

Young research investigators honored at the 2012 Gordon Research Conference on photosynthesis

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Abstract We provide a News Report on the 2012 Gordon Research Conference on Photosynthesis held at Davidson College, North Carolina during July 8–13 that focuses on four young investigators who were presented awards during the conference.

Keywords Brandon Greene · Katrin Linke · Elisabet Romero · Anna Schneider

Introduction

The 2012 Gordon Research Conference (GRC) on Photosynthesis was held during July 8–13 at the Davidson College, Davidson, North Carolina (see Fig. 1 for a group photograph). For a brief history of this conference, see <http://www.grc.org/conferences.aspx?id=0000207>. The conference was chaired by Richard J. Debus (University of California, Riverside) (Fig. 2 top left); the Vice-chair was David

M. Kramer (Michigan State University, East Lansing, MI) (Fig. 2 top middle). The 2012 conference had an emphasis on applications of photosynthetic energy conversion that can contribute to the development and use of solar energy as a renewable energy source. Reflecting the interdisciplinary nature of photosynthesis research, a diverse group of invited speakers presented a variety of scientific approaches to investigate photosynthesis including Nathan S. Lewis (California Institute of Technology, Pasadena, California, USA) (shown later in Fig. 4 bottom left) who delivered the closing lecture titled “Sunlight-driven hydrogen formation by membrane-supported photoelectrochemical water splitting”. The complete program and names of the conference speakers are available at: <http://www.grc.org/programs.aspx?year=2012&program=photosyn>. Indeed, as stated in the first sentence at the site:

Solar energy is the only clean, renewable source of energy that has sufficient capacity to replace fossil fuels and meet rising global energy needs.

Focal points of talks and discussions at this GRC included: artificial photosynthesis, solar energy conversion strategies, engineering organisms for biofuels and hydrogen production, electron transport, proton transport, energy coupling, photoprotection mechanisms, structure and function of the photosynthetic reaction centers (including rewiring of reaction centers for artificial photosynthesis), energy capture and light-harvesting solutions (including quantum coherence) as well as the structure of the oxygen evolving complex and the mechanism of oxygen production. The collegial atmosphere of the Photosynthesis GRC, with programmed discussion sessions as well as informal gatherings in the afternoons and evenings, enabled participants to brainstorm, exchange ideas, and forge new collaborations.

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Fig. 1 The 2012 photosynthesis GRC group photo. The photograph is provided as a courtesy of the Gordon conference

Fig. 2 The organizers and keynote speaker. *Top left:* 2012 conference chair Richard J. Debus, with the T-shirt celebrating “Who is wrong?” between Rienk van Grondelle and Alfred Holzwarth; *top middle:* 2012 conference vice-chair and 2014 chair David M. Kramer; *top right:* 2012 Gordon research seminar chair Gary F. Moore; *bottom left:* 2012 Gordon research seminar keynote speaker Gary W. Brudvig, with Alison Haddy and Govindjee; *bottom right:* 2014 conference vice-chair Fabrice Rappaport



This conference was preceded by a Gordon Research Seminar (GRS) subtitled Photosynthesis, Biofuels and Artificial Photosynthesis (July 7–8, same location). The seminar was chaired by Gary F. Moore (Lawrence Berkeley National Lab, Berkeley, California, USA) (Fig. 2 top right) and featured a keynote presentation by Gary W. Brudvig (Yale University, New Haven, Connecticut, USA) (Fig. 2 bottom left) titled “Photosynthetic Water Oxidation: Learning from Nature—How to Produce Solar Fuels”. The seminar focused on coupling emerging knowledge

regarding photosynthetic energy conversion with the development of technological energy transduction schemes that might transform the way we power future economies. The GRS provided an additional opportunity for graduate students and postdocs to present their research as well as a mechanism to encourage active participation by junior scientists interested in photosynthesis and its applications. The complete program and names of the seminar speakers are available at: http://www.grc.org/programs.aspx?year=2012&program=grs_phtsyn.

The awardees

One of the highlights of the conference was a session featuring short talks by junior investigators selected from the poster presentations. The 2012 awardees were: Brandon Green (Emory University, Atlanta, Georgia, USA), Katrin Linke (University of Uppsala, Uppsala, Sweden), Elisabet Romero (VU University Amsterdam, Netherlands) and Anna Schneider (University of California at Berkeley, Berkeley, California, USA) (Fig. 3). Each of the honored investigators was invited to present a research seminar in the Thursday evening session of the conference. All four presentations gave the audience a fascinating view of the research performed by the awardees. Each awardee received a certificate from the conference Chair and Vice-chair honoring their research achievements. In addition, Govindjee, the Founding Series Editor of *Advances in Photosynthesis and Respiration Including Bioenergy and Related Processes* (<http://www.springer.com/series/5599>) presented a gift of one volume from the series to each winner in recognition of their exceptional talent. We provide below a brief academic background of the 2012 awardees based on information obtained from the investigators.

Brandon Greene completed his B.S. in chemistry at Washington State University in 2009, performing research under James Brozik on single molecule fluorescence microscopy of the human serotonin receptor as well as homology modeling and directed Molecular Dynamics (MD) simulations. Brandon is currently pursuing his Ph.D. in physical chemistry under the direction of R. Brian Dyer at Emory University. Brandon's research has focused on the catalytic mechanism of NiFe hydrogenases, particularly proton reduction, in the pursuit of the first sub-turnover understanding of proton reduction. This research employs electrostatically bound nano-crystal quantum dots for extremely fast optically pumped enzyme reduction. Using FTIR (Fourier Transform Infrared) and time-resolved IR spectroscopy, he probed the electronic changes at the active site involved in proton reduction by the unique CO and CN⁻ ligands of the NiFe active site. His poster at the GRC titled "Multi-photon, multi-electron photo-reduction of H₂ase by QDs reveals novel H₂ production mechanism" explored these aspects of hybrid nano-crystal enzyme complexes.

Katrin Linke received her Ph.D. in Biochemistry from the Technical University in Munich, Germany, in 2005. All research for her graduate work on heat shock proteins in *E. coli* was done at the University of Michigan, Ann Arbor, USA, under the supervision of Ursula Jakob. During her



Fig. 3 The 2012 young investigator awardees. *Top left:* Katrin Linke and Brandon Greene; *top right:* Elisabet Romero, and Anna Schneider; *bottom left:* Anna Schneider holding the 2012 book on *Photosynthesis* (edited by Julian Eaton-Rye et al.) presented as a gift by Govindjee; *bottom right:* Katrin Linke and Govindjee (wearing the lab apron of Robert Emerson, discoverer of the Emerson enhancement effect that led later to the concept of two-light reactions and two pigment systems in photosynthesis); all awardees received different books from the Series "Advances in Photosynthesis and Respiration Including Bioenergy and Related Processes" (Springer, Dordrecht)

first post-doctoral appointment, Katrin performed functional and structural (X-ray crystallography) analysis on apoptotic proteins at the University of Otago, Dunedin, New Zealand, under the supervision of Catherine Day. Currently, Katrin is a post-doctoral fellow at the University of Uppsala, Sweden, where she works together with Felix Ho on proton transport in Photosystem II (PSII) of the green alga *Chlamydomonas*. The title of her poster was "Investigation of a proton pathway in PS2 through parallel in vivo mutagenesis and in silico molecular dynamics studies". For this project, Katrin mutated amino acid residues in PsbA that are predicted to be involved in proton transport. To analyze the effect of the mutations on photosynthetic activity, she determined steady-state and flash oxygen evolution. Furthermore she uses EPR (Electron Paramagnetic Resonance) spectroscopy to obtain information on individual S-state transitions.



Fig. 4 Activities, ambiance and people at the conference (1). *Top left:* Iftach Yacoby and Oliver Lenz; *top middle:* (Noam Adir; Herbert van Amerongen; and Alfred Holzwarth), *top left:* Victor Batista;

bottom left: James (Jim) Barber, Govindjee and Charles (Chuck) Dismukes; *bottom middle:* Per Siegbahn; *bottom left:* Nathan S. Lewis (Perspectives Lecturer)

Elisabet Romero received her Ph.D. in Biophysics from Vrije Universiteit (VU) Amsterdam, Netherlands, in 2011. During her Ph.D. at the laboratory led by Rienk van Grondelle, she studied the electronic structure and charge separation dynamics in the Photosystem II Reaction Center (PSII RC) complex by means of several steady-state and time-resolved spectroscopic techniques. The main finding of her Ph.D. thesis was the demonstration of the presence of two different charge separation pathways in the PSII RC. Currently, she is a postdoc researcher working on the implementation and utilization of Two-Dimensional Electronic Spectroscopy at the VU University Amsterdam. This emerging spectroscopic technique provides information on the intriguing quantum effects exploited by photosynthetic complexes. Her Gordon Conference poster, titled “Quantum-coherent charge separation in the Photosystem II reaction center,” showed that the coherent mixing of electronic states may be responsible for ultrafast and efficient charge separation. This conclusion provides a direct link between the observed quantum effects and the high efficiency in the conversion of solar energy into electrochemical energy in photosynthesis. This study is a collaborative effort between the VU University (Amsterdam),

Donatas Zigmantas from Lund University (Sweden) and Vladimir I. Novoderezhkin from Moscow State University (Russia).

Anna Schneider received her B.S. in Biochemistry and Mathematics from the University of Washington, Seattle, Washington, USA, in 2007. She is now working toward a Ph.D. in Biophysics in Phillip Geissler’s theoretical chemistry group at the University of California, Berkeley, USA. Anna is interested in the driving forces that determine thylakoid protein organization, and how changes in those driving forces produce the protein rearrangements seen in photoprotection and other adaptation processes. In particular, her current research uses computer simulations to study how PSII and Light-Harvesting Complex II (LHCII) are distributed within grana membranes. She has built a nanoscale computational model of a stacked membrane system that captures PSII arrays, PSII–LHCII supramolecular complexes, and other known structural motifs. Her Gordon Conference poster, titled “Phase diagrams of self-assembling photosynthetic membrane proteins,” argued that PSII arrays represent a crystalline thermodynamic phase that appears to coexist with a disordered fluid phase *in vivo*.

Fig. 5 Activities, ambiance and people at the conference. *Top left (left to right):* Ruchira Chatterjee; Amanda Applegate; Erica Wunderlich Majumder, and Katharina Brinkert returning to the conference from the soccer game; *top right:* Herbert van Amerongen jogging; *bottom left:* Gary Brudvig playing in the soccer field; *bottom middle:* Stenbjorn Styring checking his e-mail; *bottom right:* Gabor Bernat walking away after the conference



Fig. 6 Activities, ambiance, and people at the conference. *Top left:* Yulia Pushkar; *top middle (left to right):* Govindjee, Roberta Croce, and Herbert van Amerongen; *top right:* Ana Moore; *bottom left (left*

to right): Charles Dismukes, Petra Fromme, David Vinyard (standing) and Gennady Ananyev; *bottom right:* Vittal Yachandra, Jonannes Messinger, Govindjee, and Junko Yano

Concluding remarks

The 2012 GRC on photosynthesis provided established as well as beginning researchers the opportunity to present the latest developments in our field. Likewise, it was a wonderful environment for socializing with colleagues both old and new (Figs. 4, 5, 6). Perspectives on previous Photosynthesis GRCs can be found in: Govindjee et al. (2007, 2011); and in Govindjee (2009).

We wish success to David M. Kramer (Michigan State University) and Fabrice Rappaport (Centre National de la Recherche Scientifique, Paris, France) (Fig. 2 top middle and bottom right) who will serve as Chair and Vice-chair at the 2014 GRC on Photosynthesis, respectively. In 2013, the 16th International Photosynthesis Congress will be held in Saint Louis, Missouri, USA, during August 11–16, 2013. The co-organizers of this congress are Robert E. Blankenship (Washington University, St. Louis, MO) and Donald Ort (University of Illinois at Urbana-Champaign). See: <http://ps16stlouis.wustl.edu/>. Information on previous international photosynthesis congresses can be found in Govindjee and David Knaff (2006) and in Govindjee and Yoo (2007).

Acknowledgments We end this News Report by expressing our appreciation to attendees of the 2012 Conference and Seminar for contributing to discussions on various aspects of photosynthesis and advancing the frontiers of science. We thank Richard Debus and

David Kramer for their efforts as Chair and Vice-chair. For the description on the Awardees, we are grateful to Brandon Greene, Katrin Linke, Elisabet Romero and Anna Schneider for providing us information on their academic activities. We also thank Elmars Krausz and Warwick Hillier for sharing some of their photographs with us as well as the GRC for allowing us use of the 2012 group photograph (Fig. 1). Most of the photographs presented here were taken, and arranged into panels, by Gennady Ananyev. Govindjee thanks Ineke Ravesloot (Springer, Dordrecht, The Netherlands) for mailing the books to be given to the Awardees, and Alice Haddy (The University of North Carolina at Greensboro) for bringing these books to the conference site.

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