

## NIGMS Funds Upgrade the Macromolecular Crystallography Beamlines

Ernie Fontes, Karl Smolenski, and Qun Shen -

*CHESS, Cornell University*

The CHESS wiggler stations have certainly been among the most, if not the most productive macromolecular beamlines in existence. For more than a decade MacCHESS and CHESS have pioneered many aspects of modern protein crystallography at storage rings and have helped catalyze the present biostructure revolution. Structural biology at CHESS has been tremendously successful and now utilizes three out of our four highest intensity wiggler stations. These stations are heavily over-subscribed.



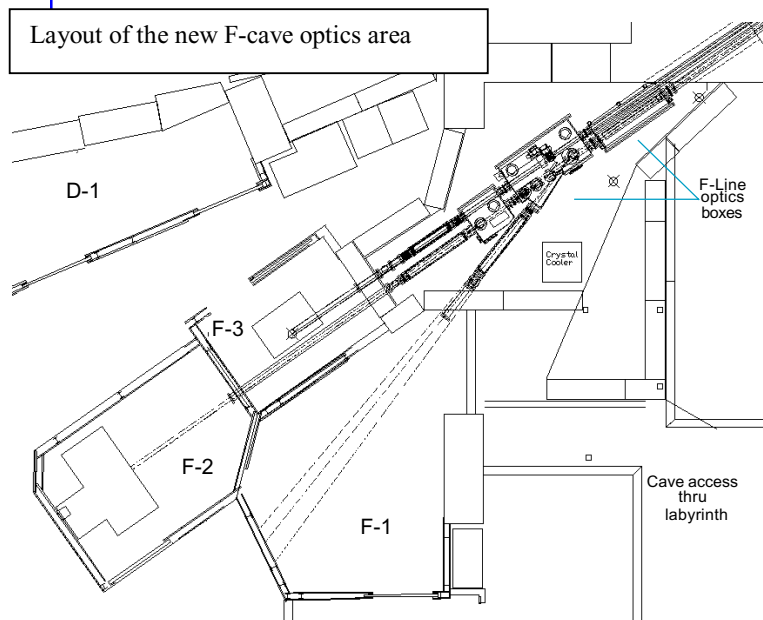
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To help satisfy the growing demand for crystallography facilities, the National Institute of General Medical Sciences (NIGMS) has provided funds to CHESS to upgrade the high intensity A-1, F-1 and F-2 experimental stations. The goal of this multiyear upgrade program is to provide the biological user with higher quality X-ray beams and facilities – first and foremost to deliver X-ray beams with higher intensity, better energy resolution, easier tunability and a higher level of stability. During 1999 we redesigned and replaced the X-ray optics room, housing, and monochromator optics on the F-1 and F-2 stations. When installed in the Fall of 2000, a new collimating mirror will filter the high power white beam and reduce the enormous heat load on the X-ray monochromator crystals. Additional developments in X-ray beam diagnostics and position stabilization with feedback are planned. A faster computer network and more reliable software and computer equipment enhances data collection.

### Front-End Optics at Wiggler Beam Lines

With the continued increase in CESR currents, the front-end X-ray optics at A- and F- wiggler lines at CHESS require considerable redesign and improvements. The F-Line front-end is nearly rebuilt and will have a new water-cooled white-beam mirror as the first optical element when reconstruction is completed.

This mirror serves two crucial functions. First, it operates as a power filter so that the heat loads at F-1 and F-2 monochromator crystals are cut down by two-thirds. Second, the mirror can be vertically bent to make the X-ray beam more parallel, improving the energy resolution for MAD experiments by about a factor of two at the F-2 station without any significant loss of X-ray flux. This mirror has been fabricated by Seso and will be installed in Fall 2000.



The redesigned new F-Line also employs separate vacuum-compatible boxes for monochromators and mirrors to reduce the heat-load interference among crucial optical components. The double-bounce energy-tunable monochromator for F-2 has been completely redesigned and will be more suitable for rapid energy changes used by MAD crystallographers. Also in the plan are longer focusing mirrors for F-1 and F-2 with state-of-the-art optical flatness that is at least a factor of two better than the current ones. In other improvement areas, new heavy concrete shielding walls of the F-cave area increase the attenuation of neutron radiation by orders of magnitude, which is necessary in anticipation of the CESR current increases in the near future. A new capability has been added to the F-3 bend-magnet station so that focusing multilayer monochromators are installed and operated with ease.

### Optic Developments for MAD at CHESS

The optics for the F-2 station have been re-designed to be optimized for work in the quickly growing field of MAD crystallography. A new monochromator, along with a new collimating white beam mirror located upstream on F-Line, will provide many advantages for MAD experiments. The upstream mirror will reduce heat load by two-thirds and increase the energy resolution at the MAD experiment to its source-size limit. A set of Si(220) crystals is being fabricated which, when used with the upstream mirror, will provide energy resolution at the core-hole limit for Se. Newly separated vacuum chambers for each optical element will greatly reduce energy drifts due to thermal 'cross talk' between these components. Finally, a real time energy/position monitoring system is planned to quickly diagnose and compensate for any drift in X-ray beam energy or position caused by particle beam motion.

