

## **Instrumentation for High Pressure Structural Biology and Extreme Biophysics**

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Discoveries of the past few decades have uncovered a rich and vast world of organisms that live under intense pressures deep in the ocean and in rock pores. These extremophiles that can often live under high temperatures and chemically toxic environments are very poorly understood, yet have yielded some of the most important tools we have in molecular biology. Astrobiologists are also quite interested in understanding how life can survive extreme conditions. But high pressure biology is more than of academic interest; high-pressure food processing is big business and there are also applications in pharma as well. The Cornell High Energy Synchrotron source now supports the nation's only facility devoted to high-pressure structural biology (HP-Bio). We design, build, and operate state-of-the-art instruments for X-ray scattering of biological samples under intense hydrostatic pressure. Student projects involve designing, simulating, fabricating, and testing new components for our instruments. In particular, we wish to extend and improve our unique high-pressure chromatography-coupled X-ray scattering system. We need to integrate visible-light techniques such as dynamic light scattering (DLS) with our high-pressure X-ray cell. Performance of chromatography media, typically micron-sized core-shell silica and other materials, are very poorly understood under pressure and new designs, and even new materials, are needed to improve the lifetime and performance of the separations. Pumping and valve designs need to be improved to reach higher pressures. To push beyond our current pressure limits, we need to design flow-based systems with diamond windows or other ultra-hard, but X-ray transparent materials. Students will have opportunity to collect and process actual X-ray scattering data at Cornell synchrotron source to test their designs.