

**PHYSICS DEPARTMENT  
COLLEGE BASED FEES  
QUARTERLY REPORT  
FINAL REPORT  
2004-2005**

Message from Richard B. Frankel, Chair

The College Based Fee Committee, comprising students and faculty, endorsed the 2004-2005 proposal offered by the Physics Department Committee. The proposal included a summer student research program, student and faculty travel to physics meetings, senior project expenses, additional startup funding for new faculty, equipment purchases and support for physics electives and extra sections of required courses. The 2004 summer research program was very successful with nineteen students taking part. I want to thank all the physics students for their support of the College Based Fee which makes it possible for the department to offer an enriched undergraduate experience to our students.

Courses: Electives for Majors

Budgeted	Expended
\$45,000.00	\$44,975.00

The Department offered two upper division Physics electives in the Fall: Physics 406 Quantum Mechanics II and Physics 412 Solid State Physics, and provided majors with two additional lab sections for Physics 323 Optics and Physics 340 Quantum Physics Lab I, both required courses. For Winter Quarter, Physics 423 Advanced Optics, an elective, and Physics 341 Quantum Physics Lab II, a requirement, were supported. Spring quarter offerings were Physics 405 Quantum Mechanics I, a required course, and Phys 470 Quantum Field Theory, and Physics 357 Advanced Instrumentation in Experimental Physics, both electives.

Student Travel

Budgeted	Expended
\$2,260.00	\$2,259.65.00

A group of students traveled to UC Davis and Lawrence Livermore lab for tours and meetings with staff to explore graduate opportunities. Three students went to the MRS conference in San Francisco with Dr. Echols. Five students went to the APS meeting in Los Angeles with Dr. Schwartz. One student went to the AAS meeting in San Diego.

Student Project Expenses

Budgeted	Expended
\$3,219.00	\$3,218.66

SPS made improvements to the Senior Project Rom, 52-E25. They also purchased two new computers and some computer supplies for use by all department majors. Two students purchased small supplies for their senior projects.

## Student Summer Research Support

Budget	Expended
\$26,228.00	\$26,228.00

The projects were as follows;

**Dr. Bensky:** Mollie Small and Mary Lee Weeks built an ultraviolet fluorimeter which was submersed into the ocean at the Cal Poly Avila Pier. It is being used to track the concentration of chlorophyll in the upper 10m of the ocean water.

**Dr. Echols:** John Ross and Paul Sutter continued research trying to understand the possible influence of the solar sun spot cycle on an equatorial wind oscillation in the stratosphere called the quasi-biennial oscillation (QBO). They worked to make an existing model of the QBO more realistic by adding more forcing waves, including a semi-annual oscillation, and incorporating variations in solar ultra-violet power due to the solar cycle. Tim Arlen and Robert Poorman conducted research understanding the details of determining how recent data from Type 1a supervova (exploding white dwarf stars) is used to find the mass density and vacuum energy density in our Universe. They wrote computer code to simulate the evolution of the Universe's scale factor allowing a determination of the age of our universe once the mass density and energy density is known. They wrote additional computer code to process existing Type 1a supernova data to create plots of magnitude verses redshift from which mass density and vacuum energy density can be extracted.

**Dr. Field:** Art Evans investigated the transport of electromagnetic and thermal energy in the interior of the Sun.

**Dr. Garcia:** Paul Dudley's study consisted of analyses of the fundamental controls on valley width and stream terrace formation in Arroyo Seco, Monterey Country. Rock type plays a fundamental role in the shape of mountainous valleys carved by bedrock streams (they have channels that flow directly on rocks that underlie mountain ranges). Bedrock streams in tectonically active mountains evolve to smooth concave-up forms resulting in even distribution of stream power (a function of discharge, and channel-bed slope). Streams channels flowing over relatively hard rocks are narrow on vertical erosion. "Excess" stream power in stream segments formed in weak rock is expended on lateral incision and alley widening, because less stream power is necessary to maintain a vertical erosion rate equal to that in hard rock. Paul Dudley's field based study will establish a quantitative relationship between stream power valley width, and rock type.

**Dr. Moelter:** Scott Lewis and Bryan Neff developed a LabView interface for temperature control and data taking from room temperature down to 10K. This was then used to study the use of PVDF as an ultrasonic transducer over this range. The PVDF experiences a permanent failure in the vicinity of 100K. Barrett Spells fixed a thin film sputtering apparatus and developed usage protocol. He then made a sequence of thin films of gold on glass, and developed data acquisition procedure for obtaining reflectance vs. angle of surface plasmon resonance in thin gold films.

**Dr. Schwartz:** Four students (Daniel Hansen, Steve Vanderet, Phil Rogers and Carl Bauer) worked on DNA-guided assembly of microsphere. They made excellent progress in defining a working system and have written a paper to be submitted to Langmuir. Josh West fixed the AFM given to us by MATE. Then he moved on to learning about surface phonons on a monolayer and what one might expect the Debye temperature of the surface of a monolayer to be. They hope to publish helium diffraction data. Matt Leyden made headway with the SEM. He was able to image a water meniscus using MATE's SEM. Crystal Phend conducted extensive research on ethical issues related to the intersection of scientific research, business, and Intellectual Property, with particular focus on Dr. Schwartz' experience in nanotec research.

Faculty Travel

Budgeted	Expended
\$9,838.00	\$9,837.59

Dr. Castilla attended a meeting of the AAPT in Sacramento. Dr. Castilla also visited the IPAM at UCLA. Dr. Knight attended the AAPT meetings in both Sacramento and New Mexico. Dr. Saenz and Dr. Buffa were at that same meeting in New Mexico, and Saenz also traveled to Indiana for a meeting on the PhysTec grant. Dr. Frankel was invited to present a paper at the Ferrites Conference in San Francisco, and also met with his research collaborator in Cambridge UK. Dr. Schwartz attended the Nanostructure Conference in New Hampshire. Dr. Bensky attended a meeting on Fluorescence in San Jose. Dr. Benzahra went to the University of Minnesota to consult with colleagues regarding his research paper on quantum chromodynamics. Dr. Echols went to the MRS meeting in San Francisco and brought some of his students. Dr. Garcia conducted geology fieldwork in San Ardo, CA. Dr. Hoellwarth and Nancy Stauch visited the University of Arizona Physics Department to attend a Teacher Advisory Meeting. Dr. Hoffman went to the AGU meeting in San Francisco. Drs. Moelter and Saunders were at the APS meeting in Los Angeles. Dr. Mottmann traveled to San Diego for a meeting of the AAS. Dr. Poling drove to Vallejo to join the Maritime Academy Cruise. Dr. Schwartz was in NH for the Nanostructure Conference. Dr. Sharpe presented a paper at the SIAM Dynamical System Conference in Utah.

New Faculty Start Up

Budgeted	Expended
\$23,400.00	\$23,398.65

Dr. Bensky used his funds provide for a variety of needs. He regassed a carbon dioxide laser to be used in Physics 315 Introduction to Lasers and Laser Applications, and for and senior projects. A student is already working with it. He purchased two diode lasers and temperature probes for laser spectroscopy of Rb. This was used to complete a student's senior project, and will hopefully become an experiment in a quantum physics lab. He also purchased a photomultiplier module sensitive at 680 nm. This is being used in an under-sea fluorescence experiment. Finally, he upgraded a computer and some optics to run a fiber-optics experiment at Avila Pier. The results were updated at [atom.physics.calpoly.edu/Marine/FiberArray](http://atom.physics.calpoly.edu/Marine/FiberArray).

Dr. Echols used his allocation to spend more time on his research Spring quarter.

Dr. Garcia used his funds to support his geology research. A student assistant (a Physics major with a minor in Geology) collected field and map data in August 2004 for an ongoing study in Arroyo Seco, Monterey County. A stereoscope, used for analysis of aerial photography, was purchased. Funds were used to support Dr. Garcia in the field in May and June 2005. His allocation also maintained his membership in the Geological Society of American and paid for a subscription to the journal Geology.

Dr. Hoellwarth bought a microscope to be used for sample preparation. He also bought consumable supplies: alumina boats spatulas, and C60. The alumina boars and spatulas were used to make superconductors. The C60 was for studying a novel low-temperature synthesis route for TiC.

Dr. Moelter had his temperature controller repaired and purchased a programmable power supply. Both are being used to measure the temperature dependence of ultrasonic and resistive properties of high Tc superconductors.

Dr. Schwartz employed three students, Tim Arlen, Matt Leyden and Josh West. Tim Arlen and Dr. Schwartz developed a computer model of molecules moving around on a gold surface at different temperatures. They used it to simulate some helium reflectivity measurements taken a decade ago. The model's results were strikingly similar to the real data, and may yield a number of energies in the system. They plan to publish the results. Matt Leyden and Josh West continued the research described above.

Dr. Sharpe used his allocation to support two different projects. Physics/EE senior Adam Mednick designed, constructed and tested a quadrant photodiode system for high resolution position sensing of trapped particles in optical tweezers. In the future this will be part of a tweezers system for the upper division labs. Some of the money was also used to support travel to the Society of Industrial and Applied Mathematics Conference on Dynamical Systems in May 2005 to present an invited paper on pattern formation in nonlinear optics. This paper was coauthored with Professor N. Sungar and K. Saunders of the Physics Department and Dr. P.L. Ramazza of the Italian National Applied Optics Institute.

Equipment/Labs

Budgeted	Expended
\$28,295	\$30,957.05

The College Based Fee funds were used to purchase equipment for our laboratory courses. Electronics lab got new function generators to complement the recently purchased oscilloscopes. Quantum lab made significant improvements this year. We obtained all new laptops for data acquisition and analysis. Two new digital scopes along with a tail pulse generator will be used in all of the counting and decay experiments especially the muon decay. A new optical breadboard will be used for speed of light and photon counting. A new residual gas analyzer along with analysis and control software

will replace the aging mass spectrometry apparatus allowing much finer resolution and more rapid acquisition of spectra. A new UV-vis spectrometer will be used in the light experiment, the Zeeman effect, and the recently instituted optical pumping experiment. Optics lab completed the upgrading of the student workstations with translation stages and photodetectors.

<b>Total Allocation</b>	<b>Total Spent</b>	<b>Balance</b>
<b>\$138,240.00</b>	<b>\$140,874.60</b>	<b>-\$2,634.60</b>

The deficit was due to a combination of errors in Cal Poly Purchasing Department, and some equipment purchases coming in over quote. About \$1000 of that will be returned as a credit in 2005-2006.