In the Wings

The DFPase success story may soon be repeated with other enzymes being studied at the PCS.

Kovalevsky is focused on improving the effectiveness of xylose isomerase (XI) because it's used in the food industry to convert glucose from starch into the much-sweeter fructose. XI is also used in the biofuel industry to convert xylose, a sugar derived from woody plants, into xylulose, a sugar that microorganisms more readily convert into ethanol.

XI has been studied for 30 years, but it took the PCS to locate the hydrogens. Kovalevsky has found them not only in the native enzyme but also in the enzyme crystallized with an intermediate form of the sugar. An unexpected amino acid, far from the purported active site, had removed a hydrogen from the sugar, not donated one, as expected for this type of reaction. The reaction seems to be proceeding in new way, one first intuited from x-ray and solution experiments. Kovalevsky needs neutron diffraction results from two more stages of the reaction to pin down the exact mechanism.

Also under study at the PCS is a type of carbonic anhydrase (CA) found in humans—HCAII—the fastest acting of all the enzymes that catalyze the conversion of carbon dioxide to bicarbonate. HCAII is being extensively developed for potential use in the sequestration of carbon—capturing and chemically changing carbon dioxide for underground burial. The rate of catalysis is limited by how fast the enzyme moves hydrogen ions away from its active site. Using recent PCS neutron data, Los Alamos postdoctoral fellow Zoe Fisher and researchers from the University of Florida hope to map out this transfer pathway, information that could lead to improving this enzyme's performance.

At this point the PCS is a unique instrument with many more subscribers than can be handled during the year.

Schoenborn believes this is just the beginning for neutron crystallography. "We've only scratched the surface. The information we gather will increase in value as scientists, especially the drug design people, need more details about enzyme action."

Langan agrees. "The greater the demand for new, improved enzymes to address new challenges in renewable energy, the environment, chemical and biological threat reduction, and therapeutics, the more scientists will turn for answers to neutron crystallography and the greater the need will be for new instruments like the PCS."