Arthur Pardi

Education

A.B.	Chemistry	1976	University of California, San Diego
Ph.D.	Chemistry	1980	University of California, Berkeley (with I. Tinoco, Jr.)

Professional Experience

Postdoctoral Fellow, Laboratory of Chemical Biodynamics, Lawrence Berkeley Lab, Berkeley, CA, 1/81-12/81 (with I. Tinoco, Jr.).
Postdoctoral Fellow, Institute for Molecularbiologie und Biophysik, E.T.H., Zurich, Switzerland, 1/82-7/83 (with K. Wüthrich).
Associate Senior Investigator, Analytical and Physical Chemistry, Smith Kline Beckman, Philadelphia, PA, 8/83-8/84.
Assistant Professor, Department of Chemistry, Rutgers University, New Brunswick, NJ, 8/84-12/87.
Assistant Professor, Department of Chemistry and Biochemistry, University of Colorado Boulder, 1/88-6/91.
Associate Professor, Department of Chemistry and Biochemistry, University of Colorado Boulder, 7/91-7/97.
Professor, Department of Biochemistry, University of Colorado Boulder, 8/97 -present.
Director of Biochemistry Division, Department of Chemistry and Biochemistry, University of Colorado Boulder, 7/01 – 7/12.
Consultant, Department of Physical Chemistry, Hoffmann-La Roche, Nutley, NJ 1/86-12/91.
Member, Scientific Advisory Board, NeXagen Inc., Boulder, CO 9/91-9/94
Member, NIH Biophysical Chemistry Study Section (BBCB), 2/92-6/95.
Editorial Board - *RNA* 1995-1996.
Editorial Advisory Board - *Biochemistry* 1994-present.
Editorial Board – *J. Biomolecular NMR* 2005-present.
Member, Board of Directors, GlobeImmune, Inc. Denver, CO, 6/02-6/03.
Visiting Member, JILA, Boulder, CO 8/02-2/03
Co-Director, W.M. Keck Ultra-High Field NMR Facility, 2002-2017.
Co-Director, Rocky Mountain Region Ultra-High Field NMR Facility, 2003-2017.

Honors

NATO Postdoctoral Fellowship in Science, 1982-1983.
Henry Rutgers Research Fellow, 1985-1987.
Searle Scholar, 1985-1988.
Johnson & Johnson Discovery Research Award 1987.
NIH Research Career Development Award 1991-1996.
Procter & Gamble Lecturer, University of Illinois at Urbana-Champaign, April 1999.
NIH Career Merit Award 1999 – 2010.
Faculty Fellowship Award, University of Colorado, 2002-2003.
College Scholar Award, University of Colorado, 2010.

Publications

1. Tinoco, I., Jr., Martin, F. H., Nelson, J. W. & Pardi, A. (1981). "Mismatched Bases in Nucleic Acids: Their Effects on Structure and Stability," *Macromol. Chem. Phys. Macromol. Chemie*, S4, 143-154 (1981).

2. Pardi, A., Martin, F.H., and Tinoco, I., Jr. "Comparative Study of Ribonucleotide, Deoxyribonucleotide, and Hybrid Oligonucleotide Helices by Nuclear Magnetic Resonance," *Biochemistry,* 20, 3986-3996 (1981).

3. Patel, D.J., Pardi, A., and Itakura, K. "DNA Conformation, Dynamics and Interactions in Solution," *Science,* 216, 581-590 (1982).

4. Dahl, K.S., Pardi, A. and Tinoco, I., Jr. "Structural Effects on the Circular Dichroism of Ethidium Ion-nucleic Acid Complexes," *Biochemistry,* 21, 2730-2737 (1982).

5. Pardi, A., and Tinoco, I., Jr. "The Kinetics for Exchange of Imino Protons in DNA, RNA and Hybrid Oligonucleotide Helices," *Biochemistry,* 21, 4686-4693 (1982).

6. Pardi, A., Morden, K.M., Patel, D.J., and Tinoco, I., Jr. "The Kinetics for Exchange of the Imino Protons in the d(CGCGAATTCGCG) Double Helix and in Two Similar Helices Which Contain a G-T Base Pair d(CGTGAATTCGCG) and an Extra Adenine d(CGCAGAATTCGCG)," *Biochemistry,* 21, 6567-6574 (1982).

7. Pardi, A., Morden, K.M., Patel, D.J., and Tinoco, I., Jr. "The Kinetics for Exchange of Imino Proton of the Double Helix d(CGCGAATTCGCG) in Complexes with the Antibiotics Netropsin and/or Actinomycin," *Biochemistry,* 22, 1107-1113 (1983).

8. Pardi, A., Walker, R., Rapoport, H., Wider, G., and Wüthrich, K. "Sequential Assignments for the ^{1}H and ^{31}P Atoms in the Backbone of Oligonucleotides by Two-Dimensional Nuclear Magnetic Resonance," *J. Am. Chem. Soc.,* 105, 1652-1653 (1983).

9. Wagner, G., Pardi, A., and Wüthrich., K. "Hydrogen Bond Length and ^{1}H NMR Chemical Shifts in Proteins," *J. Am. Chem. Soc.,* 105, 5948-5949 (1983).

10. Pardi, A., Wagner, G., and Wüthrich, K. "Protein Conformations and Proton Nuclear Magnetic Resonance Chemical Shifts," *Eur. J. Biochem.,* 127, 445-454 (1983).

11. McCord, E.F., Morden, K.M., Pardi, A., Tinoco, I., Jr., and Boxer, S. G. "Chemically Induced Dynamic Nuclear Polarization Studies of Guanosine in Nucleotides, Dinucleotides, and Oligonucleotides," *Biochemistry,* 23, 1926-1934 (1984).

12. Pardi, A., Billeter, M. and Wüthrich, K. "Calibration of the Angular Dependence of the Amide-Proton-C$^{\alpha}$Proton Coupling Constants, $^{3}J_{\alpha NH}$, in a Globular Protein. Use of $^{3}J_{\alpha NH}$ for Identification of Helical Secondary Structure," *J. Mol. Biol.,* 180, 741-751 (1984).

13. Patel, D.J., Kozlowski, S.A., Pardi, A., Bhatt, R., Ikuta, S., and Itakura, K. "Sequence Dependence of DNA Conformation Dynamics and Interactions in Solution," *Pontificiae Academiae Scientiarum Scripta Varia,* 55, 133-173 (1984).

14. Mueller, L., and Pardi, A. "Uncovering Remote Nuclear Spin Connectivities by Relayed Zero and Double Quantum Coherence," *J. Am. Chem. Soc.,* 107, 3484-3487 (1985).

15. Wang, C., and Pardi, A. "NMR Spectra of Exchangeable Protons Using Uniform Excitation Solvent Suppression Pulse Sequences," *J. Magn. Reson.,* 71, 154-158 (1987).

16. Bach, A.C, II, Selsted, M.E., and Pardi, A. "Two-Dimensional NMR Studies of the Antimicrobial Peptide NP-5," *Biochemistry,* 26, 4389-4397 (1987).

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26. Metzler, W.J., Wang, C., Kitchen, D.B., Levy, R.M., and Pardi, A. "Determining Local Conformational Variations in DNA: NMR Structures of the DNA Duplexes d(CGCCTAATCG) and d(CGTCACGCGC) Generated Using Back-Calculation of the NOE Spectra, a Distance Geometry Algorithm and Constrained Molecular Dynamics," *J. Mol. Biol.,* 214, 711-736 (1990).

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109. Boots, J. L., Canny, M. D., Azimi, E. and Pardi, A. "Metal ion specificities for folding and cleavage activity in the *Schistosoma* hammerhead ribozyme" *RNA*, (2008), 14, 2212-2222.

110. Latham, M. P. and Pardi, A. "Measurement of imino ^{1}H-^{1}H residual dipolar couplings in RNA" *J. Biomol. NMR* (2009), 43, 121-129.

111. Walton, T. A., Sandoval, C. M., Fowler, C. A., Pardi, A. and Sousa, M. C. "The cavity-chaperone Skp protects its substrate from aggregation but allows independent folding of substrate domains" *Proc. Natl. Acad. Sci. U.S.A.* (2009), 106, 1772-1777.

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113. Farjon, J., Boisbouvier, J., Schanda, P., Pardi, A., Simorre, J. P. and Brutscher, B. "Longitudinal-Relaxation-Enhanced NMR Experiments for the Study of Nucleic Acids in Solution" *J. Am. Chem. Soc.* (2009) 131, 8571-8577.

114. Latham, M. P., Zimmermann, G. R. and Pardi, A. "NMR Chemical Exchange as a Probe for Ligand-Binding Kinetics in a Theophylline-Binding RNA Aptamer" *J. Am. Chem. Soc.* (2009) 131, 5052-5053.

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116. Gatzeva-Topalova, P. Z., Warner, L. R., Pardi, A. & Sousa, M. C. "Structure and flexibility of the complete periplasmic domain of BamA: the protein insertion machine of the outer membrane" *Structure* (2010) 18, 1492-501.

117. Warner, L. R., Varga, K., Lange, O. F., Baker, S. L., Baker, D., Sousa, M. C. & Pardi, A. "Structure of the BamC Two-Domain Protein Obtained by Rosetta with a Limited NMR Data Set", *J. Mol. Biol.* (2011), 411, 83-95.

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119. Dodevski, I., Nucci, N. V., Valentine, K. G., Sidhu, G. K., O'Brien, E. S., Pardi, A. & Wand A. J. "Optimized reverse micelle surfactant system for high resolution NMR spectroscopy of encapsulated proteins and nucleic acids dissolved in low-viscosity fluids" *J. Am. Chem. Soc.* (2014) 136, 3465-74.

120. Xiao, Y., Lee, T., Latham, M. P., Warner, L. R., Tanimoto, A., Pardi, A. & Ahn N. G. "Phosphorylation releases constraints to domain motion in ERK2" *Proc. Natl. Acad. Sci. U.S.A.* (2014) 111, 2506-11.

121. Rudolph J., Xiao Y., Pardi A. & Ahn N. G. "Slow inhibition and conformation selective properties of extracellular signal-regulated kinase 1 and 2 inhibitors" *Biochemistry* (2015) 54, 22-31.

122. Xiao Y., Liddle J. C., Pardi A. & Ahn N. G. "Dynamics of protein kinases: insights from nuclear magnetic resonance" *Acc. Chem. Res.* (2015) 48, 1106-14.

123. Xiao Y., Warner L. R., Latham M. P., Ahn N. G. & Pardi A. "Structure-Based Assignment of Ile, Leu, and Val Methyl Groups in the Active and Inactive Forms of the Mitogen-Activated Protein Kinase Extracellular Signal-Regulated Kinase 2" *Biochemistry* (2015) 54, 4307-19.

124. Warner L. R., Gatzeva-Topalova P. Z., Doerner P.A., Pardi A., & Sousa M.C. "Flexibility in the Periplasmic Domain of BamA Is Important for Function" *Structure* (2017) 25, 94-106.

TEACHING

Rutgers University:

Chemistry 342, Physical Chemistry II: Biochemical Systems, Winter 1985
Chemistry 341, Physical Chemistry I: Biochemical Systems, Fall 1985
Chemistry 341, Physical Chemistry I: Biochemical Systems, Fall 1986
Chemistry 342, Physical Chemistry II: Biochemical Systems, Winter 1987

University of Colorado:

Chemistry 588, Advanced Biochemistry - Protein Structure and Dynamics, Spring 1988, Shared 50% with Professor J. Falke
Chemistry 486, Biochemistry Lab, Spring 1988, Shared 50% with Professor J. Falke
Chemistry 5781, Advanced Biochemistry - Protein Structure and Dynamics, Spring 1989, Shared 50% with Professor J. Falke
Chemistry 4431, Physical Chemistry II: Biological Applications, Spring 1989, Shared 50% with Professor J. Falke
Chemistry 5781, Advanced Biochemistry - Protein Structure and Dynamics, Spring 1990, Shared 50% with Professor J. Falke
Chemistry 4431, Physical Chemistry II: Biological Applications, Spring 1990, Shared 50% with Professor J. Falke
Chemistry 5771, Biochemistry Core - Macromolecular Structure, Fall 1990
Chemistry 5771, Biochemistry Core - Macromolecular Structure, Fall 1991
Chemistry 5561, Biophysical Techniques, Spring 1992, Shared with J. Falke, Stan Gill, and Craig Kundrot - Pardi 9 of 43 lectures.
Chemistry 5771, Biochemistry Core - Macromolecular Structure, Fall 1992.
Chemistry 4431, Physical Chemistry II: Biological Applications, Spring 1994.
Chemistry 1171, General Chemistry II, Spring 1996.
Chemistry 1171, General Chemistry II, Spring 1997.
Chemistry 1171, General Chemistry II, Spring 1998.
Chemistry 5771, Biochemistry Core - Macromolecular Structure, Fall 1998.
Chemistry 5661, Advanced Topics in Biophysics, Spring 1999, Shared with 5 other faculty
Chemistry 5561, Molecular Methods in Biophysics, Spring 2000, Team taught 3 credit course with 6 other faculty
Chemistry 4431, Spring 2000, Physical Chemistry Biological Applications II, 3 credit course, 26 students.
Chemistry 5771, Fall 2000 Advanced General Biochemistry I (Core Course), 5 credits, shared 50% one other faculty, 14 students
Chemistry 5776, Fall 2000, Scientific Ethics and Responsible Conduct in Research, 1 credit, team taught with 2 other MCDB faculty, 14 students in Biochemistry section.
Chemistry, 4901-921, Spring 2000, Undergraduate Independent Study, 3 credit hours, 2 students.
Chemistry, 8991-926, Spring 2000, Doctoral Dissertation, 3 credit hours, 2 students
Chemistry, 8991-934, Fall 2000, Doctoral Dissertation, 3 credit hours, 1 students

Chemistry 5771, Fall 2001 Advanced General Biochemistry I (Core Course), 5 credits, shared 50% one other faculty, 16 students
Chemistry 5776, Fall 2001, Scientific Ethics and Responsible Conduct in Research, 1 credit, shared 50% with one other faculty, 16 students.
Chemistry 4431, Spring 2004, Physical Chemistry Biological Applications II, 3 credit course, 33 students.
Chemistry 4431, Spring 2005, Physical Chemistry Biological Applications II, 3 credit course, 23 students.
Chemistry 4431, Spring 2006, Physical Chemistry Biological Applications II, 3 credit course, 27 students.
Chemistry 5771, Fall 2006 Advanced General Biochemistry I (Core Course), 5 credits, shared 50% one other faculty, 17 students
Chemistry 5776, Fall 2006, Scientific Ethics and Responsible Conduct in Research, 1 credit, shared 50% with one other faculty, 18 students.
Chemistry 5771, Fall 2007 Advanced General Biochemistry I (Core Course), 5 credits, shared 50% one other faculty, 13 students
Chemistry 5776, Fall 2007, Scientific Ethics and Responsible Conduct in Research, 1 credit, shared 50% with one other faculty, 13 students.
Chemistry 5561, Fall 2008, Methods in Molecular Biophysics, 3 credit, 18 students.
Chemistry 5781, Spring 2010 Advanced General Biochemistry II (Core Course), 5 credits.
Chemistry 4431, Spring 2012, Physical Chemistry Biological Applications II, 3 credit course, 35 students.
Chemistry 5771, Fall 2012 Advanced General Biochemistry I (Core Course), 5 credits, shared 50% one other faculty, 15 students
Chemistry 5776, Fall 2012 Scientific Ethics and Responsible Conduct in Research, 1 credit, shared 50% with one other faculty, 18 students.
Chemistry 5771, Fall 2013 Advanced General Biochemistry I (Core Course), 5 credits, shared 50% one other faculty, 15 students
Chemistry 5776, Fall 2013 Scientific Ethics and Responsible Conduct in Research, 1 credit, shared 50% with one other faculty, 16 students.
Chemistry 5771, Fall 2014 Advanced General Biochemistry I (Core Course), 5 credits, shared 50% other faculty, 10 students.
Chemistry 5776, Fall 2014, Scientific Ethics and Responsible Conduct in Research, 1 credit, shared 50% with other faculty, 15 students.
Chemistry 5561, Fall 2014, Methods in Molecular Biophysics, 3 credit, 18 students, lectured 1 week in the team taught course.

Chemistry 5771, Fall 2015 Advanced General Biochemistry I (Core Course), 5 credits, shared 25% other faculty, 9 students
Chemistry 5776, Fall 2015, Scientific Ethics and Responsible Conduct in Research, 1 credit, shared 25% with other faculty, 9 students.
Chemistry 5491, Fall 2018, CHEM-: Modern Biophysical Methods, 3 credits, 19 students.

Undergraduate Supervised for Independent Study or Undergraduate Research

Beverly Burke, 1984 - 85.
Robert C. Morshauser, 1985
Elizabeth Cheng-Kwock 1985- 86.
Duane Maniconte, 1985 - 86.
Michael Smith, 1988 - 89.
David J. Ciesla, 1988 - 89.
Benjamin Wilson, 1990.
Michael Adams, 1990
Leslie M. Baer, 1990 - 91.
Jodi Ryter, Summer 1991.
Thomas A. Loegering, 1994 - 95.
Catherine L. Wick, 1994 - 95.
Molly Slazas, Summer 1996.
Jonathan Caruthers, 1996.
Linda Ste. Marie, 1996 - 97.
Kevin Pojasek, 1997.
Jeffrey R. Wank, 1997 - 98
Gabe Gittings, 1999 - 2000.
Rebecca M. Phillips, 1999 - 2000.
Richard Rymer, 2001-2002
Andrew Waas, 2002 – 2003.
Sara Stahle, 2002 – 2004.
Steven Bakos, 2005.
Kathleen Phu, 2005. UROP
Ehman Azimi, 2004 – 2006.
Anisa Wiley, 2006-2007 UROP
Kevin Davidson, 2009
Carolyn Foster, 2010-2011 UROP

Undergraduate Honors Theses Supervised

David J. Ciesla, "NMR Studies of ω-Conotoxin GVIA, Spring 1989.
Leslie M. Baer, "Preparation and Characterization of ^{15}N Labelled Ribonucleotide 5' Triphosphates", Spring 1991.
Linda Ste. Marie, "Solution Structure Studies of a RNA-Basic Fibroblast Growth Factor Complex using Diethyl Pyrocarbonate, Hydrazine and Ethylnitrosourea", Spring 1997.
Jeffrey R. Wank, "Determination of Microsecond Dynamics in the Lead Dependent Ribozyme", Fall 1998.
Rebecca M. Phillips, "Kinetic Analysis of a Theophylline-RNA Complex", Spring 2000.
Ehman Azimi, “Kinetics of the Schistosoma Hammerhead Ribozyme in the Presence of Divalent Metal Ions, Spring 2006.

European Graduate Students who Spent Part of their Ph.D. in my Lab

Ellen Moors, 1992.
Paul Michiels, 1994.
Kent Bondensgaard 1999-2000.

Graduate Students Supervised (Asterisks by those who have graduated)

Xiao-Lu Zhang*, Ph.D., "Solution Structures of Antimicrobial Peptides," Department of Chemistry, Rutgers University, January 1989.
Xing-Hao Wu, 1986 - 1987.
Chaun Wang*, Ph.D., "Solution Structures of DNA Oligomers," Department of Chemistry, Rutgers University, January 1989.
Leslie A. Dokken*, M.S., "Betabellin: Examination of a *De Novo* Designed Protein Using Nuclear Magnetic Resonance," Department of Chemistry and Biochemistry, University of Colorado, Boulder, October 1989.
Mary Ann Tomka*, M.S., "Studies of a Dodecamer DNA Hairpin by Nuclear Magnetic Resonance Spectroscopy," Department of Chemistry and Biochemistry, University of Colorado, Boulder, June 1990.
Jill Royal, 1991.
Megan McEvoy, 1992.
Jack J. Skalicky *- Ph.D., "Structure, Dynamics, and Function of the Defensin Antimicrobial Peptides and the Calcium Channel Antagonist ω-Conotoxin GVIA," University of Colorado, Boulder, August 1993
David Ciesla*, M.S., "The Hairpin Ribozyme: Synthesis and NMR Studies," University of Colorado, Boulder, September 1993
Gerard Ostheimer, 1994.
Fiona M. Jucker *, Ph.D., "RNA Tetraloops: A Study by Heteronuclear NMR Spectroscopy", January 1995.
Pascale Legault*, Ph.D., "Structural Studies of Ribozymes by Heteronuclear NMR Spectroscopy", January 1995.
Erin Gill, 1995.
Grant R. Zimmermann* - Ph.D. "Structural Studies of an RNA-Theophylline Complex Using Multidimensional Heteronuclear Magnetic Resonance Spectroscopy, December 1997.
Patrick Shiflett* - M.S., "Structure Determination of Two Small Antimicrobial Peptides α-RTD-1 and RTD-1 using Nuclear Magnetic Resonance Spectroscopy, January 2000.
Christopher E. Sillence* – M.S., "Protein-RNA Recognition: A NMR Study of a High-Affinity RNA Aptamer to the Basic Fibroblast Growth Factor", February, 2000.
Annaleen Vermeulen* – Ph.D. "Determining Nucleic Acid Global Structure by Application of NMR Residual Dipolar Couplings," Dec. 2003.
Chung-Tien Lee, 2003.
Renee Lagutaris* – M.S., "Metal Dependence of a Natural Hammerhead Ribozyme," December, 2004.
Lisa Brassell*, - M. S. , Dec. 2006.
Darin J. Brown, 2005 -2006.
Christopher D. Downey* - Ph.D. "Metal Ion Dependence , Thermodynamics and Kinetics of the GAAA Tetraloop-Receptor RNA Tertiary Interaction", Dec. 2006.

Jennifer L. Boots*- Ph.D. “Structural and Functional Studies of the Natural Hammerhead Ribozyme”, June 2007.

Daniel D. Cash* - M.S., “Solution NMR Studies of the Class II GTP-Binding RNA Aptamer Complex to Determine the Role of Conserved Residues in Complex Formation”, June, 2008.

Michael P. Latham* - Ph.D. "Developing Improved Methods for Structural and Dynamics Studies of RNA by NMR Spectroscopy", Aug. 2008.

Haemi Lee*, 2006 - 2010. Ph.D. "A Study of the Metal Concentration and Metal Identity Effects on Structural Dynamics of the Non-Cleavable Hammerhead Ribozyme by Single-Molecule Fluorescence Resonance Energy Transfer", August 2010.

Andrew Libby,* - M.S. " NMR Resonance Assignment of the Therapeutic RNA Aptamer Macugen in Complex with its *in vivo* Target, the Heparin Binding Domain of $VEGF_{165}$", June 2010.

Lisa Warner* - Ph.D. "Structural characterization of proteins from the E. coli β-barrel assembly machine using NMR spectroscopy" Dec. 2011.

Laura Johnson*, Ph.D., "Probing the Dynamics of Red Fluorescent Protein Variants using NMR Spectroscopy: How Directed Development Affected Protein Dynamics" Dec. 2013

Jeff Swan*, - M.S. "The effect of fluorescent labeling on structural dynamics and catalysis of the *Schistosoma mansoni* hammerhead ribozyme, Feb. 2014.

Yao Xiao*, Ph.D., "Conformational Dynamics in the Regulation of MAP Kinase, ERK2", August 2015.

Sabrina Hunt, Ph.D. "Structure Determination of Vascular Endothelial Growth Factor Heparin-Binding Domain in Complex with a DNA Aptamer", June 2017.

Postdoctoral Research Fellows

Alvin C. Bach, 1985 - 1987
Hans A. Heus, 1987 - 1990
William J. Metzler, 1988 - 1990
Ping F. Yip, 1990 - 1992
Edward P. Nikonowicz, 1990 - 1993
Fareed Aboul-Ela, 1992 -1993
Zhu Shen, 1994 - 1995
Ken Addess, 1994 - 1997
Tom Shields, 1995 - 1998
Jean-Pierre Simorre, 1994 - 1996
Charlie Hoogstraten, 1995 - 1998
Sherlock Lam, 1996 – 1997
Mark R. Hansen, 1997 – 1999
Paul Hanson, 1998 – 2001
Emilia Mollova, 1998 – 2001
Hongjun Zhou, 1999 –2001
Fiona M. Jucker, 1999 – 2005
Scott McCallum, 1999 – 2003
Ligia Muntean, 2000 – 2001

Javier Cabello, 2003 – 2005
Joon-Hwa Lee, 2003 – 2005
Kevin Orwig, 2005 – 2007
Nicole Kruse, 2006 – 2007
Justin Douglas, 2006 -2009
Krisztina Varga, 2009 – 2010
Russell Burge, 2011