

SRI International

Home Institutions and Research Projects of REU Program Participants — 1999

The SRI REU program assigns each student to work with a staff professional on a separate research project. Typically these projects are a sub-task on a larger research program of the mentor. Some of these projects are independent with the mentor overseeing the students progress on a daily basis. More than half of the projects involve the student working in the laboratory side-by-side with a Ph.D. staff member. Here the data collection task is more collaborative than independent. Since the student projects are each individually supervised, the SRI program can accommodate students with different starting and ending dates.



1999 REU Students & Program Directors

1999 REU Projects at SRI

Student from Pomona College

Mentor: Dr. Philip Cosby

Project: "Electron-Impact Dissociation of Neutral Molecules and Radicals"

This project examines the dissociation products produced by electron-impact dissociation of neutral molecules and radicals. A fast beam of neutral molecules is produced by ionizing, mass selecting, and collimating a parent ion, then passing the ion beam through a charge transfer cell. The resulting neutral beam is crossed with an electron beam to produce dissociation fragments, which are collected by a time- and position-sensitive detector to determine absolute cross sections for the electron-impact dissociation process and product translational energy distributions.

Student from Cornell University

Mentors: Dr. Harald Oser and Dr. Michael Coggiola

Project: "Real-Time Detection of Chlorinated Aromatic Compounds by REMPI-MS"

Chlorinated aromatic compounds, especially dioxin and furan species, are extremely toxic to humans, even at the level of one part per trillion. These types of molecules are often created in waste incinerators and metal plants. We are developing a REMPI-based instrument to detect these and other compounds in real-time, with a high degree of sensitivity. Supersonic-cooled, resonance enhanced multiphoton ionization (Jet-REMPI) combined with time-of-flight mass spectrometry (ToF-MS) provides the necessarily high chemical selectivity.

Student from Georgia Institute of Technology

Mentors: Dr. Tom Slanger, Dr. Philip Cosby, and Dr. David Huestis

Project: "The Contribution of Keck/Hires to Terrestrial Nightglow Studies: Atomic/Molecular Spectroscopy and Kinetics"

The unsurpassed resolution and sensitivity of the HIRES spectrograph at the 10-m Keck I telescope creates new opportunities for investigating the emissions of the Earth's atmosphere. Through collaborations between astronomers and aeronomers, diagnostic information about the terrestrial middle and upper atmosphere can be attained. This research is intended to provide a foundation for selecting and interpreting new measurements from the ground, from rockets and balloons, and from space platforms. We need a good model of terrestrial and extraterrestrial sources of emission and absorption features to take advantage of the improvements in optical instruments. Because the real atmosphere is variable on time scales of season, time-of day, or even minutes, we need schemes of calibrations that can be acquired with just a few measurements. The overall objective is to develop a comprehensive model of terrestrial nightglow emissions with the target of identifying and characterizing the nightglow emissions that provide new diagnostics for ionospheric processes.

Student from the New College of the University of South Florida

Mentor: Dr. Gregory Faris

Project: "Photon Density Waves in Turbid Media"

The long-term goal of this project is to develop optical, noninvasive, medical diagnostic techniques. We use a measurement system comprising an amplitude-modulated laser and photomultiplier tube to measure the absorption and scattering coefficients of tissue or tissue phantoms. Tissue phantoms are made using Ropaque and blue food dye (FD&C No. 1). Accurate measurement of tissue properties is possible by immersion of a human hand in the tissue phantom. Concentrations of chromophores of biological interest can be derived from measured absorption coefficients. We are extending this technique to multiple wavelengths for spectroscopy, using light emitting diodes (LEDs) as light sources and examining approaches for improving experimental accuracy.

Student from Valparaiso University

Mentors: Dr. Jeff Johnston and Dr. Laura Iraci

Project: "Uptake Coefficient Measurement of HNO₃ on Soot Aerosols"

Soot emissions from jet aircraft in the upper troposphere and lower stratosphere may have an impact on the generation/destruction of tropospheric and stratospheric ozone. We are interested in the reaction of HNO₃ on soot aerosols, which may have implications for ozone levels in the stratosphere. HNO₃ may react on soot surfaces to produce NO_x (i.e., NO and NO₂) and H₂O or otherwise adsorb onto the soot surface, in effect, removing HNO₃ from the stratosphere and thus producing less ozone depleting NO_x. This experiment is designed to determine how HNO₃ behaves on soot aerosols by exposing HNO₃ to soot aerosols in a flow tube reactor.

Student from the University of Portland

Mentor: Dr. Gregory Faris

Project: "Development of Stimulated Scattering as a Diagnostic for Supercritical Fluids"

The goal of this project is to develop techniques for monitoring collective fluctuations in the critical region and above, which will be suitable for studying supercritical fuel behavior. By overlapping a strong pump laser beam and a weaker probe laser beam in a sample, we can induce gain or loss on the probe beam. By scanning the frequency of either the pump or probe laser, we can perform spectroscopy on the resonant scattering modes of a sample. We use the fundamental wavelength of a Nd:YAG laser as a pump beam with pulse energies ranging from 50 microJoules to 1 milliJoule. A single-mode tunable diode laser is used as the probe laser, and stimulated Brillouin scattering and Rayleigh scattering are observed in supercritical hexane.

Student from the University of St. Thomas

Mentors: Dr. Laura Iraci and Dr. David Golden

Project: "Solubility of HOBr in Sulfuric Acid under Stratospheric Conditions"

Halogen compounds are the dominant catalyst for the formation of the polar ozone hole and for global ozone loss in the upper stratosphere. Although bromine concentrations are much lower than chlorine concentrations and thus contribute to only a small fraction of direct ozone destruction, bromine compounds

can indirectly enhance ozone loss through coupling to other radical families. One possible pathway for coupling the bromine and chlorine families is the reaction of HOBr with HCl in cold sulfuric acid aerosols. As a first step in this reaction, both gases must dissolve in the concentrated aerosol droplets found in the global stratosphere at approximately 10-12 km. The solubility of HCl is well understood, but HOBr has not been systematically investigated. Experiments are in progress to study the solubility of HOBr in a wide range of sulfuric acid solution concentrations and temperatures.

Student from Columbia University

Mentor: Dr. Richard Copeland

Project: "Pressure Dependence of the (3+1) REMPI Spectrum of O₂"

The absorption of solar ultraviolet (UV) radiation by the oxygen molecule is the starting point for many important chemical processes in the Earth's atmosphere. A way to examine the excited states of O₂ responsible for the single-photon UV absorption and the nearby states that are optically forbidden in single photon studies is resonantly enhanced multi-photon ionization (REMPI) via a (3+1) process. In this (3+1) REMPI experiment, three 368-384 nm photons pump O₂ to the excited states, and the fourth photon ionizes. The effects of pressure on the $E^3\Sigma_u^- \leftarrow X^3\Sigma_g^-$ (the longest band), the $f^1\Sigma_u^+(v = 3, 2, 1) \leftarrow X^3\Sigma_g^-$ and the $D^3\Sigma_u^+(v = 3, 2) \leftarrow X^3\Sigma_g^-$ bands of O₂ are studied. Between 0.1 and 200 Torr, we find that the relative intensities of the bands vary unexpectedly with pressure. For example, the relative intensity of the longest band decreases at higher pressures, while the relative intensity of the $D^3\Sigma_u^+(v = 3, 2) \leftarrow X^3\Sigma_g^-$ band increases dramatically at higher pressures. The pressure dependence is attributed to collisional mixing with the previously unobserved one-photon forbidden, three-photon allowed $^3\Delta_u \leftarrow X^3\Sigma_g^-$ band.