

Outreach and Education at CHESS

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As an NSF national facility, the mission of CHESS has always included various types of education and outreach to the general public. In the broadest sense, the CHESS Center members (including MacCHESS and G-line) consider it a natural part of every workday to be involved with the scientific community on campus as well as the public at large. Activities we host cover all ranges of ages and preparation, starting with an elementary school science club organized by Staff Scientist Ken Finkelstein, hosting summer projects for high school students and teachers, part-time undergraduate employment and mentoring, long-term graduate student training, organizing weekly Journal Clubs and, new this year, a university-wide scientific lecture series on x-ray science in biology.

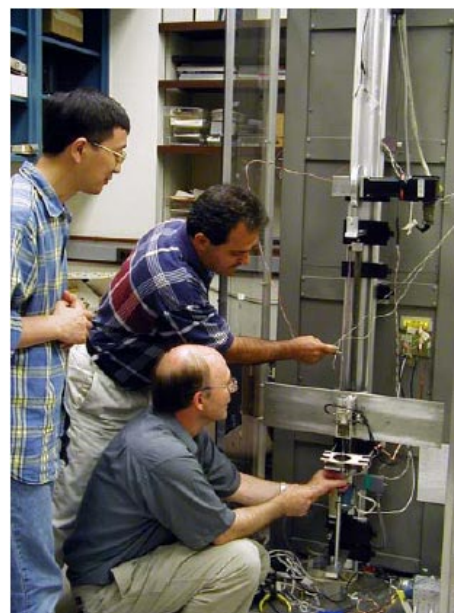


The science club worked together to measure the rate of water flow in Fall Creek. In smaller groups they did experiments including those to understand why the sky is blue, how eye glasses work, how light is broken into spectral lines, and why salt is used to make ice cream.

Many staff members become involved in giving tours to various school and public interest groups, impressing them with how large and complicated the Wilson laboratory is, as well as what types of science we can do and what types of careers in science and engineering might be pursued. This article will highlight some of the people who visited CHESS and projects that were carried out over the past year.

Each year we host several high school teachers for an intense 6-week summer visit. These teachers are recruited through the NSF program "Research Experiences for Teachers" (RET) that tries to expose teachers from inner-city schools to the trials and tribulations of scientific research. We especially like this program because we feel that science teachers who become knowledgeable about scientific research will also become better motivated and able to convey to their students the excitement and benefits of careers in science.

One of our summer 2003 visitors was **Massoud Assadi** from Cody High School in Detroit, Michigan. He worked with Don Bilderback and Rong Huang (the CHESS capillary x-ray optics group) on a project to better characterize the tapered glass capillary optics fabricated at CHESS. One of the difficult technical steps in fabricating these types of x-ray optics is the need to measure the outer and inner diameters of the tapered glass capillaries. Massoud spent a large part of his stay retrofitting a video camera onto the glass pulling apparatus in an attempt to better measure the glass profiles. The video camera and software for image analysis were borrowed from a development project for x-ray



RET high school teacher **Massoud Assadi** with Rong Huang (left) and Don Bilderback (bottom) examining the glass capillary puller.

beam position monitors done by Staff Scientist Peter Revesz. He compared the video profile accuracy to the human measured profiles performed using a standard microscope. He learned a great deal about accuracy and mechanical stability and helped the team come together to understand the capabilities of the video system.

A second RET visitor was **Dr. Nasreen Jelili**, Ph.D., also from Cody High School. Nasreen is a Chemist and Medical Physicist. She spent the summer building a tool to measure strain in crystals used for x-ray optics at various stages of their manufacture. During her work with CHESS Engineer Jim Savino and Research Support Specialist Lee Geiger, she found that the two steps most often hypothesized to introduce strains into the crystal did not produce significant strains. After both cutting the cooling channels and brazing the crystal to a blank (to form channels for the cooling water), the strain of the crystal was increased by less than two ten-thousandths of a degree – the crystal was virtually indistinguishable from a perfect crystal. This means that there is no need to develop methods to relieve or minimize the strains generated by crystal cutting and brazing. In addition to learning some rather important details of x-ray diffraction, Nasreen learned about the Wilson Synchrotron Laboratory and went home with stories to tell about research outside the area of her primary training (chemistry).



RET high school teacher **Nasreen Jelili**

Rick Clinite, a recent Cornell graduate, spent the summer of 2003 working with Staff Scientist Arthur Woll on several projects aimed at upgrading the D1 experimental station for small-angle scattering and confocal scanning fluorescence microscopy. Rick implemented the first computer controlled x-ray beam defining slits from ADC, Inc (Lansing NY) and built them into a vacuum compatible beamline. He also wrote Java scripts to enable the ImageJ open-source analysis software to immediately display images from the MedOptics CCD camera. This will tremendously improve the data collection speed at the station. He also worked a different ray-tracing program in Java to model the reflections of capillary optics. The program allows the user to build a virtual optical system from a list of possible capillary shapes; it will accurately reflect sets of rays within this system and project them onto an image plane.



Undergraduate **Harold Barnard** working on the G-line optics system.

Cornell undergraduate **Harold Barnard**, an Applied and Engineering Physics major, worked extensively with the CHESS Electronics group to fabricate cables and motor drive units for the G-line project. He wired and tested almost all of the 40 motors in the new G-line optics room. He also designed and built an electronics box that controls the fluorescent screens we move into the x-ray beams for visualization and diagnostic purposes. He spent time working with Staff Scientist Ernie Fontes to create experimental hardware for the G1 station, including a new computer controlled gimbal mount for holding and aligning tapered-glass capillary optics for microbeam experiments using SAXS and GISAXS.

Undergraduate **Jacob Godwin-Jones** worked with Post Doctoral staff member Andrew Stewart to develop software to automate data collection using the Reference Beam Diffraction (RBD) technique.

This requires interacting with the sample diffractometer via SPEC, our experimental station control system. As well as automation, he generalized the routines used to accommodate all possible space groups during the reference beam alignment. Previously the program was only capable of handling space-group 96 for Lysozyme. Development of scripts for data processing has also been pursued with particular attention being paid to the nonstandard information that is required to help solve an RBD data set.

Sophie McGough (University of California, Los Angeles) joined CHESS in the mid- summer 2003. Her skills and experience in computer programming were quickly deployed in work with CHESS Staff Scientist Ken Finkelstein. Sophie developed programs for data reduction and modeling of complicated x-ray scattering patterns. She first worked on software to interpret 2-dimensional x-ray scattering data recorded by large area 'CCD' detectors. The images in question were produced by crystals that produce sharp 'Bragg-like' peaks with long, diffuse "tails." A second project involved developing tools to model the influence of focusing optics on "coherent diffraction" patterns, similar to those produced when an x-ray beam made up of waves with well-defined relative phase illuminates a sample. An ERL x-ray source should provide beams of this quality, so it is important to anticipate such effects.