New stations, optics and wiggler

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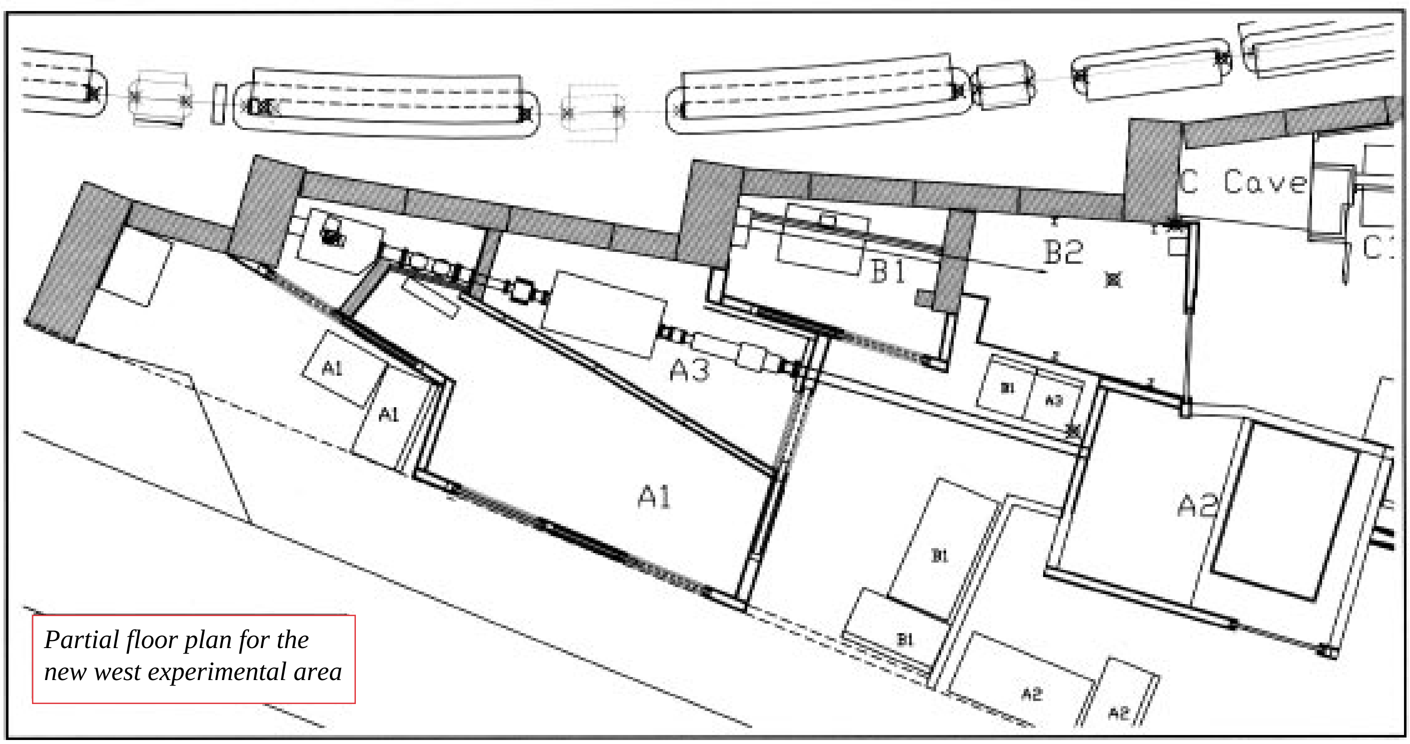
We intend to complete a major upgrade of A-line in the spring of 1993. The purpose of the upgrade is to make the stations more powerful and capable, and to handle the much higher CESR currents planned over the next several years. The plan consists of three major parts: a new 25-pole wiggler source, a new UHV beamline, and new stations (A1, A2, and A3) shown below.

Wiggler Upgrade. The current 6-pole, 1.5 T wiggler is being replace by a 25-pole 1.2 T permanent magnet wiggler (see cover photo). The magnetic design is identical to the F-line wiggler (Rev. Sci. Instr. 63 (1), 305, (1992)), however the A-line device incorporates mechanical features which permit fast opening of the pole gap to accomodate storage ring injection. The mechanics were designed and built by Bob Batterman and Stewart Brazil (a Cornell Co-op student), while the magnetic structure is due to Ken Finkelstein. This beam will be shared between the A1 and A2 end stations.

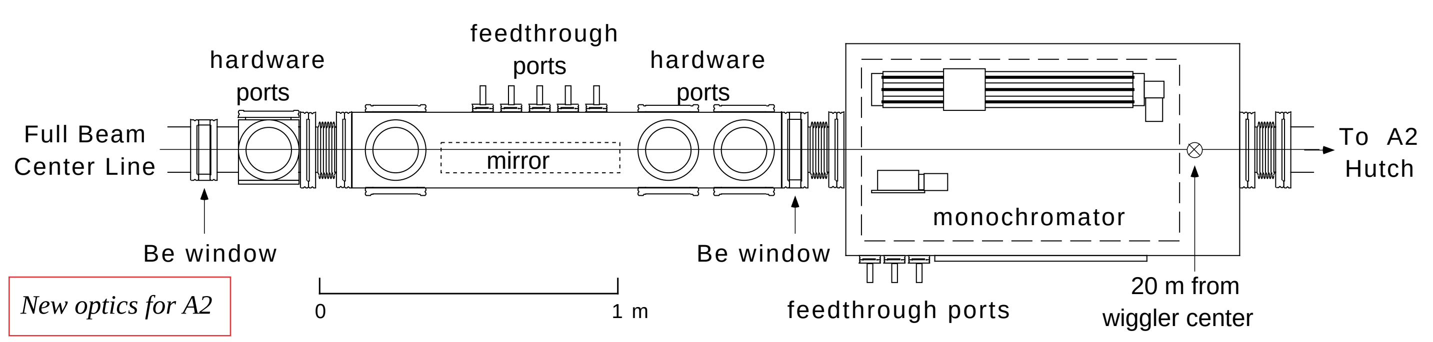
UHV Beamline Upgrade. The present A-line components (beamstops, beryllium windows, etc.) were never designed to handle the power produced by the new wiggler. The new beamline is being engineered to handle the new wiggler to a current of at least 200 mA and, where easily possible, to a 500 mA value, in anticipation of the higher currents planned for in the CESR B-factory upgrade. Consequently, new copper wedge-shaped beamstops are being fabricated with 500 mA capability (see the following article). A new tapered mask (see cover photo) will be installed ahead of the beamstop, and contains a beam position monitor that will always be active. We are considering the interlocking of this position signal to a machine safety control loop. One possibility is that above some power level, detection of synchrotron radiation outside a specified position would dump beam before beamline components could be damaged.

There will also be monitoring of infrared radiation emitted from the downstream side of the first or second beryllium x-ray windows (see separate article). We will be able to monitor the window temperature *in-situ* and sense problems before they cause damage. The new beryllium windows will be patterned after the F-line windows which presently work satisfactorily to 100 mA.

A1 Station Upgrade. The old A1 station, about the size of a telephone booth, is being replaced by a much more spacious room. In addition, the station will now be *tunable* over a range of from 7.0 keV to 14.5 keV. The optics will continue to be a horizontally focussing triangular silicon crystal followed by a vertically focussing mirror. A similar optical arrangement is presently in use on station F1, as discussed in the article on page 8. This doubly focussed line will continue to appeal to the protein crystallography and small angle scattering communities, in general. Our MacCHESS group is heavily involved



Partial floor plan for the new west experimental area



New optics for A2

in making this line as good as F1 from a diffraction point of view.

B1 Station Upgrade. See the accompanying article by Keith Brister about the changes to this station (page 17).

A2 Station Upgrade. A complete redesign will let A2 users take full advantage of the new 25 pole wiggler source or dedicated undulator operation, by offering them a tremendous number of beamline configurations ranging from unfocussed white beam to focussed white beam to highly monochromatic, doubly focussed radiation. Joel Brock's group (Applied Physics), Hector Abruna's group (Chemistry) and the CHESS staff are developing a high-resolution x-ray scattering line with funding support from both CHESS and the Materials Science Center at Cornell University.

As shown on the previous page, the old A3 station floor space will become a flexible optics room for the A2 station. The entire A2 beamline will be under vacuum. The various optics areas are separated both from the A1 optics and from each other by beryllium windows. This design will permit A1 operation to continue while A2 optical components are in access. In addition, either the monochromator box or the mirror box may be vented without venting the other, and the upstream/downstream order of the boxes is interchangeable.

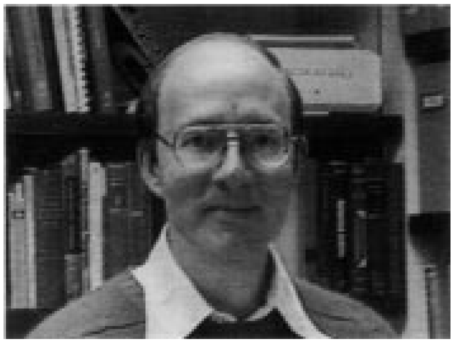
A beam position monitor will be permanently mounted upstream of the first x-ray optical element. Another is permanently installed in the front end of A-line. By combining these two position monitors we will determine both the position and angle of the white wiggler beam. Eventually, we hope to provide these signals to CESR to aid in steering the beam.

The A2 mirror will take advantage of new cooling and bending technology being developed by the APS which is capable of surviving in the intense white wiggler beam. The line will have toroidal and flat mirror options: the toroidal mirror focusses the white beam in both horizontal and vertical planes, and the flat mirror focusses in only the vertical direction. The beamline can also run without a mirror, and the A2 hutch will be white-beam capable. The mirror project is being jointly accomplished with our colleagues from APS (Dennis Mills and George Srajer). The mirror is designed to focus approximately 1/4 of the incident power to an area of a few mm^2. This will be one of the hottest beams available for hard x-ray heat-load testing and scientific purposes.

The monochromator will be a standard two-axis device. The long travel and adjustable crystal offset permit the use of synthetic multilayer crystals with small Bragg angles. The second crystal holder will contain the bending hardware currently used by the sagittal focussing crystals at CHESS. Thus, doubly focussed, monochromatic x-ray beams can be produced by combining either the toroidal mirror and flat crystals or a flat mirror and a sagittal focussing monochromator. The variable crystal offset provides the additional flexibility required to use either a back reflection geometry or, using channel cut crystals, a Dumond configuration in the monochromator.

The entire construction project will take place between January and June, with beamline commissioning in early Summer of 1993.

Joel Brock



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