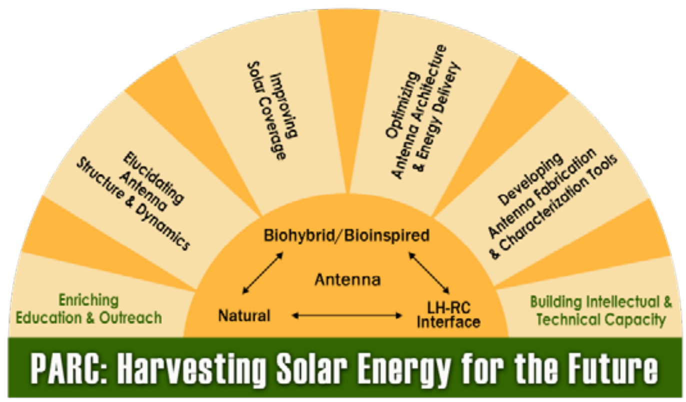
Photosynthetic Antenna Research Center (PARC)
EFRC Director: Robert E. Blankenship
Lead Institution: Washington University in St. Louis
Start Date: August 2009

Mission Statement: *To understand the basic scientific principles that underpin the efficient functioning of natural photosynthetic antenna systems as a basis for design of biohybrid and bioinspired architectures for next-generation systems for solar-energy conversion.*

Scientific Themes. Through basic scientific research, PARC seeks to understand the principles of light harvesting and energy funneling as applied to three programmatic themes:

1. *Natural Antennas*:
   Structure and Efficiency
2. *Biohybrid and Bioinspired Antennas*:
   Design and Characterization
3. *Antenna-Reaction Center Interface*:
   Organization and Delivery



Unifying Research Activities. The three scientific themes are connected by the idea that enhancements of photosynthetic light harvesting and the design of the biohybid and bioinspired antenna will draw upon the lessons learned from natural systems. The thematic activities are joined by interrelated research threads, including to:

- Elucidate antenna structure and dynamics
- Improve solar coverage
- Optimize antenna architecture and energy delivery
- Develop antenna fabrication and characterization tools

Global Impact. All of the PARC activities have the broader goals to:

- Enrich education and outreach
- Build intellectual and technical capacity

Specific Objectives for Theme 1—Natural Antennas: Structure and Efficiency
PARC seeks to understand the structure and function of the wide variety of natural photosynthetic antenna systems, including their efficiency, mechanism of action, regulation, assembly and repair. Emphasis is placed on developing new antenna systems using techniques of molecular and synthetic biology that increase the efficiency and functionality of living photosynthetic organisms. The specific objectives are to:

- Determine structures of native and modified antenna systems and correlate with function
- Understand subcellular organization of antenna systems in different photosynthetic organisms
- Examine physiological consequences of modified/alternate antenna in diverse organisms
- Confer visionary new functional attributes into living photosynthetic organisms

The overall aim is to determine and manipulate the antenna architecture and composition to maximize photosynthetic efficiency and functionality in any such organism.

Specific Objectives for Theme 2—Biohybrid and Bioinspired Antennas: Design and Characterization
PARC will use first principles and readily accessible constituents to create mesoscale antennas with tailorable performance specifications with regards to spectral coverage, absorbance intensity, and efficiency of exciton delivery and transduction. The specific objectives are to:

- Develop self-assembled macromolecular arrays based on tunable synthetic pigments coupled to natural or designer polypeptide scaffolds
- Control mesoscale architecture of antennas in lipid bilayers or liposomes
- Nanopattern arrays of biohybrid/bioinspired antennas and reaction centers (RCs) on surfaces in various geometries, including nanoscale lines and dots

The overall aim is to design biohybrid and bioinspired architectures for energy collection and storage.

Specific Objectives for Theme 3—Antenna-Reaction Center Interface: Organization and Delivery
PARC seeks a fundamental understanding of antenna-RC interfaces in native, biohybrid, and bioinspired antennas optimized for total control over molecular (structural, energy, redox) characteristics for delivery of energy, electrons or redox equivalents to downstream processes such as catalysis, fuels production or photocurrent generation. The specific objectives are to:

- Understand and manipulate the interfacing and regulation of antenna and RC units in native photosynthetic systems
- Extend the functionality of biohybrid and bioinspired arrays to include sites of energy trapping and photochemistry at defined positions
- Fabricate multi-component assemblies or networks of electronically communicating antennas and RCs on surfaces to promote long-range, directional energy flow

The overall aim is to understand and control the coupling of antenna and RC functions in solar energy conversion systems.

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