David R. Leibrandt

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Los Angeles, CA 90095

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Positions

University of California, Los Angeles 2022–
Professor, Department of Physics and Astronomy

National Institute of Standards and Technology 2013–2022
Physicist, Ion Storage Group, Time and Frequency Division
- Leader of trapped-ion optical clock and precision measurement experiments

University of Colorado Boulder 2018–
Associate Professor Adjoint, Department of Physics
Member, JILA

University of Colorado Boulder 2016–2018
Lecturer, Department of Physics

National Institute of Standards and Technology 2009–2013
Postdoctoral Research Fellow, Ion Storage Group, Time and Frequency Division
- Advisors: James C. Bergquist and Till Rosenband

Osaka University 2009
Visiting Research Scientist
- Host: Shinji Urabe

Education

Massachusetts Institute of Technology 2004–2009
Ph.D. in Physics
- Advisor: Isaac L. Chuang
- Dissertation title: Integrated chips and optical cavities for trapped-ion quantum information processing

University of Michigan 2000–2004
B.S.E. in Engineering Physics
Minor in Mathematics

Mentoring

Postdoctoral Associates

12. Mason Marshall (2021 – Present)
11. Matthew Bohman (2021 – Present)
10. Yu Liu (2020 – Present, soon University of Maryland)
9. Sayan Patra (2020 – Present)
8. Julian Schmidt (2020 – 2023, now Paul Scherrer Institute)
7. Kaifeng Cui (2019 – 2020, now Wuhan Institute of Physics and Mathematics)
6. Alejandra L. Collopy (2018 – 2020, now NIST Quantum Information)
5. May E. Kim (2018 – 2020, now MIT Lincoln Laboratories)
4. Christoph Kurz (2015 – 2017, now Zeiss SMT)
3. Aaron M. Hankin (2014 – 2018, now Honeywell Quantum Solutions)

2. Shon Cook (2013 – 2016, now Stable Laser Systems)
1. Samuel M. Brewer (2013 – 2019, now Colorado State University)

Graduate Students

9. (Mohamed) Asad Contractor (2021 – Present)
8. Margie Bruff (2020 – 2022)
7. (Zhimin) "Cheryl" Liu (2020 – Present)
6. Kevin Boyce (2019 – 2022)
5. Jacob Cook (Summer 2019, now NASA)
4. Dalton Chaffee (2019 – Present)
3. Jose Valencia (2018 – Present)
2. Ethan Clements (2016 – 2022, now MIT)
1. Jwo-Sy Chen (2013 – 2017, now IonQ)

Teaching

University of Colorado Boulder

- Physics 7550: *Atomic and Molecular Spectra*, Spring 2022
- Physics 7560: *Quantum Optics*, Spring 2021
- Physics 3330: *Electronics for the Physical Sciences*, Fall 2019

Massachusetts Institute of Technology

- Teaching assistant for 8.422: *Atomic and Optical Physics*, Spring 2007

Service

APS GPMFC Workshop 2022–2023
Co-organizer

APS Topical Group on Precision Measurement and Fundamental Constants (GPMFC) 2021–
Member at Large

IEEE International Frequency Control Symposium 2021–
Technical Program Committee Member (Group 6)

BIPM Consultative Committee for Time and Frequency (CCTF) 2020–
Working Group on Frequency Standards (WGFS) Member

Extremely Large Telescope 2020–
Line Calibrations Working Group Member

North American Conference on Trapped Ions 2019
Program Committee

IEEE International Frequency Control Symposium 2017–2020
Technical Program Committee Vice Chair (Group 6)

IEEE International Frequency Control Symposium 2015–2016
Technical Program Committee Member (Group 6)

Serve as a reviewer for 6 funding agencies 2015–
Army Research Office; Austrian Science Fund; Department of Energy, Office of Science; European Research Council; National Science Foundation, UK Research and Innovation

Serve as a reviewer for 17 journals 2011–
Journal of Luminescence; Journal of Applied Physics; Journal of Physics B: Atomic, Molecular and Optical Physics; Journal of the Optical Society of America B; Metrologia; Nature Communications; Nature Photonics; Nature Physics; Nature Physics Reviews; Optics Express; Optics Letters; Physical Review A; Physical Review Letters; Reviews of Modern Physics; Review of Scientific Instruments; Scientific Reports; New Journal of Physics

External PhD thesis examiner for 2 students
Robin Oswald (ETH Zurich, 2022)
Rattakorn Kaewuam (Centre for Quantum Technologies, National University of Singapore, 2020)

Awards

Fellow of the American Physical Society 2021
For "exceptional scientific creativity and leadership in designing and demonstrating a state-of-the-art trapped ion optical clock with the lowest reported clock systematic uncertainty of 0.94×10^{-18}, and for implementing novel clock comparisons"

Young Scientist Award 2021
European Frequency and Time Forum (EFTF)
For "exceptional scientific creativity and achievement in designing and implementing state-of-the-art trapped-ion optical clocks with the lowest systematic uncertainty"

Bronze Medal Award 2021
Department of Commerce
For "breakthrough metrology to control and entangle atomic and molecular ions, providing powerful new approaches to quantum computing and networking"

Gold Medal Award 2019
Department of Commerce
For "creating and networking the world's best optical atomic clocks for a 100-fold improvement in precision timekeeping over state of the art"

Colleagues' Choice Award 2016
National Institute of Standards and Technology
For "the development of open-source hardware and software designs for a state-of-the-art digital servo that is being rapidly adopted by researchers inside and outside of NIST"

Postdoctoral Research Fellowship 2010–2012
National Research Council

Wolfe Fellowship 2004–2005
Massachusetts Institute of Technology

Patents

1. *High-efficiency microfabricated spherical RF Paul ion trap*

D.R. Leibrandt, D.B. Hume, R. Brown, and J. Sherman
Provisional Patent 63/144,066 (2021)

Publications

40. *Rotational spectroscopy of a single molecular ion at sub part-per-trillion resolution*
A.L. Collopy, J. Schmidt, D. Leibfried, **D.R. Leibrandt**, C.W. Chou
arXiv:2207.10215 (2022)

39. *Prospects of a thousand-ion Sn^{2+} Coulomb-crystal clock with sub-10^{-19} inaccuracy*
D.R. Leibrandt, S.G. Porsev, C. Cheung, and M.S. Safronova
arXiv:2205.15484 (2022)

38. *Scalable quantum logic spectroscopy*
K. Cui, J. Valencia, K.T. Boyce, **D.R. Leibrandt**, and D.B. Hume
PRL **129**, 193603 (2022)

37. *New Horizons: Scalar and Vector Ultralight Dark Matter*
D. Antypas *et al.*
arXiv:2203.14915 (2022)

36. *Cold atoms in space: community workshop summary and proposed road-map*
I. Alonso *et al.*
EPJ Quantum. Technol. **9**, 30 (2022)

35. *Improved interspecies optical clock comparisons through differential spectroscopy*
M.E. Kim, W.F. McGrew, N.V. Nardelli, E.R. Clements, Y.S. Hassan, X. Zhang, J. Valencia, H. Leopardi, D.B. Hume, T.M. Fortier, A.D. Ludlow, and **D.R. Leibrandt**
Nat. Phys. (2022)

34. *Frequency ratio measurements with 18-digit accuracy using a network of optical clocks*
The Boulder Atomic Clock Optical Network (BACON) Collaboration: K. Beloy, M.I. Bodine, T. Bothwell, S.M. Brewer, S.L. Bromley, J.-S. Chen, J.-D. Deschênes, S.A. Diddams, R.J. Fasano, T.M. Fortier, Y.S. Hassan, D.B. Hume, D. Kedar, C.J. Kennedy, I. Khader, A. Koepke, **D.R. Leibrandt**, H. Leopardi, A.D. Ludlow, W.F. McGrew, W.R. Milner, N.R. Newbury, D. Nicolodi, E. Oelker, T.E. Parker, J.M. Robinson, S. Romisch, S.A. Schäffer, J.A. Sherman, L.C. Sinclair, L. Sonderhouse, W.C. Swann, J. Yao, J. Ye, and X. Zhang
Nature **591**, 564 (2021)

33. *Measurement of the $^{27}Al^{+}$ and ^{87}Sr absolute optical frequencies*
The Boulder Atomic Clock Optical Network (BACON) Collaboration: H. Leopardi, K. Beloy, T. Bothwell, S.M. Brewer, S.L. Bromley, J.-S. Chen, S.A. Diddams, R.J. Fasano, Y.S. Hassan, D.B. Hume, D. Kedar, C.J. Kennedy, I. Khader, **D.R. Leibrandt**, A.D. Ludlow, W.F. McGrew, W.R. Milner, D. Nicolodi, E. Oelker, T.E. Parker, J.M. Robinson, S. Romisch, S.A. Schäffer, J.A. Sherman, L. Sonderhouse, W.C. Swann, J. Yao, J. Ye, X. Zhang, and T.M. Fortier
Metrologia **58**, 015017 (2021)

32. *Lifetime-limited interrogation of two independent $^{27}Al^{+}$ clocks using correlation spectroscopy*
E.R. Clements, M.E. Kim, K. Cui, A.M. Hankin, S.M. Brewer, J. Valencia, J.-S. Chen, C.W. Chou, **D.R. Leibrandt**, and D.B. Hume
PRL **125**, 243602 (2020)

31. *Optical atomic clock comparison through turbulent air*
M.I. Bodine, J.-D. Deschênes, I. Khader, W.C. Swann, H. Leopardi, K. Beloy, T. Bothwell, S.M. Brewer, S.L. Bromley, J.-S. Chen, S.A. Diddams, R.J. Fasano, T.M. Fortier, D.B. Hume, D. Kedar, C.J. Kennedy, A. Koepke, **D.R. Leibrandt**, A.D. Ludlow, W.F. McGrew, W.R. Milner, D. Nicolodi, E. Oelker, T.E. Parker, J.M. Robinson, J.A. Sherman, J. Yao, J. Ye, X. Zhang, N.R. Newbury, and L.C. Sinclair
Phys. Rev. Research **2**, 033395 (2020)

30. *Quantum entanglement between an atom and a molecule*
Y. Lin, **D.R. Leibrandt**, D. Leibfried, and C.W. Chou
Nature **581**, 273 (2020)

29. *Frequency-comb spectroscopy on pure quantum states of a single molecular ion*
C.W. Chou, A.L. Collopy, C. Kurz, Y. Lin, M.E. Harding, P.N. Plessow, T. Fortier, S. Diddams, D. Leibfried, and **D.R. Leibrandt**
Science **367**, 1458 (2020)

28. *Measurements of* $^{27}\mathrm{Al}^+$ *and* $^{25}Mg^+$ *magnetic constants for improved ion clock accuracy*
S.M. Brewer, J.-S. Chen, K. Beloy, A.M. Hankin, E.R. Clements, C.W. Chou, W.F. McGrew, X. Zhang, R.J. Fasano, D. Nicolodi, H. Leopardi, T.M. Fortier, S.A. Diddams, A.D. Ludlow, D.J. Wineland, **D.R. Leibrandt**, and D.B. Hume
PRA **100**, 013409 (2019)

27. *Systematic uncertainty due to background-gas collisions in trapped-ion optical clocks*
A.M. Hankin, E.R. Clements, Y. Huang, S.M. Brewer, J.-S. Chen, C.W. Chou, D.B. Hume, and **D.R. Leibrandt**
PRA **100**, 033419 (2019)

26. *An* $^{27}Al^+$ *quantum-logic clock with systematic uncertainty below* 10^{-18}
S.M. Brewer, J.-S. Chen, A.M. Hankin, E.R. Clements, C.W. Chou, D.J. Wineland, D.B. Hume, and **D.R. Leibrandt**
PRL **123**, 033201 (2019)

25. *Preparation and coherent manipulation of pure quantum states of a single molecular ion*
C.W. Chou, C. Kurz, D.B. Hume, P.N. Plessow, **D.R. Leibrandt**, and D. Leibfried
Nature **545**, 203 (2017)

24. *Hyperfine-mediated electric quadrupole shifts in* Al^+ *and* In^+ *ion clocks*
K. Beloy, **D.R. Leibrandt**, and W.M. Itano
PRA **95**, 043405 (2017)

23. *Sympathetic ground state cooling and time-dilation shifts in an* $^{27}Al^+$ *optical clock*
J.-S. Chen, S.M. Brewer, C.W. Chou, D.J. Wineland, **D.R. Leibrandt**, and D.B. Hume
PRL **118**, 053002 (2017)

22. *Probing beyond the laser coherence time in optical clock comparisons*
D.B. Hume and **D.R. Leibrandt**
PRA **93**, 032138 (2016)

21. *An open source digital servo for atomic, molecular, and optical physics experiments*
D.R. Leibrandt and J. Heidecker
Rev. Sci. Instrum. **86**, 123115 (2015)

20. *Laser-Frequency Stabilization Based on Steady-State Spectral-Hole Burning in* $Eu^{3+}{:}Y_2SiO_5$
S. Cook, T. Rosenband, and **D.R. Leibrandt**
PRL **114**, 253902 (2015)

19. *Absolute and relative stability of an optical frequency reference based on spectral hole burning in* $Eu^{3+}{:}Y_2SiO_5$
D.R. Leibrandt, M.J. Thorpe, C.W. Chou, T.M. Fortier, S.A. Diddams, and T. Rosenband
PRL **111**, 237402 (2013)

18. *Exponential scaling of clock stability with atom number*
T. Rosenband and **D.R. Leibrandt**
arXiv:1303.6357 (2013)

17. *Cavity-stabilized laser with acceleration sensitivity below* 10^{-12} g^{-1}
D.R. Leibrandt, J.C. Bergquist, and T. Rosenband
PRA **87**, 023829 (2013)

16. *Shifts of optical frequency references based on spectral-hole burning in $Eu^{3+}:Y_2SiO_5$*
M.J. Thorpe, **D.R. Leibrandt**, and T. Rosenband
New J. Phys. **15**, 033006 (2013)

15. *Trapped-ion state detection through coherent motion*
D.B. Hume, C.W. Chou, **D.R. Leibrandt**, M.J. Thorpe, D.J. Wineland, and T. Rosenband
PRL **107**, 243902 (2011)

14. *Ion crystal transducer for strong coupling between single ions and single photons*
L. Lamata, **D.R. Leibrandt**, I.L. Chuang, J.I. Cirac, M.D. Lukin, V. Vuletic, S.F. Yelin
PRL **107**, 030501 (2011)

13. *Field-test of a robust, portable, frequency-stable laser*
D.R. Leibrandt, M.J. Thorpe, J.C. Bergquist, and T. Rosenband
Opt. Express **19**, 10278 (2011)

12. *Spherical reference cavities for frequency stabilization of lasers in non-laboratory environments*
D.R. Leibrandt, M.J. Thorpe, M. Notcutt, R.E. Drullinger, T. Rosenband, and J.C. Bergquist
Opt. Express **19**, 3471 (2011)

11. *Measurement and real-time cancellation of vibration-induced phase noise in a cavity-stabilized laser*
M.J. Thorpe, **D.R. Leibrandt**, T.M. Fortier, and T. Rosenband
Opt. Express **18**, 18744 (2010)

10. *Cavity sideband cooling of a single trapped ion*
D.R. Leibrandt, J. Labaziewicz, V. Vuletić, and I.L. Chuang
PRL **103**, 103001 (2009)

9. *Demonstration of a scalable, multiplexed ion trap for quantum information processing*
D.R. Leibrandt, J. Labaziewicz, R.J. Clark, I.L. Chuang, R. Epstein, C. Ospelkaus, J. Wesenberg, J. Bollinger, D. Leibfried, D. Wineland, D. Stick, J. Sterk, C. Monroe, C.-S. Pai, Y. Low, R. Frahm, and R.E. Slusher
Quant. Inf. Comput. **9**, 901 (2009)

8. *Two-dimensional blast-wave-driven Rayleigh-Taylor instability: experiment and simulation*
C.C. Kuranz, R.P. Drake, E.C. Harding, M.J. Grosskopf, H.F. Robey, B.A. Remington, M.J. Edwards, A.R. Miles, T.S. Perry, B.E. Blue, T. Plewa, N.C. Hearn, J.P. Knauer, D. Arnett, and **D.R. Leibrandt**
ApJ **696**, 749 (2009)

7. *Temperature dependence of electric field noise above gold surfaces*
J. Labaziewicz, Y. Ge, **D.R. Leibrandt**, S.X. Wang, R. Shewmon, and I.L. Chuang
PRL **101**, 180602 (2008)

6. *Suppression of heating rates in cryogenic surface-electrode ion traps*
J. Labaziewicz, Y. Ge, P. Antohi, **D.R. Leibrandt**, K.R. Brown, and I.L. Chuang
PRL **100**, 13001 (2008)

5. *Laser ablation loading of a surface-electrode ion trap*
D.R. Leibrandt, R.J. Clark, J. Labaziewicz, P. Antohi, W. Bakr, K.R. Brown, and I.L. Chuang
PRA **76**, 55403 (2007)

4. *Loading and characterization of a printed-circuit-board atomic ion trap*
K.R. Brown, R.J. Clark, J. Labaziewicz, P. Richerme, **D.R. Leibrandt**, and I.L. Chuang
PRA, **75**, 15401 (2007)

3. *Modeling ion trap thermal noise decoherence*
D. Leibrandt, B. Yurke, and R. Slusher
Quant. Inf. Comput. **7**, 52 (2007)

2. *Experimental investigation of planar ion traps*
C.E. Pearson, **D.R. Leibrandt**, W.S. Bakr, W.J. Mallard, K.R. Brown, and I.L. Chuang
PRA **73**, 32307 (2006)

1. *A validation test of the flux-limited diffusion approximation for radiation hydrodynamics*
D.R. Leibrandt, R.P. Drake, A.B. Reighard, and S.G. Glendinning
ApJ **626**, 616 (2005)

Conference Proceedings

6. *Trapped-ion optical atomic clocks at the quantum limits*
D.R. Leibrandt, S.M. Brewer, J.-S. Chen, C.W. Chou, A.M. Hankin, D.B. Hume, and D.J. Wineland
Proceedings of the 48th Annual Precise Time and Time Interval Systems and Applications Meeting, 48 (2017)

5. *ZEUS-2D simulations of laser-driven radiative shock experiments*
D.R. Leibrandt, R.P. Drake, and J.M. Stone
Astrophys. Space Sci. **298**, 273 (2005)

4. *Progress toward the study of laboratory scale, astrophysically relevant, turbulent plasmas*
C.C. Kuranz, R.P. Drake, **D.R. Leibrandt**, E.C. Harding, H.F. Robey, A.R. Miles, B.E. Blue, J.F. Hansen, H. Louis, M. Bono, J. Knauer, D. Arnett, and C.A. Meakin
Astrophys. Space Sci. **298**, 9 (2005)

3. *The effect of a short-wavelength mode on the evolution of a long-wavelength perturbation driven by a strong blast wave*
A.R. Miles, M.J. Edwards, B. Blue, J.F. Hansen, and H.F. Robey, R.P. Drake, C. Kuranz, and **D.R. Leibrandt**
Phys. Plasmas **11**, 5507 (2004)

2. *Numerical simulation of supernova-relevant laser-driven hydro experiments on OMEGA*
A.R. Miles, D.G. Braun, M.J. Edwards, H.F. Robey, R.P. Drake, and **D.R. Leibrandt**
Phys. Plasmas **11**, 3631 (2004)

1. *Nonlinear mixing behavior of the three-dimensional Rayleigh-Taylor instability at a decelerating interface*
R.P. Drake, **D.R. Leibrandt**, E.C. Harding, C.C. Kuranz, M. Blackburn, H.F. Robey, B.A. Remington, M.J. Edwards, A.R. Miles, T.S. Perry, R.J. Wallace, H. Louis, J.P. Knauer, and D. Arnett
Phys. Plasmas **11**, 2829 (2004)

Invited talks

55. *Four-second optical coherence between different atomic species, and the search for new physics with atomic clocks*
Quantum Sensors and Tests of New Physics
Hannover, Germany, October 7, 2022

54. *Four-second optical coherence between different atomic species, and the search for new physics with atomic clocks*
ETH AMO Seminar
Zurich, Switzerland, October 4, 2022

53. *Four-second optical coherence between different atomic species, and the search for new physics with atomic clocks*
ICAP
Toronto, Canada, July 21, 2022

52. *Four-second optical coherence between different atomic species, and the search for new physics with atomic clocks*
DAMOP
Orlando, FL, June 1, 2022

51. *Precision spectroscopy and quantum control as tools for new physics discovery*
Ludwig Maximilian University AMO Seminar
Munich, Germany, April 28, 2022

50. *Optical clock networks as a tool for new physics discovery*
APS April Meeting
New York, NY, April 10, 2022

49. *Quantum science and the search for new physics with atomic and molecular ions*
UCLA AMO Seminar
Virtual, February 25, 2022

48. *Four-second optical coherence between different atomic species, and the search for new physics with atomic clocks*
University of Colorado Physics Colloquium
Boulder, CO, December 8, 2021

47. *Four-second optical coherence between different atomic species, and the search for new physics with atomic clocks*
European Conference on Trapped Ions (ECTI)
Virtual, November 24, 2021

46. *The NIST quantum-logic clock and its vacuum performance*
American Vacuum Society Symposium
Virtual, October 27, 2021

45. *Trapped ion clocks meet many-body physics: a love story*
Novel movements for clocks and sensors workshop
Virtual, September 20, 2021

44. *Precision frequency comb spectroscopy of single molecular ions*
CLEO Europe
Virtual, June 22, 2021

43. *Quantum logic and precision measurements with atomic and molecular ions*
UCLA AMO Seminar
Virtual, April 2, 2021

42. *Optical oscillators (tutorial)*
Precise Time and Time Interval Systems and Applications Meeting
Virtual, January 26, 2021

41. *Quantum logic and precision measurements with atomic and molecular ions*
Garchinger Maier-Leibnitz Kolloquium
Virtual, January 21, 2021

40. *Frequency ratio measurements with 18-digit accuracy using optical clocks*
Seminar on Precision Physics and Fundamental Symmetries
Virtual, August 27, 2020

39. *Optical atomic clocks and their applications (tutorial)*
IEEE International Frequency Control Symposium
Virtual, July 19, 2020

38. *Quantum metrology at the 19^{th} decimal place*
DAMOP
Virtual, June 1, 2020

37. *Quantum metrology algorithms for optical clock applications*
NIST Time and frequency division seminar
Boulder, CO, April 30, 2020

36. *Quantum metrology at the 19^{th} decimal place*
Berkeley AMO seminar
Berkeley, CA, February 3, 2020

35. *Quantum metrology at the 19^{th} decimal place*
University of Colorado physics colloquium
Boulder, CO, November 13, 2019

34. *Quantum logic and precision measurements with atomic and molecular ions*
Oregon OMQ seminar
Eugine, OR, October 4, 2019

33. *Quantum logic and precision measurements with atomic and molecular ions*
Quantum Metrology and Physics Beyond the Standard Model
Hannover, Germany, June 11–14, 2019

32. *Quantum logic and precision measurements with atomic and molecular ions*
WIPM seminar
Wuhan, China, April 30, 2019

31. *Quantum logic and precision measurements with atomic and molecular ions*
HUST seminar
Wuhan, China, April 29, 2019

30. *The Boulder optical clock network: clock uncertainty below 10^{-18} and ratio uncertainty below 10^{-17}*
International Conference on Precision Measurements
Wuhan, China, April 29–30, 2019

29. *Quantum logic and precision measurements with atomic and molecular ions*
NICT seminar
Tokyo, Japan, April 26, 2019

28. *Quantum logic and precision measurements with atomic and molecular ions*
RIKEN seminar
Tokyo, Japan, April 25, 2019

27. *Clock uncertainty below 10^{-18} and comparison uncertainty below 10^{-17}*
ISSI Workshop on Geodesy
Bern, Switzerland, March 25–28, 2019

26. *An Al^+ quantum-logic clock with uncertainty below 10^{-18}*
SPIE Photonics West
San Francisco, CA, February 2–7, 2019

25. *Quantum logic and precision measurements with atomic and molecular ions*
UMD/NIST JQI Seminar
College Park, MD, November 8, 2018

24. *Quantum logic and precision measurements with atomic and molecular ions*
MIT/Harvard CUA Seminar
Cambridge, MA, September 11, 2018

23. *Exploring physics beyond the standard model with the NIST $^{27}Al^+$ quantum-logic clock*
Marcel Grossmann Meeting
Rome, Italy, July 1–7, 2018

22. *Trapped ion optical atomic clocks and quantum logic spectroscopy*
NIST Time and Frequency Metrology Seminar
Boulder, CO, June 12–15, 2018

21. *Approaching quantum limits in the NIST Al^+ optical atomic clock*
Institute for Quantum Optics and Quantum Information
Innsbruck, Austria, October 2, 2017

20. *Optical clock protocols for Heisenberg-limited stability*
BIPM Workshop on "The Quantum Revolution in Metrology"
Paris, France, September 28–29, 2017

19. *Laser frequency stabilization based on steady-state spectral-hole burning in* $Eu^{3+}:Y_2SiO_5$
International Union of Radio Science General Assembly and Scientific Symposium
Montreal, Canada, August 19–26, 2017

18. *Laser local oscillators for optical frequency standards*
Joint Conference of the IEEE IFCS and the EFTF
Besançon, France, July 9, 2017

17. *Trapped ion optical atomic clocks and quantum logic spectroscopy*
NIST Time and Frequency Metrology Seminar
Boulder, CO, June 6–9, 2017

16. *Trapped-ion optical atomic clocks at the quantum limits*
Precise Time and Time Interval Systems and Applications Meeting
Monterey, CA, January 31, 2017

15. *Laser frequency stabilization based on steady-state spectral-hole burning in* $Eu^{3+}:Y_2SiO_5$
Winter Colloquium on the Physics of Quantum Electronics
Snowbird, UT, January 10, 2017

14. *Optical Atomic Clocks as Probes of Fundamental Physics*
Meeting on CPT and Lorentz Symmetry
Bloomington, IN, June 22, 2016

13. *Trapped ion optical atomic clocks and quantum logic spectroscopy*
NIST Time and Frequency Metrology Seminar
Boulder, CO, June 7–10, 2016

12. *The NIST* Al^+ *quantum logic clock*
Symposium on Frequency Standards and Metrology
Potsdam, Germany, October 12–16, 2015

11. *Trapped ion optical atomic clocks and quantum logic spectroscopy*
NIST Time and Frequency Metrology Seminar
Boulder, CO, June 2–5, 2015

10. *The NIST* Al^+ *quantum logic clock*
PTB Optics Division Seminar
Braunschweig, Germany, September 22, 2014

9. *The NIST* Al^+ *quantum logic clock*
European Conference on Trapped Ions
Mainz, Germany, September 15–19, 2014

8. *Optical clocks and laser stabilization using rare earth crystals* (2 lectures)
CIPRIS Summer School
Lund, Sweeden, August 25–29, 2014

7. *Optical atomic clocks - measurement at the 17th decimal place* (keynote)
IEEE International Instrumentation and Measurement Technology Conference (I2MTC)
Montevideo, Uruguay, May 12–15, 2014

6. *Trapped ion optical atomic clocks and quantum logic spectroscopy*
NIST Time and Frequency Metrology Seminar
Boulder, CO, June 3–6, 2014

5. *Ultra-stable laser local oscillators*
American Control Conference
Washington, DC, June 17–19, 2013

4. *Laser local oscillators for optical atomic clocks*
NIST Time and Frequency Metrology Seminar
Boulder, CO, June 4–7, 2013

3. *Ultra-stable laser local oscillators*
   Frontiers in Optics / Laser Science XXVIII
   Rochester, NY, October 14–18, 2012
2. *Field test of a robust, portable, ultra-stable laser*
   Optical Clocks Workshop
   Torino, Italy, December 1–3, 2010
1. *Experiments and ideas in trapped ion cavity QED*
   Workshop on Integrated Atomic Systems II
   Seattle, WA, February 18–19, 2009

Outreach

- Designed a general-purpose FPGA-based digital servo for feedback control of lasers in atomic, molecular, and optical physics experiments. Distributed hardware, firmware, and software freely and openly, and facilitated tech transfer to a company that sells complete hardware boxes. Have provided help to more than 20 atomic physics groups who have adapted these servos in their labs. Hundreds of copies are known to be in use in groups across the globe.
- Lectured annually at the NIST Time and Frequency Seminar from 2013 to 2020 – a 4 day course tailored for engineers, corporate managers, and funding program managers on clocks, oscillators, atomic frequency standards, rf and optical synchronization, optical oscillators, quantum information, optical cooling and heating; making precise frequency, time, phase-noise, and jitter measurements; and establishing measurement accuracy and traceability.
- Have given tutorial lectures at the IEEE International Frequency Control Symposium, the European Frequency and Time Forum, the Precise Time and Time Interval Systems and Applications Meeting, and the CIPRIS Summer School.

Last updated January 21, 2023.