MEMORANDUM

TO: 2009 Young Scholar

FROM: YSP Co-Directors

RE: 2009 Young Scholars Program Independent Research Project (IRP) Opportunities

DATE: May 22, 2009

Below is the listing of the research projects for 2009. Read all of the descriptions carefully regardless of the department in which it is offered; some may involve fields of science other than that of the department. Rank your top 6 choices, with 1 being the project you would most like to do. You must fax (850-644-0643), email (smith@bio.fsu.edu), or phone (850-644-6747) your 6 choices (project number and last name of researcher) to Robin Smith by **Friday, May 30, 2009**. We must match you with a project and mail the packet back in time for you to receive it before you come. Assignment is not first come, first served, but if we do not receive your choices by May 30, we will assign you to a project last.

The following descriptions have been provided by the researchers themselves, so the degree of detail varies. Also, please be aware that the *nature of science* is such that the focus or direction of a project can change at any time, set backs are not uncommon, and preliminary findings may alter your role in the project over time.

_____ 1. Dr. Volker Crede Department of Physics The discovery of new excited states of the nucleon (proton or neutron) is one of the hot topics in nuclear physics. In this project, the decay of such excited states into a proton and two further particles - a so-called pi0 and an omega meson - is studied. The student will use state-of-the-art analysis software for some exploratory studies of cross sections and learn modern analysis techniques in nuclear physics. Programming language is C++ on a Linux operating system. The student should know some C++ and some programming experience is certainly useful. (Accommodates 2 students)

_____ 2. Dr. Steven McGill National High Magnetic Field Laboratory. Students will be requested to develop a Raman spectroscopy apparatus for use in the optics user facility at the National High Magnetic Field Laboratory. The optics lab is home to several state-of-the-art continuous wave and ultrafast laser systems as well as an ultra-high magnetic field superconducting magnet dedicated for optics research. Students will design and carry out an experiment to measure Raman scattering from available crystals in the sponsor's lab. In addition to aligning optics for the experiment, students will need to design parts to be built by machinists in the lab's shop as well as create software for computer-assisted data collection. If time permits, students may have an opportunity to participate in an optical experiment carried out to approximately 31 T by the sponsor's graduate student and post-doc. The optics lab also hosts visiting scientists from all over the world who apply to use this unique facility and interactions with these visiting scientists will be encouraged. Students should have basic computer skills including knowledge of Windows and Mac OS. Also, students should have some knowledge and prior experience with CAD (computer-assisted design) software, such as AutoCAD, or laboratory virtual instrumentation software, such as LabVIEW. (Accommodates 2 students)

_____ 3. Dr. T.N. Krishnamurti, Department of Meteorology. Research interests in this lab are in the following areas: high resolution hurricane forecast (tracks, landfall, and intensity), monsoon forecasts on short, medium range, and monthly time scale and studies of interseasonal and interannual variability of the tropical atmosphere. This year students will be involved in a project to map heavy rainfall over Florida using radar and dense rain gauge data sets. Students need only a minimal knowledge of computers, web, printing, and data access. (Accommodates 1 student)

_____ 4. Dr. Naresh Dalal, Department of Chemistry and Biochemistry. Nanoparticles represent a new frontier in technology, blurring the lines and defining a sort-of conjugated system between physics, chemistry, biology and materials. A materials scientist may be interested in the ability to construct a metal or semiconductor with certain geometries for the pure challenge of the work, while at the same time, a physicist or spectroscopist may be very interested in studying that same nanomaterial to understand how size and geometry have influenced the behavior of its electrons. By taking advantage of well-characterized biological systems (eg. proteo-nucleic interactions) we are able to probe the electrons of small gold nanoparticles by observing the behavior of strategically placed nearby fluorophores at specific distances from the nanoparticle surface. The student will work with members of the research team to carry out a series of coupling chemistries of gold to nucleic acids to explore the distance dependent changes induced by nucleic-acid protein interactions using optical techniques. (Accommodates 2 students)

_____ 5. Dr. Thomas Miller, Department of Biological Science. The work in this lab focuses on carnivorous plants in the nearby forests, especially with their interactions with a number of mutualistic invertebrates that live in their leaves. Researchers want to see if fertilizing the plant helps the invertebrates inside the leaves. This will involve some field work, lots of microscope work counting bacteria and protozoa, and some computer modeling of food webs and species interactions. Programming in excel or R would be convenient, but not necessary.
(Accommodates 2 students)

_____ 6. Dr. Edmund Myers, Department of Physics. The project involves high-precision atomic mass spectrometry, for example measuring the atomic mass of sulfur to 100 parts-per-trillion (10-significant digits!) The measurements use a ***single*** atomic or molecular ion. The ion is trapped in ultra-high vacuum, at liquid helium temperature (4.2 K), by magnetic and electric fields in what is called a Penning ion trap. Students will learn about the Penning ion trap, about how the single ions are made and isolated in the trap, and how the measurements are performed and analysed. They will take part in data taking and analysis for a precision atomic mass measurement. The project will also introduce students to a wide range of interesting and important concepts in experimental atomic and nuclear physics.
The system uses MacIntosh computers, LabView control software, and Excel and IgorPro for analysis. It is hoped the students are familiar with Excel, but experience with the other software is not necessary. (Accommodates 2 students)

_____ 7. Dr. Wu-Min Deng Department of Biological Science. This research laboratory focuses on: (A) The role of cell-cell communication and signal transduction pathways in the establishment of oocyte polarity. Previous research has unveiled a muscular-dystrophy related gene, Dystroglycan, that is involved in polarizing both the oocyte and epithelial cells. We will focus on dissecting the signaling role of Dystroglycan in detail while studying its interaction with other genes and pathways to understand the molecular mechanism underlying cell polarization. (B) Regulation of the cell cycle switch. We have shown that Delta-Notch

signaling is involved in triggering a switch from mitotic cell cycle to an endoreplication cycle in *Drosophila* follicle cells. We will identify targets of the Notch pathway and determine the molecular link between signaling pathway and cell cycle gene. Basic computer skills are required. (Accommodates 1 student)

_____ 8. Dr. Thayumanasamy Somasundaram, Institute of Molecular Biophysics. The aim of the project is to crystallize a protein and study the effect of temperature on crystal dimensions. It will involve the following steps:

1) Specific laboratory skills in handling liquids, biological samples and liquid nitrogen.
2) Preparation of buffer solutions, protein samples and crystallization plates.
3) Setting-up and optical observation of crystal trays with protein samples.
4) Flash cooling of crystals using gaseous nitrogen at various temperatures.
5) Collecting x-ray diffraction pattern and obtaining crystal dimensions.
6) Drawing conclusions based on the observations

Steps 1-3 can be completed during the first three weeks, Steps 4 and 5 can be completed during the 4 and 5^{th} weeks, leaving the last week for final analysis and presentation of the results. *Please note that crystallization procedure for the protein is already known. Flash cooling procedure is a standard technique. The correlation between crystal size at various temperatures and cell dimensions are not fully known and will be the part that the student will research and learn.* (Accommodates 2 students)

_____ 9. Mr. Shawn Smith, Center for Ocean Atmospheric Prediction Studies. The Young Scholars will conduct oceanographic and meteorological data analysis as a contribution to an ongoing research project focusing on the ocean circulation on the continental shelf of the Northeastern Gulf of Mexico. Of particular interest is the cross-shelf transport, as it is important to the onshore transport of the pelagic fish larvae (specifically the gag grouper which is a commercially important fish species). Variability of the circulation or transport from February to June (time period of gag spawning and larval transport) is being assessed on various time scales using a numerical modeling approach. The Young Scholars will analyze multi-depth ocean current and surface meteorological data collected in the Northeastern Gulf of Mexico. These observations will be used to validate the numerical model results. In addition to laboratory data analysis, an opportunity might exist to conduct field work on an oceanographic day cruise in the Northern Gulf of Mexico. Some basic computer knowledge would be helpful. Most analysis will be conducted using Microsoft Excel and the students should be familiar with Microsoft Word. Any knowledge of a programming language (Basic, Fortran, C) would be helpful, but not required. Other needed computer skills will be taught to the students in our lab. (Accommodates 2 students)

_____ 10. Dr. Al Stiegman, Department of Chemistry & Biochemistry. The research in this lab involves inorganic materials chemistry, primarily using a technology known the Sol-gel process. This is a wet chemical technique for making porous glass materials. The students working for me would start out by doing chemical synthesis to make new glass materials and then they would learn to do characterization of the materials using various spectroscopic techniques. (Accommodates 2 students)

_____ 11. Dr. William M. Landing Department of Oceanography. Using ion chromatography and flame atomic absorption spectroscopy to measure anions and cations in aerosol samples collected from the open ocean on research cruises. Students may also develop their own projects using these analytical techniques. This project will investigate the chemistry of aerosol samples that were collected on a recent research cruise. (Accommodates 2 students)

_____ 12. Dr. Mike Davidson National High Magnetic Field Laboratory We propose to generate new lines of genetically-encoded calcium biosensors using backbone calcium-sensitive proteins from a family of neuronal calcium sensors that have inherently faster Ca^{+2} binding kinetics compared to both calmodulin and troponin. We will focus on the protein, recoverin, as the Ca^{+2} sensor because it has the most attractive features to be very fast and effective for this purpose. Our long term goal is to generate and make widely available to the scientific community, plasmids, cell lines and strains of mice that have effective calcium biosensors capable of accurately detecting tissue-specific and organelle-specific Ca^{+2} transients, *in vivo,* at speeds suitable for measurement of action potentials in excitable cells.
(Accommodates 2 student)

_____ 13. Dr. Scott Steppan Department of Biological Science. Evolutionary diversification of rodents. Understanding how diversity of life on earth grows is a fundamental goal of evolutionary biology and ecology. This four-year project has three goals. (1) Build an evolutionary family tree (phylogeny) using DNA sequence data from 4 genes of 550 species of muroid rodents, the most diverse and successful mammals. This phylogeny will be useful to many fields, especially the biomedical sciences because the muroid rodents include most of the species used in biomedical research (e.g., mouse, rat, hamster). (2) measure the skulls of 300 species in 3D, and (3) combine the morphology with the phylogeny to determine when and where different lineages became diverse, both in numbers of species and shape of the skull and teeth. The results will show which mechanisms-adaptation, colonizing new lands, or changes in an inherent propensity to evolve"-cause diversity to increase.
YSP students working on this project will learn about three aspects of evolutionary research: (1) conduct PCR amplifications of targeted genes for DNA sequencing, (2) discover some of the diversity among muroid rodents, and (3) the basics of estimating phylogenetic trees from DNA sequences. Each student will work on a set of tissue samples for several species. Students will then use PCR methods in the lab to amplify two different genes, prepare samples for DNA sequencing, edit any resulting sequences, and learn how to compare those sequences to existing sequences. Using some basic phylogenetic programs, students will then analyze their new sequences in combination with existing data to place their species on the evolutionary family tree.
(Accommodates 2 students)

_____ 14. Dr. Chris Hendrickson National High Magnetic Field Laboratory Awaiting description (Accommodates 1 student)

_____ 15. Dr. Eric Hellstrom National High Magnetic Field Laboratory. Awaiting description. (Accommodates 2 students)

_____ 16. Mr. Dylan Murray National High Magnetic Field Laboratory Awaiting description. (Accommodates 2 students)