Gregory B. Rieker

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Assistant Professor, Mechanical Engineering **August 2013 – Present**
University of Colorado-Boulder *Boulder, Colorado*

Co-founder **April 2018 – Present**
LongPath Technologies, Inc. (spin-out from lab) *Boulder, Colorado*

Joint and Courtesy Appointments
National Institute of Standards and Technology
National Renewable Energy Laboratory

Expertise: Diagnostics for Harsh Environments, Lasers, Combustion, Design, Energy Systems, Industrial Systems, Atmospheric Systems

AWARDS

Peter Werle Early Career Scientist Award **September 2018**
Woodward Outstanding Faculty Award **August 2018**
Research and Innovation Faculty Fellowship **December 2017**
Vogel Family Faculty Fellowship **December 2017**
National Science Foundation CAREER Award **March 2015**
National Research Council (NRC) Research Associateship **March 2012**

EDUCATION

Doctor of Philosophy in Mechanical Engineering **June 2009**
Stanford University (Advisor: R. K. Hanson) *Stanford, California*
Thesis: Wavelength-Modulation Spectroscopy for Measurements of Gas Temperature and Concentration in Harsh Environments

Master of Science in Mechanical Engineering **September 2004**
Stanford University *Stanford, California*
Focus: Thermosciences

Bachelor of Science in Mechanical Engineering **December 2002**
Missouri University of Science and Technology *Rolla, Missouri*
Summa Cum Laude, Honors Scholar in Engineering

PRIOR PROFESSIONAL EXPERIENCE

National Research Council Research Associate **July 2012 – August 2013**
National Institute of Standards and Technology (Advisor: N. Newbury) *Boulder, Colorado*
- Development of frequency comb spectrometers for gas-phase measurements in atmospheric systems

Co-Founder, Scientist **2010 – 2012**
Fluence, LLC *Newark, California*

- Design and experimental characterization of a compact, high-energy plasma accelerator for medical applications

Postdoctoral Fellow **June 2009 – December 2009, September 2011 – January 2012**
Stanford University (Advisor: M.A. Cappelli) *Stanford, California*

- Development of optical emission and solid-state nuclear track diagnostics for particle velocity and contaminant identification in plasma accelerators

PEER-REVIEWED PUBLICATIONS

*Graduate student in Rieker lab
**Postdoc / Research staff in Rieker lab

28. C. Alden**, S. Coburn**, R. Wright**, E. Baumann, K. Cossel, E. Perez, E. Hoenig, K. Prasad, I. Coddington, and **G. Rieker**, "Single-blind quantification of natural gas leaks from 1 km distance using frequency combs," accepted Environmental Science and Technology.

27. N. Hoghooghi**, R. Wright**, A. Makowiecki*, W. Swann, E. Waxman, I. Coddington, and **G. Rieker**, "Coherent broadband cavity-enhanced dual-comb spectroscopy for detection of multiple gas species," Optica 6, 28 (2019).

26. S. Coburn**, C. Alden**, R. Wright**, K. Cossel, G. Truong, E. Baumann, F. Giorgetta, C. Sweeney, N. Newbury, K. Prasad, I. Coddington, and **G. Rieker**, "Regional trace-gas source attribution using a field-deployed dual frequency comb spectrometer," Optica 5, 320 (2018).

25. J. Christopher*, N. Wimer, C. LaPointe, T. Hayden*, I. Grooms, **G. Rieker**, and P. Hamlington, "Parameter estimation for complex thermal-fluid flows using approximate Bayesian computation," Physical Review Fluids 3, 104602 (2018).

24. J. Yang*, P. Schroeder*, M. Cich, B. Drouin, F Giorgetta, W.C. Swann, I. Coddington, N. Newbury, and **G. Rieker**, "Speed-dependent Voigt Lineshape Parameter Database from Dual Frequency Comb Measurements up to 1305K. Part II: Argon-broadened H_2O Absorption, 6801-7188 cm^{-1}," Journal of Quantitative Spectroscopy and Radiative Transfer 217, 189 (2018).

23. T. Hayden*, D. Petrykowski*, A. Sanchez*, S. Nigam, C. Lapointe, J. Christopher*, N. Wimer, A. Upadhye, M. Strobel, P. Hamlington, and **G. Rieker**, "Characterization of OH, H_2O, and temperature profiles in industrial flame treatment systems interacting with polymer films," Proceedings of the Combustion Institute (indexed, peer reviewed), in press: https://doi.org/10.1016/j.proci.2018.05.058.

22. P. Schroeder*, M. Cich, J. Yang*, F Giorgetta, W.C. Swann, I. Coddington, N. Newbury, B. Drouin, and **G. Rieker**, "Speed-dependent Voigt Lineshape Parameter Database from Dual Frequency Comb Measurements up to 1305K. Part I: Pure H_2O Absorption, 6801-7188 cm^{-1}," Journal of Quantitative Spectroscopy and Radiative Transfer 210, 240 (2018).

21. C. Alden**, S. Ghosh, S. Coburn**, C. Sweeney, A. Karion, R. Wright**, I. Coddington, **G. Rieker,** and K. Prasad, "Bootstrap inversion technique for atmospheric trace gas source detection and quantification using long open-path laser measurements," Atmospheric Measurement Techniques 11, 1565 (2018).

20. E. Mitchell, M. Hoehler, F. Giorgetta, T. Hayden*, **G. Rieker**, N. Newbury, E. Baumann, "Coherent laser ranging for precision imaging through flames," Optica 5, 988 (2018).

19. P. Schroeder*, M. Cich, J. Yang*, W. Swann, I. Coddington, N. Newbury, B. Drouin, and **G. Rieker**, "Broadband, high-resolution investigation of advanced absorption lineshapes at high temperature," Physical Review A 96, 022514 (2017).

18. P. Schroeder*, D. Pfotenhauer*, J. Yang*, F. Giorgetta, W. Swann, I. Coddington, N. Newbury, and **G. Rieker**, "High temperature comparison of the HITRAN2012 and HITEMP2010 water vapor absorption databases to frequency comb measurements," Journal of Quantitative Spectroscopy and Radiative Transfer 203, 194–205 (2017).

17. K. Cossel, E. Waxman, F. Giorgetta, M. Cermak, I. Coddington, D. Hesselius, S. Ruben, W. Swann, G. Truong, **G. Rieker**, and N. Newbury, "Spatially-scanned open-path dual comb spectroscopy to an airborne retroreflector," Optica 4, 724-728 (2017).

16. E. Waxman, K. Cossel, G. Truong, F. Giorgetta, W. Swann, S. Coburn**, R. Wright**, **G. Rieker**, I. Coddington, and N. Newbury, "Comparison of open-path dual frequency comb spectroscopy for high-precision atmospheric gas measurements," Atmospheric Measurement Techniques 10, 3295-3311 (2017).

15. P. Schroeder*, R. Wright**, S. Coburn**, B. Sodergren*, K.C. Cossel, S. Droste, G.W. Truong, E. Baumann, F.R. Giorgetta, I. Coddington, N.R. Newbury, and **G.B. Rieker**, "Dual Frequency Comb Laser Absorption Spectroscopy in a 16 MW Gas Turbine Exhaust," Proceedings of the Combustion Institute 36 (indexed, peer reviewed), 4565–4573 (2017).

14. T. Hayden*, **G. Rieker**, "Large Amplitude Wavelength Modulation Spectroscopy for Sensitive Measurements of Broad Absorbers," Optics Express 24, 27910 (2016).

13. F. Giorgetta, **G. Rieker**, E. Baumann, W. C. Swann, L. C. Sinclair, J. Kofler, I. Coddington, and N. R. Newbury, "Broadband Phase Spectroscopy over Turbulent Air Paths," Physical Review Letters 115, 103901 (2015).

12. **G. Rieker**, F. Giorgetta, W. Swann, J. Kofler, A. Zolot, L. Sinclair, E. Baumann, C. Cromer, G. Petron, C. Sweeney, P. Tans, I. Coddington, N. Newbury, "Frequency Comb-Based Remote Sensing of Greenhouse Gases over Kilometer Air Paths," Optica 1, 290-298 (2014).

11. L. Sinclair, I. Coddington, W. Swann, **G. Rieker**, A. Hati, K. Iwakuni, and N. Newbury, "Operation of an Optically Coherent Frequency Comb Outside the Metrology Lab," Optics Express 22, 6996 (2014).

10. **G. Rieker**, F. Poehlmann, and M. Cappelli, "A Thomson-type mass and energy spectrometer for characterizing ion energy distributions in a coaxial plasma gun operating in a gas-puff mode," Physics of Plasmas 20, 073115 (2013).

9. F. Poehlmann, M. Cappelli, and **G. Rieker**, "Current Distribution Measurements Inside an Electromagnetic Plasma Gun Operated in a Gas-puff Mode," Physics of Plasmas 17, 123508 (2010).

8. **G. Rieker**, J. Jeffries, and R. Hanson, "Calibration-Free Wavelength Modulation Spectroscopy for Measurements of Gas Temperature and Concentration in Harsh Environments," Applied Optics 48, 5546-5560 (2009).

7. **G. Rieker**, J. Jeffries, R. Hanson, M. Gruber, T. Mathur, and C. Carter, "Diode Laser-based Detection of Combustor Instabilities with Application to a Scramjet Engine," Proceedings of the Combustion Institute 32 (indexed, peer reviewed), 831-838 (2009).

6. **G. Rieker**, J. Jeffries, R. Hanson, "Measurements of High-pressure CO_2 Absorption Near 2.0 μm and Implications on Sensor Design," Applied Physics B 94, 51-63 (2009).

5. **G. Rieker**, H. Li, J. Jeffries, R. Hanson, M. Allen, S. Wehe, P. Mullhall, and H. Kindle, "A Diode Laser Sensor for Rapid, Sensitive Measurements of Gas Temperature and Water Vapor Concentration at High Temperatures and Pressures," Measurement Science and Technology 18, 1195-1204 (2007).

4. **G. Rieker**, H. Li, X. Liu, J.T.C. Liu, J. Jeffries, R. Hanson, M. Allen, S. Wehe, P. Mulhall, H. Kindle, A. Kakulo, K. Sholes, T. Matsuura, and S. Takatani, "Rapid Measurements of Temperature and H2O Concentration in IC Engines with a Spark Plug-Mounted Diode Laser Sensor," Proceedings of the Combustion Institute 31 (indexed, peer reviewed), 3041-3049 (2007).

3. **G. Rieker**, X. Liu, H. Li, J. Jeffries, and R. Hanson, "Measurements of Near-IR Water Vapor Absorption at High Pressure and Temperature," Applied Physics B 87, 169-178 (2007).

2. H. Li, **G. Rieker**, X. Liu, J. Jeffries, and R. Hanson, "Extension of Wavelength Modulation Spectroscopy to Large Modulation Depth for Diode Laser Absorption Measurements in High-Pressure Gases," Applied Optics 45, 1052-1061 (2006).

1. J.T.C. Liu, **G. Rieker**, J. Jeffries, R. Hanson, M. Gruber, T. Mathur, and C. Carter, "Near-Infrared Diode Laser Absorption Diagnostic for Temperature and Water Vapor in a Scramjet Combustor," Applied Optics 44, 6701-6711 (2005).

SUBMITTED MANUSCRIPTS

A. Draper*, R. Cole*, J. Mohr, A. Zdanawicz, A. Marchese, N. Hoghooghi**, and **G. Rieker**, "Broadband Dual Frequency Comb Spectroscopy in a Rapid Compression Machine," in revision.

T. Hayden*, C. Lapointe, N. Wimer, J. Christopher*, A. Upadhye, M. Strobel, P. Hamlington, and **G. Rieker**, "Characterization of a buoyant jet from a catalytic combustor using wavelength modulation spectroscopy," in review.

N. Malarich* and **G. Rieker**, "Resolving nonuniform temperature distributions with single-beam absorption spectroscopy I) Theoretical capabilities and limitations," submitted.

T. Hayden*, N. Malarich*, D. Petrykowski*, S. Nigam, J. Christopher*, C. LaPointe, N. Wimer, A. Upadhye, M. Strobel, P. Hamlington, and **G. Rieker**, "OH radical measurements in combustion environments using wavelength modulation spectroscopy and dual frequency comb spectroscopy near 1491 nm," submitted.

N. Wimer, M. Day, C. Lapointe, A. Makowiecki*, J. Glusman, J. Daily, **G. Rieker**, and P. Hamlington, "High-Resolution Numerical Simulations of a Large-Scale Helium Plume Using Adaptive Mesh Refinement," submitted.

PATENTS

C. Alden**, K. Prasad, S. Coburn**, R. Wright**, **G. Rieker**, "Apparatus and Methods for Location and Sizing of Trace Gas Sources," U.S. Application No: PCT/17/57234; Filed October 18, 2017.

K. Prasad, C. Alden**, S. Ghosh, **G. Rieker**, R. Wright**, S. Coburn**, "Determing a Location and Size of Gas Source with a Spectrometer Gas Monitor," U.S. Application No: 15/729,079; Filed October 10, 2017. *(patent allowed, awaiting number)*

G. Rieker, I. Coddington, N. Newbury, K. Prasad, A. Karion, "Hub And Spoke System For Detecting And Locating Gas Leaks," U.S. Application No: 15/152,543; Filed May 12, 2016. *(patent allowed, awaiting number)*

F. Poehlmann, M. Cappelli, **G. Rieker**, "Method and Apparatus for Inductive Amplification of Ion Beam Energy," U.S. Patent No: 8,558,461; Issued October 15, 2013.

G. Rieker, V. Vasudevan, U. Kumar, W. Croisettier, W. Bragg, G. Mekikian, R. Whyte, "Method and Apparatus to Prevent Esophageal Damage," U.S. Patent No: 8,454,588; Issued June 4, 2013.

CONFERENCE PRESENTATIONS (Oral, with proceedings as indicated)

25 invited, 36 with proceedings

87. (Invited) G. Rieker, "Multi-facility methane leak detection with a long-distance frequency comb laser system," *EUCI Stakeholder Symposium on Mitigating Methane Emissions*, Los Angeles, CA, March 2019.

86. A. Draper*, R. Cole*, J. Mohr, A. Zdanawicz, C. Gould, A. Marchese, N. Hoghooghi**, and **G. Rieker**, "Progress Toward Dual Frequency Comb Spectroscopy in a Rapid Compression Machine," *AIAA Science and Technology Exhibition and Forum*, San Diego, CA, January 2019 (w/ proceedings).

85. (Invited) **G. Rieker**, R. Cole*, N. Hoghooghi**, and A. Draper*, "Dual-frequency comb spectroscopy for dynamic, high-pressure combustion systems," *Fourier Transform Spectroscopy*, Singapore, Singapore, November 2018.

84. J. Christopher*, D. Petrykowski*, T. Hayden*, C. Lapointe, N. Wimer, S. Nigam, I. Grooms, P. Hamlington, and **G. Rieker**, "Parameter Estimation using Wavelength Modulation Spectroscopy Temperature Measurements and Approximate Bayesian Computation," *OSA Optics and Photonics for Energy & the Environment (E2),* Singapore, Singapore, November 2018 (w/ proceedings).

83. R. Cole*, A. Draper*, P. Schroeder*, and **G. Rieker**, "Dual Frequency Comb Absorption Spectroscopy of Extreme Pressure and Temperature Environments," *Field Laser Applications in Industry and Research (FLAIR),* Assisi, Italy, September 2018.

82. C. Alden**, S. Coburn**, R. Wright**, A. Rybchuk*, G. Wendland**, K. Cossel, E. Baumann, K. Prasad, I. Coddington, and **G. Rieker**, "New monitoring and detection methodology for methane emissions from oil and gas," *2nd annual National Enforcement Investigation Center (NEIC) Technical Information Exchange*, Denver, CO, August 2018.

81. I. Coddington, G. Truong, E. Waxman, K. Cossel, P. Schroeder*, R. Wright**, S. Coburn**, C. Alden**, E. Baumann, F. Giorgetta, W. Swann, **G. Rieker**, N.R. Newbury, "Dual-comb spectroscopy for precision green-house gas measurement", *24th International Conference on Optics*, Tokyo, Japan, August 2018.

80. T. Hayden*, D. Petrykowski*, A. Sanchez*, S. Nigam, C. Lapointe, J. Christopher*, N. Wimer, A. Upadhye, M. Strobel, P. Hamlington, and **G. Rieker**, "Characterization of OH, H2O, and temperature profiles in industrial flame treatment systems interacting with polymer films," *37th International Symposium on Combustion*, Dublin, Ireland, July 2018.

79. N. Malarich* and **G. Rieker**, "Theoretical limits of nonuniform temperature retrievals with single-beam absorption spectroscopy," *Laser Applications to Chemical, Security and Environmental Analysis (LACSEA),* Orlando, FL, July 2018 (w/ proceedings).

78. (Invited) **G. Rieker**, S. Coburn**, C. Alden**, R. Wright**, S. Conley, I. Faloona, K. Prasad, and I. Coddington, "Dual Frequency Comb Methane Leak Detection at Operational Oil and Gas Facilities," *73nd International Symposium on Molecular Spectroscopy*, Champaign-Urbana, IL, June 2018.

77. R. Cole*, P. Schroeder*, A. Draper*, M. Cich, B. Drouin, and **G. Rieker**, "Dual Frequency Comb Spectroscopy for Development and Testing of High Pressure, High Temperature Absorption Models," *73nd International Symposium on Molecular Spectroscopy*, Champaign-Urbana, IL, June 2018.

76. E. Waxman, K. Cossel, F. Giorgetta, G. Truong, M. Cermak, W. Swann, D. Hesselius, **G. Rieker**, N. Newbury, I. Coddington, "Dynamic Regional and City Scale Sensing of GHG's using a Dual-comb Spectrometer," *73nd International Symposium on Molecular Spectroscopy*, Champaign-Urbana, IL, June 2018.

75. (Invited) **G. Rieker**, P. Schroeder*, R. Cole*, J. Yang*, A. Draper*, M. Cich, B. Drouin, "Frequency Comb Lasers in High-temperature Spectroscopy: Spectral Database Development to Practical Field Measurements," *15th International HITRAN conference*, Cambridge, MA, June 2018.

74. (Invited) **G. Rieker**, S. Coburn**, C. Alden**, R. Cole*, A. Draper*, P. Schroeder*, R. Wright**, I. Coddington, K. Cossel, E. Baumann, K. Prasad, N. Newbury, "Novel Uses of Stabilized Optical Frequency Combs: from Regional Methane Leak Source Identification to Diagnostics for Extreme Combustion," *IEEE International Frequency Control Symposium*, Squaw Valley, CA, May 2018.

73. (Invited) N. Hoghooghi**, R. Wright**, W. Swann, I. Coddington, N. Newbury, and **G. Rieker**, "Sensitive Detection of Multiple Gas Species using a Cavity Enhanced Dual-Comb Spectrometer," *CLEO 2018*, San Jose, CA, May 2018 (w/ proceedings).

72. S. Coburn**, C. Alden**, R. Wright**, E. Baumann, K. Cossel, N. Newbury, K. Prasad, I. Coddington, and **G. Rieker**, "Quantifying methane emissions among simulated gas wells with a dual-frequency comb spectrometer," *CLEO 2018*, San Jose, CA, May 2018 (w/ proceedings).

71. C. Alden**, S. Coburn**, R. Wright**, E. Baumann, K. Cossel, C. Sweeney, A. Karion, I. Coddington, **G. Rieker**, "Single-blind testing of a regional, continuous monitoring system for finding methane leaks from oil and gas operations," *NOAA/ESRL Laboratory Global Monitoring Annual Conference*, Boulder, CO, May 2018.

70. N. Wimer, A. Makowiecki*, J. Glusman, A. Poludnenko, C. Hoffman, J. Daily, **G. Rieker**, and P. Hamlington, "Direct Numerical Simulation of a Turbulent Helium Plume and Methane Pool Fire," *The Fire Continuum Conference*, Missoula, MT, May 2018.

69. I. Coddington, K. Cossel, E. Waxman, F. Giorgetta, M. Cermak, D. Hesselius, S. Ruben, W. Swann, G. Truong, **G. Rieker**, and N. Newbury, "Regional sensing with an open-path dual comb spectroscopy and a UAS," *SPIE Defense + Security*, Orlando, FL, April 2018.

68. I. Coddington, C. Alden**, E. Baumann, S. Coburn**, K. Cossel, F. Giorgetta, D. Herman, K. Prasad, N. Newbury, **G. Rieker**, E. Waxman, R. Wright**, G. Ycas, "Fiber frequency combs for remote sensing", *SPIE Photonics Europe*, Srasbourg, France, April 2018.

67. P. Schroeder*, M. Cich, J. Yang*, B. Drouin, R. Cole*, A. Draper*, and **G. Rieker**, "Study of High Temperature Absorption Lineshapes using Frequency Comb Lasers," *Western States Section Combustion Institute (WSSCI) Spring Meeting*, Bend, OR, March 2018 (w/ proceedings).

66. J. Glusman, A. Makowiecki*, N. Wimer, K. Niemeyer, **G. Rieker**, P. Hamlington, J. Daily, "A Chemical Kinetic Mechanism Reduction and Pyrolysis Model for Wildland Fire Direct Numerical Simulation," *Western States Section Combustion Institute (WSSCI) Spring Meeting*, Bend, OR, March 2018 (w/ proceedings).

65. N. Wimer, A. Mackowiecki*, J. Glusman, A. Poludnenko, C. Hoffman, J. Daily, **G. Rieker**, and P. Hamlington, "Examination of Wildland Fire Spread at Small Scales Using Direct Numerical Simulations and High-Speed Laser Diagnostics," *American Geophysical Union Fall Meeting*, New Orleans, LA, December 2017.

64. (Invited) S. Coburn**, C. Alden**, R. Wright**, K. Cossel, E. Baumann, F. Giorgetta, G. Truong, N. Newbury, I. Faloona, S. Conley, S. Ghosh, K. Prasad, I. Coddington, and **G.**

Rieker, "Quantification of Variable Trace Gas Emissions across Large Regions using a Field-deployed Dual-comb Spectrometer", *OSA Optics and Photonics for Energy & the Environment (E2)*, Boulder, CO, November 2017 (w/ proceedings).

63. (Invited) **G. Rieker**, "Prospects for Laser-Based Sensing in Solar Reactors", *Optics for Solar Energy (SOLAR)*, Boulder, CO, November 2017.

62. T. Hayden*, N. Wimer, C. Lapointe, J. Christopher*, S. Nigam, P. Hamlington, **G. Rieker**, "Wavelength Modulation Spectroscopy of OH Radical in an Industrial Flame", *OSA Optics and Photonics for Energy & the Environment (E2),* Boulder, CO, November 2017 (w/ proceedings).

61. A. Makowiecki*, N. Wimer, J. Glusman, A. Poludnenko, C. Hoffman, J. Daily, P. Hamlington, and **G. Rieker**, "Examination of Wildland Fire Spread at Small Scales using Frequency Comb Laser Diagnostics and Direct Numerical Simulations," *7th International Fire Ecology and Management Conference Smoke Management and Modeling*, Orlando, FL, November, 2017.

60. J. Christopher*, N. Wimer, C. Lapointe, T. Hayden*, I. Grooms, **G. Rieker**, P. Hamlington, "A Parameter Estimation for a Pulsating Turbulent Buoyant Jet Using Approximate Bayesian Computation", *70th Annual Meeting of the APS Division of Fluid Dynamics*, Denver, CO, November 2017.

59. N. Wimer, A. Makowiecki*, A. Poludnenko, C. Hoffman, J. Daily, **G. Rieker,** P. Hamlington, "Direct Numerical Simulation of Wildland Fires at Small Scales", *70th Annual Meeting of the APS Division of Fluid Dynamics*, Denver, CO, November 2017.

58. S. Nigam, C. Lapointe, J. Christopher*, N. Wimer, T. Hayden*, **G. Rieker**, P. Hamlington, "Flame Structure and Dynamics for an Array of Pre-mixed Methane-Air Jets," *70th Annual Meeting of the APS Division of Fluid Dynamics*, Denver, CO, November 2017.

57. (Invited) **G. Rieker**, "Tackling the Grand Challenge of Fugitive Methane Emissions from Oil and Gas Production," *21st Century Energy Transition Symposium*, Fort Collins, CO, October 2017.

56. N. Wimer, A. Makowiecki*, A. Poludnenko, C. Hoffman, J. Daily, **G. Rieker,** P. Hamlington, "Direct Numerical Simulation of Wildland Fires at Small Scales", *Western States Section Combustion Institute (WSSCI) Fall Meeting*, Laramie, WY, October 2017 (w/ proceedings).

55. (Invited) **G. Rieker**, "Frequency Combs in Combustion," *Gordon Conference on Laser Diagnostics in Combustion,* Mt. Snow, VT, August 2017.

54. A. Draper*, R. Cole*, P. Schroeder*, **G. Rieker**, "Design and Evaluation of a High-Temperature and High-Pressure Spectroscopic Cell", *Rocky Mountain Fluids Meeting*, Boulder, CO, August 2017.

53. A. Makowiecki*, T. Hayden*, M. Nakles, N. Pilgram, N. MacDonald, W. Hargus, **G. Rieker**, "Wavelength modulation spectroscopy for measurements of temperature and species

concentration downstream from a supersonic nozzle," *53rd AIAA/SAE/ASEE Joint Propulsion Conference*, 2017 AIAA Propulsion and Energy Forum and Exposition, Atlanta, GA, July 2017 (w/ proceedings).

52. P. Schroeder*, M. Cich, J. Yang*, B. Drouin, **G. Rieker**, "Multispectral fitting validation of the speed dependent Voigt profile at up to 1300K in water vapor with a dual frequency comb spectrometer", *72nd International Symposium on Molecular Spectroscopy*, Champaign-Urbana, IL, June 2017.

51. T. Hayden*, N. Wimer, C. Lapointe, J. Christopher*, P. Hamlington, **G. Rieker**, "Characterization of the Output from a Catalytic Combustor Using Wavelength Modulation Spectroscopy", *2017 AIAA Aviation and Aeronautics Forum and Exposition (AIAA AVIATION Forum)*, Denver, CO, June 2017 (w/ proceedings).

50. J. Christopher*, C. Lapointe, T. Hayden*, N. Wimer, I. Grooms, **G. Rieker**, P. Hamlington, "Parameter Estimation for a Turbulent Buoyant Jet with Rotating Cylinder Using Approximate Bayesian Computation", *Computational Fluid Dynamics Conference*, Denver, CO, June 2017.

49. C. Lapointe, J. Christopher*, N. Wimer, T. Hayden*, **G. Rieker**, P. Hamlington, "Optimization for Internal Turbulent Compressible Flows Using Adjoints", *2017 AIAA Aviation and Aeronautics Forum and Exposition (AIAA AVIATION Forum)*, Denver, CO, June 2017 (w/ proceedings).

48. N. Wimer, C. Lapointe, T. Hayden*, J. Christopher*, **G. Rieker**, P. Hamlington, "Near- and Far-Field Properties of High-Temperature Turbulent Buoyant Jets", *2017 AIAA Aviation and Aeronautics Forum and Exposition (AIAA AVIATION Forum)*, Denver, CO, June 2017 (w/ proceedings).

47. (Invited) **G. Rieker**, "Methane Leak Detection with Fielded Frequency Comb Lasers," *CLEO 2017*, San Jose, CA, May 2017.

46. N. Malarich*, **G. Rieker**, "Resolving gas temperature distributions with single-beam dual-comb absorption spectroscopy," *CLEO 2017*, San Jose, CA, May 2017 (w/ proceedings).

45. P. Schroeder*, D. Pfotenhauer*, J. Yang*, F. Giorgetta, W. Swann, I. Coddington, N. Newbury, **G. Rieker**, "Comparison of dual frequency comb absorption spectra of air-broadened water vapor up to 1300K with HITRAN Online and HITEMP 2010 Models," *CLEO 2017*, San Jose, CA, May 2017 (w/ proceedings).

44. T. Hayden*, C. Lapointe, N. Wimer, J. Christopher*, P. Hamlington, and **G. Rieker**, "Characterization of a Jet Above a Catalytic Combustor Using Wavelength Modulation Spectroscopy", *10th US National Combustion Meeting*, College Park, MD, April 2017 (w/ proceedings).

43. J. Christopher*, C. Lapointe, N. Wimer, T. Hayden*, I. Grooms, **G. Rieker**, and P. Hamlington, "Parameter Estimation for a Turbulent Buoyant Jet Using Approximate Bayesian Computation," *AIAA Science and Technology Exhibition and Forum*, Grapevine, TX, January 2017 (w/ proceedings).

42. A. Makowiecki*, T. Hayden*, M. Nakles, N. Pilgram, N. MacDonald, W. Hargus, and **G. Rieker**, "Wavelength Modulation Spectroscopy for Measurements of Temperature in a Simulated Thruster Plume," *JANNAF 8th Spacecraft Propulsion Meeting*, Phoenix, AZ, December 2016 (w/ proceedings).

41. T. Hayden* and **G. Rieker**, "Ultra-large amplitude wavelength modulation spectroscopy," *Optics and Photonics for Energy and the Environment (E2)*, Leipzig, Germany, November 2016 (w/ proceedings).

40. P. Schroeder*, J. Yang*, F. Giorgetta, W. Swann, I. Coddington, N. Newbury, and **G. Rieker**, "Dual frequency comb spectroscopy of high temperature water vapor: absorption model development for combustion sensors," *Fourier Transform Spectroscopy*, Leipzig, Germany, November 2016 (w/ proceedings).

39. (Invited) I. Coddington, G. Truong, E. Waxman, K. Cossel, P. Schroeder*, S. Coburn**, R. Wright**, F. Giorgetta, W. Swann, **G. Rieker**, and N. Newbury, "Dual-Comb spectroscopy for GHG quantification," *Optics and Photonics for Energy and the Environment (E2)*, Leipzig, Germany, November 2016 (w/ proceedings).

38. (Invited) E. Baumann, F. Giorgetta, **G. Rieker**, W. Swann, L. Sinclair, I. Coddington, G. Truong, K. Cossel, E. Waxman, and N. Newbury, "Dual Comb Outdoor Spectroscopy for Complex Molecular Response Retrieval." *Fourier Transform Spectroscopy*, Leipzig, Germany, November 2016 (w/ proceedings).

37. (Invited) **G. Rieker**, "Combustion and Environmental Science Applications of Fieldable Frequency Combs," *Field Laser Applications in Industry and Research (FLAIR)*, Aix-les-Bains, France, September 2016.

36. N. Wimer, C. Lapointe, T. Hayden*, J. Christopher*, **G. Rieker**, and P. Hamlington, "Effects of Exit Variability on Near-field Statistics for Turbulent Buoyant Jets," *69th Annual Meeting of the APS Division of Fluid Dynamics*, Portland, OR, November 2016.

35. J. Christopher*, N. Wimer, T. Hayden*, C. Lapointe, I. Grooms, **G. Rieker**, and P. Hamlington, "Parameter Estimation for a Turbulent Buoyant Jet Using Approximate Bayesian Computation," *69th Annual Meeting of the APS Division of Fluid Dynamics*, Portland, OR, November 2016.

34. C. Lapointe, N. Wimer, T. Hayden*, J. Christopher*, **G. Rieker**, and P. Hamlington, "Scaling Analysis of Temperature Variability Between a Rotating Cylinder and a Turbulent Buoyant Jet," *69th Annual Meeting of the APS Division of Fluid Dynamics*, Portland, OR, November 2016.

33. P. Schroeder*, R. Wright**, S. Coburn**, B. Sodergren, K. Cossel, S. Droste, G. Truong, E. Baumann, F. Giorgetta, I. Coddington, N. Newbury, and **G. Rieker**, "*Dual Frequency Comb Laser Absorption Spectroscopy in a 16 MW Gas Turbine Exhaust*," 36th International Symposium on Combustion, Seoul, South Korea, July 2016.

32. (Invited) **G. Rieker**, P. Schroeder*, S. Coburn**, C. Alden**, R. Wright**, K. Cossel, G. Truong, E. Baumann, F. Giorgetta, W. Swann, I. Coddington, and N. Newbury "Combustion diagnostics and chemical sensing with frequency comb lasers," Paper LW2G–1, *Laser Applications to Chemical, Security and Environmental Analysis (LACSEA),* Heidelberg, Germany, July 2016.

31. (Invited) **G. Rieker**, "Open-path Dual-comb Spectroscopy for Localizing Fugitive Gas Sources," *Laser Applications to Chemical, Security and Environmental Analysis (LACSEA),* Heidelberg, Germany, July 2016.

30. (Invited) **G. Rieker**, "Localizing Gas Sources with Kilometer-scale Open-path Dual-comb Spectroscopy and High-resolution Transport Modeling," *OSA Incubator on Precision Atmospheric Measurements,* Washington D.C., May 2016.

29. S. Coburn**, C. Alden**, R. Wright**, K. Cossel, G. Truong, E. Baumann, S. Ghosh, K. Prasad, N. Newbury, I. Coddington, and **G. Rieker**, "Dual frequency comb spectroscopy and atmospheric modeling for the detection of methane leaks at oil and gas production sites," *18th Coherent Laser Radar Conference*, Boulder, CO, June 2016.

28. S. Coburn**, R. Wright**, K. Cossel, G. Truong, E. Baumann, I. Coddington, N. Newbury, C. Alden**, S. Ghosh, K. Prasad, and **G. Rieker**, "Methane Detection for Oil and Gas Production Sites Using Portable Dual-comb Spectrometry," *71st International Symposium on Molecular Spectroscopy,* Champaign-Urbana, IL, June 2016.

27. K. Cossel, E. Waxman, G. Truong, F. Giorgetta, W. Swann, S. Coburn**, R. Wright**, **G. Rieker**, I. Coddington, and N. Newbury, "A portable dual frequency comb spectrometer for atmospheric applications," *71st International Symposium on Molecular Spectroscopy,* Champaign-Urbana, IL, June 2016.

26. (Invited) I. Coddington, G. Truong, E. Waxman, K. Cossel, P. Schroeder*, R. Wright**, S. Coburn**, B. Sodergren, F. Giorgetta, W. Swann, **G. Rieker**, and N. Newbury, "Frequency Comb Measurements Through Turbulent Paths," *CLEO 2016*, San Jose, CA, May 2016 (w/ proceedings).

25. K. Cossel, G. Truong, E. Waxman, E. Baumann, F. Giorgetta, **G. Rieker**, L. Sinclair, W. Swann, I. Coddington, and N. Newbury, "Long-path Atmospheric Measurements Using Dual Frequency Comb Spectroscopy," *American Geophysical Union Fall Meeting,* San Francisco, CA, Dec. 2015.

24. (Invited) **G. Rieker,** F. Giorgetta, W. Swann, P. Schroeder*, J. Kofler, L. Sinclair, E. Baumann, G. Petron, C. Sweeney, P. Tans, I. Coddington, and N. Newbury, "Precision atmospheric trace gas monitoring with frequency comb lasers," *Frontiers in Optics/Laser Science*, San Jose, CA, October 2015.

23. E. Baumann, F. Giorgetta, **G. Rieker**, L. Sinclair, I. Coddington, W. Swann, and N. Newbury, "Dual-comb Spectrometer for Direct Phase Spectroscopy of Greenhouse Gases across an Open Air Path," *Advanced Solid State Lasers*, Berlin, Germany, October 2015 (w/ proceedings).

22. P. Schroeder*, D. Pfotenhauer*, and **G. Rieker**, "Dual Frequency Comb Spectroscopy of High Temperature Water Vapor Absorption," *Rocky Mountain Fluid Mechanics Research Symposium*, Boulder, CO, August 2015.

21. (Invited) I. Coddington, **G. Rieker**, A. Klose, S. Diddams, F. Giorgetta, L. Sinclair, E. Baumann, G. Truong, G. Ycas, W. Swann, N. Newbury, "Dual-comb Spectroscopy in the Open Air," *International Symposium on Molecular Spectroscopy*, Champaign-Urbana, IL, June 2015.

20. F. Giorgetta, **G. Rieker**, L. Sinclair, E. Baumann, I. Coddington, W. C. Swann, and N. R. Newbury, "Phase Spectroscopy of Atmospheric Gases across a 2-km Open-Air Path by Dual-Comb Spectroscopy," *Imaging and Applied Optics 2015*, Arlington, VA, June 2015 (w/ proceedings).

19. **G. Rieker**, F. Giorgetta, W. Swann, L. Sinclair, C. Cromer, E. Baumann, I. Coddington, and N. R. Newbury, "Dual-Frequency Comb Measurements of Atmospheric Absorption: Comparison with HITRAN Database Parameters," *CLEO 2015*, San Jose, CA, May 2015 (w/ proceedings).

18. T. Hayden*, P. Schroeder*, and **G. Rieker**, "Large Amplitude Wavelength Modulation Spectroscopy for Sensitive Measurements of Broad Absorbers," *CLEO 2015*, San Jose, CA, May 2015 (w/ proceedings).

17. **G. Rieker**, F. Giorgetta, I. Coddington, W. Swann, L. Sinclair, C. Cromer, E. Baumann, A. Zolot, N.R. Newbury, J. Kofler, G. Petron, C. Sweeney, and P. Tans, " Frequency Comb Spectroscopy of CO_2, CH_4, H_2O, and Isotopes Over a 2km Outdoor Path: Concentration Retrievals Using Different Absorption Models," *13th International HITRAN conference*, Cambridge, MA, June 2014.

16. I. Coddington, F. Giorgetta, **G. Rieker**, W. Swann, A. Zolot, L. Sinclair, E. Baumann, C. Cromer N.R. Newbury, "CO2 phase and amplitude spectra measured over 2 km outdoor path with a dual-comb spectrometer," *Infrared Remote Sensing and Instrumentation XXII*, 921907, September 2014 (w/ proceedings).

15. (Invited) I. Coddington, **G. Rieker**, F. Giorgetta, W.C. Swann, L.C. Sinclair, C. Cromer, E. Baumann, A. Zolot, and N.R. Newbury, "Dual Frequency Comb Spectroscopy for Accurate and Precise Carbon Monitoring over Multi-kilometer Paths," *PIERS 2014*, Guangzhou, China, August 2014.

14. F. Giorgetta, **G. Rieker**, I. Coddington, W. Swann, A. Zolot, L. Sinclair, E. Baumann, C. Cromer, N. Newbury, "High-Resolution CO2 Phase Spectra Measured over an Open Air Path with a Dual-Comb Spectrometer," *6th EPS-QEOD Europhoton Conference*, Neuchatel, Switzerland, August 2014 (w/ proceedings).

13. (Invited) N. Newbury, **G. Rieker**, F. Giorgetta, W. Swann, L. Sinclair, E. Baumann, A. Zolot, and I. Coddington, "Dual-Comb Spectroscopy of Greenhouse Gases Over a 2-km Outdoor Path," *Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)*, Seattle, Wa, July 2014.

12. L. Sinclair, I. Coddington, W. Swann, L. Sonderhouse, **G. Rieker**, A. Hati, K. Iwakuni, and N. Newbury, "A frequency comb that maintains optical coherence under significant vibrations," *CLEO 2014*, San Jose, CA, June 2014 (w/ proceedings).

11. **G. Rieker**, F. Giorgetta, I. Coddington, W.C. Swann, L.C. Sinclair, C. Cromer, E. Baumann, A. Zolot, N.R. Newbury, J. Kofler, G. Petron, C. Sweeney, and P. Tans, "Measurements of CO_2, CH_4, H_2O, and HDO over a 2-km Outdoor Path with Dual-Comb Spectroscopy," A24B-05, *American Geophysical Union Fall Meeting,* San Francisco, CA, Dec. 2013.

10. (Invited) **G. Rieker**, F. Giorgetta, I. Coddington, W. Swann, L. Sinclair, C. Cromer, E. Baumann, A. Zolot, and N. Newbury, "Dual-Comb Spectroscopy of Greenhouse Gases Over a 2-km Outdoor Path," *Optical Instrumentation for Energy and Environmental Applications (E2),* Tucson, AZ, Nov. 2013.

9. (Invited) I. Coddington, A. Zolot, E. Baumann, F. Giorgetta, **G. Rieker**, J. Nicholson, W. Swann, and N. Newbury, "High-resolution Frequency Comb Molecular Spectroscopy," *Optical Instrumentation for Energy and Environmental Applications (E2),* Tucson, AZ, Nov. 2013.

8. E. Baumann, A. Zolot, **G. Rieker**, F. Giorgetta, I. Coddington, W. Swann, K. Knabe, P. Williams, and N. Newbury, "Coherent Comb-based Spectroscopy in the Mid and Near-infrared," *Mid-infrared Coherent Sources (MICS),* Paris, France, Oct. 2013 (w/ proceedings).

7. (Invited) **G. Rieker**, F. Giorgetta, I. Coddington, E. Baumann, A. Zolot, W. Swann, L. Sinclair, C. Cromer, and N. Newbury, "Frequency Comb-based Laser Sensors for Precision Ranging, Spectroscopy and Frequency Transfer," (given by G. Rieker in place of N. Newbury), *Optical Sensors*, Rio Grande, Puerto Rico, July 2013.

6. (Postdeadline) **G. Rieker**, F. Giorgetta, W. Swann, I. Coddington, L. Sinclair, C. Cromer, E. Baumann, A. Zolot, and N. Newbury, "Open-Path Dual-Comb Spectroscopy of Greenhouse Gases," *CLEO 2013*, San Jose, CA, June 2013 (w/ proceedings).

5. N. R. Newbury, A. Zolot, E. Baumann, I. Coddington, F. Giorgetta, **G. Rieker**, W. Swann, "Precision spectroscopy with coherent dual frequency combs", CLEO Europe 2013, Munich, Germany, May 2013.

4. M. Constantin, D. Constantin, J. Perl, P. Keall, F. Poehlmann, **G. Rieker**, M. Cappelli, "Monte Carlo Simulations of Beam Characteristics for a Compact Plasma Proton Accelerator," *52nd AAPM Annual Meeting*, 2010.

3. M. Gruber, C. Carter, M. Ryan, **G. Rieker**, J. Jeffries, R. Hanson, J. Liu, and T. Mathur, "Laser-Based Measurements of OH, Temperature, and Water Vapor Concentration in a Hydrocarbon-Fueled Scramjet," *Proceedings of the 44th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit*, 2008 (w/ proceedings).

2. **G. Rieker**, J. Jeffries, R. Hanson, T. Mathur, C. Carter, and M. Gruber, "Comparison of Wavelength Modulation and Direct Absorption Spectroscopy for Measurements of Gas Temperature in a Scramjet Combustor," *Proceedings of the 5th U.S. National Combustion Meeting*, 2007 (w/ proceedings).

1. **G. Rieker,** J.T.C. Liu, J. Jeffries, R. Hanson, T. Mathur, M. Gruber, and C. Carter, "Diode Laser Sensor for Gas Temperature and H2O Concentration in a Scramjet Combustor Using Wavelength Modulation Spectroscopy," *Proceedings of the 41st AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit*, 2005 (w/ proceedings).

SEMINARS

31. "Decoding the Stories of Distant Planets," October 17, 2018, *RIO Faculty Fellow TED-style Talks at the Dairy Performing Arts Center*, Boulder, CO.

30. "Laser Spectroscopy for Combustion and Atmospheric Systems," October 12, 2018, *National Renewable Energy Laboratory*, Golden, CO.

29. "Have 100,000 lasers, will travel – Frequency comb spectroscopy of atmospheric and combustion systems," September 28, 2018, *George Washington University*, Washington D.C.

28. "An introduction to the work of the Precision Laser Diagnostics Laboratory at the University of Colorado," September 10, 2018, *Universite Grenoble Alpes and CNRS-Grenoble*, Grenoble, France.

27. "Frequency Comb-based Methane Detection Network," July 13, 2018, *Operational Renegade Gas Working Group Meeting*, Boulder, CO.

26. "Regional Methane Monitoring with Frequency Combs," December 21, 2017, *Breakthrough Energy Coalition*, Boulder, CO.

25. "A Different Path to the Professorship," October 18, 2017, *University of Colorado Advocates Meeting*, Boulder, CO. (short presentation and discussion of entrepreneurial faculty pathways)

24. "Frequency Combs in Combustion," September 26, 2017, *Zolo Technologies*, Lafayette, CO.

23. "High precision GHG measurement in the open air," July 11, 2017, *EPA Regional Science Council Seminar*, Denver, CO.

22. "Frequency Comb-based Methane Detection Network," May 22, 2017, *Operational Renegade Gas Working Group Meeting*, Boulder, CO.

21. "Progress on frequency comb spectroscopy of atmospheric trace gases," April 18, 2017, *NOAA Global Monitoring Carbon Cycle Group Seminar*, Boulder, CO.

20. "Have 100,000 lasers, will travel – Frequency comb spectroscopy of atmospheric trace gases," April 10, 2017, *NCAR Atmospheric Chemistry Observations and Modeling Seminar*, Boulder, CO.

19. "A Different Path to the Professorship," February 1, 2017, *University of Colorado Chancellor's Cabinet*, Boulder, CO. (short presentation and discussion of entrepreneurial faculty pathways)

18. “Practical Frequency Comb Spectroscopy in Combustion and Atmospheric Research,” January 20, 2017, *California Institute of Technology / Jet Propulsion Laboratory*, Pasadena, CA.

17. “Probing Harsh Environments with Lasers: Sensing in 3M-relevant Combustion Systems,” November 3, 2016, *3M Technical Forum*, St. Paul, MN.

16. “Frequency Comb-based Methane Detection Network,” September 28, 2016, *Methane Monitoring Open Forum*, Fort Collins, CO.

15. “Have 100,000 Lasers, Will Travel – Field Applications of Frequency Combs from Methane Detection to Combustion,” August 17, 2016, *Colorado State University Energy and Environment Seminar*, Fort Collins, CO.

14. “Fire, Lasers, and Saving the World – How Engineering Led Me to the Coolest Job Ever,” July 14, 2016, *BOLD Aspire Summer Bridge Program*, Boulder, CO.

13. “Free Range Frequency Combs: Field Applications of NIST Technology from Methane Detection to Combustion,” March 17, 2016, *NIST Time and Frequency Seminar Series,* Boulder, CO.

12. “Have (100,000) Lasers, Will Travel – Frequency Comb Lasers for Trace Gas Monitoring,” November 16, 2015, *Institute for Artic and Alpine Research Seminar*, Boulder, CO.

11. “Fire, Lasers, and Saving the World – How Engineering Led Me to the Coolest Job Ever,” July 15, 2015, *BOLD Aspire Summer Bridge Program*, Boulder, CO.

10. “Probing Harsh Environments with Lasers: from Field-Deployed Diodes to Frequency Combs,” June 29, 2015, *Air Force Research Laboratories – Edwards AFB,* CA.

9. “Frequency Comb Laser Systems for Continuous, Multi-site Methane Monitoring,” April 7, 2015, *RPSEA First Protocol Development Workshop*, National Oceanic And Atmospheric Administration, Boulder, CO.

8. "Greenhouse Gas Concentration Measurements over a 2-km Outdoor Path using Dual-comb Spectroscopy," January 14, 2014, *Mechanical Engineering Graduate Seminar Series*, University of Colorado-Boulder, Boulder, CO.

7. “Probing Harsh Environments with Lasers: from Field-deployed Diodes to Frequency Combs,” November 15, 2013, *Optical, Electronic, and Quantum Systems Seminar*, University of Colorado-Boulder, Boulder, CO.

6. “Greenhouse Gas Concentration Measurements over a 2-km Outdoor Path using Dual-comb Spectroscopy,” November 7, 2013, *Collaborative for Air Quality Research Seminar*, University of Colorado-Boulder, Boulder, CO.

5. “Oh, The Places Your Laser Beam Will Go – Optical Sensing in Harsh Environments,” October 29, 2013, *Boulder Fluids Seminar*, University of Colorado-Boulder, Boulder, CO.

4. "Intermediate-path Sensing of Greenhouse Gases with Dual Comb Spectroscopy," April 30, 2013, *Carbon Cycle Greenhouse Gases Group Seminar*, National Oceanic and Atmospheric Administration, Boulder, CO.

3. "Frequency comb laser sources and their prospects for practical sensing," Nov. 16, 2012, *Institute for Combustion and Gas Dynamics Seminar Series*, University of Duisburg-Essen, Duisburg-Essen, Germany.

2. "Practical Laser-based Sensors for Harsh Combustion Environments," Sept. 20, 2012, *Mechanical Engineering Graduate Seminar Series*, University of Colorado-Boulder, Boulder, CO.

1. "Innovations in Particle Beam Generation with Plasmas," Oct. 2010, *Program in Radiation Biology Seminar*, Stanford University, Stanford, CA.

CONFERENCE PRESENTATIONS (Poster)

34. C. Alden**, S. Coburn**, R. Wright**, E. Baumann, K. Cossel, C. Sweeney, A. Karion, K. Prasad, I. Coddington and **G. Rieker**, "Regional, Continuous Methane Leak Detection Using Dual Frequency Comb Lasers and Atmospheric Inversions," *American Geophysical Union Fall Meeting*, Washington D.C., December 2018.

33. N. Wimer, M. Day, A. Makowiecki*, J. Glusman, J. Daily, **G. Rieker**, and P. Hamlington, "Progress Towards Direct Numerical Simulations of Plumes and Pool Fires," 71st Annual meeting, Division of Fluid Dynamics, American Physical Society, Atlanta, GA, November 2018.

32. **G. Rieker**, S. Coburn**, C. Alden**, R. Wright**, N. Hoghooghi**, R. Cole*, P. Schroeder*, N. Malarich*, A. Makowiecki*, A. Rybchuk*, G. Wendland**, M. Cich, B. Drouin, and I. Coddington, "The Expanding Reach of Fielded Dual Frequency Comb Spectrometers: from Kilometer-scale Measurements of Oil & Gas Fields to Model Development for Exoplanet Spectroscopy," *Field Laser Applications in Industry and Research (FLAIR),* Assisi, Italy, September 2018.

31. A. Makowiecki*, J. Steinbrenner, J. Glusman, N. Wimer, J. Daily, P. Hamilington and **G. Rieker**, "Dual Frequency Comb Spectroscopy for the Investigation of Ignition Behaviour of Wildland Fire Fuels," *Field Laser Applications in Industry and Research (FLAIR),* Assisi, Italy, September 2018.

30. N. Hoghooghi**, R. Cole*, and **G. Rieker**, "GHz Frequency Comb Generation Using Spectral Mode Filters for Rapid Dual-comb Spectroscopy," *Field Laser Applications in Industry and Research (FLAIR),* Assisi, Italy, September 2018.

29. N. Wimer, C. Lapointe, M. Day, A. Poludnenko, J. Glusman, A. Makowiecki*, J. Daily, **G. Rieker**, and P. Hamlington, "Progress Towards Direct Numerical Simulations of Fire Using Adaptive Mesh Refinement," *37th International Symposium on Combustion*, Dublin, Ireland, July 2018.

28. A. Makowiecki*, J. Steinbrenner, J. Glusman, N. Wimer, J. Daily, P. Hamlington, and G. Rieker, "Diagnostics Suite for Benchmark Data of Wildland Fire Fuels for Application to Physics-Based Models," *37th International Symposium on Combustion*, Dublin, Ireland, July 2018.

27. J. Glusman, A. Makowiecki*, N. Wimer, K. Niemeyer, G. Rieker, P. Hamlington, and J. Daily, "Experimental Comparison of Small-Scale Biomass Pyrolysis and Reduced Chemical Kinetic Models for Direct Numerical Simulations of Wildland Fires," *37th International Symposium on Combustion*, Dublin, Ireland, July 2018.

26. S. Coburn**, C. Alden**, R. Wright**, K. Cossel, E. Baumann, G. Truong, N. Newbury, K. Prasad, I. Coddington, T. Weaver and **G. Rieker**, "Frequency Comb-based Methane Observation Network," *2018 ARPA-E Energy Innovation Summit*, Washington D.C., March 2018 (hosted a demo booth).

25. C. Alden**, S. Coburn**, R. Wright**, E. Baumann, K. Cossel, C. Sweeney, S. Ghosh, N. Newbury, K. Prasad, I. Coddington and **G. Rieker**, "Continuous time-resolved regional methane leak detection with on-line background estimation using a novel combination of dual frequency comb laser spectroscopy and atmospheric inversions", *American Geophysical Union Fall Meeting*, New Orleans, LA, December 2017.

24. S. Coburn**, C. Alden**, R. Wright**, K. Cossel, E. Baumann, G. Truong, N. Newbury, K. Prasad, I. Coddington, T. Weaver and **G. Rieker**, "Frequency Comb-based Methane Observation Network," *CH4 Connections*, Ft. Collins, CO, December 2017 (hosted a demo booth).

23. S. Coburn**, C. Alden**, R. Wright**, K. Cossel, E. Baumann, G. Truong, N. Newbury, K. Prasad, I. Coddington, T. Weaver and **G. Rieker**, "Regional scale monitoring of methane emissions using sensitive open path laser measurements and an atmospheric inversion technique," *SPARK 2017*, Edmonton, Canada, November 2017.

22. N. Wimer, A. Makowiecki*, J. Glusman, A. Poludnenko, C. Hoffman, J. Daily, G. Rieker, and P. Hamlington, "Examination of Wildfire Spread at Small Scales Using Direct Numerical Simulations and Frequency Comb Laser Diagnostics," *Strategic Environmental Research and Development Program (SERDP) and Environmental Security Technology Certification Program (ESTCP) Symposium*, Washington, D.C., November 2017.

21. R. Cole*, P. Schroeder*, A. Draper*, and **G. Rieker**, "Dual Frequency Comb Absorption Spectroscopy at High Pressures and Temperatures: Toward Model Improvement for Laser Diagnostics in Extreme Environments," *Gordon Research Conference on Laser Diagnostics in Combustion*, Mt. Snow, VT, August 2017.

20. A. Makowiecki*, N. Hoghooghi**, N. Wimer, J. Daily, P. Hamlington, **G Rieker**. "Cavity Enhanced Dual Frequency Comb Spectroscopy for Characterization of Biomass Pyrolysis." *Gordon Research Conference on Laser Diagnostics in Combustion*, Mt. Snow, VT, August 2017.

19. N. Wimer, A. Makowiecki*, A. Poludnenko, C. Hoffman, J. Daily, **G. Rieker**, and P. Hamlington. "Examination of Wildland Fire Spread at Small Scales Using Direct Numerical

Simulations and Frequency Comb Laser Diagnostics," *12th International Symposium on Fire Safety Science,* Lund University, Sweden, June 2017.

18. C. Alden**, S. Coburn**, R. Wright**, S. Ghosh, I. Coddington, C. Sweeney, A. Karion, N. Newbury, K. Prasad, G. Rieker, "Continuous, regional approach to methane source detection and sizing using dual frequency comb laser spectroscopy and atmospheric inversions," *Global Monitoring Annual Conference 2017*, Boulder, Colorado, May 2017.

17. C. Alden**, R. Wright**, K. Prasad, T. Weaver, and **G. Rieker**, "Regional Methane Leak Detection with Frequency Comb Lasers," *2017 ARPA-E Energy Innovation Summit*, Washington D.C., March 2017 (hosted a demo booth).

16. S. Coburn**, R. Wright**, K. Cossel, G. Truong, E. Baumann, I. Coddington, N. Newbury, C. Alden**, S. Ghosh, K. Prasad, and **G. Rieker**, "Portable Dual-comb Spectrometer for Stable Detection of Methane Leaks over Kilometer Scale Paths at Oil and Natural Gas Production Sites," *AGU 2016*, December 2016.

15. C. Alden**, K. Prasad, S. Ghosh, A. Karion, C. Sweeney, S. Coburn**, R. Wright**, K. Cossel, G. Truong, E. Baumann, I. Coddington, N. Newbury, and **G. Rieker**, "A new method for top-down quantification of methane and pollutant emissions from natural gas production," *AGU 2016*, December 2016.

14. A. Makowiecki*, T. Hayden*, M. Nakles, N. Pilgram, N. MacDonald, W. Hargus, and **G. Rieker**, "Wavelength Modulation Spectroscopy in a Supersonic Ammonia Jet," *Colorado Photonics Industry Association Annual Meeting*, November 2016**.**

13. **G. Rieker**, I. Coddington, "Frequency Comb-based Methane Detection Network," *Rice University Natural Gas Industry Day*, October 2016.

12. A. Torres*, P. Schroeder*, D. Pfotenhauer*, and **G. Rieker**, "The Design of a High-Temperature, High-Pressure Spectroscopic Cell," *Discovery Learning Apprenticeship Annual Review*, May 2016.

11. K. Cossel, E. Waxman, G. Truong, **G. Rieker**, F. Giorgetta, W. Swann, I. Coddington, N. Newbury, "A portable dual frequency comb spectrometer for atmospheric applications," *EGU 2016,* April 2016.

10. C. Alden**, K. Prasad, S. Ghosh, A. Karion, C. Sweeney, S. Coburn**, R. Wright**, E. Baumann, G. Truong, K. Cossel, I. Lopez Coto, I. Coddington, **G. Rieker**, "Continuous Monitoring of Pollutant Emissions at Site- to Regional- Scales," *44th Annual Global Monitoring Conference,* March 2016.

9. **G. Rieker**, C. Alden**, S. Coburn**, R. Wright**, K. Prasad, S. Ghosh, I. Coddington, "Frequency Comb-based Methane Detection Network," *2016 ARPA-E Energy Innovation Summit,* February 2016.

8. **G. Rieker**, P. Schroeder*, D. Pfotenhauer*, F. Giorgetta, W. Swann, I. Coddington, N. Newbury, "Transitioning Frequency Comb Laser Diagnostics from the Lab to the

Combustor," *Gordon Research Conference on Laser Diagnostics in Combustion*, August 2015.

7. P. Schroeder*, **G. Rieker**, F. Giorgetta, W. Swann, I. Coddington, N. Newbury, "Dual Frequency Comb Spectroscopy of High Temperature Water Vapor Absorption," *Gordon Research Conference on Laser Diagnostics in Combustion*, August 2015.

6. T. Hayden*, **G. Rieker**, "Large Amplitude Wavelength Modulation Spectroscopy for Sensitive Measurements of Broad Absorbers," *Rocky Mountain Fluid Mechanics Research Symposium*, August 2015.

5. P. Schroeder*, **G. Rieker**, "Combining Science and Engineering: Spectroscopy of Water Vapor in a Coal Gasifier Using Frequency Comb Lasers." *CU Energy Frontiers Conference*, March 2015. People's choice award.

4. P. Schroeder*, **G. Rieker**, "Combining Science and Engineering: Spectroscopy of Water Vapor in a Coal Gasifier Using Frequency Comb Lasers." *Colorado Photonics Industry Association Annual Meeting*, November 2014**.** Award for best poster.

3. **G. Rieker**, S. Cauble, F. Poehlmann, and M. Cappelli, "Medical imaging isotope production using a novel compact plasma accelerator," *Center for Biomedical Imaging at Stanford Symposium*, April 2012.

2. M. Constantin, P. Keall, J. Perl, F. Poehlmann, **G. Rieker**, M. Cappelli, "Monte Carlo Simulations of Compact Plasma Accelerators for Proton Radiotherapy," *51st AAPM Annual Meeting*, 2009.

1. **G. Rieker**, J. Jeffries, R. Hanson, T. Mathur, M. Gruber, and C. Carter, "Calibration-Free Wavelength-Modulation Spectroscopy for Measurements of Temperature and H_2O Concentration in Harsh, Non-Uniform Environments," *Gordon Research Conference on Laser Diagnostics in Combustion*, 2007.

PRESS RELEASES AND MEDIA COVERAGE

Colorado Public Radio live interview (2018): https://www.cpr.org/news/story/detecting-methane-leaks-could-turn-into-big-business

9news Colorado story (2018): https://www.9news.com/video/news/scientists-working-to-find-invisible-methane-leaks/73-8134745

CBS news Colorado story (2018): https://denver.cbslocal.com/2018/05/02/colorado-researchers-team-up-on-gas-leak-detecting-technology/

Colorado Public Radio story (2018): http://www.kunc.org/post/how-scientists-are-using-lasers-hunt-leaky-oil-and-gas-equipment

Boulder Weekly story (2018): http://www.boulderweekly.com/boulderganic/enter-boulder-born-laser-methane-comb/

Grand Junction Sentinel story (2018):
https://www.gjsentinel.com/news/western_colorado/lasers-developed-at-cu-fight-methane-leaks/article_9d2971aa-4138-11e8-8d84-10604b9f6eda.html

University of Colorado press release (2018):
https://www.colorado.edu/mechanical/2018/03/22/detecting-methane-miles-away

Optical Society of America press release (2018): https://www.osa.org/en-us/about_osa/newsroom/news_releases/2018/laser-based_system_offers_continuous_monitoring_of/

Select sites carrying above press releases (2018):

1. Science Daily: https://www.sciencedaily.com/releases/2018/03/180322103259.htm
2. Patch.com (oil and gas industry news): https://patch.com/colorado/boulder/cu-built-laser-based-sensor-detects-methane-leaks-miles-away
3. Physics World: https://physicsworld.com/a/infrared-frequency-combs-detect-gas-leaks/
4. https://www.eurekalert.org/pub_releases/2018-03/nios-md031918.php
5. https://www.rdmag.com/article/2018/03/laser-based-instrument-finds-gas-leaks-distance
6. https://eponline.com/articles/2018/03/26/new-method-shown-for-detecting-methane-leaks.aspx
7. https://www.pddnet.com/news/2018/03/laser-based-sensing-system-can-detect-methane-leaks-miles-away

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https://cen.acs.org/articles/96/i16/Overhaul-needed-methane-measurements-National.html

"Regional Methane Leak Detection", Senator Michael Bennet [meeting with U.S. Senator Michael Bennet to describe our work under the ARPA-E MONITOR program], March 14, 2018.

"Regional Methane Leak Detection", Senator Cory Gardner [meeting with U.S. Senator Cory Gardner to describe our work under the ARPA-E MONITOR program], April 17, 2017.

"Dual-Comb Spectroscopy", *Optics and Photonics News* [our work on mobile dual frequency comb spectroscopy highlighted in article by Takuro Ideguchi], January 1, 2017, https://www.osa-opn.org/home/articles/volume_28/january_2017/features/dual-comb_spectroscopy/ .

"CU Boulder team to track methane leaks using lasers" *CU Mechanical Engineering* [press release], January 26, 2017, http://www.colorado.edu/mechanical/2017/01/26/cu-boulder-team-track-methane-leaks-using-lasers.

"CU Engineers Using Lasers to Track Gas Leaks", *KUNC All Things Considered*, [article], and Radio Interview, February 6, 2017, http://www.kunc.org/post/cu-engineers-using-lasers-track-gas-leaks.

"CU Boulder Team Tracks Methane Leaks with Lasers", *Photonics Spectra*, [article], January 31, 2017, https://www.photonics.com/Article.aspx?PID=6&VID=146&IID=931&AID=61644

"Engineers at CU Boulder to track gas leaks using lasers", *BizWest* [article], January 27, 2017, https://bizwest.com/2017/01/27/engineers-cu-boulder-track-gas-leaks-using-lasers/

"New Methane Leak Detector Could Save Oil Industry $30 Billion Per Year", oilprice.com, [article], February 2, 2017, http://oilprice.com/Energy/Energy-General/New-Methane-Leak-Detector-Could-Save-Oil-Industry-30-Billion-Per-Year.html

"CU Boulder-led team lands grant to study gas storage emissions", Daily Camera, [article], January 27, 2017, http://www.dailycamera.com/cu-news/ci_30754199/cu-boulder-led-team-lands-grant-study-gas

"NIST/CU Team Launches 'Comb and Copter' System to Map Atmospheric Gases", NIST [press release], June 23, 2017, https://www.nist.gov/news-events/news/2017/06/nistcu-team-launches-comb-and-copter-system-map-atmospheric-gases

"IRISS Teams Up with NIST and DARPA to Test Nobel Prize-Winning Technology", Grand Challenge Integrated Remote and In Situ Sensing [press release], June 27, 2017, http://www.colorado.edu/iriss/2017/02/10/iriss-uas-reflects-frequency-combs

CURRENT AND PAST RESEARCH GRANTS

Total as PI: $ 10,702,697
Total as PI or Co-PI: $ 19,352,697
Total Share to Rieker Laboratory: $ 7,127,400

GRADUATE TEACHING

Faculty Course Questionnaires (FCQs) max score 6.0

Fall 2013	**MCEN 5065/5075: Graduate Design**
	18 students, FCQs: 5.4 course overall, 5.2 instructor overall
Spring 2014	**MCEN 5055: Advanced Product Design**
	26 students, FCQs: 5.3 course overall, 5.8 instructor overall
AY 14-15	**MCEN 5065/5075: Graduate Design Team Mentorship**
	1 *team of 3 students, no FCQ*
AY 15-16	**MCEN 5065/5075: Graduate Design Team Mentorship**
	2 teams of 3 students, no *FCQ*
AY 16-17	**MCEN 5065/5075: Graduate Design Team Mentorship**
	2 teams of 3 students, no *FCQ*
Spring 2015	**MCEN 5055: Advanced Product Design**
	25 students, FCQs: 5.2 course overall, 5.5 instructor overall
Spring 2016	**MCEN 5055: Advanced Product Design**
	18 students, FCQs: 5.4 course overall, 5.8 instructor overall
Fall 2016	**MCEN 5055: Advanced Product Design**
	27 students, FCQs: 4.7 course overall, 5.4 instructor overall

UNDERGRADUATE TEACHING

Faculty Course Questionnaires (FCQs) max score 6.0

AY 15-16	**MCEN 4045/4085: Undergraduate Design Team Mentorship**
	1 team of 6 students, FCQs: 6.0 course overall, 6.0 instructor overall
Spring 2017	**MCEN 4228: Thermofluids Laboratory (new course)**
	11 students, FCQs: 4.8 course overall, 5.8 instructor overall
Fall 2017	**MCEN 3012: Thermodynamics I**
	114 students, FCQs: 5.2 course overall, 5.6 instructor overall
Spring 2018	**MCEN 4228: Thermofluids Laboratory**
	6 students, FCQs: 6.0 course overall, 5.8 instructor overall
Fall 2018	**MCEN 3012: Thermodynamics I**
	103 students (2 sections), FCQs: 5.2 course overall, 5.6 instructor overall

EDUCATION GRANTS

Total as PI: $ 133,500

RESEARCH ADVISING

Alumni	Torrey Hayden PhD 2018 (now with Zolo Technologies, Inc.)
	Jason Christopher PhD 2018 (co-advised with Hamlington, now with Air Force)

Paul Schroeder PhD 2017 (now NRC Postdoc with NOAA)

Anthony Draper MS 2018 (now with Blue Origin)
Bennett Sodergren MS 2015 (now with Vescent Photonics, Inc.)
Jinyu Yang MS 2017 (now with Notre Dame)

Jaylen Hinds BS (You're @ CU 2014)
Matthew Chamot BS (DLA 2016-2017)
Brendan Bitterlin BS (DLA 2017-2018)
Bill Andrew BS (summer intern 2015)
Bryan Watson BS (summer intern 2016)
Josh Biggio BS (summer intern 2017)
Sonya Schuppan (summer intern 2017)
Zak Armacost (summer intern 2018)
Nicolas Seitz BS (summer intern 2018)
Cesar Galan Gutierrez BS (part-time staff 2017-2018)

Postdoc Caroline Alden (2015-present)
Sean Coburn (2015-present)
Nazanin Hoghooghi (2015-present)

Full-time Staff Robert Wright (2015-present)
Griffith Wendland (2017-present)

PhD Amanda Makowiecki
Nathan Malarich
Ryan Cole
Elizabeth Strong
Alex Rubchyk
Emily Hannah
David Yun

MS Alan Sanchez

BS Robert Giannella
Alexandra Jaros (SPUR)
Christopher Kling (DLA)
Cameron Casby (DLA)

Other Matt Francisco, MS Thesis Committee 2013
Ricardo Jiminez, PhD Committee (Physics) 2013
Ricardo Piedrahita, Preliminary exam 2014, PhD Committee 2015
Ben Yu, PhD Committee (Physics) 2015
Dan Maser, PhD Comprehensive Exam (Physics) 2015, PhD Committee 2017
Fnu Shikhar, PhD Committee 2015
Kim Urness, PhD Comprehensive Exam 2013, PhD Committee 2014
Colin Towery, PhD Comprehensive Exam 2015, PhD Committee 2017
Bill Tandy, PhD Comprehensive Exam (Aerospace) 2016, PhD Committee 2017
Awad Alquaity, PhD Committee (KAUST) 2016

Nick Wimer, PhD Comprehensive Exam 2017
Sid Nigam, MS Thesis Committee 2018
Yao Zhai, PhD Comprehensive Exam 2017, PhD Committee 2018
Daniel Cole, PhD Committee (Physics) 2018
Holly Leopardi, PhD Comprehensive Exam (Physics) 2018
Samuel Whitman, Preliminary exam 2018
Caelan LaPointe, Preliminary exam 2018
Corey Rogers, Preliminary exam 2018

DEPARTMENT SERVICE

2013 - 2014	Graduate committee
	Graduate visit day (GEARRS) event co-lead
	Design track admissions lead
2014 - 2015	Graduate committee
	Graduate visit day (GEARRS) event co-lead
	Design track admissions lead
2015 - 2016	Graduate committee
	Graduate visit day (GEARRS) event lead
	Faculty search committee
2016 - 2017	External relations committee
	Design track admissions lead
2017 - 2018	Graduate committee
2018 - 2019	External relations committee
	Department chair search committee
	Quantum Science search committee
2015-2018	Secured funding for 6 senior and graduate design teams

COLLEGE/CAMPUS SERVICE

2015 - 2019	BOLD Center Goldshirt Interviews
2015, 2016	BOLD Center Aspire Summer Bridge Presenter
2015, ‘16, ‘19	Innovative Seed Grant Review Panels
2017-2018	Water-energy Nexus Innovative Research Thrust Executive Committee
2017-2018	Quantum Integrated Sensor Systems Innovative Research Thrust Executive Committee
2017-2019	Organizer and Faculty Lead, Operational Renegade Gas (ORG) Working Group
2018	Faculty Innovation Ambassador
2018-2019	Quantum Sensing and Metrology Pillar Lead, CU Quantum Science Initiative

NATIONAL/INTERNATIONAL SERVICE

2014	DOE Basic Energy Sciences Early Career Proposal Review Panel
2015	NSF Combustion and Fire Systems Proposal Review Panel
2016	Organizing Committee, OSA *Fourier Transform Spectroscopy* conference
2017	Local Organizing Committee, OSA *Light and Energy Congress* conference
2017	Participant, NSF Junior Faculty in Combustion Workshop

2017, 2018	Organizing Committee, OSA *CLEO* conference, Applications and Technology subgroup
2018	Organizing Committee, OSA *Optics for Energy and Environment* conference
2018	Organizing Committee, OSA *Laser Applications in Chemical, Security, and Environmental Analysis* conference
2019	Chair, OSA *CLEO* conference, Applications and Technology subgroup
2015-2018	Presider/Chair, 9 conference sessions

JOURNAL REVIEWER

Optica
Optics Express
Combustion and Flame
Journal of Quantitative Spectroscopy and Radiative Transfer (JQSRT)
Proceedings of the Combustion Institute
Applied Optics
Optics Letters
Applied Physics B
Journal of Molecular Spectroscopy
AIAA Journal
Journal of Applied Remote Sensing
Measurement Science and Technology
Applied Spectroscopy
Optics and Laser Technology
Journal of Physics D
Journal of Energy & Fuels