MENTOR PROJECT DESCRIPTIONS

1.	ASTRONOMY David Cowley cowley@ucolick.org	We have a donor who is interested in us restoring the 12 inch Alvan Clark telescope originally used on Mt Hamilton in 1882(I think). We have most of the telescope in storage in Santa Cruz. What we do not know is what it was originally like and if we have all the parts. We know the original sidereal drive clock is missing, but do not know what it actually looks like. It may still be on Mt Hamilton in a box, somewhere. What we need is for the research to be done to tell us what the telescope should look like after it is restored. We need to track down the details of the sidereal clock and how it drove the telescope and find out if we can find the original or get a replacement. Others have restored similar telescopes, we need an estimate of how much effort and materials it is likely going to take to restore ours. The plan is to install the 12 inch telescope in its original dome. The pier that the telescope was mounted on was removed in 1976 when the 40 inch telescope was installed. We need the dimensions and specifications needed to replace that pier.
2.	ASTRONOMY Greg Laughlin Prof. Gregory Laughlin, Dept. of Astronomy and Astrophysics glaughli@ucsc.edu	Title: Searching for Planet "X" Advisor: Prof. Gregory Laughlin, Dept. of Astronomy and Astrophysics, UC Santa Cruz One Paragraph Description: There is a slim, but nevertheless finite possibility that the distant outer reaches of our solar system contain an as-yet undetected planet-mass object. In this project, we will analyze the orbits of long-period comets with the goal of putting limits on the mass and orbit of a large unseen body in the outer solar system. This project will involve computer programming, and so prior experience with a computer programming language (for example, Java), and an enthusiasm for challenging mathematical reasoning are prerequisites. url: http://www.oklo.org
3.	ASTRONOMY Jennifer Burt Dept. of Astronomy and Astrophysics jaburt@ucsc.edu	Students will learn how to access and work with data taken by the Kepler satellite as it reveals hundreds of planets orbiting other stars.. They will assist in creating and/or running filters that comb the Quarter 0 and Quarter 1 data sets looking for evidence of transiting planets similar to Jupiter in size, location and eccentricity. After the filter flags such candidates, students will help to determine whether the results are true Jupiter analogs or false positives (e.g. binary-star systems). http://research.pbsci.ucsc.edu/astro/gregory-p-laughlin/
4.	ASTRONOMY Jerry Nelson Professor Center for Adaptive Optics jnelson@ucolick.org	This project is to assess the impact of sky brightness on observations of faint objects with the Thirty Meter Telescope (TMT), in particular the impact of moonlight. Moonlight scatters in the atmosphere, causing additional background light that degrades the sensitivity of science observations, particularly of faint targets where the background light can exceed the signal. The moon brightness is a function of the phase of the moon, and the scattering from Raleigh scattering is a function of the wavelength. Thus we want to establish the brightness of the sky as a function of moon phase and wavelength and compare this with the other natural backgrounds,

		hence determine when moonlight limits observations, particularly with spectrographs working in the 300-1100 nm region. For TMT this is particularly important since the main science targets will be extremely faint, hence natural backgrounds will limit the ultimate sensitivity. This work will be guided by Jerry Nelson (TMT Project Scientist) and Drew Phillips.
5.	ASTRONOMY Sandy Faber http://www.ucolick.org/~faber/ faber@ucolick.org 3 mentors from Sandra Faber's dept	Title: The Death of Active Galactic Nuclei Project Description: All large galaxies harbor massive black holes in their nuclei, weighing up to a billion solar masses. When gas falls into these holes, energy is released just outside the event horizon, and the resulting bodies are paradoxically NOT black but are instead among the brightest objects in the universe. This family of bright point-like objects, ranging in brightness from "quasars" down through "Seyferts" to "LINERS", is called Active Galactic Nuclei (AGNs). A popular theory holds that this brightness sequence represents the shutdown (i.e., "death") of AGN black holes as their gas supply is shut off. This project will use existing measured data on AGN host galaxies to try to establish whether the nuclear brightness sequence is in fact an evolutionary sequence as predicted by this theory and how long it takes for AGNs to die away.
6.	ASTRONOMY Angie Wolfgang UCSC PhD student May also work with: Greg Laughlin (UCSC faculty) www.ucolick.org/~wolfgang/index.html http://www.ucolick.org/~wolfgang/research.html	- (preliminary) description of the project that a student who I mentor may work on: **Statistically determining the interior composition of a population of exoplanets** Use IDL routines developed by the mentor to perform a Marchov-chain Monte Carlo analysis determining which interior composition (ice, rock, iron) or any combination or variation thereof is a statistical best-fit to the distribution of Kepler transiting exoplanet candidates. Explore a variety of mass-to-radius relationships; characterize the dependence of the best-fit on these parameters and identify any degeneracies which may exist. Vary the shape of the underlying period and mass distributions and investigate their effect on the magnitude of the best fit. NOTE: This project will begin on July 1 with Angie, however we may be able to partner the student with another mentor in the program in June, as well as assign background reading.
7.	BIOMEDICAL ENGINEERING Ed Green ed@soe.ucsc.edu	The Green lab is interested in investigating the genetic basis of human uniqueness. We use population genetics methods to compare the genomes of currently living humans with those of our extinct relatives like the Neanderthals. We are seeking motivated, creative individuals with programming experience.
8.	BIOMEDICAL ENGINEERING David Haussler Haussler@soe.ucsc.edu	Throughout life, every individual accumulates many changes in the DNA inherited from his or her parents, the individual's genome. These changes may drive cancer, control immune response, or lead to other diseases. Working with the National Cancer Institute's Cancer Genome Atlas Project, we are managing a very large database of genome sequences for cancer patients. We seek a highly talented computer wiz to help us organize and compare these genome files.

9.	CHEMISTRY Yat Li Assistant Professor of Chemistry yli@chemistry.ucsc.edu	"Synthesis and Characterization of Semiconductor Metal Oxide Nanowires for Photoelectrochemical Hydrogen Generation" The primary goal of this project is to develop and validate a new type of nanostructured photoelectrodes for solar hydrogen generation, with radical improvements in efficiency, cost and scalability. This is an interdisciplinary project. The high-school student interns will work with graduate students on the synthesis and characterization of metal oxide nanowires and nanowire heterostructures. Photoelectrodes will be fabricated using these nanomaterials. Photoelectrochemical studies would be carried out to measure the efficiency of hydrogen generation, and more importantly, to understand the fundamental correlation between photoelectrochemical properties and the structure of nanomaterials. Students will have a unique chance to get hands-on experience on material synthesis (hydrothermal synthesis, chemical vapor deposition) and characterization techniques (electron microscopy, UV-visible and Raman spectroscopy, fabrication and measurement of photoelectrochemical cells).
10.	MARINE SCIENCES Baldo Marinovic Assoc Res Biologist/Lecturer Long Marine Laboratory marinovic@biology.ucsc.edu	Research in the Marinovic lab focuses on zooplankton ecology in general and specifically krill population dynamics and community interactions. Krill are centrally important organisms in the pelagic food web of the California Current and are the main prey for a variety of commercially important fish species as well as several endangered seabird and marine mammal species. Researchers in the lab collaborate with other oceanographers at institutions such as the National Marine Fisheries service, the Monterey Bay Aquarium Research Institute, the Naval Postgraduate School, and Scripp's Institute of Oceanography with the goal of understanding how oceanographic processes influence krill populations and in turn krill predator species. Interns receive training in how to process and analyze zooplankton samples collected in the field. In particular they learn how to identify krill (species, sex, reproductive status) and how to use state of the art digital imaging technology in order to accurately measure krill. Interns also learn about data entry and management. In addition there is the possibility to participate in field sampling activities.
11.	PHYSICS Alexander Sher Assistant Professor Santa Cruz Institute for Particle Physics Physics Department sasha@scipp.ucsc.edu	Below is the project description. Please note that at this point I can not guarantee a student placement. I will know for sure in April/May. Neural visual processing. The project involves a study of the visual information processing by the central nervous system. The focus is on the "front-end" processing that occurs in the retina. This processing involves multiple parallel neural circuits, each having its own unique spatio-temporal and chromatic filtering properties. We study function, structure, and development of these circuits through simultaneous recording of activity of hundreds of retinal neurons in response to computer controlled visual stimuli. The student will use the programming and experimental tools/techniques that exist in the lab and hopefully develop new ones. Project #1: fitting measured spatio-temporal liner kernel of neuron's responsewith a function in order to extract some salient features of the cell's functional properties. Project #2: use data collected with a new visual stimulus to measure the response properties of the detected cells to this stimulus.

		Both projects require the student to write a new piece of code in MatLab. The code is not very difficult but the student will need to understand conceptually what is involved and then be able to code in MatLab. http://scipp.ucsc.edu/groups/Neuroproject/index2.html http://physics.ucsc.edu/people/faculty/sher.html
12.	PHYSICS Dave Belanger Professor Physics Department dave@dave.ucsc.edu	Cobaltite nanoparticles, particles with diameters less than 100nm, will be grown and characterized for future neutron scattering experiments. Existing neutron scattering data will be analyzed for structural and magnetic differences between the nanoparticles and bulk particles of the same material that have sizes of about 10 microns. This will involve the use of computer fitting programs on existing data sets. The nanoparticles have important industrial applications, but are not yet well understood. These studies will contribute to the effort to understand the effect of small size on the behavior of the cobaltite system