

CURRICULUM VITAE

Lewis Edward Kay

Department of Molecular Genetics,
Department of Biochemistry
Department of Chemistry
University of Toronto
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Academic Degrees

- 1988 PhD in Molecular Biophysics, Yale University, New Haven, Connecticut, USA.
Supervisor: Dr. J.H. Prestegard; Thesis: "NMR Methods for Studying Motional and Structural Properties of Molecules in Solution"
- 1983 BSc in Biochemistry (first class honours), University of Alberta, Edmonton, Alberta, Canada

Employment

- 1995 - Professor of Molecular Genetics (previously Medical Genetics), Biochemistry and Chemistry, University of Toronto, Toronto, Ontario, Canada
Phone: 416-978-0741, Fax: 416-978-8548, E-mail: kay@pound.med.utoronto.ca
- 1992 - 1995 Assistant Professor of Molecular Genetics (previously Medical Genetics), Biochemistry and Chemistry, University of Toronto, Toronto, Ontario, Canada
- 1988 - 1991 Alberta Heritage and Medical Research Council of Canada Post-Doctoral Fellow, Laboratory of Dr. Adrian Bax, Laboratory of Chemical Physics, National Institutes of Health, Bethesda, Maryland, USA

Endowed Lectures

- Birss Lecturer, Department of Chemistry, University of Alberta, Edmonton, October 1999.
- NIH Director's Wednesday Afternoon Lecture Series, May, 2006.
- Wilbur Cross Medal Lecture, Yale University, Oct, 2006.
- The Gitte Vold Memorial Lecture, University of California, San Diego, March 2007.
- Proctor and Gamble Lecture, Department of Chemistry, UMass Amherst, October 2007

Hartek Lecturer, Department of Chemistry, RPI, October 2007

McDowell Lecture, Department of Chemistry, UBC, October 2009.

Colter Lecture, Department of Biochemistry, University of Alberta, Fall 2011.

Aline U. and James M. Orten Memorial Lecturer, Department of Biochemistry and Molecular Biology, Wayne State University, April 2012.

Sackler Lecturer, Tel Aviv University, 2013-2014.

Sir Rex Richards Lecture, Dept of Chemistry, Oxford, April 2016.

National Lecturer, Biophysical Society of Canada, Winnipeg, Manitoba, June, 2016.

2016 Distinguished Lecturer, Scripps Research Institute, La Jolla, CA, Sept. 2016.

Peng Memorial Lecture, Biophysics, University of Connecticut Health Center, Oct. 2016.

Robert Olson Lecture, Washington University & University of St. Louis, Dec, 2017.

2018 Lemieux Lecture, Dept. of Chemistry, University of Ottawa, May 2018.

Krimm Lecture, Dept. of Biophysics, University of Michigan, April 2019.

John T. Edsall Lecture, Molecular and Cellular Biology, Harvard University, May 2019.

2019 Garner King Lecture, Faculty of Medicine, University of Alberta, June 2019.

Maude Menten Lecture, Western University, October 2019. (Postponed)

Silvestri Lecture, Villanova, December 2020.

Nordin Lecture, UMass Amherst, May 2023.

Honors and Awards

2023 Akutsu Prize, Korean Magnetic Resonance Society, Seoul, Korea

2023 Honorary Doctorate of Science, University of Ottawa

2020 Elected International Member of the National Academy of Sciences, USA

2019 Honorary Doctorate of Science, University of British Columbia

2018 Nakanishi Prize, American Chemical Society

2018 Gerhard Herzberg Canada Gold Medal for Science and Engineering

2017 Protein Society Christian B Anfinsen Award

2017 Canada Gairdner Foundation International Award

2017 Fellow of the Biophysical Society Award

2016 Appointed Officer of the Order of Canada

2016 Fellow of the Biophysical Society of Canada

2013 E. W. R. Steacie Award, Canadian Society for Chemistry

2012 University Professor, University of Toronto

2012 Khorana Prize, Royal Society of Chemistry, UK

2010 Election to the Royal Society of London

2009 Distinguished Alumni Award, University of Alberta

2008 Premier's Discovery Award, Province of Ontario

2008 Elected as one of the initial fellows of the International Society of Magnetic Resonance

2007 Dales Prize, Faculty of Medicine, University of Toronto

2006 Election to the Royal Society of Canada

2006 Wilbur Cross Medal of the Yale University Graduate School.

2005 Listed in ISI's database of Highly Cited Researchers in Chemistry

2004 Gunther Laukien Prize, Experimental NMR Conference.

2002 Founders Medal from the International Society of Magnetic Resonance in Biological Systems

2002 Flavelle Medal from the Royal Society of Canada

2000 Canada Research Chair, Tier 1

1999 Premier's Research Excellence Award, Province of Ontario

1999 Steacie Prize from the National Research Council of Canada

1999 Medical Research Council of Canada Scientist Award (1999-2000)

- 1998 University of Toronto McLean Award
- 1998 Canada's Top 40 Under 40 Award
- 1997 International Research Scholar of the Howard Hughes Medical Institute (1997-2002)
- 1996 Merck Frosst Award
- 1995 Alfred P. Sloan Research Fellow (1995-1997)
- 1994 - 1999 MRC (Medical Research Council of Canada) Scholarship

SERVICE

Associate Editor Journal of Magnetic Resonance; Associate Editor of Journal of Biomolecular NMR

PUBLICATIONS

1. J. Gariepy, Lewis E. Kay, I.D. Kuntz, B.D. Sykes and R.S. Hodges. Nuclear Magnetic Resonance Determination of Metal-Proton Distances in a Synthetic Calcium Binding Site of Rabbit Skeletal Troponin-C. *Biochemistry* **24**, 544-550 (1985).
2. D.C. Corson, T.C. Williams, Lewis E. Kay and B.D. Sykes. ¹H NMR Spectroscopic Studies of Calcium Binding Proteins: 1: Stepwise Proteolysis of the C-Terminal Alpha-Helix of a Helix-Loop-Helix Metal-Ion-Binding Domain. *Biochemistry* **25**, 1817-1826 (1986).
3. Lewis E. Kay and J.H. Prestegard. An application of Pulse-Gradient Double Quantum Spin Echoes to Diffusion Measurements on Molecules with Scalar-Coupled Spins. *J. Magn. Reson.* **67**, 103-113 (1986).
4. Lewis E. Kay, J.N. Scarsdale, D.R. Hare and J.H. Prestegard. Simulation of Two Dimensional Cross-Relaxation Spectra in Strongly Coupled Spin Systems. *J. Magn. Reson.* **68**, 515-525 (1986).
5. Lewis E. Kay, T.A. Holak, B.A. Johnson, I.M. Armitage and J.H. Prestegard. Second Order Effects in Two Dimensional Cross Relaxation Spectra of Proteins: Investigation of Glycine Spin Systems. *J. Am. Chem. Soc.* **108**, 4242-4244 (1986).
6. Lewis E. Kay, M. Pascone, B.D. Sykes and J.W. Shriver. ¹⁹F Nuclear Magnetic Resonance as a Probe of Structural Transitions and Cooperative Interactions in Heavy Meromyosin. *J. Biol. Chem.* **262**, 1984-1988 (1987).

7. Lewis E. Kay and J.H. Prestegard. Methyl Group Dynamics from Relaxation of Double Quantum Filtered NMR Signals: Application to Deoxycholate. *J. Am. Chem. Soc.* **109**, 3829-3835 (1987).
8. Lewis E. Kay, P.J. Jones and J.H. Prestegard. Strong Coupling Effects in the Homonuclear RELAY Experiment: Application to Leucine Spin Systems of Octanoyl-Acyl Carrier Protein. *J. Magn. Reson.* **72**, 392-396 (1987).
9. Lewis E. Kay, T. Jue, B. Bangerter and P.C. Demou. Sensitivity Enhancement of ^{13}C T_1 Measurements Via Polarization Transfer. *J. Magn. Reson.* **73**, 558-564 (1987).
10. Lewis E. Kay and R.E.D. McClung. A product Operator Description of AB and ABX Spin Systems. *J. Magn. Reson.* **77**, 258-273 (1988).
11. Lewis E. Kay, T.A. Holak and J.H. Prestegard. AX_3 Spin System Dynamics from Forbidden Cross Peak Intensities in Double Quantum Spectra: Application to Acyl Carrier Protein. *J. Magn. Reson.* **76**, 30-40 (1988).
12. Lewis E. Kay and J.H. Prestegard. T_1 Relaxation Rates Via 2D Accordion Spectroscopy. *J. Magn. Reson.* **77**, 599-605 (1988).
13. Lewis E. Kay and J.H. Prestegard. Simultaneous Measurement of ^{13}C Multiplicities and ^1H and ^{13}C Chemical Shifts. *J. Magn. Reson.* **78**, 172-177 (1988).
14. A.F. Frederick, Lewis E. Kay and J.H. Prestegard. Location of Divalent Ion Sites in Acyl Carrier Protein Using Relaxation Perturbed 2D NMR. *FEBS Lett.* **238**, 43-48 (1988).
15. D.M. LeMaster, Lewis E. Kay, A.T. Brunger and J.H. Prestegard. Protein Dynamics and Distance Determination by NOE Measurements. *FEBS Lett.* **236**, 71-76 (1988).
16. Lewis E. Kay, D.S. Thomson and J.H. Prestegard. Extraction of ^1H - ^1H and ^1H - ^{13}C Dipolar Couplings from Spectra Acquired in Inhomogeneous Magnetic Fields. *Magn. Reson. in Chem.* **26**, 860-866 (1988).
17. A. Bax, Lewis E. Kay, S.W. Sparks and D.A. Torchia. Line Narrowing of Amide Proton Resonances in 2D NMR Spectra of Proteins. *J. Am. Chem. Soc.* **111**, 408-490 (1989).
18. D. Marion, Lewis E. Kay, S.W. Sparks, D.A. Torchia and A. Bax. Three-Dimensional Heteronuclear NMR of ^{15}N Labeled Proteins. *J. Am. Chem. Soc.* **111**, 1515-1517 (1989).
19. Lewis E. Kay, D. Marion and A. Bax. Practical Aspects of 3D Heteronuclear NMR of Proteins. *J. Magn. Reson.* **84**, 72-84 (1989).
20. Lewis E. Kay and A. Bax. Separation of NH and NH_2 Resonances in ^1H Detected Heteronuclear Multiple Quantum Spectra. *J. Magn. Reson.* **84**, 598-603 (1989).

21. Lewis E. Kay, B. Brooks, S.W. Sparks, D.A. Torchia and A. Bax. Measurement of NH-C¹³H Coupling Constants in Staphylococcal Nuclease by Two-Dimensional NMR and Comparison with X-ray Crystallographic Results. *J. Am. Chem. Soc.* **111**, 5488-5490 (1989).
22. D. Marion, P. Driscoll, Lewis E. Kay, P.T. Wingfield, A. Bax, A.M. Gronenborn and M. Clore. Overcoming the Overlap Problem in the Assignment of ¹H NMR Spectra of Larger Proteins by Use of Three-Dimensional Heteronuclear ¹H-¹⁵N Hartmann-Hahn-Multiple Quantum Coherence and Nuclear Overhauser-Multiple Quantum Coherence Spectroscopy: Application to Interleukin 1 β . *Biochemistry* **28**, 6150-6156 (1989).
23. Lewis E. Kay, D.A. Torchia and A. Bax. Backbone Dynamics of Proteins as Studied by ¹⁵N Inverse Detected Heteronuclear NMR Spectroscopy: Application to Staphylococcal Nuclease. *Biochemistry* **28**, 8972-8979 (1989).
24. Lewis E. Kay and A. Bax. New Methods for the Measurement of NH-C¹³H J Couplings of ¹⁵N Labeled Proteins of Intermediate Size. *J. Magn. Reson.* **86**, 110-126 (1990).
25. J.D. Forman-Kay, A.M. Gronenborn, Lewis E. Kay, P.T. Wingfield and G.M. Clore. Studies on the Solution Conformation of Human Thioredoxin using Heteronuclear ¹⁵N-¹H Nuclear Magnetic Resonance Spectroscopy. *Biochemistry* **29**, 1566-1572 (1990).
26. A. Bax, M. Ikura, Lewis E. Kay, D.A. Torchia and R. Tschudin. Comparison of Different Modes of Two-Dimensional Reverse Correlation NMR for the Study of Proteins. *J. Magn. Reson.* **86**, 304-318 (1990).
27. M. Ikura, Lewis E. Kay and A. Bax. Three-Dimensional NOESY-HMQC Spectroscopy of a ¹³C-Labeled Protein. *J. Magn. Reson.* **86**, 204-209 (1990).
28. Lewis E. Kay, M. Ikura and A. Bax. Proton-Proton Correlation via Carbon-Carbon Couplings: A Three-Dimensional NMR Approach for the Assignment of Aliphatic Resonances in Proteins Labeled with Carbon-13. *J. Am. Chem. Soc.* **112**, 888-889 (1990).
29. D.A. Torchia, S.W. Sparks, H.B.R. Cole, D.M. Baldissari, Lewis E. Kay, D. Marion and A. Bax. Assignments, Structure and Dynamics of Staphylococcal Nuclease. *Polymer Preprints* **91**, 2618-2619 (1990).
30. M. Ikura, Lewis E. Kay, D.A. Torchia, C. Klee and A. Bax. Novel Approaches for Obtaining Resonance Assignments of Larger Proteins. *Polymer Preprints* **91**, (1990).
31. M. Ikura, D. Marion, Lewis E. Kay, H. Shih, M. Krinks, C. Klee and A. Bax. Heteronuclear 3D NMR and Isotopic Labeling of Calmodulin: Towards the Complete Assignment of the ¹H NMR Spectrum. *Biochem. Pharmacol.* **40**, 153-160 (1990).
32. M. Ikura, Lewis E. Kay and A. Bax. A Novel Approach for Sequential Assignment of ¹H, ¹³C, and ¹⁵N Spectra of Larger Proteins: Heteronuclear Triple Resonance 3D NMR Spectroscopy. *Biochemistry* **29**, 4659-4667 (1990).

33. A. Bax, G.M. Clore, P.C. Driscoll, A. Gronenborn, P. Driscoll, M. Ikura and Lewis E. Kay. Practical Aspects of Proton-Carbon-Carbon-Proton Three Dimensional Correlation Spectroscopy of ^{13}C Labeled Proteins. *J. Magn. Reson.* **87**, 620-627 (1990).
34. G.M. Clore, A. Szabo, A. Bax, Lewis E. Kay, P.C. Driscoll and A. Gronenborn. Deviations from the Simple Two Parameter Model Free Approach to the Interpretation of ^{15}N Nuclear Magnetic Relaxation of Proteins. *J. Am. Chem. Soc.* **112**, 4989-4991 (1990).
35. Lewis E. Kay, M. Ikura, R. Tschudin and A. Bax. Three Dimensional Triple Resonance NMR Spectroscopy of Isotopically Labelled Proteins. *J. Magn. Reson.* **89**, 496-514 (1990).
36. Lewis E. Kay, G.M. Clore, A. Bax and A.M. Gronenborn. Four-Dimensional Heteronuclear Triple Resonance Spectroscopy of a Protein in Solution. Application to Interleukin- 1β . *Science* **249**, 411-414 (1990).
37. G.M. Clore, Lewis E. Kay, A. Bax and A.M. Gronenborn. Four-Dimensional ^{13}C - ^{13}C Edited Nuclear Overhauser Enhancement Spectroscopy of a Protein in Solution: Application to Interleukin- 1β . *Biochemistry* **30**, 12-18 (1991).
38. A. Bax, M. Ikura, Lewis E. Kay and G. Zhu. Removal of F_1 Baseline Distortion and Optimization of Folding in Multi-Dimensional NMR Spectra. *J. Magn. Reson.* **91**, 174-178 (1991).
39. Lewis E. Kay, M. Ikura and A. Bax. The Design and Optimization of Complex NMR Experiments: Application to a Triple Resonance Pulse Scheme Correlating $\text{H}\alpha$, NH and ^{15}N Chemical Shifts in ^{15}N - ^{13}C Labeled Proteins. *J. Magn. Reson.* **91**, 84-92 (1991).
40. Lewis E. Kay, M. Ikura, G. Zhu and A. Bax. Four Dimensional Heteronuclear Triple Resonance NMR of Isotopically Enriched Proteins for Sequential Assignment of Backbone Atoms. *J. Magn. Reson.* **91**, 422-428 (1991).
41. R. Boelens, C. Griesinger, Lewis E. Kay, D. Marion and E.R.P. Zuiderweg. Applicability and Limitations of Three Dimensional NMR Spectroscopy for the Study of Proteins in Solution. In "Computational Aspects of the Study of Biological Macromolecules." pp 127-150, NATO ASI Series, Ed. J. Hoch; Plenum Press, New York.
42. Lewis E. Kay, J.D. Forman-Kay, W.D. McCubbin and C.M. Kay. Solution Structure of a Dimer of the Fourth Ca^{2+} Binding Site of Troponin C by 2D NMR. *Biochemistry* **30**, 4323-4333 (1991).
43. M. Ikura, Lewis E. Kay and A. Bax. A Triple Resonance Multi-Dimensional NMR Study of Calmodulin Complexed with the Binding Domain of Myosin Light Chain Kinase: Indication of a Conformational Change in the Central Helix. *Biochemistry* **30**, 5498-5504 (1991).
44. Lewis E. Kay and D.A. Torchia. The Effects of Dipolar Cross-Correlation on ^{13}C Methyl Group T_1 , T_2 and NOE Measurements in Macromolecules. *J. Magn. Reson.* **95**, 536-547 (1991).

45. M. Ikura, S. Spera, G. Barbato, Lewis E. Kay, M. Krinks and A. Bax. Side-Chain ^1H and ^{13}C Resonance Assignments and Secondary Structure of Calmodulin in Solution Determined by Heteronuclear Multi-Dimensional NMR Spectroscopy. *Biochemistry* **30**, 9216-9228 (1991).
46. M. Ikura, Lewis E. Kay and A. Bax. Improved Three-Dimensional ^1H - ^{13}C - ^1H Correlation Spectroscopy of a ^{13}C Labeled Protein Using Constant-Time Evolution. *J. Biomol. NMR*. **1**, 299-304, (1991).
47. A. Bax, M. Ikura, Lewis E. Kay, G. Barbato and S. Spera. Multi-Dimensional Triple Resonance NMR Spectroscopy of Isotopically Uniformly Enriched Proteins: A Powerful New Strategy For Structure Determination. In "Protein Conformation." pp 108-134, (Ciba Foundation Symposium 161), Wiley, Chichester (1991).
48. L.K. Nicholson, Lewis E. Kay, D.M. Baldisseri, A. Bax and D.A. Torchia. A ^{13}C NMR Study of Leucine Sidechain Dynamics in S. Nase. *Biochemistry* **31**, 5253-5263 (1992).
49. Lewis E. Kay, L.K. Nicholson, F. Delaglio, A. Bax and D.A. Torchia. The Effects of Cross-Correlation Between Dipolar and Chemical Shift Anisotropy Relaxation Mechanisms on the Measurement of Heteronuclear T_1 and T_2 Values in Proteins: Pulse Sequences for the Removal of Such Effects. *J. Magn. Reson.* **97**, 359-375 (1992).
50. G. Barbato, M. Ikura, Lewis E. Kay, R. Pastor and A. Bax. Backbone Dynamics of Calmodulin Studied by ^{15}N Relaxation Using Inverse Detected Two-Dimensional NMR Spectroscopy: The Central Helix is Flexible. *Biochemistry* **31**, 5269-5279 (1992).
51. Lewis E. Kay, T.E. Bull, L.K. Nicholson, C. Griesinger, A. Bax and D.A. Torchia. On the Measurement of Heteronuclear Transverse Relaxation Times in AX_3 Spin Systems Via Polarization Transfer Techniques. *J. Magn. Reson.* **100**, 538-558 (1992).
52. Lewis E. Kay and T.E. Bull. Heteronuclear Transverse Relaxation in AMX , AX_2 and AX_3 Spin Systems. *J. Magn. Reson.* **99**, 615-622 (1992).
53. Lewis E. Kay, M. Wittekind, M. McCoy, M. Freidrichs and L. Mueller. Four-Dimensional Triple Resonance Experiments for Protein Backbone Assignment With Simultaneous Constant Time Evolution Periods. *J. Magn. Reson.* **98**, 443-450 (1992).
54. Lewis E. Kay, M. Ikura, A. Grey and D.R. Muhandiram. Three-Dimensional NMR Experiments for the Separation of Sidechain Correlations in Proteins via the Carbonyl Chemical Shift. *J. Magn. Reson.* **99**, 652-659 (1992).
55. Lewis E. Kay. A Three-Dimensional NMR Experiment for the Separation of Aliphatic Carbon Chemical Shifts via the Carbonyl Chemical Shift in ^{15}N , ^{13}C Labeled Proteins. *J. Magn. Reson. Series B* **101**, 110-113 (1993).
56. M. Gorch, M. Wittekind, B.T. Farmer II, Lewis E. Kay and L. Mueller. Measurement of 3JHN Vicinal Coupling Constants in Proteins. *J. Magn. Reson. Series B* **101**, 194-200 (1993).

57. Lewis E. Kay, P. Keifer and T. Saarinen. Pure Absorption Gradient Enhanced Heteronuclear Single Quantum Correlation Spectroscopy with Improved Sensitivity. *J. Am. Chem. Soc.* **114**, 10663-10665 (1992).
58. D.A. Torchia, L.K. Nicholson, H.B.R. Cole and Lewis E. Kay. Heteronuclear NMR Studies of the Molecular Dynamics of Staphylococcal Nuclease. In "Topics in Molecular and Structural Biology Series: NMR of Proteins." pp 190-219, Eds. G.M. Clore and A.M. Gronenborn; The Macmillan Press Ltd (1993).
59. Lewis E. Kay. A Pulsed Field Gradient Enhanced Three Dimensional NMR Experiment for Correlating $\{^{13}\text{C}\beta, ^{13}\text{C}\alpha\}$, $^{13}\text{C}'$, $^1\text{H}\alpha$ Chemical Shifts in Uniformly ^{13}C Labeled Proteins Dissolved in H_2O . *J. Am. Chem. Soc.* **115**, 2055-2057 (1993).
60. Lewis E. Kay, G.Y. Xu, A.U. Singer, D.R. Muhandiram and Julie D. Forman-Kay. A Gradient Enhanced HCCH-TOCSY Experiment for Recording Sidechain ^1H and ^{13}C Correlations in H_2O Samples of Proteins. *J. Magn. Reson. Series B* **101**, 333-337 (1993).
61. D.R. Muhandiram, Guang-Yi Xu and Lewis E. Kay. An Enhanced Sensitivity Pure Absorption Gradient 4D ^{15}N - ^{13}C -Edited NOESY Experiment. *J. Biol. NMR* **3**, 463-470 (1993).
62. D.R. Muhandiram, Neil Farrow, Guang-Yi Xu, Stephen H. Smallcombe and Lewis E. Kay. A Gradient ^{13}C NOESY-HSQC Experiment for Recording NOESY Spectra of ^{13}C Labeled Proteins Dissolved in H_2O . *J. Magn. Reson. Series B* **102**, 317-321 (1993).
63. T. Yamazaki, J.D. Forman-Kay and Lewis E. Kay. Two-Dimensional NMR Experiments for Correlating $^{13}\text{C}\beta$ - $^1\text{H}\delta/\epsilon$ Chemical Shifts of Aromatic Residues in ^{13}C Labeled Proteins via Through-Bond Connectivities. *J. Am. Chem. Soc.* **115**, 11054-11055 (1993).
64. D.R. Muhandiram and Lewis E. Kay. Gradient Enhanced Triple Resonance Three Dimensional NMR Experiments with Improved Sensitivity. *J. Magn. Reson. Series B* **103**, 203-216 (1994).
65. S.M. Pascall, D.R. Muhandiram, T. Yamazaki, J.D. Forman-Kay and Lewis E. Kay. Simultaneous Acquisition of ^{15}N - and ^{13}C -Edited NOE Spectra of Proteins Dissolved in H_2O . *J. Magn. Reson. Series B* **103**, 197-201 (1994).
66. S. Bagby, T.S. Harvey, Lewis E. Kay, S.G. Eagle, S. Inouye and M. Ikura. Unusual Helix-Containing Greek Keys in Development-Specific Ca^{2+} -Binding Protein S. ^1H , ^{15}N and ^{13}C Assignments and Secondary Structure Determined Using Multidimensional Double and Triple Resonance Heteronuclear NMR Spectroscopy. *Biochemistry* **33**, 2409-2421 (1994).
67. N.A. Farrow, R. Muhandiram, A.U. Singer, S.M. Pascal, C.M. Kay, G. Gish, S.E. Shoelson, T. Pawson, J.D. Forman-Kay and Lewis E. Kay. Backbone Dynamics of a Free and Phosphopeptide-Complexed Src Homology 2 Domain Studied by ^{15}N NMR Relaxation. *Biochemistry* **33**, 5984-6003 (1994).

68. T. Yamazaki, D.R. Muhandiram and Lewis E. Kay. NMR Experiments for the Measurement of Carbon Relaxation Properties in Highly Enriched Uniformly ^{13}C , ^{15}N Labeled Proteins: Application to $^{13}\text{C}\alpha$ Carbons. *J. Am. Chem. Soc.* **116**, 8266-8278 (1994).
69. Lewis E. Kay, G. Yi Xu and T. Yamazaki. Enhanced Sensitivity Triple Resonance Spectroscopy with Minimal H_2O Saturation. *J. Magn. Reson. Series A* **109**, 129-133 (1994).
70. S.M. Pascal, A.U. Singer, G. Gish, S.E. Shoelson, T. Pawson, Lewis E. Kay and J.D. Forman-Kay. NMR Structure of an SH2 Domain of Phospholipase C- γ 1 Complexed with a High Affinity Binding Peptide. *Cell* **77**, 461-472 (1994).
71. T. Yamazaki, W. Lee, M. Revington, D. Mattiello, F. Dahlquist, C.H. Arrowsmith and Lewis E. Kay. An HNCA Pulse Scheme for the Backbone Assignment of ^{15}N , ^{13}C , ^2H Labeled Proteins: Application to a 37 kDa Trp Represson-DNA Complex. *J. Am. Chem. Soc.* **116**, 6464-6465 (1994).
72. N.A. Farrow, O. Zhang, J.D. Forman-Kay and Lewis E. Kay. A Heteronuclear Correlation Experiment for Simultaneous Determination of ^{15}N Longitudinal Decay and Chemical Exchange Rates of Systems in Slow Equilibrium. *J. Biomol. NMR* **4**, 727-734 (1994).
73. W. Lee, M.J. Revington, C.H. Arrowsmith and Lewis E. Kay. A Pulsed Field Gradient Isotope-Filtered 3D ^{13}C HMQC-NOESY Experiment for Extracting Intermolecular NOE Contacts in Molecular Complexes. *FEBS Lett.* **350**, 87-90 (1994).
74. O. Zhang, Lewis E. Kay, J.P. Olivier and J.D. Forman-Kay. Backbone ^1H and ^{15}N Resonance Assignments of the N-terminal SH3 Domain of Drk in Folded and Unfolded States using Enhanced Sensitivity Pulsed Field Gradient NMR Techniques. *J. Biomol. NMR* **4**, 845-858 (1994).
75. T. Yamazaki, W. Lee, C.H. Arrowsmith, D.R. Muhandiram and Lewis E. Kay. A Suite of Triple Resonance NMR Experiments for the Backbone Assignment of ^{15}N , ^{13}C , ^2H Labeled Proteins with High Sensitivity. *J. Am. Chem. Soc.* **116**, 11655-11666 (1994).
76. C.H. Arrowsmith, W. Lee, M. Revington, T. Yamazaki and Lewis E. Kay. Toward the Solution Structure of Large (> 30 kDa) Proteins and Macromolecular Complexes. In "Techniques in Protein Chemistry VI." Ed. J.W. Crabb; Academic Press, pp 503-510 (1995).
77. N.A. Farrow, O. Zhang, J.D. Forman-Kay and Lewis E. Kay. Comparison of the Backbone Dynamics of a Folded and an Unfolded SH3 Domain Existing in Equilibrium in Aqueous Buffer. *Biochemistry* **34**, 868-878 (1995).
78. T. Yamazaki, S.M. Pascal, A.U. Singer, J.D. Forman-Kay and Lewis E. Kay. NMR Pulse Schemes for the Sequence Specific Assignment of Arginine Guanidino ^{15}N and ^1H Chemical Shifts in Proteins. *J. Am. Chem. Soc.* **117**, 3556-3564 (1995).
79. M.K. Rosen, T. Yamazaki, G.D. Gish, C.M. Kay, T. Pawson and Lewis E. Kay. Direct Demonstration of an Intramolecular SH2-Phosphotyrosine Interaction in the Signalling Protein Crk. *Nature* **374**, 477-479 (1995).

80. N.A. Farrow, O. Zhang, D.A. Torchia and Lewis E. Kay. Mapping Spectral Density Functions from ^{15}N Relaxation Data Exclusively. *J. Biomol. NMR* **6**, 153-162 (1995).
81. G.Y. Xu, E. Ong, N.R. Gilkes, D.G. Kilburn, D.R. Muhandiram, M. Harris-Brandts, J.P. Carver, Lewis E. Kay and T.S. Havey. Solution Structure of a Cellulose-Binding Domain from *Cellulomonas fimi* by Nuclear Magnetic Resonance Spectroscopy. *Biochemistry* **34**, 6993-7009 (1995).
82. Lewis E. Kay. Pulsed Field Gradient Multi-Dimensional NMR Methods for the Study of Protein Structure and Dynamics in Solution. *Prog. Biophys. Molec. Biol.* **63**, 277-299 (1995).
83. D.R. Muhandiram, T. Yamazaki, B.D. Sykes and Lewis E. Kay. Measurement of ^2H T_1 and $T_{1\rho}$ Relaxation Times in Uniformly ^{13}C Labeled and Fractionally ^2H Labeled Proteins in Solution. *J. Am. Chem. Soc.* **117**, 11536-11544 (1995).
84. Lewis E. Kay. Field Gradient Techniques in NMR Spectroscopy. *Curr. Opin. Struct. Biol.* **5**, 674-681 (1995).
85. Megan M. McEvoy, J. Zhou, A.F. Roth, D.F. Lowry, T.B. Morrison, Lewis E. Kay and F.W. Dahlquist. Nuclear Magnetic Resonance Assignments and Global Fold of a Che Y-binding Domain in CheA, the Chemotaxis-Specific Kinase of *E. Coli*. *Biochemistry* **34**, 13871-13880 (1995).
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87. Steve M. Pascal, Alex Singer, Toshio Yamazaki, Lewis E. Kay and Julie D. Forman-Kay. Structural and Dynamic Characterization of an SH2 domain-phosphopeptide Complex by NMR Approaches. *Biochem. Soc. Trans.* **23**, 729-733 (1995).
88. L.K. Nicholson, Lewis E. Kay and D.A. Torchia. Protein Dynamics as Studied by Solution NMR Techniques (Chapter 5). In "NMR Spectroscopy and Its Applications to Biomedical Research." Ed. Susanta Sarkar; Elsevier, Amsterdam (1996).
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RESEARCH TRAINING

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5) Yves Aubin, Post-Doctoral Associate, September 1993 - October 1995.

6) Mike Rosen, Post-Doctoral Associate, October 1993 - January 1996.

7) Ping Xu, Post-Doctoral Associate, January 1994 - September 1994.

- 8) Li-Lin Tay, Graduate Student (MSc) in Chemistry with Dr. Bill Reynolds. September 1994 - November 1996.
- 9) N. Rao, Post-Doctoral Associate, April 1995 - October 1996.
- 10) D. Yang, Post-Doctoral Associate, May 1995 – May 2001.
- 11) Kevin Gardner, Post-Doctoral Associate, August 1995 - July 1998.
- 12) Pascale Legault, Post-Doctoral Associate, September 1995 - July 1998.
- 13) Sebastian Vincent, Post-Doctoral Associate, May 1996 - September 1997.
- 14) Catherine Zwahlen, Post-Doctoral Associate, May 1996 - December 1998.
- 15) Joel Tolman, Post-Doctoral Associate, December 1997 - September 1999.
- 16) Logan Donaldson, Post-Doctoral Associate, July 1998 - September 2000.
- 17) Geoff Mueller, Post-Doctoral Associate, September 1998 – May 2001.
- 18) James Choy, Post-Doctoral Associate, October 1998 – Nov 2005.
- 19) Nikolai Skrynnikov, Post-Doctoral Associate, January 1998 – Sept. 2002.
- 20) Frans Mulder, Post-Doctoral Associate, February 1998 – July 2001.
- 21) Johan Evenas, Post-Doctoral Associate, July 1999 – February 2001.
- 22) Tony Mittermaier, Graduate Student, September 1997 – Jan 2004.
- 23) Natalie Goto, Graduate Student, September 1997 - February 2001.
- 24) Peter Hwang, Graduate Student, September 1999 – Nov 2005.
- 25) Jason Ollerenshaw, Graduate Student, September 2000 – Sept 2005.
- 26) Vitali Tugarinov, Post-Doctoral Associate, December 2000 – July 2007.
- 27) Oscar Millet, Post-Doctoral Associate, September 2000 – April 2004.
- 28) Dimitry Korzhnev, Post-Doctoral Associate, September 2001-Sept 2010.
- 29) Irina Bezsonova, Graduate Student, September 2001-Sept. 2008
- 30) Karen Kloibler, Post-Doctoral Associate, September 2001-Jan 2004.
- 31) Pramodh Vallurupalli, Post-Doctoral Associate, Oct 2002-June 2009.

- 32) Remco Sprangers, Post-Doctoral Associate, April 2003-March 2008.
- 33) Algirdas Velyvis, Post-Doctoral Associate, April 2003-2009.
- 34) Philipp Neudecker, Post-Doctoral Associate, April 2004-Oct. 2010.
- 35) Jason Malthrop, Graduate Student, Sept. 2004-February 2008.
- 36) Flemming Hansen, Post-Doctoral Associate, Sept 2005-Sept 2010.
- 37) Patrik Lundstrum, Post-Doctoral Associate, Oct 2005-February 2009.
- 38) Eugene V. Tischenko, Post-Doctoral Associate, Oct 2005-August 2009.
- 39) Tomasz Religa, Post-Doctoral Associate, August 2008-October 2011.
- 40) Andy Baldwin, Post-Doctoral Associate, May 2008-July 2012.
- 41) Amy Ruschak, Post-Doctoral Associate, June 2008-April 2012.
- 42) Michael Latham, Post-Doctoral Associate, July 2008-Nov 2014.
- 43) Hugo van Ingen, Post-Doctoral Associate, August 2008-Dec 2010.
- 44) Guillaume Bouvignies, Post-Doctoral Associate, August 2008-November 2013.
- 45) Julia Barette, Graduate Student, January 2009, August 2011.
- 46) Alex Hansen, Post-doctoral Fellow, January 2009-February 2014.
- 47) Rina Rosenzweig, Post-Doctoral Associate, September 2010-June 2016.
- 48) Lichi Shi, Post-Doctoral Associate, Jan 2011-Sept 2014.
- 49) Julianne Kitevski, Post-Doctoral Associate, July 2013-June 2017.
- 50) Ashok Sekhar, Post-Doctoral Associate, July 2011-August 2017.
- 51) Rafal Augustyniak, Post-Doctoral Associate, May 2012-June 2018.
- 52) Dong Long, Post-Doctoral Associate, Oct 2012-May 2015.
- 53) Anne Schuetz, Post-Doctoral Associate, August 2013-May 2017.
- 54) Enrico Rennella, Post-Doctoral Associate, June 2014-Present.
- 55) Rui Huang, Post-Doctoral Associate, Sept 2014-May 2020.

- 56) Rob Culik, Post-Doctoral Associate, Sept 2014-August 2017.
- 57) Siavash Vahidi, Post-Doctoral Associate, Sept 2015-May 2020.
- 58) Zev Ripstein, Graduate Student, Sept 2015-Oct 2020
- 59) Tairan Yuwen, Post-Doctoral Associate, Nov 2015-Nov 2019
- 60) Jacob Brady, Post-Doctoral Associate, Nov 2015-Nov 2019.
- 61) Tae Hun Kim, Post-Doctoral Associate, Dec 2016-Dec 2022.
- 62) Gili Abramov, Post-Doctoral Associate, Jan 2018-Feb 2022.
- 63) Rob Harkness, Post-Doctoral Associate, July 2018-Present.
- 64) Alex Conicella, Post-Doctoral Associate, July 2018-Feb 2021.
- 65) Leo Wong, Post-Doctoral Associate, November 2018-July 2020.
- 66) T. Reid Alderson, Post-Doctoral Associate, February 2019-Feb 2022.
- 67) Yuki Toyama, Post-Doctoral Associate, April 2019-Sept 2022.
- 68) Zev Ripstein, Post-Doctoral Associate, Oct 2020-Aug 2021.
- 69) Alex Sever, Graduate Student, Sept 2020-Present.
- 70) Rashik Ahmed, Post-Doctoral Associate, Nov. 1, 2021-Present.
- 71) Atul Kaushik Rangadurai, Post-Doctoral Associate, Nov. 1, 2021-Present
- 72) Nicolas BolikCoulon, Post-Doctoral Associate, Dec. 1, 2021-Present.
- 73) Jeff Paul Bonin, Post-Doctoral Associate, July 1, 2022-Present.
- 74) Philipp Roessler, Post-Doctoral Associate, Jan 1, 2023 – Present.
- 75) Aidan Estelle, Post-Doctoral Associate, April 15, 2023-Present.

Current statistics show that only about 10% of trainees go on to independent research careers – yet 40 of 57 trainees who have left the Kay laboratory are on faculty at major research intensive universities, an additional 5 are scientists in government laboratories and 6 are in industry. My trainees are now professors at University of Toronto, Université de Montréal, McGill University, University of Ottawa, York University, Guelph University, University of Manitoba, and other academic centers, group leaders at Health Canada and industrial sites. Other trainees have

established careers at universities throughout the U.S., Europe, Israel and Asia at sites as diverse as Singapore, Dallas, New York, London and Hyderabad. Included in this list are a very significant number of women.

Listed below are former trainees that are now on faculty across the world: Steven Pascal, Professor, Massey University, New Zealand; Toshio Yamazaki, Professor, Osaka University, Japan; Mike Rosen, Professor, Southwestern Medical Center and Howard Hughes Investigator, USA; Daiwen Yang, Professor, National University of Singapore, Singapore; Kevin Gardner, Professor, Southwestern Medical Center, USA. Pascale Legault, Professor, University of Montreal, Canada; Joel Tolman, Professor, Johns Hopkins University, USA; Logan Donaldson, Professor, York University, Canada; James Choy, Professor, University of Western Ontario, Canada; Nikolai Skrynnikov, Professor, Purdue University, USA; Frans Mulder, Professor, University of Groningen, Netherlands; Tony Mittermaier, Professor, McGill University, Canada; Natalie Goto, Professor, University of Ottawa, Canada; Oscar Millet, Professor, University of Bilbao, Spain; Voula Kanelis, Professor, University of Toronto, Canada; Remco Sprangers, Group Leader, Max Planck, Tuebingen, Germany; Patrik Lundstrum, Professor, Linköping University, Sweden; Vitali Turgarinov, Professor, University of Maryland, USA; Flemming Hansen, Professor, Imperial College, London, UK; Dmitry Korzhnev, Professor, University of Connecticut. Tomasz Religa, Professor, Case Western Reserve, Cleveland, USA; Amy Ruschak, Professor, Case Western Reserve, Cleveland, USA. Philipp Neudecker, Professor, Jülich Institutes. Pramodh Vallurupalli, Professor, Hyderabad, India. Andy Baldwin, Professor Oxford. Alex Hansen, Research Professor Ohio State. Guillaume Bouvignies, CNRS Grenoble France. Irina Bezsonova, Professor, University of Connecticut. Don Long, Professor, University of Science and Technology, China. Michael Latham, Professor, Texas Tech University. Peter Hwang, Professor, University of Alberta. Rina Rosenzweig, Professor Weizmann Institute, Israel. Several trainees have pursued industry related careers: Yves Aubin, Merck Frosst, Canada; Neil Farrow, Beringer-Manheim, USA; Sebastian Vincent, Nestle, Switzerland; Johan Evenas, Astra Zeneca, Sweden as well as independent positions in government laboratories: Ping Xu, NRC, Canada; Geoff Mueller, National Cancer Institute, North Carolina, USA. Eugene Tishchenko, JEOL, USA. Rafal Augustyniak, Warsaw University, Poland. Anne Schuetz, University of Munich, Germany. Ashok Sekhar, Indian Institute of Science, Bengaluru, India. Rafael Augustyniak, Assistant Professor, University of Warsaw, Tairan Yuwen, Assistant Professor, Peking University, Rui Huang, University of Guelph, Siavash Vahidi, University of Guelph. Leo Wong, Shenzhen Institute of Advanced Technology (SIAT) in Shenzhen, China. Zev Ripstein, University of Manitoba. Reid Alderson, University of Graz. Tae Hun Kim, Case Western Reserve.