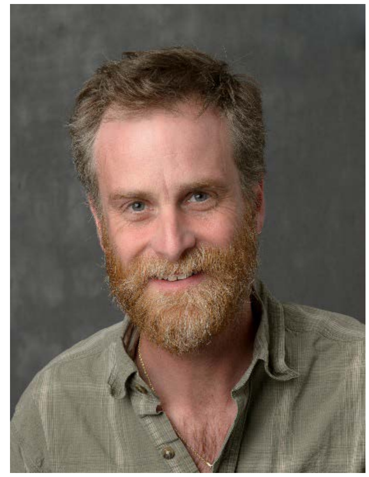
College of Science
Research Award Presentations
February 28, 2017
LWSN 1142; 3:00 p.m.



Darryl E. Granger
Professor of Earth, Atmospheric, and Planetary Sciences

Dating Early Human Evolution with Cosmic Ray-produced Radionuclides

Our knowledge of early human evolution and migration out of Africa is strongly limited by a lack of reliable dating methods. Although the fossil record in East Africa has been exquisitely well dated by interbedded volcanic ash layers, other sites across most of Asia, Europe, and southern Africa remain poorly dated. In this talk I will show how we can use rare nuclides that are produced in mineral grains by secondary cosmic rays (*i.e.*, cosmogenic nuclides) to date the sediments associated with fossils or stone tools found on ancient river terraces or in caves. The cosmogenic nuclides ^{26}Al and ^{10}Be build up in the mineral quartz when it is exposed at the ground surface, and then decay by radioactivity after the quartz is buried. By measuring ^{26}Al and ^{10}Be with accelerator mass spectrometry and accounting for the buildup and decay of the two nuclides simultaneously we can determine the burial age of the deposit. Examples from China and South Africa show how the cosmogenic nuclide method is impacting the history of early human evolution and migration.

Bio: Dr. Granger joined the Purdue faculty in 1996, and has been affiliated with the PRIME Lab accelerator mass spectrometry facility. He holds a Ph.D. in geology from the University of California, Berkeley, and a B.S. in physics and scientific instrumentation from Carnegie Mellon University. His research largely focuses on geologic applications of cosmogenic nuclides produced in mineral grains, especially for problems related to landscape evolution, caves, and archaeology. He has authored or coauthored over 70 peer-reviewed papers, including 5 in *Nature* and *Science*. He is a fellow of the Geological Society of America and a recipient of an NSF CAREER award. He has been featured in two *National Geographic* documentaries, and his research has been highlighted 3 different times in *Discover* magazine's top 100 science stories of the year.

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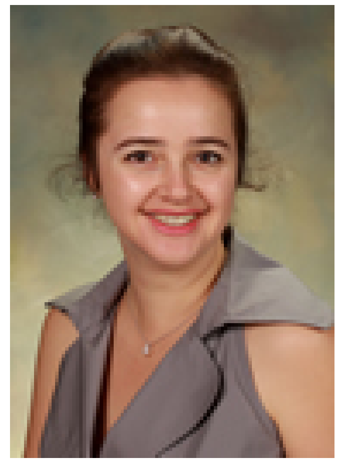

Yulia Pushkar
Associate Professor of Physics and Astronomy

Molecular Mechanisms of Natural and Artificial Photosynthesis

Oxygen present at ~20% in Earth's atmosphere comes mostly from photosynthesis that occurs in cyanobacteria, green algae and higher plants. This oxygen is generated from water by a process which evolved about 3 billion years ago. The light driven water splitting achieved in the oxygen evolving complex (OEC) of Photosystem II is a critical process that sustains our biosphere. It has also inspired research into artificial photosynthesis which aims at converting sun light into fuels for clean and sustainable energy. Photosynthetic water splitting is fascinating in its efficiency, however, it is not yet understood. Achieving new energy solutions based on concept of artificial photosynthesis requires understanding the molecular mechanisms of water splitting. At the heart of the water splitting process occurring in the Photosystem II is the Mn_4Ca cluster embedded in a fine tuned protein environment. Using spectroscopic techniques we have determined the geometry of the Mn_4Ca cluster and followed evolution of its electronic structure in time during the formation of O_2 molecule. Our experiments were supported by computational analysis and electronic structure calculations. While Mn is an earth abundant element, efficient Mn based molecular catalysts for artificial Photosynthesis have not been yet demonstrated. Ru based molecular catalysts of water oxidation are available with variety of ligand environments and provide convenient systems for mechanistic analysis. We have used *in situ* EPR, X-ray spectroscopy and resonance Raman measurements to characterize catalytic Ru complexes under water splitting conditions and detect reactive intermediates. Uncovered molecular mechanisms allowed to move forward to design a more efficient water splitting assemblies for future production of so called solar fuels.

Bio: Yulia Pushkar graduated with MS in Physical Chemistry from the Moscow State University, Russia in 1999. She obtained PhD in Biophysics in 2003 from Free University Berlin studying mechanisms of the electron transfer in the Photosynthetic proteins. She worked as a postdoctoral researcher at the Physical Biosciences Division of the Lawrence Berkeley National Laboratory until she obtained a faculty position at Purdue University in 2008. In 2014 she was promoted to associate professor.

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Plamen Stefanov
Professor of Mathematics

Local Boundary Rigidity

Anisotropic media can be modeled with Riemannian metrics. The rigidity problem consist of recovering the metric in a domain, up to an isometry, from the distance between boundary points. We show that in dimensions three and higher, knowing the distance near a fixed strictly convex boundary point allows us to reconstruct the metric inside the domain near that point, and that this reconstruction is stable. We also prove semi-global and global results under certain convexity conditions. The problem can be reformulated as a recovery of the metric from the arrival times of waves between boundary points; which is known as travel-time tomography. The interest in this problem is motivated by imaging problems in seismology: to recover the sub-surface structure of the Earth given travel-times from the propagation of seismic waves. In oil exploration, the seismic signals are man-made and the problem is local in nature. In particular, we can recover locally the compressional and the shear wave speeds for the elastic Earth model, given local information. The talk is based on joint work with Uhlmann (UW) and Vasy (Stanford).

Bio: Plamen Stefanov joined the Department of Mathematics at Purdue in 2000. He received his Ph.D. in math from the University of Sofia in 1988. Since then, and before coming to Purdue, he has worked at universities in Bulgaria, Finland, France, Canada, Brazil and the US. His research is in analysis and applied analysis; most recently in the field of Inverse Problems and applications of microlocal analysis. In particular, his most recent work is focused on mathematical inverse problems arising in various medical imaging methods, geometry, seismology, radar imaging and cosmology.