most metabolically active region in the PET and the same location in the MRI, on average, was greater than the average distance between the location the subject clicked on the active region in the fused image and the same location in the PET. After analyzing all of the results, it was determined that the genetic algorithm, one of the fusion techniques, was preferred by the radiologists. The next step is to perform a Receiver Operating Characteristic curve study using the techniques preferred by the radiologists with images that contain actual lesions in the hope that the accuracy of diagnosis will be improved.

Mentor: Maria Helguera

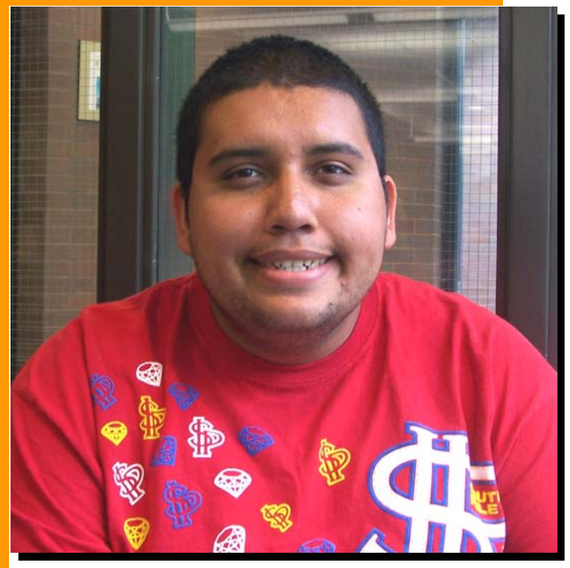


Sara Reynolds is an undergraduate mathematics and anthropology major at Nazareth College of Rochester. This summer she is attending the NSF REU in Mathematics at RIT. Sara and her partner, Stanley Snelson, are working in the area of Dynamical Systems under the guidance of Dr. Tamas Wiandt.

The Lang-Kobayashi Equations

Abstract: We investigate the Lang-Kobayashi equations, a nonlinear delay differential equation system in three variables that describes the behavior of semiconductor lasers. Delay differential equations (DDE's) are similar to ordinary differential equations, except that the rates of change of the state variables depend on both the state at the present time and at some time in the past. Our research focuses on a family of periodic solutions of this system known as External Cavity Modes (ECM's). We use a combination of analytical and numerical techniques to study the qualitative behavior of the ECM's. The analytic investigation is supplemented by a thorough numerical study using the cutting-edge MATLAB package DDE-BIFTOOL.

Mentor: Tamas Wiandt

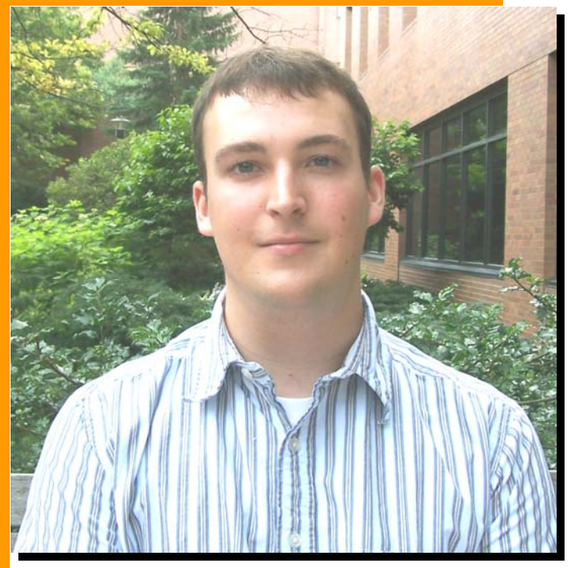


Juan Pablo Ortiz, a southern California native, was born and raised in the Los Angeles area. He has two older brothers and a twin sister. Juan just finished his third year at California Lutheran University. He plans to get his B.S. in Mathematics and minor in Art. He is the vice president of the Latin American Student Organization (LASO) and the president of Mathematics club at his university. After graduating from California Lutheran University he plans to get his doctorate in Mathematics. His career goal is to become a college professor. He wants to share his passion for mathematics with others.

The *k*-rankings and rank number for ladder and the square of the path

Abstract: Given a graph *G*, a function *f*:*V*(*G*)à{1,2,...,k} is a *k*-ranking of *G* if *f*(*u*)=*f*(*v*) implies that every *u*-*v* path contains a vertex *w* such that *f*(*w*)>*f*(*u*). A *k*-ranking is minimal if the reduction of any label greater than 1 violates the described ranking property. The rank number of a graph is the smallest *k* such that *G* has a minimal *k*-ranking. The *a*-rank number of a graph is the largest *k* such that *G* has a minimal *k*-ranking. We found new results involving the rank numbers of ladders and paths squared.

Mentor: Darren Narayan



Ryan Miller is a third year mechanical engineering student from Long Valley, New Jersey. He enrolled in the fall of 2005. In the fall of 2006, he began considering a program change and began to investigate the physics department. In order to become more involved in the program, he sought a research project and began working with Dr. Christopher O'Dea, Dr. Stefi Baum, Dr. Jake Noel-Storr, and graduate student George Privon. Ryan and George began the construction of a radio interferometer in December of 2006. Ryan signed on for the summer of 2007 to complete this project and to build an additional single-dish radio telescope. He is currently pursuing his Bachelor's Degree and Master of Engineering Degree in mechanical engineering and intends to pursue a PhD after graduation.

The RIT Radio Observatory: Radio Telescopes as Teaching Tools

Abstract: The RIT Observatory currently uses a pair of optical telescopes, as well as several portable optical telescopes. These tools provide for a good introduction to astronomy. However, the Observatory is severely limited in its ability to survey in other bands. The RIT Radio Observatory aims to bolster the existing facility through the addition of two radio telescopes. The first, a two-element interferometer based off of NASA's existing RadioJove receiver kits, will provide for observations at a narrow band around 20.1 MHz, useful for observing the sun, Jupiter, and various other objects. The second, a single-dish telescope built from recycled television and microwave components, will work near 1420 MHz and will allow for detection of neutral hydrogen in various sources. The addition of these telescopes will allow for a broader survey of astronomical techniques to be demonstrated within the astronomy courses.

Mentors: Jake Noel-Storr, Stefi Baum, Chris O'Dea

Marc O'Donnell is a 2004 graduate of Elmira Free Academy (Elmira, NY). He will be a fourth year student in the fall majoring in Biochemistry. He is a member of the RIT varsity cross country and track teams. Marc was a member of the RIT ECAC champion 4x800 meter relay team in indoor track, and was a member of the 2nd place 4x800 meter relay team at the outdoor track state championships, setting a new RIT school record of 7:46.03. Marc was the recipient of the RIT College of Science Physical Chemistry award in 2007. Marc plans on attending medical school in the fall of 2008.

Single Wall Carbon Nanotubes as Quenchers of Fluorescent Probes

Abstract: Single Wall Carbon Nanotubes (SWNT) provide possibilities for increasing the efficiency of organic solar cells through increasing the conductivity of composite materials used in such devices, or through use as a charge acceptor in a bulk heterojunction device. Yet, these same nanotubes may also quench the same excited states that would ultimately provide a photocurrent. In my research I am investigating the potential of SWNTs as fluorescence quenchers by studying their influence on a set of fluorescent probes and laser dyes. The quenching information will lead to a better understanding of chemical interactions of SWNTs with these organic fluorescent probes. The data will also provide a better understanding of how SWNTs can be used successfully when fluorescent probes are replaced by conjugated polymers for use in the actual solar cells.

Mentor: Christopher J. Collison

Deepika Gosain was born in Kota, India. She came to RIT two years back to pursue Biotechnology. RIT was one of her top choices as it has one of the best Biotechnology programs and has astounding research opportunities. RIT offers a unique experience of combining classroom learning along with hands on experience through co-ops and undergraduate research. She is privileged to be in an institute where faculty and staff go above and beyond to help you learn and understand things better. Ms. Gosain is engrossed with some extracurricular activities other than pursuing a degree in biotech. She is the treasurer of college of science student advisory board. She was a resident advisor in my second year. She is the current president of RIT leadership institute. She is also involved with student alumni networking.
She started her research in her freshman year in the spring quarter with Dr. Stelle where she did voluntary work for a quarter. Starting the fall of her second year, Ms. Gosain joined the river otter research team and started going to fields, doing lab work, etc. She realized during this time that she also had a keen interest in genetics and she started to learn the genetic techniques to start her own project.
She feels doing summer research with your own project is a very good form of erudition where one actually gets acquainted with the experimental techniques and produce results on your own. She feels highly indebted to the college of science for giving her this golden opportunity.

To do the diet investigation of British Columbia samples of river otter (Lontra canadensis) and compare them with New York samples

Abstract: North American river otters (Lontra Canadensis) range throughout the continent but populations are fragmented due to human influences. River otters were extirpated from western and central New York during 18th and 19th century, so as a coalition of concerned companies and individuals the River Otter Project was initiated, where 279 otters were released at sites such as Black creek and Lake Honeoye. Dr. Stelle started the river otter research lab in winter of 2003/4 where continuous efforts are being made by its members to search Black creek, Honeoye creek, and Oatka creek for signs of otters (tracks, feces, and sightings).
Through the use of molecular scatology, I am striving to extract DNA from feces of samples from British Columbia in order to determine their diet and then compare it with the ones that we have collected from New York. I am obliged to Dr. Stelle and Dr. Buckley for advising and guiding me in my project.

Mentor: Lei Lani Stelle

Ben Haehnel grew up in Oneonta, NY. He spent 2 years in Italy learning the language and culture as well as meeting the people between his freshmen and sophomore year.

Colliod Osmotic Pressure of Alpha and Gamma Crystallins

Abstract: Cataract disease, or clouding of the eye lens, is the leading cause of blindness in the world today. However, more knowledge is needed about the causes and formation of cataracts in order to create a viable treatment world wide. It is known that the attractive forces between proteins in the lens cause them to group together, scattering light so that the lens is no longer transparent; much like raindrops block out and scatter light from the sun. Some of the proteins involved in this process are the alpha, beta, and gamma crystallins. I will eventually be focusing my attention on mixtures of the alpha and gamma crystallins, using osmometry to obtain the pure and mixed second virial coefficients, which quantitate inter-protein repulsions and attractions.

Mentor: George Thurston

Brittany Lipchick will be entering her fourth year in biochemistry this fall. Before arriving at RIT, she attended UMASS Amherst as a chemistry major and transferred for the opportunities RIT has to offer. Britt enjoys running and playing field hockey and works in the Center for Campus Life during the school year. She also plans to continue to do research work with Dr. Hornak throughout the school year.

A STUDY OF THE MAGNETIC RESONANCE PROPERTIES OF A GADOLINIUM-COPPER MRI PHANTOM.

Abstract: Magnetic resonance imaging (MRI) phantoms are anthropogenic objects used to test the performance of an MRI system. MRI phantoms contain a filler material possessing a nuclear magnetic resonance (NMR) signal bearing liquid. The filler material should possess predictable NMR spin-lattice and spin-spin relaxation rates, R_1 and R_2 respectively. Recently filler materials of aqueous Cu^{+2} and Gd^{+3}-(DTPA-BMA) were observed to exhibit color changes on mixing, indicating a possible nonlinear dependence of R_1 and R_2 on $[Cu^{+2}]$ and $[Gd^{+3}]$ due to complexing of the Cu^{+2} with the (DTPA-BMA) ligand. This study examines the relationship between R_1, R_2, $[Cu^{+2}]$, and $[Gd^{+3}]$ using UV-visible absorption and hydrogen NMR spectroscopies. The peak absorption at 804 nm from hydrated copper shifted with increasing gadolinium concentration. The R_1 values solutions with only Cu^{+2} or Gd^{+3} increased linearly with concentration of the ion. The R_1 values of solutions of Cu^{+2} and Gd^{+3} did not behave as linear combinations of the concentrations of the two ions. R_2 values as a function of $[Cu^{+2}]$ and $[Gd^{+3}]$ are expected to follow a similar trend and will be presented. All the results support the formation of a Cu-Gd-(DTPA-BMA) complex in solution. This finding will allow scientists to make phantom filler materials with more predictable NMR properties.

Mentor: Joseph Hornack

Daniel Michler is from Lexington, Kentucky, where he grew up and now attends college. Always being interested in anything high-tech, the choice of Computer Science as a major seemed obvious. With a special interest in Astronomy, and coming from an area in which the lack of education in science is often apparent, the attraction of this project was instant, and a great deviation from the isolated environment CS often provides.

Abstract: Surveys of American citizens continue to show disheartening results, for example in one recent survey 26% of people were unable to answer that the Earth orbited around the Sun, and not the other way around. Things like this, which most of us think of as undeniable facts, continue to show us our failure as a country to educate our progeny, especially in the areas of science. To reverse this trend we must find some way of eliminating the apathy, fear, and false ideas children develop towards science at a young age. A lack of knowledge in science influences us in more ways than we know, it affects our understanding of our own world, and incorporates into everything from our daily activities to politics and war.

I have been analyzing surveys and statistics from science-oriented summer camps and family programs for elementary and middle school aged children to determine what influences interest in and attitudes towards science and what maintains those interests and attitudes. This information can be used in program development for new activities, family programs, and active classrooms in an effort to engage and retain children in science learning. I have also been working to adapt a survey to judge the attitudes towards science and make it appropriate for use with middle school aged children. Previously these tools have only been validated for high school and college aged students, and cannot be accurately applied to middle school students without preparation. Developing and validating a tool for use in the middle grades will allow teachers and education researchers to understand their kids attitudes towards science and science learning, and allow them to improve teaching methods and programs. The aim is to produce both guidelines for creating content to promote interest in science as well as developing methods to analyze attitudes towards science and keep children from becoming bored, or feeling incapable of learning science in various settings.

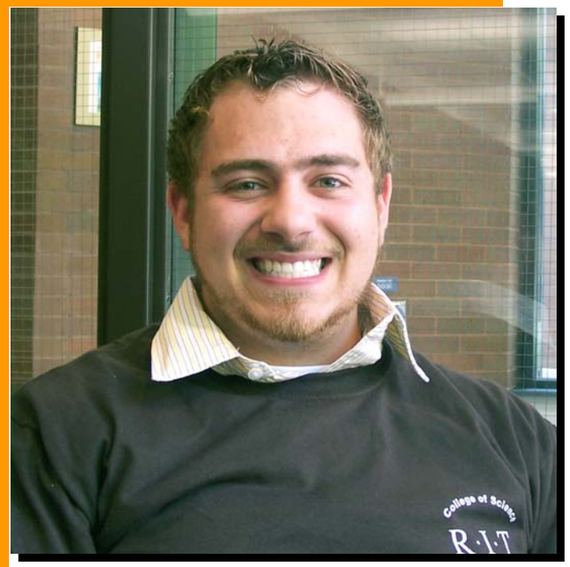
Mentors: Jacob Noel-Storr, Stefi A. Baum

Kevin Shimkus realized during high school biology that he wanted to pursue a degree in the field. After leaving his hometown of Rotterdam, NY, Kevin came to RIT as a Biology major who wasn't quite sure what he wanted to strive for, and for the first two years his goals swayed from one idea to another, and it took him until his third year to find his calling in the Biomedical Sciences program. Athletics being a major part of his life, he discovered he wanted to make a career of working with athletes, and he found his niche in the subjects of anatomy, exercise physiology, kinesiology, and any other class he could find related to exercise science. Kevin looks to complete his final year at RIT before moving towards a Ph.D. in Exercise Physiology, which he hopes will allow him to make an impact in any number of fields. Always working to expand his capabilities and potential, he currently works to keep RIT athletes safe and healthy as a student athletic trainer, and he hopes to soon sit for the Certified Strength & Conditioning Specialist exam. Kevin has competitively participated in rugby, soccer, and track, and enjoys camping, skiing, and volleyball.

BEYOND POWERPOINT: UTILIZATION OF MULTI-PROJECTION SYSTEMS FOR A SEMI-IMMERSIVE LEARNING ENVIRONMENT

Abstract: Advances in technology and media often offer improvements in teaching, especially at the level of higher education. As RIT has dedicated itself as a front runner of innovative learning techniques and technologies, it is necessary to explore new ways of displaying information with hopes of improved learning. Dataton (Linkoping, Sweden) has created software capable of multi-projection displays, and RIT has already seen a good deal of promise in this technology. Utilizing the new program WATCHOUT, visual presentations of human gross anatomy will be created to offer a larger, more detailed view of the material with the interest of an improved impact of retention. In particular, the goal of the project is focused on the upper limb, from the axilla to the individual digits of the hand. Human dissection and study provide the best method for truly understanding the complex details of the extremity characterized by its mobility and ability to grasp and manipulate, and after exposing areas of important structures, namely individual muscles and nervous innervations, still and video images can be used to capture the important details for use in the presentation. The WATCHOUT shows can be created on any PC using a wide variety of images, video, and audio, and RIT has the ability to display the shows in several of its auditoriums, offering the potential to teach human gross anatomy on a level never before seen. The main focus of the research is to determine if WATCHOUT is a plausible and effective way to improve the lectures of human gross anatomy to RIT students that provides more benefits than the current methods.

Mentor: Richard Doolittle



Andy Puccio is from Tonawanda , NY , a suburb of Buffalo. Andy has always had an interest in Science, ever since he was a small child. After finishing high school, he decided to attend RIT primarily for the extensive hands-on laboratory work. He has finished his first year at RIT as a Biomedical Science major. He is now working in the MCC Bridges program to help improve laboratory protocol for the Introductory Biology labs. During the course of the ten week program, he went through numerous different laboratory projects, rewriting protocol, adding exercises and creating new supplements for the course.

Revision to Introductory Biology Procedure

Abstract: These projects were performed were to improve the quality and efficiency of the Introductory Biology laboratory exercises. Several tests were run, including new methods and several different testing variables. Protocol for the five-week laboratory projects has been drastically changed to increase understanding of the biological concepts. Also, additional exercises were created to supplement the laboratory methods. One laboratory procedure followed was an enzymology lab, using lactase enzyme extracted from Lactaid™ pills. Several pills, both brand name and generic, were tested at different variables to assess its effectiveness. Also, a DNA sequencing lab was performed, where Mitochondrial DNA was extracted and sequenced, allowing it for comparison between different ethnic groups. Chicken contamination was also tested, assessing the difference in bacterial contamination between different cuts and types of chicken.

Mentors: Dina Newman and Leslie Kate Wright

Shawn Staudaher is originally from Sterling Massachusetts, a small town fifteen minutes from Worcester, where cows outnumber people. There, he developed interests in science, photography, and astronomy. This led him to pursue a degree in Imaging Science at RIT starting in the late summer of 2004. After three years of convolutions, back-projections and Fourier Transforms he decided astronomy research would be the perfect way to introduce some diversity to his education. For the future he plans to continue his education in an as yet undetermined graduate school studying an as yet undetermined subject.

Near-Mid IR Emission Line Diagnostics of 3CR Galaxies

Abstract: It is a common theory in astronomy that a number of different objects such as quasars, blazars, and radio galaxies can be unified under one banner as Active Galactic Nuclei (AGN). Their differences are thought to be due to a combination of factors, including viewing angle and differences in structural components. The only way to identify these factors is to find common elements among samples of these objects, which can be found by using spectral analysis. Spectra show emission lines which correspond to the energetics and the physical properties of the matter in the source being imaged. If these galaxies share common components then it can be assumed that observed differences in their properties are due to a difference in viewing angle and not because they are different types of objects, even if their images appear different.

Every AGN is thought to have a supermassive black hole at its center, surrounded by an accretion disc containing Polycyclic Aromatic Hydrocarbons (PAHs), or dust. The PAH emission lines can be found in the near-mid infrared portion of an object's spectrum. The Spitzer Space Telescope has imaged a number of radio galaxies from the 3CR catalog of radio galaxies in the near-mid infrared in order to find their spectra. The purpose of this research is to extract and then diagnose the spectra of these 3CR galaxies in order to test AGN unification theories by examining the PAH and atomic emissions and to determine other miscellaneous properties of these galaxies such as star formation rate and redshift.

Mentors: Jake Noel-Storr, Stefi Baum, Chris O'Dea

Bryan Ague has been a Rochester local his whole life and lives in the town of Chili. After gaining an interest in physics and astronomy while attending high school, he entered RIT in the fall of 2006 as a physics major. During the fall quarter, he became involved in undergraduate research with Dr. Stefi Baum, Dr. Jake Noel-Storr, and Dr. Chris O'Dea, learning about Active Galactic Nuclei as well as becoming familiar with imaging software used in astronomical image analysis. Bryan will be a 2nd year physics student this upcoming fall and plans to continue being active in research throughout his college career.

Multiwavelength Studies of UGC FR-1 Galaxies

Abstract: Images of Active Galactic Nuclei across various wavelengths provide a unique perspective of such objects, allowing the chance to better understand what is occurring. We have chosen a group of 21 nearby low luminosity Radio Galaxies and have acquired multi-wavelength images of these objects including visual light, radio, x-ray, infrared, as well as some ultra-violet emission images. A large catalog of images has been created for these 21 galaxies, showing the placement of different emission types in each galaxy, as well as demonstrating any correlations between emission type position and intensity. We see emission from different radiative processes and several components to the radio galaxy, including, old stars, young stars, hot gas, and relativistic electrons. We report our findings of relationships between the separate components, where they appear within the host galaxy and what they imply about the physical processes in the radio galaxy.

Mentors: Stefi Baum, Jake Noel-Storr, Chris O'Dea

Irene Kannyo lives in Avon, NY (just south of Henrietta). She is a biotechnology major, and will be entering her second year at R.I. T. in the fall. Ms. Kannyo is excited to continue in the biotech program, especially after working in the lab over the summer. During the school year she will be participating on the RIT step team, RIsTep. In the future Irene would like to do research, in either the genetic or the neuroscience fields.

Abstract: Our project is revising the Intro Bio Lab course. We have been going through each lab and testing different ways of carrying them out, editing the protocols as we go. We also are generating worksheets and guides to go along with the labs. Our goal is to make Intro Bio Lab easier to understand, and to add more of a comprehension component to the otherwise very hands on course.

Mentors: Leslie Kate Wright and Dina Newman

Karen Jackmin was born in Ithaca, NY and entered RIT in the fall of 2004. During her sophomore year she developed an interest in the behavior of differential equations, and the following fall began studying delay differential equations. In the winter of 2006, under the supervision of Dr. Tamas Wiandt, she studied a delay system for an inverted pendulum and performed stability analysis on the system. Outside of academics, Karen is involved in the Navy ROTC program, as well as being a calculus teaching assistant. Upon completing her degree at RIT, she plans to serve her time in the Navy and then go on to receive a PhD in mathematics.

Stability Analysis and Bifurcations in Semiconductor Lasers

Abstract: This project continues previous research on the area of semiconductor laser bifurcations. The behavior of semiconductor lasers is described by a system of nonlinear delay differential equations. These systems are notoriously hard to analyze, and a complete description still does not exist. We analyze the behavior at certain parameter levels by investigating external cavity modes of the system with a two-pronged approach: analytical and numerical studies.

Mentor: Tamas Wiandt

Joe Panzik will be a Senior Physics Major for the 2007-2008 academic year. Some of Joe's activities on campus include Alpha Phi Omega, Phi Sigma Pi, Society of Physics Students College of Science Student Advisory Board, Intramural Soccer, and Assisting Teacher's with University Physics. Other interests include rock climbing, music, eating, and hanging out with friends. After graduating from RIT, Joe plans to continue on to Graduate School to earn his PhD in Geophysics.

How Do Blackholes Get Their Kicks?

Abstract: Until recently it has been commonly thought that Supermassive Blackholes (SMB) resided in the center of the hosting galaxy. New evidence has hinted that this may not be true, and that black holes may actually be displaced from the galactic center. When to galaxies collide, the two blackholes merge and the resulting gravitational waves emitted result in the blackhole being "kicked" from the galactic center. Spectral data that Dr. Axon and Dr. Robinson acquired has shown the displacement from a spectral perspective. The aim of this project is to prove the displacement from an optical perspective using images acquired from the Hubble Space Telescope (HST) Archive. The images acquired view the galaxy in the visible and near-infrared wavelengths. By fitting the galaxies with models that remove the Active Galactic Nuclei (AGN) which signifies the accretion disk around the blackhole, the remaining images contains light from the host galaxy only. Comparing where the center of the host galaxy light is centered to that of where the AGN light is centered shows a displacement of the blackhole from the center of the galaxy.

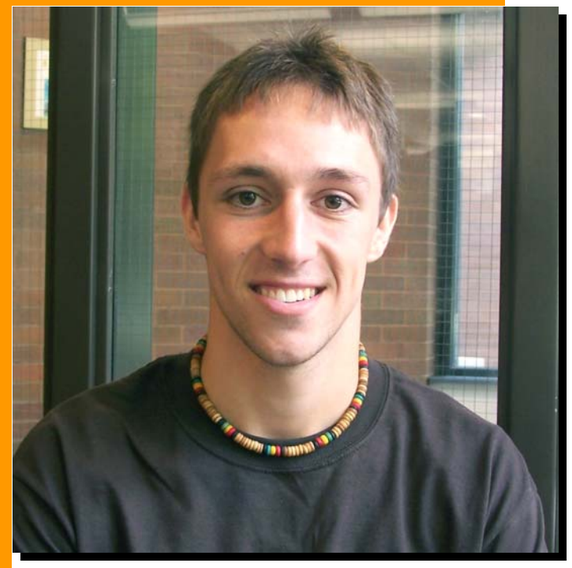
Mentors: Andrew Robinson, David Axon

Zachary Dell was born in Niagara Falls, NY and has lived there for his entire life. As a young child he developed an interest in the sciences and mathematics, which continued throughout high school. Upon graduating from Niagara Falls High School, Zack pursued his interests in science when deciding to attend RIT for physics. He is now entering his sophomore year at RIT and plans on going to graduate school in the future. Currently, his goal is to get his Doctorate Degree in either Physics or Astrophysics. Zack began doing research in the summer of 2006 when he was invited to RIT for a pilot program allowing pre-freshmen to do scientific research. During that program he worked with Dr. Batcheldor, studying the interaction of dumbbell galaxies. This summer Zack continues to work with his previous mentor, but is now studying the relationship between luminosity and black hole mass in the brightest galaxies.

The Formation and Evolution of the Brightest Cluster Galaxies

Abstract: Brightest Cluster Galaxies (BCGs) provide a unique chance to study the process involved in galactic formation and evolution. Being some of the largest and most luminous galaxies in the universe, BCGs offer insight into some of the fundamental questions in modern astrophysics, including how galactic cores form and how luminosity correlates with black hole size. We purpose to look at a sample of BCGs using the WFPC2 camera on the Hubble Space Telescope (HST). By reducing and analyzing the images of these galaxies we will develop a clearer picture of the merger history of the galaxies and ultimately be able to determine the mass of the central black hole. Comparing our results with previous observations will result in a clearer picture of what goes on in BCGs and will shed light on the details of galactic merging.

Mentor: Dan Batcheldor



Joshua Thomson was born and raised in Alexandria Bay, NY, in the Heart of the Thousand Islands. The information that Josh received from R.I.T. concerning undergraduate research left him strongly considering attending the university. However, it was the opportunity to start research prior to his freshman year, through the College of Science Honors Summer Research Program, that finalized his decision. He was extremely pleased with the program, conducting, first-hand, the exciting research that he had only read about in the past. After becoming acquainted with the research experience and having a successful summer, Josh's research mentor, Dr. Suzanne O'Handley, asked if he would like to continue throughout the academic year. Josh readily accepted the opportunity to be involved in research during his freshman year. Throughout the fall, winter, and spring quarters he continued to work with Dr. O'Handley, primarily on the purification of an enzyme, Rv2985, as a novel antibiotic target from M. tuberculosis. Josh presented his work at the national meeting for the American Society of Biochemistry and Molecular Biology in Washington, D.C. in May, and will be presenting at the national meeting of the American Chemical Society in Boston in August. Josh is a member of the ASBMB Student Affiliate Program at R.I.T. This summer he has been working on aspects of multiple projects within Dr. O'Handley's lab. In his spare time Josh enjoys reading, drawing, and running. He has been training for the Rochester Marathon, which will be held this September. In the future, Josh intends to continue with research, attend graduate school to obtain his PhD., and conduct research in his own lab on infectious diseases.

Abstract: The O'Handley lab focuses on two main enzyme superfamilies, the Nudix hydrolases and the HAD (haloacid dehalogenase) superfamily. The Nudix hydrolases are a family of enzymes that cleave substrates containing a nucleoside diphosphate linked to some other moiety, while the HAD superfamily consists of a variety of enzymes, especially phosphatases. We are concentrating on enzymes from human pathogens (M. tuberculosis, M. leprae, and S. aureus) as potential novel antibiotic targets. I am currently involved in a few projects. I am finishing the purification and characterization of Rv2985 from M. tuberculosis, an enzyme believed to enable the pathogen to invade human macrophages. I am continuing the characterization of an Orf135 E. coli mutant, which appears to be less susceptible to the antibiotic streptomycin. I will investigate whether Rv1160 from M. tuberculosis complements this phenotype of Orf135, and what this phenotype indicates at the molecular level. Additionally, I am finishing the characterization of a S. aureus phosphoglycolate phosphatase virulence factor.

Mentor: Suzanne O'Handley