OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

SANS studies reveal structural details of photosynthetic system of *Chloroflexus aurantiacus*

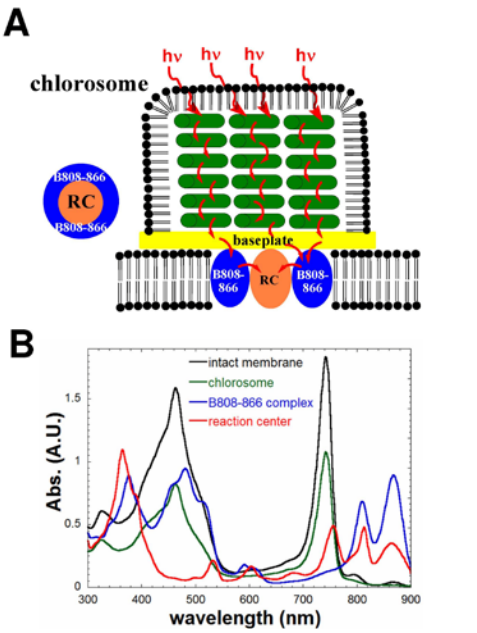
Researchers have obtained the first small-angle neutron scattering (SANS) measurements of the structure and overall photosynthetic machinery of the green bacterium *Chloroflexus aurantiacus*. The results of the experiments provide the most reliable information to date about the structure and size of the main elements of the *Cfx. aurantiacus* light harvesting and conversion apparatus and enable a more precise comparison of its features with those of purple bacteria.

The research was conducted under the auspices of the Photosynthetic Antenna Research Center, a DOE Energy Frontier Research Center working to clarify the scientific principles underlying the natural photosynthetic system as a basis for man-made systems to convert sunlight into fuels.

The Bio-SANS instrument at the HFIR, in conjunction with direct light scattering, was used to explore the *Cfx. aurantiacus* photosynthetic system, which consists of a peripheral light-harvesting complex (LHC) made up of chlorosomes, an integral membrane LHC B808-866, and a reaction center (RC) where light energy is converted into chemical energy for use by the organism. Analagous structures in purple bacteria also were examined for comparison. The results indicate the *Cfx. aurantiacus* B808-866 LHC to be comparable in size and conformation to LHC1 located in the core of the purple bacterium *Rhodopseudomonas palustris*, although the B808-866 complex is about 10% (15–20 Å) larger. The *Cfx. aurantiacus* RC appeared to be ~20% smaller than the RC of *Rps. palustris*. The B808-866 complex was found to be wrapped around the RC in *Cfx. aurantiacus*, and SANS data indicate it is smaller by about 90 Å than previously reported estimates of 220 Å.

The SANS measurements also indicate that the *Cfx. aurantiacus* chlorosome is a rod-shaped lipid body and that the self-assembly of bacteriochlorophylls, the major component making up the chlorosomes, is lipid-like. Two populations of the chlorosomes were found to be present in solution.

The green photosynthetic bacteria are known to harvest light efficiently in low-light environments because their chlorosomes can absorb light in the red to near-infrared regions. *Cfx. aurantiacus* is one of the most widely studied green bacteria. A clearer understanding of its RC and RC-B808-866 complex assembly is essential to efforts to gain a clearer picture of the Cfx. aurantiacus photosystem.



The proposed photosystem (A) and absorption spectra (B) of the intact membrane, chlorosome, B808-866 complex, and reaction center of Chloroflexus aurantiacus.

The structural data gained via SANS provide insights into the *Cfx. aurantiacus* RC-B808-866 co-complex and into the configuration of the chlorosome, including pigment arrangements. Given the uniqueness of the chlorosome among antenna LHCs, the greater structural detail provided by SANS and other biophysical approaches is of great value in investigating the photosynthetic machinery in phototrophic bacteria.

"SANS investigation of the photosynthetic machinery of *Chloroflexus aurantiacus*," K. H. Tang, V. S. Urban, J. Wen, Y. Xin, and R. E. Blankenship, *Biophysical Journal* **99**(12), 2938–2407, October 2010.

Contact: Kuo-Hsiang Tang, 314-935-6343, tangj@biology2.wustl.edu

Funding Sources: DOE Office of Basic Energy Sciences, DOE Office of Biological and Environmental Research

Resources: High Flux Isotope Reactor, ORNL

U.S. DEPARTMENT OF ENERGY