Seek

Volume 8
Issue 1 *Spring*

Article 10

April 2018

UDP Focus: Jankowiak Shines Light on the Mysteries of Photosynthesis

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Recommended Citation

Hancock, Sarah Caldwell (2018) "UDP Focus: Jankowiak Shines Light on the Mysteries of Photosynthesis," *Seek*: Vol. 8: Iss. 1.

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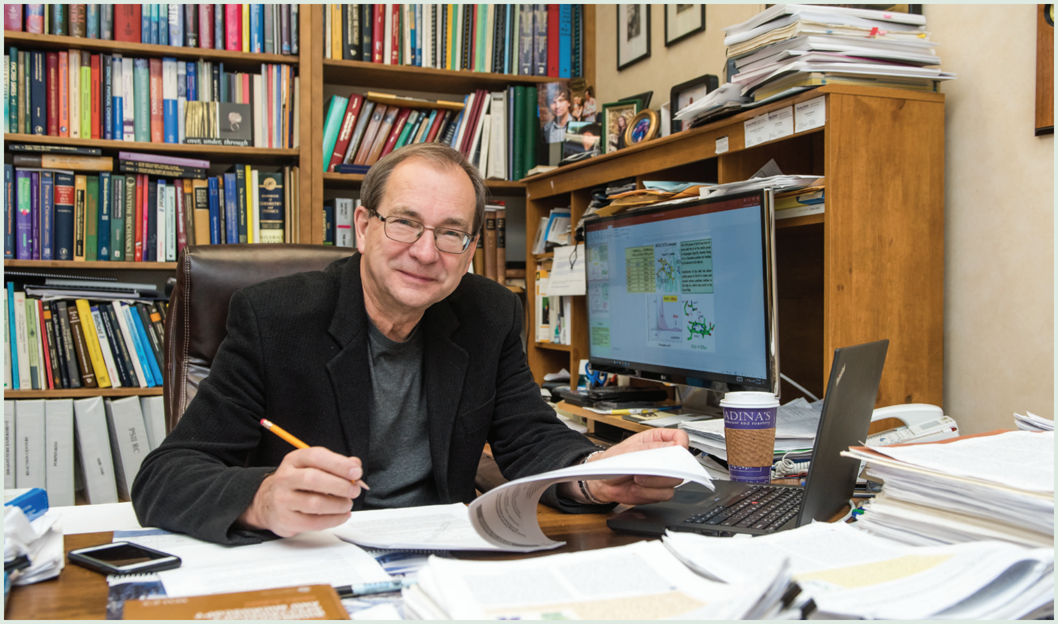
Jankowiak shines light on the mysteries of photosynthesis

— *Sarah Caldwell Hancock*

The chemistry lab in your mind's eye contains glass beakers full of different-colored chemicals bubbling over Bunsen burners or sitting under fume hoods. That's definitely not what you'll find in Ryszard Jankowiak's lab at Kansas State University.

Instead, you'll see lasers, spectrometers, cryogenic equipment and other instruments to conduct sophisticated experiments with light. Jankowiak, a university distinguished professor of chemistry and ancillary distinguished professor of physics, studies processes involved in photosynthesis. Spectroscopy is the analysis of the interaction between light and matter, and it helps Jankowiak understand the fundamental nature of the primary events in the seemingly miraculous process whereby plants and various photosynthetic bacteria convert light into chemical energy.

The process is complex, but a simplified explanation is that higher plants and photosynthetic bacteria contain various light-harvesting antennas and reaction centers. Antenna systems funnel the absorbed light energy into the reaction centers where the photochemistry takes place, thus executing energy conversion. Jankowiak's goal is to understand and model these processes, which one day could help researchers imitate the energy transfer and charge separation processes and design better solar power systems.



Advances in understanding natural electronic structure and energy transfer are coming in the form of better tools, better methodologies and more advanced theories.

"The photosynthetic processes are very fast — and scientists have developed better lasers and methodologies to study them — but what is most important is the development by scientists of many new theories that need to be tested. In my group, we use a density matrix theory and a new algorithm to fit simultaneously different types of spectra with one set of parameters to understand the electronic structure and dynamics of these complex biological systems," Jankowiak said.

Jankowiak works with postdoctoral researcher Anton Khmelnitskiy and doctoral student Mahboobe Jassas. Both Khmelnitskiy and Jassas are thankful for Jankowiak's productivity, high standards and skills as a mentor.

> **"Working for Jankowiak was what kept me in chemistry."**

"I have worked with many professors, and sometimes they are too busy to contact you personally and give you advice," Khmelnitskiy said. "He never refuses to give you advice or talk to you about your job or your results."

Jassas added that Jankowiak and his wife are caring and help international students adjust, often hosting dinner parties and making sure students have what they need.

Mike Reppert, Banting postdoctoral fellow at the University of Toronto, worked for Jankowiak while he was an undergraduate student at K-State. He graduated in 2009 and now holds a doctorate from the Massachusetts Institute of Technology. He studies quantum mechanical effects in biological processes, including photosynthesis.

"Working for Jankowiak was what kept me in chemistry," Reppert said. "He gave me a different perspective on what research in chemistry is actually like. Working in a research lab is a lot more interesting than doing research in a lab class — you're working on questions that no one actually knows the answer to."

Reppert appreciated Jankowiak's approach.

"He never pushed me to support a result I didn't actually believe or agree with," Reppert said. "He supported intellectual honesty — reporting what you find, and not what you want to find."

Jankowiak's internationally known findings continue. He has published more than 240 papers and his lab boasted 13 major publications in 2016-2017. His current focus is to unravel mutation-induced effects in various antenna systems and reaction centers and their impact on excitonic structure and relevant photosynthetic processes. Researchers change a single amino acid close to a particular molecule within a complex antenna system, for example, and see how the electronic structure and dynamics are affected.

"We aim to reach a unified understanding of the ultrafast solar energy-driven primary events of photosynthesis," Jankowiak said. "It's not easy to describe very complex biological systems — you need experimental data, then you model it and see if it makes sense." k