## BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
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NAME: Brudvig, Gary Wayne

eRA COMMONS USER NAME (credential, e.g., agency login): GBRUDVIG

POSITION TITLE: Benjamin Silliman Professor of Chemistry, Professor of Molecular Biophysics and Biochemistry (MB&B), Director of the Yale Energy Sciences Institute

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

| INSTITUTION AND LOCATION | DEGREE *(if applicable)* | Completion Date MM/YYYY | FIELD OF STUDY |
|---|---|---|---|
| University of Minnesota, Minneapolis | B.S. | 1976 | Chemistry |
| California Institute of Technology | Ph.D. | 1981 | Chemistry |
| University of California, Berkeley | Postdoc | 1980-1982 | Chemistry |

### A. Personal Statement

During my 37 years on the faculty at Yale University, I have advised 50 PhD students, 33 postdoctoral scholars, 13 MS students and 69 undergraduate researchers. These research scholars have all gone on to successful careers in a diverse range of fields including academia, biotech and pharmaceutical companies, law and medicine. Many hold faculty positions at academic institutions including: Michigan State Univ., Arizona St. Univ., Univ. of Massachusetts-Amherst, Washington Univ., Rensselaer Polytechnic Institute, Univ. of London, Nanyang Technological Univ., Singapore, National Chung Cheng University, Taiwan, National Chung Hsing University, Taiwan, Northeast Normal University, China, Nanjing Agricultural University, China, Louisiana St. Univ., Univ. of Kentucky, Univ. of Kansas, Univ. of Connecticut, Univ. of New Hampshire, Univ. of Cincinnati, North Dakota State Univ., Lewis & Clark College, Centre College and The College of New Jersey. My current research group includes 8 PhD students, 2 postdocs and 3 undergraduate students.

My research has been continuously supported during my 37 years at Yale by grants from a variety of federal agencies and foundations including the NIH, DOE, NSF and USDA. My research group is currently funded by the DOE and the TomKat Foundation.

Currently, I am the Benjamin Silliman Professor of Chemistry, with a secondary appointment as Professor of Molecular Biophysics and Biochemistry (MB&B), at Yale University and I direct the Energy Sciences Institute on Yale's West Campus. Our research involves study of the chemistry of solar energy conversion in natural photosynthesis, especially research aimed at determining the molecular mechanism of photosynthetic oxygen evolution by photosystem II, and work to develop artificial bioinspired systems for solar fuel production. Research carried out by our group in the Energy Sciences Institute involves the design, synthesis, characterization and application of organic photosensitizers and inorganic catalysts for use in photoelectrochemical applications for artificial photosynthesis.

At Yale, I have served in a number of administrative positions in which I worked to enhance training and mentoring, and to promote inclusive and supportive scientific research environments. I served for 6 years as Director of Graduate Studies in the Department of Chemistry. During this time, I promoted graduate mentoring

by establishing annual meetings of all Chemistry graduate students with their faculty committee. I also served for 9+ years as Chair of the Department of Chemistry. As Department Chair, I attended three NIH-sponsored workshops in Washington, DC on promoting gender diversity, racial diversity and inclusivity of handicapped trainees and brought back information to my department to increase awareness of these topics. In addition, I served as Director of the NIH-supported Biophysics Training Program at Yale University from 1999 to 2006. As Director, I strived to promote mentorship and to increase the number of underrepresented minorities in the training program.

## B. Positions and Honors

### Positions and Employment

1975 Student Aide, Argonne National Laboratory
1976-80 National Institutes of Health Predoctoral Trainee, Caltech
1980-82 Miller Postdoctoral Fellow, University of California, Berkeley
1982-87 Assistant Professor of Chemistry, Yale University
1987-91 Associate Professor of Chemistry, Yale University
1991-present Professor of Chemistry, Yale University (Chair, 2003-2009 and 2015-2018)
2003-present Professor of Molecular Biophysics and Biochemistry, Yale University
2012-present Founding Director, Energy Sciences Institute, Yale University

### Other Experience and Professional Memberships

Chair, Eastern Regional Photosynthesis Conference, 1985
Chair, Gordon Research Conference on Biophysical Aspects of Photosynthesis, 2000
Chair, Gordon Research Conference on Solar Fuels, 2018
Executive Committee, Bioenergetics Subgroup of the Biophysical Society, 1994-1997
Editorial Board Member: *Photosynth. Res.*,1986-1995; *American Scientist*, 1989-1990; *Biospectroscopy*, 1994-2003; *Current Chemical Biology*, 2006-2017; Oxford University Press, 2009-present; *Nanotechnology*, 2011-present; *CRC Press*, 2011-present; World Scientific Publishers, 2014-present; *Biochemistry*, 2017-present; *Nano Futures*, 2017-present; *Inorganics*, 2018-present
Faculty Member, F1000Prime, 2018-present
Associate Editor, *Biochemistry*, 2000-2016
Member, NIH Physical Biochemistry Study Section, 2000-2004
DOE Review Panels: Biological Energy Research Program, 1985; Energy Biosciences Program, 1993; SISGR Program, 2009; Solar Photochemistry Program, 2011; Early Career Research Program, 2015; Physical Biosciences Program, 2016, 2019; Office of Science Graduate Student Research Program, 2017
Lawrence Berkeley National Laboratory, Structural Biology Division Review Committee, 1997
Lawrence Berkeley National Laboratory, Physical Biosciences Division Review Committee (Chair), 2004, 2005
USDA Review Panel, Competitive Research Grants Program, 1987
NIH Special Study Sections: Program Project/Research Resource Reviews, 1992, '93, '97, '98
NIH Study Sections, ad hoc member: Metallobiochemistry, 1995; Physical Biochemistry, 1995, '96, '99; Molecular & Cellular Biophysics, 1996; Small Instrumentation Grants, 1993, '96; Fellowships, 2002, ‘08
External reviewer: Dept. of Chemistry, Univ. of Albany, 2005; Dept. of Chemistry & Biochemistry, Arizona St. Univ., 2006, 2013; Dept. of Chemistry, Emory Univ., 2010; Dept. of Chemistry, Johns Hopkins Univ., 2011; Dept. of Chemistry, Dartmouth College, 2020
Scientific Advisory Committee, The Institute of Chemistry, Academia Sinica, 2017-present

### Honors

1975 Phi Beta Kappa Honor Society
1976 Award of the American Institute of Chemistry for Outstanding Chemistry Student
1980 Herbert Newby McCoy Award for Outstanding Research in Chemistry
1982 Camille and Henry Dreyfus Newly Appointed Faculty Fellowship
1983 Searle Scholar
1985 Camille and Henry Dreyfus Teacher-Scholar
1986 Alfred P. Sloan Research Fellow
1989 Milton Harris, ‘29 Ph.D., Associate Professor of Chemistry, Yale University

1995 Elected Fellow of the American Association for the Advancement of Science
1997 Distinguished Alumni Award, Mounds View High School, Minnesota
1998 R. T. Major Lecture, University of Connecticut
2002 Watkins Lecture, Wichita State University
2005 Sunney I. Chan Lecture, Institute of Chemistry, Academia Sinica, Taipei, Taiwan
2008 Eugene Higgins Professorship, Yale University
2008 Baker Lecture, Cornell University
2011 Benjamin Silliman Professorship, Yale University
2012 Harry C. Allen Lecture, Clark University
2016 Sunney and Irene Chan Lecture, Hong Kong Polytechnic University
2016 Outstanding Achievement Award, University of Minnesota
2019 Elected member, Connecticut Academy of Science and Engineering (CASE)

**C. Contributions to Science**

1. Our group has contributed much of the work leading to the current understanding of water oxidation by photosystem II. The following are representative publications.

"Mechanism for Photosynthetic $O_2$ Evolution", Gary W. Brudvig and Robert H. Crabtree (1986) *Proc. Natl. Acad. Sci. USA 83*, 4586-4588.
• First molecular mechanism proposed for O—O bond formation in photosystem II; this mechanism, based on our characterization of the $O_2$-evolving complex together with inorganic coordination chemistry, was included in a number of textbooks, including Stryer's "Biochemistry".

"Quantifying the Ion Selectivity of the $Ca^{2+}$ Site in Photosystem II: Evidence for Direct Involvement of $Ca^{2+}$ in $O_2$ Formation", John S. Vrettos, Daniel A. Stone and Gary W. Brudvig (2001) *Biochemistry 40*, 7937-7945.
• Demonstration that $Ca^{2+}$ is part of the $O_2$-evolving complex and functions as a Lewis acid in the water-oxidation chemistry of photosystem II; subsequent crystallographic analyses confirmed that $Ca^{2+}$ is part of the $Mn_4CaO_5$ catalytic core of the $O_2$-evolving complex and placed $Ca^{2+}$ appropriately to activate water as a nucleophile, as we proposed.

"Structure-Based Mechanism of Photosynthetic Water Oxidation", James P. McEvoy and Gary W. Brudvig (2004) *Phys. Chem. Chem. Phys. 6*, 4754-4763.
• This manuscript connects our proposed mechanism for O—O bond formation involving nucleophilic attack of $Ca^{2+}$-bound water on an electrophilic Mn-bound oxo with the cuboidal model of the $O_2$-evolving complex proposed in the 3.5 Å X-ray crystal structure of photosystem II.

"Water-Splitting Chemistry of Photosystem II", James P. McEvoy and Gary W. Brudvig (2006) *Chem. Rev. 106*, 4455-4483.
• This highly cited review provides a critical analysis of proposed mechanisms, including the mechanism involving nucleophilic attack of water bound to $Ca^{2+}$ on an electrophilic terminal oxo bound to high-valent Mn that our group has championed.

2. Our group has characterized electron transfer in photosystem II and contributed much of the work that led to the current understanding of this system. The following are representative publications.

"Electron Transfer in Photosystem II at Cryogenic Temperatures", Julio C. de Paula, Jennifer B. Innes and Gary W. Brudvig (1985) *Biochemistry 24*, 8114-8120.
• This study quantified the conditions for controlled advancement of the $O_2$-evolving complex by variation of the illumination temperature that enabled generation of the intermediate oxidation states of the $O_2$-evolving complex in high yield for spectroscopic investigation.

"Cytochrome $b_{559}$ May Function to Protect Photosystem II from Photoinhibition", Lynmarie K. Thompson and Gary W. Brudvig (1988) *Biochemistry 27*, 6653-6658.

• Demonstration that cytochrome $b_{559}$ is photooxidized in a secondary electron-transfer side path via an accessory chlorophyll that we named chlorophyll-Z; this chlorophyll was later resolved in the crystal structure of PSII and our name for it has been adopted by the field; our proposal that cytochrome $b_{559}$ functions in photoprotection clarified the role of this enigmatic component of photosystem II and our proposed mechanism of action is now generally accepted.

"Directed Alteration of the D1 Polypeptide of Photosystem II: Evidence that Tyr-161 is the Redox Component, Z, Connecting the Oxygen-Evolving Complex to the Primary Electron Donor, P680", James G. Metz, Peter J. Nixon, Matthias Rögner, Gary W. Brudvig and Bruce A. Diner (1989) *Biochemistry 28*, 6960-6969.
• By using site-directed mutagenesis and EPR spectroscopy, it is demonstrated that tyrosine-161 of the D1 protein of photosystem II is the electron-transfer intermediate, formerly known as redox cofactor Z and now Tyr-Z, that connects the charge-separation in the photosystem II reaction center involving P680 to the $O_2$-evolving complex.

"Characterization of Carotenoid and Chlorophyll Photooxidation in Photosystem II", Cara A. Tracewell, Agnes Cua, David H. Stewart, David F. Bocian and Gary W. Brudvig (2001) *Biochemistry 40*, 193-203.
• Identification of conditions under which a carotenoid in photosystem II is reversibly photooxidized in high-yield in side-path electron transfer; the reversible oxidation of carotenoids in photosystem II is a unique reaction in a biological system and of significant interest as an example of a molecular wire connecting redox cofactors.

3. Our group has developed many of the most active and robust synthetic molecular water-oxidation catalysts that are of great current interest for solar water-splitting applications. The following are representative publications.

"A Functional Model for O—O Bond Formation by the $O_2$-Evolving Complex in Photosystem II", Julian Limburg, John S. Vrettos, Louise M. Liable-Sands, Arnold L. Rheingold, Robert H. Crabtree and Gary W. Brudvig (1999) *Science 283*, 1524-1527.
• The Mn-terpy dimer reported in this study remains the most active homogeneous Mn-based water-oxidation catalyst and has had a major impact in efforts to develop water-oxidation catalysts based on first-row transition metals for applications in solar energy conversion processes.

"Highly Active and Robust Cp* Iridium Complexes for Catalytic Water Oxidation", Jonathan F. Hull, David Balcells, James D. Blakemore, Christopher D. Incarvito, Odile Eisenstein, Gary W. Brudvig and Robert H. Crabtree (2009) *J. Am. Chem. Soc. 131*, 8730-8731.
• This report that organometallic Ir complexes are highly active for water oxidation catalysis initiated a new direction for homogeneous water-oxidation catalysis.

"Distinguishing Homogeneous from Heterogeneous Catalysis in Electrode-Driven Water Oxidation with Molecular Iridium Catalysts", Nathan D. Schley, James D. Blakemore, Navaneetha K. Subbaiyan, Christopher D. Incarvito, Francis D'Souza, Robert H. Crabtree and Gary W. Brudvig (2011) *J. Am. Chem. Soc. 133*, 10473-10481.
• A new method is reported for probing homogeneous vs. heterogeneous catalysis based on simultaneous mass analysis and cyclic voltammetry using an electrochemical quartz crystal nanobalance.

4. Our group developed methods based on saturation-recovery EPR spectroscopy for determination of long-range distances between paramagnetic centers in biomacromolecules. The following are representative publications.

"Using Saturation-Recovery EPR to Measure Distances in Proteins: Applications to Photosystem II", Donald J. Hirsh, Warren F. Beck, Jennifer B. Innes and Gary W. Brudvig (1992) *Biochemistry 31*, 532-541.
• We developed a new application of pulsed EPR based on our home-built instrumentation and demonstrated its use for long-range distance measurements in proteins; long-range distance measurements by EPR are now of major importance in protein structure-function studies and our method is gaining renewed interest as a technique that can be applied at both cryogenic and physiological temperature, whereas other pulsed EPR methods can only be carried out at cryogenic temperatures.

5. Our group in collaboration with the group of Victor Batista has developed computational models of the $O_2$-evolving complex in photosystem II that connect experimental spectroscopic data to mechanistic and structural models of the active site of this enzyme.

"Quantum Mechanics/Molecular Mechanics Study of the Catalytic Cycle of Water Splitting in Photosystem II", Eduardo M. Sproviero, José A. Gascón, James P. McEvoy, Gary W. Brudvig and Victor S. Batista (2008) *J. Am. Chem. Soc. 130*, 3428-3442.
• This QM/MM study extended the 3.5 Å X-ray crystal structure of photosystem II with chemically sensible models of the $O_2$-evolving complex in the $S_0$-$S_4$ states and support for a mechanism of O—O bond formation involving nucleophilic attack of a $Ca^{2+}$-bound water on a $Mn^{4+}$-oxyl radical species.

A full list of publications from our group (416 to date) is available at: http://brudviglab.yale.edu/node/98.

**D. Additional Information: Research Support and/or Scholastic Performance**

**Current Grant Support**
"Structure-Function Studies of Photosystem II"
Principal Investigator: Gary W. Brudvig
Agency: Department of Energy; Grant No. DE-FG02-05ER15646; Period: April 1, 2005 to June 30, 2020
The specific aims of this project are to use biophysical and computational methods to investigate the water-oxidation chemistry and electron-transfer reactions of photosystem II in conjunction with studies of biomimetic inorganic oxomanganese model complexes.

"Photocatalytic Assemblies for Solar Fuel Production"
Principal Investigator: Gary W. Brudvig
Co-Principal Investigators: Victor Batista, Robert Crabtree and Charles Schmuttenmaer
Agency: Department of Energy; Grant No. DE-FG02-07ER15909; Period: September 1, 2007 to February 28, 2020
The specific aims of this project are to develop and investigate systems for photocatalytic water oxidation using photosensitizers and catalysts attached to the surface of metal oxide nanoparticles.

"ANSER/LEAP EFRC"
Principal Investigator: Michael R. Wasielewski
Co-Principal Investigators: Gary W. Brudvig plus 17 others
Agency: Department of Energy; Grant No. DE-PS02-08ER15944; Period: September 1, 2009 to August 31, 2020
The specific aim of my portion of this project is to develop molecular water-oxidation catalysts for solar fuel applications.

## BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Gisriel, Christopher James

eRA COMMONS USER NAME (credential, e.g., agency login): N/A

POSITION TITLE: Postdoctoral Associate, Yale Department of Chemistry

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

| INSTITUTION AND LOCATION | DEGREE *(if applicable)* | Completion Date MM/YYYY | FIELD OF STUDY |
|---|---|---|---|
| Arizona State University | B.S. | 2013 | Biochemistry |
| Arizona State University | Ph.D. | 2017 | Biochemistry |
| Arizona State University | Postdoc | 2017-2019 | Biochemistry |
| Yale University | Postdoc | 2019-Present | Chemistry |

### A. Personal Statement

The focus of my research is the study of photosystem II (PSII), the light-driven enzyme responsible for the presence of nearly all the oxygen in the atmosphere by oxidizing an essentially endless fuel: water. The ability to understand the structure, function, and variation of PSII between organisms will help to inform artificial bio-hybrid systems to catalyze fuel production in a variety of environments. This research is funded by the DOE and aims to solve cryoEM structures of a novel type of PSII.

During my academic career I have collaborated with various biochemists, chemists, engineers, biophysicists, and structural biologists to understand many of the fundamental aspects of extant phototrophy. Through the lens of a structural biologist, I have published novel papers that provide insight into the basic building blocks of photosynthesis, and used these observations to speculate how photosynthesis has evolved on Earth – the emergence of water oxidation, placement of cofactors in the electron transport chains of the photosystems, and protein rearrangements to facilitate various light conditions (References C1 and C2 below). In a more applied direction, I have published on a ground-breaking technique employed in structural biology, serial femtosecond crystallography using an X-ray Free Electron Laser (Reference C3). This, and my understanding of gaps within field of photosynthesis research, makes me well-suited for obtaining stable freezing conditions of PSII described within this application and publishing high-quality research thereafter, especially as I have a publication of a closely-related protein structure, photosystem I, in press (Reference C4).

As a group, we are well-established scientists who have the ability to isolate our protein to high purity. While I bring cryoEM and other structural-biology-related expertise to my current group, we closely collaborate with biochemists, chemists, and molecular dynamics groups who drastically enhance the ability to derive conclusions from data, resulting in impactful publications.

### B. Positions and Honors

**Positions and Employment**

2011-13 Undergraduate Research Assistant, Arizona State University
2013-17 Graduate Research Assistant, Arizona State University
2018-19 Postdoctoral Research Associate, Arizona State University
2019-Present Postdoctoral Research Associate, Yale University

**Other Experience and Professional Memberships**

Ad hoc reviewer: Nature Communications (Nature Research), 2019-Present
Ad hoc reviewer: eLife (eLife Sciences Publications), 2019-Present
Ad hoc reviewer: Nature Plants (Nature Research), 2019-Present
Ad hoc reviewer: Free Radical Biology and Medicine (Elsevier), 2019-Present
Ad hoc reviewer: Geobiology (Wiley), 2018-Present
BioXFEL scholar, 2018-Present
Achievement Rewards for College Scientists (ARCS) Scholar, 2017-Present
Gordon Research Seminar Chair, 2017-2019

**Honors**

2012 Wayne W. Luchsinger Chemistry Scholarship recipient, ASU
2017 Richard Malkin Award recipient, Western Photosynthesis Conference
2017 Johnston Endowment Scholar award recipient, ARCS Foundation
2017 College of Liberal Arts and Sciences CLAS Leader, ASU
2017 College of Liberal Arts and Sciences Graduate Excellence Award, ASU
2017 College of Liberal Arts and Sciences Outstanding Graduate, ASU

**C. Contributions to Science**

1. At ASU my group solved the first structure of a fourth class of reaction center protein that had major implications in our understanding of how photosynthesis evolved from a primitive anoxygenic environment which led to the following publications:

- **Gisriel, C.**, Sarrou, I., Ferlez, B., Golbeck, J., Redding, K., & Fromme, R.† (2017). Structure of a symmetric photosynthetic reaction center–photosystem. *Science*, *357* (6355), 1021-1025.
- Orf, G.*****, **Gisriel, C.***, & Redding, K.† (2018). Evolution of photosynthetic reaction centers: insights from the structure of the heliobacterial reaction center. *Photosynthesis Research*, *138* (1), 11-37.

2. To reveal the functional characteristics of anoxygenic photosynthesis, I participated in the following studies:

- Ferlez, B., Cowgill, J., Dong, W., **Gisriel, C.**, Lin, S., Flores, M., Walters, K., Cetnar, D., Redding, K.†, & Golbeck, J.† (2016). Thermodynamics of the electron acceptors in *Heliobacterium modesticaldum*: An exemplar of an early homodimeric type I photosynthetic reaction center. *Biochemistry*, *55*(16), 2358-2370.
- Herrera-Theut, K. A., **Gisriel, C.**, Laureanti, J., Orf, G., Baker, P., Jones, A. K., & Redding, K.† (2017). Evaluating the role of a multi-heme cytochrome c in electron transfer from an electrode surface to *Heliobacterium modesticaldum*. *The FASEB Journal*, *31*, 913.13-913.13.

3. To increase the novelty and accessibility of crystallography performed at X-ray Free Electron Lasers, I solved a large membrane protein structure at room temperature using serial femtosecond crystallography which led to the following publication:

- **Gisriel, C.***, Coe, J.*, Letrun, R., Yefanov, O. M., Luna-Chavez, C., Stander, N. E., Lisova, S., Mariani, V., Kuhn, M., Aplin, S., Grant, T. D., Dörner, K., Sato, T., Echelmeier, A., Cruz Villarreal, J., Hunter, M. S., Wiedorn, M. O., Knoska, J., Mazalova, V., Roy-Chowdhury, S., Yang, J.-H., Jones, A., Bean, R., Bielecki, J., Kim, Y., Mills, G., Weinhausen, B., Meza, J. D., Al-Qudami, N., Bajt, S., Brehm, G., Botha, S., Boukhelef, D., Brockhauser, S., Bruce, B. D., Coleman, M. A., Danilevski, C., Discianno, E., Dobson, Z., Fangohr, H., Martin-Garcia, J. M., Gevorkov, Y., Hauf, S., Hosseinizadeh, A., Januschek, F., Ketawala, G. K., Kupitz, C., Maia, L., Manetti, M., Messerschmidt, M., Michelat, T., Mondal, J., Ourmazd, A., Previtali, G., Sarrou, I., Schön, S., Schwander, P., Shelby, M. L., Silenzi, A., Sztuk-Dambietz, J., Szuba, J., Turcato, M., White, T. A., Wrona, K., Xu, C., Abdellatif, M. H., Zook, J. D., Spence, J. C. H., Chapman, H. N., Barty, A., Kirian, R. A., Frank, M., Ros, A., Schmidt, M., Fromme,

R., Mancuso, A. P., Fromme, P.†, & Zatsepin, N. A.† (2019). Membrane protein megahertz crystallography at the European XFEL. *Nature Communications*, *10* (1), 5021.

4. To reveal the adaptive mechanisms of photosynthesis in nature, the following article has been accepted for publication and is in press:

- **Gisriel, C.**, Coe, J., Shen, G., Kurashov, V., Ho, M-Y., Zhang, S., Williams, D., Golbeck, J., Fromme, P., & Bryant, D.† (2019). Structure of far-red light Photosystem I. *Science Advances,* ***Accepted – awaiting publication***.

5. In service to the photosynthesis research community, I have participated in the following news reports:

- **Gisriel, C.**, Saroussi, A., Ramundo, S., Fromme, P., & Govindjee, G.† (2017). Gordon Research Conference on photosynthesis: photosynthetic Plasticity from the environment to synthetic systems. *Photosynthesis Research*, *136* (3), 393-405.
- Kaur, D.*, **Gisriel, C.†**, Burnap, R., Fromme, P., & Govindjee, G.† (2019). Gordon Research Conference 2019: From the biophysics of natural and artificial photosynthesis to bioenergy conversion. *Current Plant Biology*. (doi: https://doi.org/10.1016/j.cpb.2019.100129)

†represents corresponding author, *represents co-first authors

A full list of publications can be found here:
https://scholar.google.com/citations?user=ghvm3OMAAAAJ&hl=en&oi=ao

**D. Additional Information: Research Support and/or Scholastic Performance**

**Current Grant Support**

"Structure-Function Studies of Photosystem II"
Principal Investigator: Gary W. Brudvig
Agency: Department of Energy; Grant No. DE-FG02-05ER15646; Period: April 1, 2005 to June 30, 2020
The specific aims of this project are to use biophysical and computational methods to investigate the water-oxidation chemistry and electron-transfer reactions of photosystem II in conjunction with studies of biomimetic inorganic oxomanganese model complexes.