

**Patricia L. Clark, Ph.D.**  
 University of Notre Dame  
 Department of Chemistry & Biochemistry  
 251 Nieuwland Science Hall, Notre Dame, IN 46556

## RESEARCH INTERESTS

Cellular mechanisms that support proper protein folding and suppress aggregation, specifically how appearance of polypeptides from one end to the other during protein synthesis and membrane transport affect protein folding mechanisms. I am particularly interested in how vectorial protein folding affects the formation of complex protein topologies, including  $\beta$ -sheet structure and multimeric proteins.

## EDUCATION & TRAINING

1997 - 2001	<u>Postdoctoral Fellow</u>	<i>Advisor:</i> Dr. Jonathan King Department of Biology, Massachusetts Institute of Technology, Cambridge, MA
1997	<u>Ph.D. Molecular Biophysics</u>	<i>Advisor:</i> Dr. Lila M. Gierasch University of Texas Southwestern Medical Center at Dallas, Molecular Biophysics Graduate Program
1991	<u>B.S. Chemistry</u>	Georgia Institute of Technology, Department of Chemistry & Biochemistry

## ACADEMIC POSITIONS

2013 -	Professor of Chemistry & Biochemistry, Univ. Notre Dame
2011 -	Concurrent Professor of Chemical & Biomolecular Engineering, Univ. Notre Dame
2010 -	Rev. John Cardinal O'Hara, CSC Professor of Biochemistry, Univ. Notre Dame
2008 - 2013	Associate Professor, Univ. Notre Dame
2006 - 2008	Assistant Professor, Univ. Notre Dame
2001 - 2006	Clare Boothe Luce Assistant Professor of Biochemistry, Univ. Notre Dame

## ADMINISTRATIVE POSITIONS

2020 -	Advisor to the Vice President for Research, University of Notre Dame
2018 -	Founder and Director, Biophysics Instrumentation Core Facility, Univ, Notre Dame
2017 -	Founder and Director, Biophysics Graduate Program, College of Science, University of Notre Dame
2013 - 2014	Provost Fellow, University of Notre Dame
2011 - 2012	Associate Department Chair, Department of Chemistry & Biochemistry, University of Notre Dame

## SELECT HONORS, AWARDS & FELLOWSHIPS

2013, 2018	Joyce Award for Excellence in Undergraduate Teaching, <i>Univ. Notre Dame</i>
2018	63rd Annual Francis Clifford Phillips Lecturer, <i>University of Pittsburgh</i>
2017	Peter B. Sherry Memorial Lecturer, <i>Georgia Institute of Technology</i>
2015 - 2016	Faculty Fellow, Kaneb Center for Teaching and Learning, <i>Univ. Notre Dame</i>
2013	Michael & Kate Bárány Award, <i>Biophysical Society</i>
2013	Session Chair & Opening Speaker, Kavli Frontiers of Science Symposium, <i>National Academy of Sciences</i>
2011 - 2012	Inaugural Class, ND LEAD Leadership Development Program, <i>Univ. Notre Dame</i>
2007	100 Years of Chemistry Symposium Speaker, <i>Georgia Institute of Technology</i>
2003 - 2008	Early Career Development (CAREER) Award, <i>NSF (Molecular Biophysics)</i>
2003 - 2007	National Scientist Development Award, <i>American Heart Association</i>
2001 - 2006	Clare Boothe Luce Assistant Professorship, <i>Henry Luce Foundation</i>
1998 - 2001	National Research Service Award F32 Postdoctoral Fellowship, <i>NIH</i>

1996 Student Research Achievement Award, *Biophysical Society*  
1994 - 1997 Molecular Biophysics T32 Predoctoral Training Fellowship, *NIH*

## **NATIONAL AND INTERNATIONAL SERVICE**

### **Conference Organization**

2021 Organizer, EMBO Workshop on Codon Usage: Mechanism, Function and Evolution (with Greg Kudla, Yi Liu & Yitzhak Pilpel)  
2020 Program Co-Chair, 2020 Annual Meeting of the Biophysical Society (with Bill Kobertz, UMass Medical School)  
2016 Organizer, FASEB Protein Folding in the Cell Summer Conference (with Jim Bardwell, Univ. Michigan)  
2014 Co-Organizer, FASEB Protein Folding in the Cell Summer Conference (with Jeff Brodsky, Univ. Pittsburgh)  
2014 Organizing Committee, US-Indonesia Frontiers of Science Symposium (sponsored by the US National Academy of Sciences)  
2012 Organizer, 26<sup>th</sup> Annual Gibbs Conference on Biothermodynamics (with Aaron Lucius, Univ. Alabama)  
2009 - 2011 Co-Vice Chair (2009) and Co-Chair (2011), Proteins Gordon Research Conference, Holderness, NH (with Jim Bowie, UCLA)  
2005 - 2007 Organizing Committee, Annual German-American Frontiers of Science Symposium (co-sponsored by the US National Academy of Sciences and the Alexander von Humboldt Foundation)  
2005 - Founder & Organizer, Annual Midwest Conference on Protein Folding, Assemblies & Molecular Motions

### **Leadership Within Professional Societies**

2016 - 2019 Elected Member, Protein Society Executive Council  
2016 - 2019 Chair, Publications Committee, Protein Society  
2017 Elected Chair, Biopolymers *In Vivo* Subgroup, Biophysical Society  
2015 Elected President, Gibbs Society for Biothermodynamics  
2013, 2014 Speaker, Telluride Town Talk, Telluride Science Research Center, Telluride, CO.  
2009 - 2012 Elected Member, Biophysical Society Council  
2000 - 2006 Founder and Chair, Early Careers Committee, Biophysical Society

### **Review Panels**

2021 Stage 2 Editorial Board Review Panel, NIH DP2 New Innovator Award  
2017 Ad hoc reviewer, NIH F03B (Biophysical, Physiological, Pharmacological and Bioengineering Neuroscience Fellowship) study section  
2013 Ad hoc reviewer, NIH MSFC study section  
2006, 2011, 2020 Ad hoc reviewer, NIH MSFB study section  
ongoing: Ad hoc reviewer for US National Science Foundation and UK Wellcome Trust  
ongoing: Ad hoc reviewer for various journals including: *Science*, *Nature*, *PNAS*, *Molecular Cell*, *Cell Reports*, *Nature Structural & Molecular Biology*, *Nature Chemical Biology*, *Nature Communications*, *Nature Microbiology*, *eLife*, *PLoS Computational Biology*, *Journal of Theoretical Biology*, *JACS*, *Biochemistry*, *Biophysical Journal*, *JBC*, *JMB*, *Protein Science*, and *Trends in Biochemical Sciences*

### **Editorial Roles**

2019 Editor, Special issue "Proteins in the Cell", *Protein Science*  
2009 - 2015 Editorial Board Member, *Biophysical Journal*

## UNIVERSITY OF NOTRE DAME SERVICE & COMMITTEES

- 2020 - Executive Committee, Academic Council, University of Notre Dame
- 2019 - Academic Council, University of Notre Dame
- 2018 - Research Vision Initiative (develop university's overarching research vision for next 15-20 years)
- 2018 - 2019 Planning Committee, McKenna Conference Center Building Project
- 2011 - 2013, 2016 - 2019 Biochemistry Group Leader (develop teaching assignments, coordinate faculty search committees)
- 2014 - 2017 Chair, College of Science Biophysics Committee
- 2012 - 2016 Vision Committee, Department of Chemistry & Biochemistry
- 2015 - 2016 Member, Undergraduate Studies Committee, Department of Chemistry & Biochemistry
- 2012 - 2013 Notre Dame Multi-Disciplinary Research Committee
- 2011 - 2014 Seminar Committee, Eck Institute for Global Health
- 2011 - 2012 Member, Inaugural class, ND LEAD (university leadership development program)
- 2011 - 2012 Associate Chair, Department of Chemistry & Biochemistry
- 2010 - 2012 Committee for Appointments and Promotions, Department of Chemistry & Biochemistry
- 2010 - 2011 Focus Group Leader ("Research Excellence"), Department of Chemistry & Biochemistry 10-year External Review
- 2009 - 2010 Notre Dame Strategic Research Investments Committee ("SAPC II")
- 2005 - 2010 Steering Committee, NIH Chemistry-Biology-Biochemistry Interface (CBBI) Training Grant (T32 GM75762)
- 2005 - 2010 Graduate Studies Committee, Biochemistry representative
- 2001 - 2010 Judging Pool, Regional Finals, Siemens Westinghouse Science & Technology Competition (Midwest regional finals are held each November at Notre Dame)
- 2008 - 2009 College of Science Luce Chair Faculty Search Committee
- 2004 - 2008 Faculty Coordinator, Biophysical Chemistry Journal Club
- 2007 Faculty Participant, Fisher/Pangborn Residence Hall Career Discernment Dinner
- 2006 Organizer, Notre Dame Biochemistry Retreat (a two-day, off-campus event)
- 2001 - 2005 Biochemistry Graduate Recruitment Coordinator, Department of Chemistry & Biochemistry

## PROFESSIONAL MEMBERSHIPS

- American Association for the Advancement of Science
- American Society for Biochemistry & Molecular Biology
- Biophysical Society
- Gibbs Society for Biothermodynamics
- Protein Society

## REFEREED PUBLICATIONS (\* = corresponding author)

ORCID ID: 0000-0001-5462-8248

44. Bowman M.A., Riback J.A., Rodriguez, A., Gao H., Li J., Sosnick T.R.\* & Clark P.L.\* (2020) Properties of protein unfolded states suggests broad selection for expanded conformational ensembles. *Proceedings of the National Academy of Sciences USA* **117**, 23356-23364.  
<https://doi.org/10.1073/pnas.2003773117>
43. Newaz, K., Wright G., Piland, J., Li, J., Clark P.L., Emrich S.J. & Milenkovic T.\* (2020) Network analysis of synonymous codon usage. *Bioinformatics* **36**, 4876-4884.  
<https://doi.org/10.1093/bioinformatics/btaa603>
42. Wright G.\*, Rodriguez A., Li J., Clark P.L. Milenkovic T. & Emrich S.J. (2020) Analysis of computational codon usage models and their association with translationally slow codons. *PLoS ONE* e:0232003.  
<https://doi.org/10.1371/journal.pone.0232003>
41. Clark P.L.\*, Plaxco K.W.\* & Sosnick T.R.\* (2020) Water as a good solvent for unfolded proteins: Folding and collapse are fundamentally different. *Journal of Molecular Biology* **432**, 2882-2889.  
<https://doi.org/10.1016/j.jmb.2020.01.031>
40. Walsh I.M., Bowman M.A., Soto Santarriaga I.F., Rodriguez A. & Clark P.L.\* (2020) Synonymous codon substitutions perturb co-translational folding *in vivo* and impair cell fitness. *Proceedings of the National Academy of Sciences USA* **117**, 3528-3534.  
<https://doi.org/10.1073/pnas.1907126117>
39. Riback J.A., Bowman M.A., Zmyslowski A., Plaxco, K.W., Clark P.L.\* & Sosnick T.R.\* (2019) Commonly used FRET fluorophores promote collapse of an otherwise disordered protein. *Proceedings of the National Academy of Sciences USA* **116**, 8889-8894.  
<https://doi.org/10.1073/pnas.1813038116>
38. Bartkiewicz M.\*, Kazazic S., Krasowska J., Clark P.L., Wielgus-Kutrowska B. & Bzowska A.\* (2018) Non-fluorescent mutant of green fluorescent protein sheds light on the mechanism of chromophore formation. *FEBS Letters* **592**, 1516-1523.  
<https://doi.org/10.1002/1873-3468.13051>
37. Rodriguez A., Wright, G., Emrich S. & Clark P.L.\* (2018) %MinMax: A versatile tool for calculating and comparing synonymous codon usage and its impact on protein folding. *Protein Science* **27**, 356-362.  
<https://doi.org/10.1002/pro.3336>
36. Faisal F.E., Newaz K., Chaney J.L., Li J., Emrich S.J., Clark P.L. & Milenkovic, T.\* (2017) GRAFENE: Graphlet-based alignment-free network approach integrates 3D structural and sequence (residue order) data to improve protein structural comparison. *Scientific Reports* **7**, 14890.  
<https://doi.org/10.1038/s41598-017-14411-y>
35. Riback J.A., Bowman M.A., Zmyslowski A., Knoverek C.R., Jumper J., Hinshaw J., Kaye E.B., Freed K.F., Clark P.L.\* & Sosnick T.R.\* (2017) Innovative scattering analysis shows that hydrophobic disordered proteins are expanded in water. *Science* **358**, 238-241.  
<https://doi.org/10.1126/science.aan5774>
  - *Technical Comment published in Science (August 2018); corresponding authors Best & Schuler*
  - *Technical Comment published in Science (August 2018); corresponding authors Lemke & Pappu*
  - *Response to Technical Comment published in Science (August 2018); Clark & Sosnick*
34. Chaney J.L., Steele A., Carmichael R., Rodriguez A., Specht A.T., Ngo K., Li J., Emrich S.\* & Clark P.L.\* (2017) Widespread position-specific conservation of synonymous rare codons within coding sequences. *PLoS Computational Biology*. **13**:e1005531. doi: 10.1371/journal.pcbi.1005531.  
<https://doi.org/10.1371/journal.pcbi.1005531>
33. Jacobson G.N. & Clark P.L.\* (2016) Quality over quantity: Optimizing co-translational protein folding with non-'optimal' synonymous codons. *Current Opinion in Structural Biology* **38**, 102-110.

<https://doi.org/10.1016/j.sbi.2016.06.002>

32. Braselmann E.\*, Chaney J.L., Champion M.M. & Clark P.L. (2016) DegP chaperone suppresses toxic inner membrane translocation intermediates. *PLoS ONE* **11**, e0162922.  
<https://doi.org/10.1371/journal.pone.0162922>
31. Besingi R.N. & Clark P.L.\* (2015) Extracellular protease digestion to evaluate membrane protein cell surface localization. *Nature Protocols* **10**, 2074-2080.  
<https://doi.org/10.1038/nprot.2015.131>
30. Cressiot B., Braselmann E., Oukhaled A., Elcock A.H., Pelta J. & Clark P.L.\* (2015) Dynamics and energy contributions for transport of unfolded pertactin through a protein nanopore. *ACS Nano* **9**, 9050-9061.  
<https://doi.org/10.1021/acsnano.5b03053>
29. Chaney J.L. & Clark P.L.\* (2015) Roles for synonymous codon usage in protein biogenesis. *Annual Review of Biophysics* **44**, 143-166.  
<https://doi.org/10.1146/annurev-biophys-060414-034333>
28. Drobnak I., Braselmann E. & Clark P.L.\* (2015) Multiple driving forces required for efficient secretion of autotransporter virulence proteins. *Journal of Biological Chemistry* **290**, 10104-10116.  
<https://doi.org/10.1074/jbc.m114.629170>
27. Drobnak I., Braselmann E., Chaney J.L., Leyton D., Bernstein H.D., Lithgow T., Luirink J., Nataro J.P. & Clark P.L.\* (2015) Of linkers and autochaperones: An unambiguous nomenclature to identify common and uncommon themes for autotransporter secretion. *Molecular Microbiology* **95**, 1-16.  
<https://doi.org/10.1111/mmi.12838>
26. Sander I.M., Chaney J.L. & Clark P.L.\* (2014) Expanding Anfinsen's principle: Contributions of synonymous codon selection to rational protein design. *Journal of the American Chemical Society* **136**, 858-861.  
<https://doi.org/10.1021/ja411302m>
  - Highlighted in *Nature Chemical Biology* (March 2014).
  - Highlighted in *Nature Chemistry* (April 2014).
25. Besingi R.N., Chaney J.L. & Clark P.L.\* (2013) An alternative outer membrane secretion mechanism for an autotransporter protein lacking a C-terminal stable core. *Molecular Microbiology* **90**, 1028-1045.  
<https://doi.org/10.1111/mmi.12414>
24. Braselmann E., Chaney J.L. & Clark P.L.\* (2013) Folding the proteome. *Trends in Biochemical Sciences* **38**, 336-343.  
<https://doi.org/10.1016/j.tibs.2013.05.001>
  - Cover article.
23. Braselmann E. & Clark P.L.\* (2012) Autotransporters: The cellular environment reshapes a folding mechanism to promote protein transport. *Journal of Physical Chemistry Letters* **3**, 1063-1071.  
<https://doi.org/10.1021/jz201654k>
  - Cover article.
22. Renn J.P., Junker M., Besingi R.N., Braselmann E. & Clark P.L.\* (2012) ATP-independent control of autotransporter virulence protein transport via the folding properties of the secreted protein. *Chemistry & Biology* **19**, 287-296.  
<https://doi.org/10.1016/j.chembiol.2011.11.009>
  - Cover article.
21. Bryan A.W., Starmer-Kreinbrink J., Hosur R., Clark P.L.\* & Berger B.\* (2011) Structure-based prediction reveals capping motifs inhibit  $\beta$ -helix aggregation. *Proceedings of the National Academy of Sciences USA* **108**, 11099-11104.  
<https://doi.org/10.1073/pnas.1017504108>

20. Ugrinov K.G. & Clark P.L.\* (2010) Co-translational folding increases GFP folding yield. *Biophysical Journal* **98**, 1312-1320.  
<https://doi.org/10.1016/j.bpj.2009.12.4291>
19. Clarke T.F. IV & Clark P.L.\* (2010) Increased incidence of rare codon clusters at 5' and 3' gene termini: Implications for function. *BMC Genomics* **11**, 118.  
<https://doi.org/10.1186/1471-2164-11-118>
  - *Highlighted in Faculty of 1000; evaluated by Vladamir Uversky*
18. Krasowska, J., Olasek M., Bzowska A., Clark P.L. & Wielgus-Kutrowska B.\* (2010) The comparison of aggregation and folding of enhanced green fluorescent protein (EGFP) by spectroscopic studies. *Journal of Spectroscopy* **24**, 343-348.  
<https://doi.org/10.3233/SPE-2010-0445>
17. Junker M. & Clark P.L.\* (2010) Slow formation of aggregation-resistant  $\beta$ -sheet folding intermediates. *Proteins: Structure, Function & Bioinformatics* **78**, 812-824.  
<https://doi.org/10.1002/prot.22609>
16. Junker M., Besingi R.N. & Clark P.L.\* (2009) Vectorial transport and folding of an autotransporter virulence protein during outer membrane secretion. *Molecular Microbiology* **71**, 1323-1332.  
<https://doi.org/10.1111/j.1365-2958.2009.06607.x>
15. Clarke T.F. IV & Clark P.L.\* (2008) Rare codons cluster. *PLoS ONE* **3**, e3412.  
<https://doi.org/10.1371/journal.pone.0003412>
14. Evans M.S., Sander, I.M. & Clark P.L.\* (2008) Co-translational folding promotes  $\beta$ -helix formation and prevents aggregation *in vivo*. *Journal of Molecular Biology* **383**, 683-692.  
<https://doi.org/10.1016/j.jmb.2008.07.035>
13. Renn J.P. & Clark P.L.\* (2008) A conserved stable core structure in the passenger domain  $\beta$ -helix of autotransporter virulence proteins. *Biopolymers* **89**, 420-427.  
<https://doi.org/10.1002/bip.20924>
12. Wielgus-Kutrowska B., Narczyk M., Buszko A., Bzowska A. & Clark P.L.\* (2007) Folding and unfolding of a non-fluorescent mutant of green fluorescent protein. *Journal of Physics: Condensed Matter* **19**, 285223.  
<https://doi.org/10.1088/0953-8984/19/28/285223>
11. Junker M., Schuster C., McDonnell, A.V., Sorg K.E., Finn M.C., Berger B. & Clark P.L.\* (2006) Pertactin  $\beta$ -helix folding mechanism suggests common themes for secretion and folding of autotransporter proteins. *Proceedings of the National Academy of Sciences USA* **103**, 4918-4923.  
<https://doi.org/10.1073/pnas.0507923103>
  - *Highlighted in Faculty of 1000; evaluated by Doug Barrick*
10. Evans M.S., Ugrinov, K.G., Frese M.A. & Clark P.L.\* (2005) Production of a homogeneous pool of stalled ribosome nascent chain complexes *in vivo* or *in vitro*. *Nature Methods* **2**, 757-762.  
<https://doi.org/10.1038/nmeth790>
9. Jain M., Evans M.S., King J. & Clark P.L.\* (2005) Monoclonal antibody epitope mapping describes tailspike  $\beta$ -helix refolding and aggregation intermediates. *Journal of Biological Chemistry* **280**, 23032-23040.
8. Evans M.S., Clarke T.F. IV & Clark P.L.\* (2005) Conformations of co-translational folding intermediates. *Protein and Peptide Letters* **12**, 189-195.
7. Clark P.L.\* (2004) Protein folding in the cell: Reshaping the folding funnel. *Trends in Biochemical Sciences* **29**, 527-534.
  - *Cover article.*
6. Benton C.B., King J. & Clark P.L.\* (2002) Characterization of the protrimer intermediate in the folding pathway of the interdigitated  $\beta$ -helix tailspike protein. *Biochemistry* **41**, 5093-5103.

5. Clark P.L.\* & King J. (2001) A newly synthesized, ribosome-bound polypeptide chain adopts conformations dissimilar from early *in vitro* refolding intermediates. *Journal of Biological Chemistry* **276**, 25411-25420.
4. Raso S.W., Clark P.L., Haase-Pettingell C., King J. & Thomas G.J.\* (2001) Distinct cysteine sulfhydryl environments detected by analysis of Raman S-H markers of Cys→Ser mutant proteins. *Journal of Molecular Biology* **307**, 899-911.
3. Clark P.L., Weston B.F. & Gierasch L.M.\* (1998) Probing the folding of a  $\beta$ -clam protein using single-tryptophan constructs. *Folding & Design* **3**, 401-412.
  - *Folding & Design merged with Structure in 1999.*
2. Clark P.L., Liu Z.P., Rizo J. & Gierasch L.M.\* (1997) Cavity formation before stable hydrogen bonding in the folding of a  $\beta$ -clam protein. *Nature Structural Biology* **4**, 883-886.
1. Clark P.L., Liu Z.P., Zhang J. & Gierasch L.M.\* (1996) Intrinsic tryptophans of CRABPI as probes of structure and folding. *Protein Science* **5**, 1108-1117.

## NON-REFERREED PUBLICATIONS

### **Review Articles, Perspectives, Editorials & Book Chapters**

9. Clark PL (2019) Proteins in the cell. *Protein Science* **28**, 1175-1176.
  - *Guest editor for special issue: Proteins in the Cell*
8. Riback J.A., Bowman M.A., Zmyslowski A., Knoverek C.R., Jumper J., Hinshaw J., Kaye E.B., Freed K.F., Clark P.L.\* & Sosnick T.R.\* (2018) Response to Comment on “Innovative scattering analysis shows that hydrophobic disordered proteins are expanded in water”. *Science* **361**, doi:10.1126/science.aar7949.
7. Wilson D.N.\* & Clark P.L.\* (2016) Climbing to the peak of nascent chain knowledge. *Nature Structural & Molecular Biology* **23**, 949-951.
6. Clark P.L.\* & Elcock A.H. (2016) Molecular chaperones: Providing a safe place to weather a mid-life protein-folding crisis. *Nature Structural & Molecular Biology* **23**, 621-623.
5. Clark P.L.\* (2016) How to build a complex, functional propeller protein, from parts. *Trends in Biochemical Sciences* **41**, 290-292.
4. Brodsky J.L.\* & Clark P.L.\* (2014) Protein folding in the cell, from atom to organism. *FASEB Journal* **28**, 5034-5038.
3. Renn J. & Clark P.L.\* (2011) Disulfide bond-mediated passenger domain stalling as a structural probe of autotransporter outer membrane secretion *in vivo*. *Methods in Enzymology* **492**, 233-251.
2. Clark P.L.\* (2011) Adding protease digestion to the membrane protein toolbox. *Journal of Molecular Biology* **406**, 543-544.
1. Clark P.L.\* & Ugrinov K.G. (2009) Measuring co-translational conformations of nascent polypeptide chains. *Methods in Enzymology* **466**, 565-588.

### **Other Publications**

4. Clark P.L. “Ask Professor Sarah Bellum” a career development column published in the *Biophysical Society Newsletter* (2002-2005; 2011-2013).
  - print circulation:** >11,000 members of the Biophysical Society; the columns are also freely accessible on the Society’s web site:  
([www.biophysics.org/ProfessionalDevelopment/Careers/AskSarahBellum/tabid/544/Default.aspx](http://www.biophysics.org/ProfessionalDevelopment/Careers/AskSarahBellum/tabid/544/Default.aspx))
  - frequency:** 4-6 columns/year
3. Gao B., Clark P.L., Finn M.C. & Lieberman M.\* (2004) Attachment of *Salmonella* phage tailspike protein to chemically modified silicon [100]. *TMS Letters* **1**, 123-124.
2. Clark P.L.\* (2003) “Chaperones” in *Genetics*. 1st Ed, Macmillan USA, Farmington Hills, MI.
  - readership:** an edited encyclopedia geared toward high school students and entry level undergraduates not majoring in the natural sciences

1. Clark P.L., Liu Z.-P., Rizo J., Sukumar M., Rotondi K.S. & Gierasch L.M.\* (1999) Folding of a predominantly  $\beta$ -sheet protein with a central cavity, in *Peptides: Frontiers of Peptide Science*, J.P. Tam and P.T.P. Kaumaya, Eds., Kluwer/ESCOM, pp. 349-351.

## **PATENT**

Clark, P.L., Evans, M.S., Ugrinov, K.G., Clarke, T. IV, Frese, M.A. Molecular constructs and uses thereof in ribosomal translational events. US Patent #9,006,393

## **GRANT SUPPORT**

*Dr. Clark's research program has been awarded >\$14M in grant funding since 2001.*

### **Current Awards**

National Institutes of Health (R01 GM130122)

Role: PI (with T.R. Sosnick (multi-PI))

*total costs: \$1,413,000*

*Manipulating and Predicting the Unfolded Ensembles of Disordered Proteins*

09/01/18-08/31/22

Keck Foundation Research Grant

Role: PI

*total costs: \$2,086,000*

*Suppressing Aggregation by Folding Proteins Vectorially*

01/01/18-12/31/21

National Institutes of Health (R01 GM120733-02)

Role: PI (with T. Milenkovic, S. Emrich, J. Li (multi-PI))

*total costs: \$1,139,000*

*Integrative Computational Framework for Pattern Mining in Big -omics Data: Linking Synonymous Codon Usage to Protein Biogenesis*

07/15/16-04/30/20 (currently NCE)

National Institutes of Health (S10 OD028553)

Role: Facility Director (with B. Baker (PI))

*total costs: \$343,000*

*Biacore T200 SPR For Notre Dame Biophysics Instrumentation Core (BIC) Facility*

07/10/2020 – 07/09/2021

### **Pending Application**

National Institutes of Health (DP1 OD031338)

Role: PI

*total costs: \$TBD*

*Decoding the Regulation of Protein Folding by Synonymous Codon Usage*

09/01/21 – 08/31/26

National Institutes of Health (DP1 OD031338)

Role: PI (with S. Emrich, J. Li, T. Milenkovic (multi-PI))

*total costs: \$2,007,106*

*Integrative Computational Framework for Pattern Mining in Big -omics Data: Linking Synonymous Codon Usage to Functional Protein Production*

09/01/21 – 08/31/26

### **Previous Grant Support**

National Institutes of Health (U54 GM105816-05)

Role: PI (with A. Buskirk, N. Dovichi, D.A. Drummond, A.E. Elcock, R. Green, A. Matouschek, J. Reilly (multi-PI))

*Interactions that Affect Translation Rate and Protein Biogenesis In Vivo*

*total costs: \$3,402,000*

05/01/13 – 04/30/18



Notre Dame Equipment Restoration & Renewal (ERR) Program

Role: PI

total costs: \$64,000

*Replacing Obsolete Fast Protein Liquid Chromatography (FPLC) Systems for the New Biophysics Instrumentation Core (BIC)*

04/01/17 – 03/31/18

National Institutes of Health (R01 GM074807)

Role: PI

total costs: \$2,580,000

*Influence of Translation on Protein Folding*

09/01/05 – 03/31/17

National Institutes of Health (R01 GM097573)

Role: PI

total costs: \$1,133,000

*Outer Membrane Secretion Mechanism for Autotransporter Proteins*

09/01/11 – 08/31/16

National Institutes of Health (R13 GM111031)

Role: PI (with J. Broadsky (multi-PI))

total costs: \$5,000

*FASEB SRC Protein Folding in the Cell (conference support)*

06/01/14 – 05/31/15

National Institutes of Health (R01 GM074807-S02)

Role: PI

total costs: \$249,000

*Supplement for Collaborative Science: Influence of Translation on Protein Folding*

04/01/12 – 03/31/14

Notre Dame Edison Innovation Award

total costs (100% direct): \$40,000

Role: PI (postdoctoral fellowship support for Dr. Igor Drobnak)

08/15/13 – 08/14/14

Indiana Clinical and Translational Sciences Institute

Role: PI

total costs (100% direct): \$9,600

*Synonymous Codon Usage as a Predictive Tool for Disease Susceptibility*

01/01/11 – 12/31/11

National Institutes of Health (S10 RR026965)

Role: PI

total costs: \$144,500

*Bringing Modern Circular Dichroism Instrumentation to Notre Dame Researchers*

12/10/09 – 12/9/2010

National Institutes of Health (R01 AI043615)

Role: co-investigator (with J.P. Nataro (PI))

total costs to Clark lab: \$97,500

*Autotransporters of Enterobacteriaceae*

09/23/08 – 08/31/09

National Science Foundation (MCB-0237945)

Role: PI

total costs: \$831,000

*CAREER: Conformations of  $\beta$ -Sheet Folding Intermediates: The Discrimination Between Productive Folding and Aggregation*

02/01/03 – 01/31/08

American Heart Association National Scientist Development Grant (033015N)

Role: PI

total costs: \$260,000

*In Vitro Protein Evolution to Improve  $\beta$ -Sheet Folding and Stability*  
01/01/03 – 12/31/06

National Science Foundation (REU supplements to MCB-0237945)

Role: PI

total costs: \$28,000

*CAREER: Conformations of  $\beta$ -Sheet Folding Intermediates: The Discrimination Between Productive Folding and Aggregation*

Summer 2004: Supported ND undergraduate researchers Christopher Schuster & Emily Monti

Summer 2005: Supported ND undergraduate researcher Emily Monti

## **INVITED LECTURES AND ADDRESSES (last 5 years)**

\* = keynote lecture, student-organized or other competitive selection process

### **2022**

(scheduled) EMBO Workshop on Codon Usage: Mechanism, Function and Evolution, Edinburgh, Scotland

(scheduled) Protein Folding Dynamics GRC, Galveston, TX

### **2021**

(scheduled) Department of Biochemistry & Molecular Biology, Baylor College of Medicine, Houston, TX

(scheduled) Department of Biological Sciences, Columbia University, New York, NY

### **2020**

Department of Physiology, University of Texas Southwestern Medical Center, Dallas, TX

### **2019**

3<sup>rd</sup> Annual Conference on Protein Folding on the Ribosome, Berlin, Germany

Frontiers in Biophysics Seminar Series, Purdue University, West Lafayette, IN

HHMI Janelia Farm Research Campus, Think Tank on Proteins of Unknown Function, Ashburn, VA

Proteins Gordon Research Conference, Holderness, NH

Department of Molecular and Cellular Biology, University of Connecticut, Storrs, CT

Department of Biochemistry & Molecular Biology, University of Chicago School of Medicine, Chicago, IL

Department of Biology Seminar, University of Texas – Arlington, TX

Department of Biological Chemistry, Johns Hopkins School of Medicine, Baltimore, MD

\*Keynote Lecture, Midwest Stress Response & Molecular Chaperones Conference, Evanston, IL

PepTalk: Protein Science Week, San Diego, CA

Ribosomes 2019, Mérida, Mexico

### **2018**

Novozymes Prize Symposium 'Protein Folding on the Ribosome', Stockholm, Sweden

PEGS Europe: Protein & Antibody Engineering Summit – Lisbon, Portugal

Center for Biomolecular Sciences Seminar, University of Illinois – Chicago, IL

FASEB SRC Protein Folding in the Cell, Olean, NY

Department of Chemistry, University of Pittsburgh, Pittsburgh, PA

\*63<sup>rd</sup> Francis Clifford Philips Lecture, University of Pittsburgh, Pittsburgh, PA

Protein Expression System Engineering Conference of PEGS: The Essential Protein Engineering Summit, Boston, MA

\*Biophysical Society Annual Meeting, New & Notable Symposium, San Francisco, CA

### **2017**

Biochemical Society Conference, New Approaches for Investigating Nascent Peptide Folding, Downing College, Cambridge, UK

Department of Biochemistry Seminar, Emory University School of Medicine, Atlanta, GA

Department of Biology Seminar, Johns Hopkins University, Baltimore, MD

\*6<sup>th</sup> Celebration of Science, Texas Women's University, Denton, TX

19<sup>th</sup> International Union of Pure and Applied Biophysics (IUPAB) and 11<sup>th</sup> European Biophysical Societies (EBSA) joint meeting, Edinburgh, Scotland

Dipartimento Matematica e Fisica Lectures, Università Cattolica del Sacro Cuore, Brescia, Italy

Swedish Society for Biochemistry, Biophysics and Molecular Biology/Swedish Structural Biology Network Joint Annual Symposium, Tällberg, Dalarna, Sweden

\*Peter B. Sherry Memorial Lecture, Georgia Institute of Technology, Atlanta, GA

School of Chemistry & Biochemistry Seminar, Georgia Institute of Technology, Atlanta, GA

## 2016

\*Third International Symposium on Protein Folding & Dynamics, NCBS, Bangalore, India

Department of Chemistry Symposium, University of Heidelberg, Germany

Saturday Science Exploration Series (public lecture), University of Notre Dame, IN

\*Keynote lecture, 30<sup>th</sup> Annual Gibbs Conference on Biothermodynamics, Carbondale, IL

Nascent Chain Biology Conference, Fujikawaguchiko, Japan

EMBO Conference Ribosome Structure & Function 2016, Strasbourg, France

\*Department of Biochemistry & Molecular Biophysics, Washington University-St. Louis, MO

Gordon Research Conference on Protein Transport Across Cell Membranes, Galveston, TX

Department of Cell & Molecular Biology Seminar, Uppsala University, Uppsala, Sweden

## PRESENTATIONS VIEWABLE ONLINE

November 8, 2013: "Protein Folding", National Academy of Sciences Kavli Frontiers of Science Symposium (broad science lecture), Beckman Center, Irvine, CA. <https://vimeo.com/79963056>

June 27, 2013: "Nimble Bacteria: How They Sense Their Environment to Infect and Outwit", Telluride Town Talk (public lecture), Telluride Science Research Center, Telluride, CO.

<https://www.youtube.com/watch?v=L82Ck5Rlg5Y&list=PLV407sBhiAUtTWIPReEytE-tnbD2nl8tA&index=6&spfreload=5> (talk starts at 22:46)

## RECENT COURSES TAUGHT

### ***Undergraduate***

CHEM 40420 – Principles of Biochemistry (3 credits)

*Enrollment:* 80-160 undergraduates, primarily juniors

42 50-min lectures, 3 exams + final exam

### ***Graduate***

CHEM/BPHY 90625 – Molecular Biophysics (3 credits)

*Average Enrollment:* 8-18 graduate students

28 75-min lectures; 2 exams + final exam

BPHY 90601/90602 – Biophysics Methods Workshop (1 credit)

*Average Enrollment:* 3

8 75-min discussions/presentations

CHEM 60527 – Protein Structure and Folding (1 credit)

*Average Enrollment:* 12 graduate students

10 75-min lectures; 1 exam

## MENTORSHIP & SUPERVISION

#*Arthur J. Schmitt Leadership Fellowship*

\**NIH CBBI Training Grant Graduate Fellowship*

†*Clare Boothe Luce Graduate Fellowship*

°*NSF Graduate Research Fellowship*

## Biochemistry Doctoral Dissertations Directed

#Michael S. Evans: “Length-Dependent Conformations of Co-translational Folding Intermediates of P22 Tailspike”; defended November 27, 2006. Currently Director, Protein Development Services, Siemens Healthcare Diagnostics, Elkhart, IN.

Mirco Junker: “*In Vivo* and *In Vitro* Folding and Secretion Studies of an Autotransporter Protein from *Bordetella pertussis*”; defended July 11, 2008. Currently Senior Manager, Strategy, Analytics & Insights, Millipore Sigma, Boston, MA.

Thomas F. Clarke IV: “Rare Codon Clusters: Enrichment, Functional Effects, Non-random Localization and Conservation”; defended December 17, 2009. Currently Research Scientist, EMD Serono, Inc, Boston, MA.

Krastyu G. Ugrinov: “Co-translational Folding Properties of the  $\beta$ -Sheet Protein Green Fluorescent Protein (GFP)”; defended March 11, 2010. Currently Research Scientist, Siemens Healthcare Diagnostics, Elkhart, IN.

\*Jonathan P. Renn: “Folding and Secretion of the *E. coli* Pet Autotransporter”; defended June 2, 2010. Currently postdoctoral fellow in the laboratory of Steve Leppla, NIAID, National Institutes of Health, Bethesda, MD.

\*Ian M. Sander: “Protein Folding in the Cell is Modulated by the Translating Ribosome”; defended November 5, 2012. Currently Associate Consultant, Quintiles, Cambridge, MA.

Richard N. Besingi: “The N-terminus of the *Yersinia pestis* YapV Autotransporter Protein Destabilizes the Entire Passenger Domain *In Vitro*: Implications for *In Vivo* Secretion”; defended November 7, 2012. Currently Principal Scientist, Essential Health Translational Science, Johnson & Johnson Consumer Health, Skillman, NJ.

\*Esther Braselmann: “Investigating the Secretion and Folding Mechanism of a  $\beta$ -Sheet-Rich Virulence Protein”; defended March 27, 2014. Currently NIH K99/R00-funded Clare Boothe Luce Assistant Professor of Chemistry, Georgetown University.

†Julie Chaney: “Selection for Synonymous Codon Usage”; defended February 13, 2015. Currently Senior Scientist, Siemens Healthineers, Elkhart, IN.

\*Jennifer Starner: “Investigating Beta-Sheet Folding and Aggregation”; defended April 2, 2015. Currently Research Engineer, US Water Services, St. Michael, MN.

\*Giselle Jacobson: “Effects of Translation Rate Changes on Protein Production, Folding and Fragmentation”; defended November 15, 2017. Currently Staff Scientist, Biophysics Instrumentation Core Facility, University of Notre Dame.

Micayla Bowman: “The Earliest Steps of Protein Folding: Biases Within the Unfolded Ensemble and During Folding”; defended March 26, 2018. Currently Account Manager, IDEXX BioAnalytics, Baltimore, MD.

Ian Walsh: “Testing the Effects of Synonymous Codon Usage on Co-Translational Protein Folding Using Novel Experimental and Computational Techniques”; defended March 22, 2019. Currently Visiting Assistant Professor, Hillsdale College.

### **Masters Theses Directed**

Jiayi Chen: “Identification and Modification of the Internal Protease Cleavage Site in P.93 Pertactin”, submitted July 27, 2007. (M.S. Biochemistry)

Torrie Sleeper: “Homogeneous Stalled Ribosome Complexes Produced *In Vivo* or *In Vitro*”, defended July 15, 2010 (M.S. Science/ESTEEM Entrepreneurship Program).

Jenna Rose: June 18, 2011 (M.S. Biochemistry; non-thesis option).

Thomas Soderquist: May, 2013 (M.S. Biochemistry; non-thesis option).

John Herrington: “Elucidation of the Selection and Roles of Synonymous Codons in Protein Biogenesis”, submitted November, 2014 (M.S. Biochemistry). Currently Senior Biologist, Eli Lilly & Company, Indianapolis, IN.

### **Graduate Students Presently Under Direction**

Anabel Rodriguez (6th year, biochemistry)

Iker Soto (3rd year, IBMS)

°McKenze Moss (2nd year, analytical chemistry)

\*Taylor Lundgren (2nd year, analytical chemistry; co-mentored with Matthew Champion)

Cedrick Mukinay (1st year, biochemistry)

### **Postdoctoral Associates**

Beata Wielgus-Kutrowska (2003 - 2004; now Adjunct Professor, Univ. Warsaw, Poland)

Krastyu Ugrinov (2010 - 2012; now Senior Scientist, Siemens Healthineers)

Igor Drobnak (2011 - 2014; now Senior Scientist, Lek Pharmaceuticals/Novartis, Slovenia)

Benjamin Cressiot (2012 - 2015; now Assistant Professor, Université de Cergy-Pontoise, France)

Mohona Sarkar (2014 - 2015; now Postdoctoral Researcher, St. Jude’s Hospital, TN)

Micayla Bowman (2018 - 2019; now Account Manager, North America Central Region, IDEXX)

### **Professional Staff**

Mary C. (Kay) Finn (2001 - 2013 (retired); Research technician and lab manager)

Gina Jozwiak (2013 - present; Research technician and lab manager)

Qing Luan (2018 - present; Laboratory specialist)

Giselle Jacobson, PhD (2018 - present; Staff scientist in Biophysics Instrumentation Core Facility)

Cheryl Schairer (2017 - present; Graduate coordinator for Biophysics Graduate Program)

### **Undergraduate and High School Researchers Supervised (39 students)**

\**Notre Dame Nano-Bio REU*

♦*Drum Major, Notre Dame Marching Band (2003)*

†*DAAD-sponsored exchange students from the University of Bielefeld, Germany*

§*Balfour Undergraduate Research Fellowship*

°*NIH CBBi Summer Research Experience for Hispanic Students*

\*\**Clare Boothe Luce Summer Research Experience for Engineering Undergraduates*

‡*Notre Dame iSURE (International Summer Undergraduate Research Experience) Program*

%*Notre Dame College of Science Summer Undergraduate Research Fellowship (COS-SURF)*

#*Notre Dame Eagan Summer Research Fellowship*

°*Salutatorian, University of Notre Dame (2018)*

Elizabeth Klimek (2001-2004; research technician in San Francisco)

†Mirco Junker (2002-2003; completed PhD at Notre Dame)

\*Kelli E. Whiteman Sorg (2002; MD from Indiana University)  
 Michelle Muñoz (high school 2002; Trinity School)  
 Christopher Schuster (2002-2005; MD from U. Iowa)  
 Katherine O'Sullivan (2002-2004; MD from Loyola Chicago)  
 †Marc-Andre Fresé (2004; graduate school at University of Bielefeld, Germany)  
 Denise Emmert (2004-2005; pharmacy school)  
 Emily Monti (2004-2005; graduate school at U. Pennsylvania)  
 Matthew Pellegrino (high school 2006; St. Joseph High School)  
 \*Joseph Hoffmann (2006; biomedical engineering undergraduate at University of Texas–Austin)  
 Matthew Cavo (2005-2006; medical school)  
 Daniel Lano (2005-2007; biochemistry major)  
 Stephen Smith (2003-2006; law school)  
 Neil Reece (2006; Johnson & Johnson)  
 †Esther Braselmann (2007; completed PhD at Notre Dame)  
 \*Eric Jeffries (2007; University of Pittsburgh)  
 Kathleen Gonderman (2006-2008; high school teacher)  
 Benjamin Hechler (2006-2009; Univ. Kansas dental school)  
 Timothy J. Record (2009-2011; biochemistry major)  
 °Tatiana Quinones (2011; chemistry)  
 Ali Karim Ahmed (2011-2014; MD program at Johns Hopkins Univ.)  
 Galen Brown (high school 2011-2012; Adams High School; undergraduate Dartmouth College)  
 §Cherry Choy (2011-2013; Harvard dental school)  
 %Catherine Knoverek (2013-6; biochemistry; biophysics PhD program, WashU.)  
 Emily Kaye (2013-6; biochemistry)  
 \*\*Kim Ngo (2013-2015; computer science)  
 ‡Stephanie Pastrana-Sanchez (2014; biochemistry)  
 Cody Devine (2014-2015; biochemistry)  
 †Javier Rodriguez (2015; biochemical engineering; biomedical eng. PhD program, McGill Univ.)  
 •#Harisa Spahic (2016-2018; biochemistry; MD program, Johns Hopkins Univ.)  
 Lourdes Brea (2016-2018; chemical engineering; bioengineering PhD program, Northwestern)  
 ‡Rui Zhong (2017; biochemical engineering; biochemistry PhD program, Univ. Minnesota)  
 %Matthew Klauer (2016-2019; biochemistry; pharmacology PhD program, Duke)  
 Luke Kajewski (2017-2020; MD program, Univ. Nebraska)  
 Kevin Schnur (2018-2020; bioengineering PhD program, Univ. Illinois - Chicago)  
 James Applewhite (2018-present; biological sciences)  
 Clare Hartman (2018-present; biochemistry)  
 Nicolas Mjaess (2020-present; biochemistry & psychology)  
 Ashley Bullington (2020-present; biochemistry)

### **Thesis Committee Memberships – University of Notre Dame**

#### ***Department of Chemistry & Biochemistry (39 students; biochemistry program unless noted)***

Lica Abu-Esba (organic), Kerry Bauer, Jill Bouchard, Brigid Brown, Jooyoung Cha (organic), John Clemens, Diana Cruz, Brandon Czowski, Matthew Dawley, Mariana Figuera, Thomas Fredrick (physical), Cary Frick, Bo Gao (inorganic), Skya Gentle, Ivan Gregoretti, Rebecca Davis-Harrison, Emilia Ivanova-Hartland, Andrew Johnson (organic), Karthik Kotha (physical), Michelle Lang, Weijing Liu (analytical), Beth McNally, Trung Nguyen (organic), Apryle O'Farrell (organic), Lauren O'Neil (organic), Sasha Padilla (organic), Qingfeng Pan, Gabriela Pasat, Angela Poffenberger, Benjamin Rajewski, Jordan Scott, Susan Skube, Michael Staude (physical), Maxim Suvorov (organic), Brian Wilson, Haifeng Xu, Chao Yang, Meiling Zhang, Christine Zirkle

#### ***Department of Biological Sciences (5 students)***

Asha Jayakumar, Sarita Mendonca, George Kennedy, Micah Ferrell, Francisco Fields

#### ***Department of Computer Science & Engineering (4 students)***

Rory Carmichael, Fazle Faisal, Gabriel Wright, Khaliq Newaz

**Department of Chemical & Biomolecular Engineering (2 students)**

Miranda Burnette, Pavel Brodskiy

**Thesis Committees – International**

Annika Weise (advisor: John Christodoulou; University College, London, UK) – defended July 20, 2015

Role: Thesis examination committee member

Yanhong Pang (advisor: Suparna Sanyal; Uppsala University, Uppsala, Sweden) – defended January 28, 2016

Role: Opponent

Theresa Kriegler (advisor: Tara Jabar Hessa; Stockholm University, Stockholm, Sweden) – defended September 18, 2020

Role: Opponent

**Faculty Mentorship**

2019-present Research Mentor, Assistant Professor Katherine White (Chemistry & Biochemistry)

2017-present Research Mentor, Assistant Professor Arnaldo Serrano (Chemistry & Biochemistry)