A new, highly-optimized 3rd-generation synchrotron radiation (SR) source, the National Synchrotron Light Source -II (NSLS-II), is being planned as a replacement of the existing 2nd-generation SR source NSLS at Brookhaven National Laboratory (BNL). When NSLS-II becomes operational in 2015, it will deliver unprecedented brightness in the soft and hard x-ray spectral regions, about 10 times higher (at 8 keV) than the brightest SR sources now available.

### Site Plan at BNL

NSLS hosts a very strong macromolecular crystallography (MX) program, close to 40% of its user community. At NSLS-II, MX will be implemented in close association with other life sciences programs including small angle x-ray scattering, x-ray absorption spectroscopy, x-ray footprinting, and imaging at the nanoscale. It might be possible to co-locate the facilities which will support these life sciences programs in a “village” section of the NSLS-II facility to ensure that they are in close proximity.

### Possible Layout of a “Sector” of MX Beamlines

Here below we show how a pair of independent and tunable canted undulator MX beamlines might be laid out in the NSLS-II experimental hall. We are grateful to Lewis Doom and Michael Loftus of NSLS-II for furnishing this schematic, which emulates the GM/CA-CAT sector layout at the Advanced Photon Source (APS). We will investigate carefully this and other proposed designs for the MX beamlines, some of which might be optimized for special purposes.

### Beamline Optics Challenges

The unprecedented brightness of NSLS-II undulators will impose strenuous demands on the quality of the optics in the beamlines. Simulations of the performances of silicon crystal monochromators and Kirkpatrick-Baez focusing mirror systems in an undulator beamline, shown below, highlight this. Research and development in implementing and assuring the quality of the optics will be necessary, and is planned.

### Phased Implementation

The NSLS-II MX beamlines are proposed to be implemented in distinct phases spread over time:

#### Phase 1:
Two brand new beamlines viewing U20 undulator sources installed in two sequential low-β straight sections and three beamlines derived from existing NSLS beamlines viewing three-pole wiggler sources

#### Phase 2:
Two additional brand new beamlines viewing canted U20 undulator sources installed in the Phase 1 low-β straight sections

#### Phase 3:
Two more brand new beamlines viewing canted U20 undulator sources installed in another low-β straight section

### Endstation Challenges

Just as important will be the development of endstation equipment that will be able to cope with and exploit the brightness of NSLS-II undulators, including diffractometers which can handle crystals of microns dimension or smaller, fast-framing active-pixel detectors, automated sample exchange and cryogenic apparatus, and fluidic-based sample handling systems.

New modes of data collection such as serial crystallography will have to be explored in order to overcome the effects of radiation damage. A range of spectroscopy capabilities concurrent with diffraction will be offered, including optical absorption, Raman, and fluorescence, all of which could be used on- or off-line. These will already become available at the existing NSLS facility.