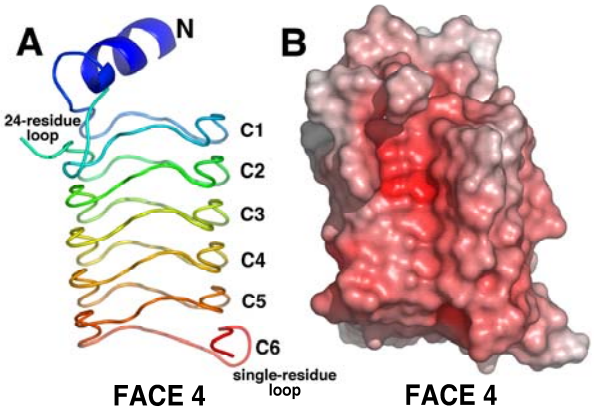
William R. Wiley
EMSL In Brief
Environmental Molecular Sciences Laboratory

New Study Reveals Protein "Towers"

Results: Using the Department of Energy's Environmental Molecular Sciences Laboratory, scientists determined the crystal structure of a protein from the blue-green bacteria, *Cyanothece*. The protein, Rfr23, belongs to a large family of proteins called pentapeptide repeat proteins (PRPs), so named for the presence of tandem repeats of five similar amino acids. Four tandem repeats form a "square" coil and in turn the coils stack together to form four-faced protein "towers."



The square coils in Rfr23 stack on top of each other to form a tower. On the right is a simple drawing; on the left, a solvent accessible electrostatic surface.

Why it matters: The biological purpose of PRPs is not yet known. However, these proteins are prolific in blue-green bacteria such as *Cyanothece* – an organism that uses circadian rhythms to perform photosynthesis during the day and nitrogren fixation at night. Consequently, many scientists hypothesize that PRPs may play a role in the bacteria's circadian lifestyle. *Cyanothece* is of interest because it naturally absorbs carbon dioxide and sequesters it as organic carbon. Furthermore, a by-product of its nocturnal nitrogen fixation is hydrogen gas, a potential fuel. Regardless of their purpose, insights into PRP's structure may provide ideas for designer or tailored proteins.

Methods: Scientists from Washington University-St. Louis, Brookhaven National Laboratory, and Pacific Northwest National Laboratory determined the crystal structure of Rfr23 at 2.1 Å resolution. The crystals were grown at PNNL, and data was collected at the National Synchrotron Light Source at BNL. Biophysical studies of the PRPs in solution were done with EMSL nuclear magnetic resonance spectrometers.

In studying the structure, the scientists discovered that the orientation of the protein's side chains were related to their position in the pentapeptide repeat. The biophysical properties of a protein are determined by these side chains, and hence, by selective positioning the side chains on the tower, researchers could design new proteins with specific physical or chemical properties.

What's next: The team will study other PRPs in *Cyanothece* to obtain clues towards the protein's raision d'etre.

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For more information, contact EMSL Communications Manager Mary Ann Showalter (509-371-6017).