Biological Imaging by Soft X-ray Diffraction Microscopy

• For imaging applications where lenses do not produce sufficient resolution, as with x-rays, or when sample thickness is limited, as with electrons, x-ray diffraction imaging may be used.

• This “lensless” imaging method relies on an iterative Fourier transform algorithm to solve the phase problem that arises when scattered magnitudes are recorded and the phase is lost.

• Once the phase is recovered, the scattered magnitudes and phases can be inverted to produce a high resolution image.

• The Stony Brook X-ray Microscopy group has developed such a diffraction microscope which is stationed at the Advance Light Source at Lawrence Berkeley National Laboratory.

• The microscope is designed to collect three-dimensional diffraction data from intact frozen hydrated biological structures such as whole cells.

• Our initial experiments with the microscope have imaged a freeze dried yeast cell to 20 nm resolution from 8 angular orientations of the cell. Experiments are on going with the goal of imaging a frozen hydrated cell in three dimensions.

• This method, when adapted to fourth generation x-ray sources, could be used to image single macromolecular protein structures; thereby alleviating the need to crystallize the proteins.