

Douglas Henry Juers

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Program in Biochemistry, Biophysics
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Education

- 2000 PhD, Department of Physics, University of Oregon, Eugene, OR. Brian W. Matthews, Advisor. Dissertation: *A Structural View of Beta-Galactosidase in Action*
- 1987 A.B., Department of Physics, Cornell University, Ithaca, NY

Professional Positions

2017 -

Professor, Department of Physics and Program in Biophysics, Biochemistry and Molecular Biology, Whitman College.

Courses taught: Introductory Mechanics Lab, Introductory Mechanics Lab, Biophysics with Lab, BBMB Senior Seminar

Research projects: Understanding the nature of cooling-induced damage to protein crystals to develop predictive cooling methods. Structural biology studies on dioxygenases (with T. Machonkin, Chemistry).

Committees/Service: Faculty Athletics Representative. Director – Program in BBMB (2017-

2010 - 2017

Associate Professor, Department of Physics and Program in Biophysics, Biochemistry and Molecular Biology, Whitman College.

Courses taught: Introductory Mechanics, Introductory Mechanics Lab, 20th Century Physics with Lab, Classical Mechanics, Biophysics with Lab, BBMB Senior Seminar, Physics Seminar,

Research projects: Understanding the nature of cooling-induced damage to protein crystals to develop predictive cooling methods. Improving methods of handling of macromolecular crystals. Structural biology studies on E. coli beta-galactoidase and on dioxygenases (with T. Machonkin, Chemistry).

Committees/Service: Curriculum Committee, Faculty Athletics Representative, Institutional Review Board, General Studies Committee, Chair – Department of Physics (2012-13, 2013-14), Director – Program in BBMB (2015-16)

2012 - present

Interactive Images Editor, Protein Science

Work with authors to develop interactive images for manuscripts accepted to Protein Science.

2004 - 2010

Assistant Professor, Department of Physics and Program in Biophysics, Biochemistry and Molecular Biology, Whitman College.

Courses taught: Introductory Mechanics with Lab, Introductory Electricity & Magnetism with Lab, Thermal Physics, 20th Century Physics Lab, Advanced Electricity & Magnetism, Biophysics with Lab.

Research projects: Understanding the nature of cooling-induced damage to protein crystals to develop predictive cooling methods. Structural biology studies on myelin basic protein, PIRL protein (with D. Vernon, Biology), aldehyde dehydrogenase (with J. Russo, Chemistry), and dioxygenases (with T. Machonkin, Chemistry).

2009

Visiting Scientist, Institute de Biologie Structurale, Laboratoire de Biophysique Moléculaire and European Synchrotron Radiation Facility, Grenoble, France

Projects: Raman spectroscopic investigations of protein crystal cooling, humidity control of protein crystal cooling, the temperature dependence of protein conformation, the temperature behavior of lipidic cubic phases, and radiation damage to protein crystals.

2000 - 2004

Post-doctoral research fellow, Department of Physics, Howard Hughes Medical Institute and Institute of Molecular Biology. Brian W. Matthews, Advisor.

Studies on long-range order in macromolecular crystals and the catalytic activity of E. coli β -galactosidase.

1993 - 2000

Graduate Research Assistant, Department of Physics, Howard Hughes Medical Institute and Institute of Molecular Biology. Brian W. Matthews, Advisor.

Structural and functional studies on E. coli β -galactosidase and thermolysin.

1988 - 1992

Teacher, coach & dorm parent. Carrabassett Valley Academy, Kingfield, ME.

Extramural Funding

Current

“New Predictive Methods for Cryoprotection in Macromolecular Crystallography” (PI). National Institutes of Health. Amount: \$316,455. Award Period: 2015-18.

“The Sources of Substrate Specificity in Hydroquinone Dioxygenases” (co-PI with T. Machonkin-PI & D. Rokshana, co-PI). National Science Foundation. \$399,456. Award Period 2015-18.

Completed

“New Predictive Methods for Cryoprotection in Macromolecular Crystallography” (PI). National Institutes of Health. Award Period: 9/01/10 – 8/31/14.

“MRI: Acquisition of a Laser Scanning Confocal Microscope to Build an Integrative Life Sciences Imaging Program and Create New Research Opportunities at Whitman College” (co-PI with Profs. Withers-PI, Wallace, Vernon, L. Knight, Department of Biology). National Science Foundation. Award Period: 8/15/10 – 8/14/13.

“The Sources of Substrate Specificity in Hydroquinone Dioxygenases” (co-PI with T. Machonkin-PI). National Science Foundation. Award Period: 4/15/10-5/14/13.

“MRI: Acquisition of an X-ray Diffraction Instrument for Interdisciplinary and Collaborative Research and Education in an Undergraduate Setting”, PI, with J. Russo, D. Vernon, T. Machonkin & K. Nicolaysen. National Science Foundation. 2007-2010.

Publications - all are peer reviewed except Juers & Matthews (2004) & Juers et al. (2012) which were invited reviews. Whitman College students are indicated with an asterisk.

1. Juhasz, M.A., Matheson, G.R.*, Chang, P.S.*, Rosenbaum, A.*, Juers, D.H. Microwave-assisted iodination: synthesis of heavily iodinated 10-vertex and 12-vertex boron clusters (2016) *Synthesis and Reactivity in Inorganic, Metal-Organic, and Nano-Metal Chemistry*, 46, 583-588.
2. Schofield, J.A.*, Brennessel, W.W., Urnezis, E., Rokhsana, D., Boshart, M.D.*, Juers, D.H., Holland, P.L., Machonkin, T.E. Metal-halogen secondary bonding in a 2,5-dichlorohydroquinonate cobalt(II) complex: insight into substrate coordination in the chlorohydroquinone dioxygenase PcpA. (2015) *European Journal of Inorganic Chemistry*, 4643-4647.
3. Wheatley, RW, Juers D.H., Lev, B., Huber, R., Noskov, S. Elucidating Factors Important for Monovalent Cation Selectivity in Enzymes: E. coli β -Galactosidase as a Model. (2015) *Physical Chemistry Chemical Physics*, 10899-10909.
4. Von Stetten, D., Giraud, T., Carpentier, P., Sever, F., Terrien, M., Dobias, F., Juers, D.H., Flot, D., Mueller-Dieckmann, C., Leonard, G.A., de Sanctis, D. & Royant, A. In crystallo optical spectroscopy (icOS) as a complementary tool on the macromolecular crystallography beamlines of the ESRF. (2015) *Acta Crystallographica D* 71, 15-26.
5. Juers, D.H. & Ruffin, J.* MAP_CHANNELS: A Computational Tool to Aid in the Visualization and Characterization of Solvent Channels in Macromolecular Crystals. (2014) *Journal of Applied Crystallography*, 47, 2105-2108.

6. Farley, C.* & Juers, D.H. Efficient Cryoprotection of Macromolecular Crystals by Vapor Diffusion of Volatile Alcohols. (2014) *Journal of Structural Biology*, 188, 102-106.
7. Farley, C.*, Burks, G.*, Siegert, T.* & Juers, D.H. Improved reproducibility of cell parameters in macromolecular cryocrystallography by limiting dehydration during crystal mounting (2014) *Acta Crystallographica* D70, 2111-2124.
8. Juhasz, M.A., Juers, D.H., Dwulet, G.E.* & Rosenbaum, A.J.* Tetraethylammonium 7,12-dicyano-1-carba-closo-dodecaborate (2014) *Acta Crystallographica* E70, o411-o412
9. Rosenbaum, A.J.*, Juers, D.H. & Juhasz, M.A. Copper-promoted Cyanation of a Boron Cluster: Synthesis, X-ray structure, and Reactivity of 12-CN-closo-CHB11H10.(2013) *Inorganic Chemistry* 52: 10717-10719.
10. Juers,D.H., Matthews,B.W. & Huber, R.E. *LacZ* beta-galactosidase: Structure and function of an enzyme of historical and molecular biological importance. (2012) *Protein Science* 21:1792-1807.
11. Marshall, H.*, Venkat, M.*, Hti Lar Seng, N.S.*, Cahn, J.*, Juers, D.H. The use of trimethylamine N-oxide as a primary precipitating agent and related methylamine osmolytes as cryoprotective agents for macromolecular crystallography. (2012) *Acta Crystallographica* D68, 69-81.
12. Russi, S., Juers, D.H., Sanchez-Weatherby, J., Pellegrini, E., Mossou, E., Forsyth, V.T., Gobbo, A., Felisaz, F., Moya, R., McSweeney, S.M., Cusack, S., Cipriani, F., Bowler, M.W. Inducing phase changes in crystals of macromolecules: Status and perspectives for controlled crystal dehydration. (2011) *Journal of Structural Biology* 175, 236-243.
13. Juers, D. H. & Weik, M. Similarities and differences in radiation damage at 100 K versus 160 K in a crystal of thermolysin. (2011) *J. Synchrotron Rad.* 18, 329-337.
14. Coquelle, N., Talon, R., Juers, D.H., Girard, É, Kahn, R. Gradual Adaptive Changes of a Protein Facing High Salt Concentrations. (2010) *Journal of Molecular Biology*. 404, 493-505.
15. Alcorn, T.* & Juers, D.H. Progress in Rational Methods of Cryoprotection in Macromolecular Crystallography. (2010) *Acta Crystallographica* D66, 366-373..
16. Juers, D.H. Rob, B., Dugdale, M., Rahimzadeh, N., Giang, C., Lee, M., Matthews, B.W. & Huber, R.E. (2009) Direct and Indirect Roles of His-418 in Metal Binding and in the Activity of β -Galactosidase (*E. coli*). *Protein Science*. 18:1281-1292.
17. Juers, D.H., Lovelace, J., Bellamy, H.D., Snell, E.H., Matthews, B.W. and Borgstahl, G.E.O. (2007) Changes to Crystals of *E. coli* β -galactosidase During Room-Temperature Low-Temperature Cycling and Their Relation to Cryo-Annealing. *Acta Crystallographica*. D63, 1139-1153.
18. Juers, D.H., Kim J., Sieburth, S. McN., and Matthews, B.W. Structural Analysis of Silendiols as Transition-State-Analogue Inhibitors of the Benchmark Metalloprotease Thermolysin. (2005) *Biochemistry* 44, 16524-16528.
19. Juers, D.H. and Matthews, B.W. Cryo-cooling in macromolecular crystallography: advantages, disadvantages and optimization. (2004) *Quarterly Reviews of Biophysics* 37, 2 pp. 1-15. Review commissioned to BWM.
20. Juers, D.H. and Matthews, B.W. (2004) The Role of Solvent Transport in Macromolecular Crystal Annealing. *Acta Crystallographica*, D60, 412-421.
21. Juers, D.H., Hadka, S., Matthews, B.W., and Huber, R.E. (2003) The Structural Basis for the Altered Activity of Gly 794 Variants of *E. coli* β -Galactosidase. *Biochemistry* 42: 13505-13511.
22. Shoemaker, G.K., Juers, D.H., Coombs, J.M.L., Matthews, B.W. and Craig, D.B. (2003) Crystallization of β -Galactosidase Does Not Reduce the Range of Activity of Individual Molecules. *Biochemistry* 42: 1707-1710.

23. Juers, D.H., Heightman, T.D., Vasella, A., McCarter, J.D., Mackenzie, L., Withers, S.G. and Matthews, B.W. (2001) A Structural View of the Action of *E. coli* (lac Z) β -Galactosidase. *Biochemistry* **40**: 14781-14794.
24. Juers, D.H. and Matthews, B.W. (2001) Reversible Lattice Repacking Illustrates the Temperature Dependence of Macromolecular Interactions. *Journal of Molecular Biology* **311** 851-862.
25. Juers, D.H., Jacobson, R.H., Wigley, D., Zhang, X.J., Huber, R.E., Tronrud, D.E. and Matthews, B.W. (2000) High resolution refinement of β -galactosidase in a new crystal form reveals multiple metal-binding sites and provides a structural basis for α -complementation. *Protein Science* **9**: 1685-1699.
26. Juers D.H., Huber, R.E. and Matthews, B.W. (1999) Structural comparisons of TIM barrel proteins suggest functional and evolutionary relationships between β -galactosidase and other glycohydrolases. *Protein Science* **8**:122-136.
27. Holland, D.R., Hausrath, A.C., Juers, D.H. and Matthews B.W. (1995) Structural analysis of zinc substitutions in the active site of thermolysin. *Protein Science* **4**: 1955-1965.

Patent Application

No. 14744901. System to Control the Local Humidity of a Sample During Manipulation Under Microscope and Subsequent Transfer to an Analytical Instrument. Filed: June 19, 2015.
Douglas H. Juers & Christopher A. Farley.

Invited Lectures

1. Macromolecular Crystallography 1914-2014 with Differential Diffusion as a Root Cause of Cracking in Protein Crystals. Annual Meeting of the Northwest Section of the American Physical Society, University of Washington, May, 2014.
2. Proteins, Powders and Small Molecules – Multidisciplinary Uses of X-ray Diffraction at an Undergraduate Institution. Annual Meeting of the American Crystallographic Association, Boston, MA, Aug 2012.
3. Multidisciplinary Uses of X-ray Diffraction with an Xcalibur Nova. Agilent Luncheon. Annual Meeting of the American Crystallographic Association, Boston, MA, Aug 2012.
4. Lessons from Ocean Going Organisms - Stabilizing Osmolytes as Tools for Protein Crystallography. Chemistry Department Seminar, Reed College, Portland, OR. February, 2012.
5. Stabilizing Osmolytes as Agents of Crystal Growth and Cryoprotection in Macromolecular Crystallography. Chemistry Department Seminar, Gonzaga University, Spokane, WA. October, 2011.
6. Rational Approaches to Crystal Cooling. CCP4 Study Weekend. Nottingham, UK. January, 2009.
7. Rational Approaches to Cryocrystallography. Gordon Conference: Diffraction Methods in Structural Biology. Bates College, Lewiston, Maine. July, 2008.
8. The Role of Cryoprotectants in the Successful Cooling of Protein Crystals. 10th Annual Meeting of the Northwest Section of the American Physical Society. Lewis & Clark College, Portland, OR. May, 2008.
9. The Role of Water Transport in Cryo-Annealing. Lecture. Annual Meeting of the American Crystallographic Association, Cincinnati, OH June 2003.

Other Presentations (Whitman student authors noted with an asterisk; presenting Whitman student authors noted in boldface; Murdock and Undergraduate Conference presentations are not included)

1. Thermal Contraction Guided Cryoprotection Optimization in Macromolecular Crystallography. Poster. Juers, DH, Farley, CA, Saxby, C, Cotter, R, Cahn, J., Holton-Burke, C. Annual Meeting of the American Crystallographic Association. New Orleans, LA June 2017
2. Thermal Contraction Guided Cryoprotection Optimization. Lecture. West Coast Protein Crystallography Workshop, Pacific Grove, CA, March 2017.
3. Improving X-ray Data Quality via Humid Manipulation and Transfer of Macromolecular Crystals. Poster. Wang, Q*, Harrison, K*, & Juers, DH. Annual Meeting of the American Crystallographic Association, Denver, CO, July 2016.
4. Experiences with SAD Structure Determination of Proteins in an Undergraduate Biophysics Laboratory Course. Lecture. Juers, DH. Annual Meeting of the American Crystallographic Association, Denver, CO, July 2016.
5. Improving X-ray Data Quality via Humid Manipulation and Transfer of Macromolecular Crystals. Poster. **Wang, Q*, Harrison, K*, & Juers, DH.** Northwest Crystallography Workshop Pullman, WA, June 2016.
6. Thermal Contraction Guided Cryoprotectant Optimization in Macromolecular Cryocrystallography. Juers, DH. Northwest Crystallography Workshop, Pullman, WA, June 2016.
7. Vapor Diffusion Based Cryoprotection. Lecture. Juers, DH. Annual Meeting of the American Crystallographic Association, Philadelphia, PA. July 2015.
8. Improved Reproducibility of Cell Parameters in Macromolecular Cryocrystallography by Limiting Dehydration During Crystal Mounting. Lecture. Juers, DH. Northwest Crystallography Workshop, Oregon State University, Corvallis, OR. July 2014.
9. Improved Cell Parameter Reproducibility in Macromolecular Cryo-Crystallography. Poster. **Farley, CA*** & Juers DH. Biophysical Society Annual Meeting, San Francisco, CA. February, 2014.
10. A Computational Tool for Characterizing Solvent Channels in Macromolecular Crystals. Poster. Juers DH, Saxby C*, Cahn J*, Venkat M*. Protein Society Annual Meeting, Boston, MA, July, 2013. Northwest Crystallography Workshop, Montana State University, Bozeman MT. July 2012.
11. Thermal Contraction Guided Cryoprotectant Selection. **Saxby C***, Cahn J*, Venkat M*, Juers DH. Poster. Northwest Crystallography Workshop, Montana State University, Bozeman, MT. July 2012.
12. Investigations of the Stabilizing Osmolyte, TMAO, as a New Precipitant for Protein Crystallization. **Marshall H*, Venkat M***, Juers D. Poster. Annual Meeting of the Northwest American Physical Society, Whitman College, Walla, Walla WA. October, 2010.
13. A Time and pH-Dependent Conformational Change in MntR Crystals. **Cahn J***, Glasfeld A, Juers DH. Poster. Northwest Crystallography Workshop, University of British Columbia, Vancouver, BC. June 2010
14. Slow Cooling, Radiation Damage and Annealing in Crystals of Thermolysin, Juers DH & Weik. M. Seminar. 6th International Conference on Radiation Damage to Crystalline Biological Samples, Stanford Synchrotron Radiation Laboratory, March 2010.
15. Towards Rational Methods of Cryoprotectant Choice in Macromolecular Crystallography, Institute de Biologie Structurale, Grenoble, France, April 2009.
16. Physical Properties of Cryoprotective Solutions for Macromolecular Crystallography. Poster. Frontiers in Microrheology Workshop, UCLA, Los Angeles, CA, Feb 2008.
17. Ibid. Poster. 52nd Annual Meeting of the Biophysical Society, Long Beach, CA, Feb 2008.

18. Hysteresis in Cryo-Cooling Crystals of *E. coli* β -galactosidase and its Relations to Cryo-Annealing. Poster. 51st Annual Meeting of the Biophysical Society, Baltimore, MD, March 2007.
19. Ibid. Poster. The 18th West Coast Protein Crystallography Workshop, Asilomar, CA, March 2007.
20. Turning off a Carbon-Based Enzyme with a Silicon-Based Inhibitor. Poster. 50th Annual Meeting of the Biophysical Society, Salt Lake City, UT, Feb 2006.
21. The Role of Cryoprotectants in Cryo-Cooling and Annealing. Poster. 48th Annual Meeting of the Biophysical Society, Long Beach, CA, Feb 2005.
22. Ibid. Lecture. Northwest Crystallography Workshop, Seattle, WA, June 2004.
23. The Role of Solvent Transport in Annealing. Lecture. 7th Northwest Crystallography Workshop, Vancouver, BC, June 2002.
24. Temperature Dependent Structural Changes in Frozen Crystals of β -Galactosidase. Poster. 45th Annual Meeting of the Biophysical Society, Boston MA, Feb 2001.
25. Ibid. Poster. The 15th West Coast Protein Crystallography Workshop, Asilomar CA, Mar 2001.
26. Reversible Changes in *E. coli* (lac Z) β -Galactosidase Crystal Packing with Freezing. Lecture. 6th Northwest Crystallography Workshop, Eugene OR, July 2000.
27. Structural Enzymology of *E. coli* β -Galactosidase: The Role of a Ligand-Induced Switch in the Dual Activity of the Enzyme. Poster. The 14th West Coast Protein Crystallography Workshop, Asilomar CA, March 1999.
28. High Resolution Structures of β -Galactosidase Inhibitor Complexes. Poster. 12th Symposium of the Protein Society, San Diego CA, July 1998.
29. Structural Studies Directed Towards the Mechanism of Action of β -Galactosidase. Poster. 11th Symposium of the Protein Society, Boston MA, July 1997.
30. Engineering by Nature and Why β -Galactosidase is So Big. Lecture. 4th Northwest Crystallography Workshop, Eugene OR, June 1996.
31. A Structural Basis for the Activity of β -Galactosidase. Lecture. 12th West Coast Protein Crystallography Workshop, Asilomar CA, March 1995.

Professional Organizations

Biophysical Society
American Crystallographic Association

Peer Review Activity

Journals: Acta Crystallographica Section D; Journal of Applied Crystallography; Crystal Growth & Design; Cellular & Molecular Life Science

Book: CRC Press

Tenure review: Review of tenure package of assistant professors at peer institutions (2010,2014).

Outreach

Conducted workshop for local middle school teachers. "Fantastic Fluids - Explorations of Cornstarch, Slime, Avalanches and other Non-Canonical Fluids", April, 2011

Visited Honors Biology classes at Walla Walla High School, Spring, 2015, 2017.

Honors

A. E. Lange Award for Distinguished Science Teaching, Whitman College, 2011

Garrett Fellow, Whitman College, 2010 -

Fulbright Alternate for research in France, 2009.

HHMI Postdoctoral Fellowship 2000-2003
NIH Predoctoral Fellowship 1993-95

Other Interests

Spending time with family, gardening, running, hiking, climbing, skiing, music.