

11th International User Meeting and Summer School on Cavity Enhanced Spectroscopy



June 16 – 19, 2015
Boulder, Colorado

www.esrl.noaa.gov/csd/events/ces2015/



NIST
National Institute of
Standards and Technology
U.S. Department of Commerce

Conference Program

ADVANCED THIN FILMS

Conference Chairs

Steven Brown

NOAA, Boulder, Colorado, USA

Rebecca Washenfelder

NOAA, Boulder, Colorado, USA

Organizing Committee

Jong Chow

*Australian National University, Canberra,
Australia*

Gianluca Gagliardi

Istituto Nazionale di Ottica, Firenze, Italy

Peter Loock

*Queen's University, Kingston, Ontario,
Canada*

Hans Osthoff

*University of Calgary, Calgary, Alberta,
Canada*

Andy Ruth

University College Cork, Cork, Ireland

Technical Support and Organization

Debe Dailey-Fisher

NOAA, Boulder, Colorado, USA

Cathy Burgdorf Rasco

NOAA, Boulder, Colorado, USA

Libby Samuelson

NOAA, Boulder, Colorado, USA

Plenary Speakers

Jonathan Reid

University of Bristol, Bristol, UK

Yinon Rudich

Weizmann Institute, Rehovot, Israel

Shailendhar Saraf

Stanford University, Palo Alto, California, USA

Jun Ye

University of Colorado, Boulder, Colorado, USA

Invited Speakers

David Chandler

Sandia National Laboratories, Albuquerque, New Mexico, USA

John Hall

University of Colorado, Boulder, Colorado, USA

Harold Linnartz

University of Leiden, Leiden, the Netherlands

Terry Miller

The Ohio State University, Columbus, Ohio, USA

Dan Murphy

National Oceanic and Atmospheric Administration, Boulder, Colorado, USA

Scott Papp

National Institute of Technology, Boulder, Colorado, USA

Sheila Rowan

University of Glasgow, Glasgow, UK

Matthew Sellars

Australian National University, Canberra, Australia

Helen Waechter

Tiger Optics, Warrington, Pennsylvania, USA

Yun-Feng Xiao

Peking University, Beijing, China

GENERAL INFORMATION

Meeting Webpage

The meeting agenda, abstracts, and information are available electronically at <http://www.esrl.noaa.gov/csd/events/ces2015/>

Meeting Location

Session will be held at the National Institute of Standards and Technology (NIST) main auditorium. The address is 325 Broadway, Boulder, Colorado, USA.

Transportation from Denver International Airport to Boulder

Airport Shuttle

SuperShuttle (303-227-0000) provides service from the airport to locations in Boulder, and will deliver you directly to your destination.

Public Transportation

Regional bus service to Boulder is available through the Regional Transportation District (RTD). The AB bus (westbound) provides service from Denver International Airport to Boulder. It departs hourly and costs \$13. Exact change is required. This option will likely require a local bus within Boulder or walk to reach your hotel. The schedule is available here: <http://www3.rtd-denver.com/schedules/getSchedule.action?routeId=AB>

Driving

Exit Denver International Airport via Peña Boulevard.

Take Peña Boulevard to I-70 West.

Split right on I-270 North (Exit 279), toward Ft. Collins and follow across I-25 to US-36 (West) toward Boulder.

Exit US-36 at Baseline Road (University of Colorado Main Campus exit).

Keep left and turn left (West) onto Baseline.

Keep left and turn left at the first light onto 27th Way.

Stay in the middle lane and turn left onto Broadway.

Take the second right at the light onto Rayleigh Road then right into the Visitors Center parking lot.

Travel within Boulder

Walk

The recommended Boulder hotels are within a 3 km walk of the NIST auditorium.

Bicycle

Local bike rentals are available at Boulder B-Cycle stations throughout the city. After you pay a daily or weekly fee, unlimited free 30-minute trips are included. Conference participants can use the promotion code NOAASS (case sensitive) to receive a \$10 / week rental rate. There is a convenient B-Cycle station in front of the NIST auditorium where bicycles can be borrowed or returned.

Bus

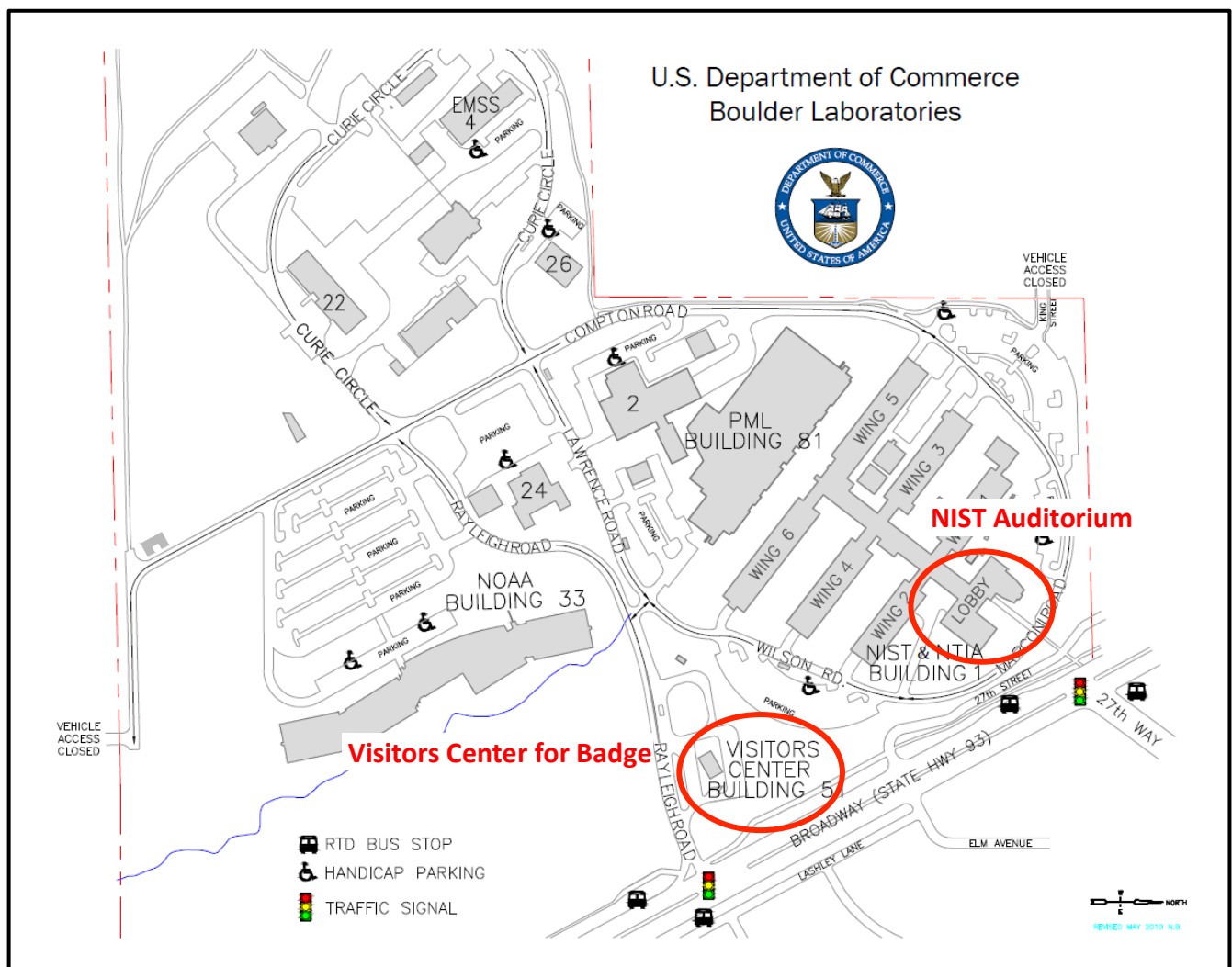
Rayleigh Road and Broadway is the closest RTD bus stop to the visitor center and is served by the SKIP, DASH, AB, B, DD, DM, GS, and J bus routes. The Flatiron Park-n-Ride (Broadway and 27th Way) is also nearby and is served by the BOUND and the 204 routes.

Arrival and Badging

Please arrive 45 minutes before the first session. You can save time by going to the visitor center on Monday June 15 (or Tuesday June 16, if you are not attending the summer school) to receive your badge in advance.

The Visitors Center is located on Broadway at Rayleigh Road. All visitors, including pedestrians and bike riders, are required to check in at the Visitors Center to receive a badge, before proceeding to the auditorium. To receive a visitor badge, U.S. visitors must present a valid photo ID (federally approved State issued driver's license, Federal ID, or original passport). International visitors must present a valid passport or green card.

Drivers must bring their vehicle registration card or rental agreement.



Registration Fee Includes

Admission to scientific sessions

Coffee breaks and lunches on June 16, 17, 18, and 19

Conference dinner on Thursday June 18

Coffee Breaks and Lunches

Food will be served in the main lobby, outside the auditorium.

Lunch menus with meal choices will be included in your arrival packet. Please complete the forms and return them at the NIST auditorium.

Wednesday and Thursday Poster Preview Talks

Each poster presenter is asked to give a brief presentation to highlight their work, in a special oral session immediately before the poster session. Each presenter will have one minute to speak and may present one slide, which has been submitted in advance. The poster presenters will be introduced in alphabetical order.

Wednesday Afternoon Laboratory Tours

Following the scientific program on Wednesday, there is a choice of two laboratory tours. One tour will visit laboratories at the National Institute of Standards and Technology (NIST) and the other tour will visit laboratories at the National Oceanic and Atmospheric Administration (NOAA).

Wednesday Dinner

Dinner is on your own, with bus tickets provided to visit Pearl Street in downtown Boulder. Pearl Street is a four-block pedestrian mall in the center of the city. You can catch the Skip bus on the east side of Broadway (across the street from the NIST auditorium), and exit the bus at Pearl Street.

Thursday Evening Poster Session and Dinner

The Thursday night poster session and dinner will be held in the beautiful NCAR Mesa Laboratory, at the base on the Flatiron mountains in Boulder. Group transportation from the NIST auditorium to the poster session and dinner will be provided. Buses will depart at 3:15 pm and return after dinner at 7:30 pm. If you prefer to drive yourself, the address is 1850 Table Mesa Drive, Boulder, Colorado.

Audiovisual Facilities

The auditorium is equipped with a laptop and projector. Speakers are asked to upload their presentation to the shared laptop at the beginning of the day or during one of the conference breaks.

Meeting Sponsors

We are appreciative of the support by our sponsors. Please visit their tables in the main lobby to learn more about their products. Silver and Gold level sponsors will make short presentations prior to the lunch break each day.

Platinum Level:

IDEX / Advanced Thin Films

ADVANCED THIN FILMS

Gold Level:

Liquid Instruments



Menlo Systems, Inc.

MenloSystems

Silver Level:

LayerTec GmbH



Research Electro-Optics, Inc.



Tiger Optics

TigerOptics

Bronze Level:

Activated Light Technology Industries

ALTI LLC (Activated Light Technology Industries)

Aerodyne Research, Inc.



Droplet Measurement Technologies



Horiba Scientific

HORIBA
Scientific

Picarro, Inc.

PICARRO

Pilot Photonics



11th International User Meeting and Summer School on Cavity Enhanced Spectroscopy
16 - 19 June 2015
Boulder, Colorado, USA

Tuesday 16 June 2015

Time	Agenda	Speaker	Lecture Title
	<i>Registration and coffee in the NIST Main Lobby</i>		
9:00	Welcome	Steve Brown	<i>Introduction to Summer School</i>
9:15	Lecture 1	Joseph Hodges	Assessing the precision and accuracy of cavity ring-down spectroscopy measurements
10:05	<i>Coffee Break</i>		
10:20	Lecture 2	Kevin Lehmann	The properties of Optical Cavities and how they effect CES
11:10	Lecture 3	Frans Harren	Off-Axis Integrated Cavity Output spectroscopy for trace gas detection
12:00	<i>Lunch</i>		
13:00	Lecture 4	Aleksandra Foltynowicz	Cavity-Enhanced Optical Frequency Comb Spectroscopy
13:50	Lecture 5	Alejandro Farinas	Industrial Applications of Cavity-Enhanced Spectroscopy Instruments
14:40	<i>Coffee Break</i>		
14:55	Lecture 6	Rebecca Washenfelder	Atmospheric Field Measurements Using Cavity Enhanced Spectroscopy
15:45	<i>Tour Science On a Sphere at NOAA</i>		

Wednesday 17 June 2015

Time	Agenda	Speaker	Presentation Title
	<i>Registration and coffee in the NIST Main Lobby</i>		
8:30	Welcome	Rebecca Washenfelder	<i>Introduction to the User Meeting</i>
	Morning Session Chair: Hans Osthoff		
8:40	Plenary talk	Shailendhar Saraf	Cavity Enhanced Molecular Spectroscopy for Developing Ultrastable Frequency Standards and Generating Frequency Combs in the Mid-IR
9:20	Invited talk	David Chandler	Dual Etalon Frequency Comb Spectrometer
9:45	Contributed talk	Jerome Morville	A Very Broadband Direct Frequency Comb - Cavity Enhanced Vernier Spectrometer
10:05	<i>Coffee Break</i>		
10:20	Contributed talk	Garwing Truong	Towards Fieldable Dual-Comb Spectroscopy For Greenhouse Gas Monitoring in Outdoor Air
10:40	Invited talk	Scott Papp	Microresonator optical frequency combs
11:05	Contributed talk	Leonid Sheps	Time-Resolved Broadband Cavity-Enhanced Absorption Spectroscopy: A New tool for Chemical Kinetics
11:25	Contributed talk	Albert A. Ruth	Laser-Induced Plasmas in Ambient Air for Incoherent Broadband Cavity-Enhanced Absorption Spectroscopy
11:45	Sponsor talk	Brent Wheelock	<i>Menlo Systems</i>
11:55	Sponsor talk	Brian Siller	<i>Tiger Optics</i>
12:00	<i>Lunch</i>		

Afternoon Session Chair: Jong Chow

13:00	Invited talk	Yunfeng Xiao	Microcavity Raman Laser and Its Application in Single-Nanoparticle Detection
13:25	Contributed talk	Dean James	Open-Access Optical Microcavities for Lab-on-a-Chip Spectroscopy
13:45	Contributed talk	Meez Islam	Bioanalytical Applications of Liquid Phase BBCEAS
14:05	Invited talk	Sheila Rowan	Low Noise Cavities in Interferometric Gravitational Wave Detectors
14:30	Poster Previews (A - L)		
14:55	Poster Session (A - L)		
16:55	<i>Lab Tours at NIST or NOAA</i>		
17:55	<i>Dinner on your own in downtown Boulder</i>		

Thursday 18 June 2015

Time	Agenda	Speaker	Presentation Title
8:30	<i>Welcome in the NIST Auditorium</i>		
	Morning Session Chair: Solomon Bililign		
8:35	Plenary talk	Yinon Rudich	Measurements of Aerosol Optical Properties using Broadband Cavity Enhanced Spectroscopy
9:15	Invited talk	Terry Miller	Near-Infrared Cavity Ringdown Spectroscopy of Intermediates in Complex Chemical Reactions
9:40	Contributed talk	Guillaume Genoud	Quantum Cascade Laser Spectroscopy for Radiocarbon Detection
10:00	Contributed talk	Giovanni Giusfredi	Spectroscopic detection of $^{14}\text{CO}_2$: Towards Parts Per Quadrillion Sensitivity
10:20	<i>Coffee Break</i>		
10:35	Contributed talk	Kevin Lehmann	Combining several spectroscopic techniques, including cw-CRDS and IR-IR double resonance to analyze the first C-H overtone region of CH_3D
10:55	Invited talk	Helen Waechter	Fiber-Loop Cavity Ring-Down Analyzer for Cryogenic Liquids
11:20	Contributed talk	Sze Tan	Investigation of Backscattered Wave Effects on Cavity Ring-Down Spectrometers with Ring Cavities
11:40	Contributed talk	Laurie McHale	Development of Open-Path Cavity Ring-Down Spectroscopy Sensors for Methane and Ammonia
12:00	Sponsor talk	Malcolm Gray	<i>Liquid Instruments</i>
12:10	Sponsor talk	Thomas Kraft	<i>LayerTec</i>
12:15	<i>Lunch</i>		
	Afternoon Session Chair: Norbert Lang		
13:00	Invited talk	John Hall	The realistic prospect of being able to separate the cavity and absorber resonances very strongly: expecting an optical molecular frequency standard with a stability and reproducibility at the Hz level
13:25	Contributed talk	Aleksandra Foltynowicz	Optical Frequency Comb Fourier Transform Spectroscopy with Resolution beyond the Path Difference Limit
13:45	Contributed talk	Ibrahim Sadiek	Saturation Dynamics and Working Regimes of Saturated Absorption Cavity Ringdown Spectroscopy (Sat.-CRDS)
14:05	Contributed talk	Erin McDuffie	The Dark Side of Cavity Ring Down - Measurements of Nocturnal Reactive Nitrogen Species, NO_3 and N_2O_5

14:25	Contributed talk	Roland Fleddermann	Cavity Enhanced Amplitude Modulated Laser Absorption Spectroscopy
14:45	Poster Previews (M - Z)		
15:10	<i>Travel to NCAR Mesa Lab and poster setup</i>		
16:00	Poster session (M - Z) with drinks at NCAR Mesa Lab		
18:00	Banquet dinner at NCAR Mesa Lab		

Friday 19 June 2015

Time	Agenda	Speaker	Presentation Title
8:30	<i>Welcome in the NIST Auditorium</i> Morning Session Chair: Adam Fleischer		
8:35	Plenary talk	Jonathan Reid	Cavity Ringdown Spectroscopy of Single Aerosol Particles
9:15	Invited talk	Dan Murphy	Opening Up and Miniaturizing Cavity Enhanced Spectroscopy
9:40	Contributed talk	Jiahao Dong	Cavity Polarization Mode Impedance Matching Spectroscopy
10:00	Contributed talk	Antonio Giorgini	An Optical-Cavity Microbalance for Surface-Plasmon-Resonance Bio-Chemical Sensing
10:20	<i>Coffee Break</i>		
10:35	Contributed talk	Andrew Freedman	Measuring Soot Optical Properties Using Cavity Attenuated Phase Shift (CAPS) Techniques
10:55	Invited talk	Harold Linnartz	Tools for Molecular Astrospectroscopy: os-BBCEAS, CESAS and CRDS
11:20	Contributed talk	Luca Ciaffoni	Using Cavity-Enhanced Spectroscopy to Improve Healthcare: In-Airways O ₂ Consumption Sensing Based on OA-CEAS
11:40	Contributed talk	Frans Harren	Sensitivity Enhancement in Off-Axis Integrated Cavity Output Spectroscopy
12:00	Sponsor talk	Darren Berns	<i>IDEX / Advanced Thin Films</i>
12:15	Sponsor talk	Quentin Turchette	<i>Research Electro-Optics, Inc.</i>
12:20	<i>Lunch</i> Afternoon Session Chair: Hendrik Nahler		
13:10	Invited talk	Matthew Sellars	Cavity enhanced rephased spontaneous emission
13:35	Contributed talk	Patrick Dupre	Photo-Dissociation Resonances of Jet-Cooled NO ₂ by CW-CRDS
13:55	Contributed talk	Dean Sheppard	Cavity-Enhanced Methods for Optical Detection of Magnetic Field Effects in Biological Systems
14:15	Contributed talk	James Hodges	Advances in Sensitive, Accurate, Precise, Ion Spectroscopy through Noise Immune Cavity Enhanced Optical Heterodyne Velocity Modulation Spectroscopy
14:35	Contributed talk	Ove Axner	Optimum conditions for Doppler-broadened NICE-OHMS – How to reach an Allan deviation in the 10 ¹⁴ cm ⁻¹ range using a tunable laser
14:55	Plenary talk	Jun Ye	Cavity-Enhanced Frequency Comb Spectroscopy
15:35	<i>Presentation of student awards</i>		
15:45	<i>Final remarks and conclusion</i>		

Poster Session Wednesday 17 June 2015, 3 - 5pm at NIST

Presenter		Abstract Title
Ove	Axner	Doppler-broadened NICE-OHMS beyond the cavity-limited weak absorption condition
Solomon	Bililign	Measuring Aerosol Scattering and Absorption - Limitations of the Extinction-Minus-Scattering Method
Mixtli	Campos-Pineda	Study of the Ozonolysis of Ethene and 2,3-Dimethyl-2-Butene using Cavity Ring-down Spectroscopy
Idil	Cazimoglu	Cavity Enhanced Absorption Spectroscopy for the Detection of Plant Volatile Organic Compounds
Sean	Coburn	Measurements of diurnal variations and eddy covariance (EC) fluxes of glyoxal over the tropical Pacific Ocean during the TORERO 2012 field experiment
Sean	Coburn	Determining optical path lengths for aerosol-free cavity enhanced spectroscopy: theoretical calculations based on mirror characterization and Rayleigh scattering vs determination from measurements of collision induced absorption of oxygen molecules
Kirstin	Doney	Infrared cavity ring-down measurements of astronomically relevant cations
Patrick	Dupre	Noise-Immune Cavity-Enhanced Optical Heterodyne Molecular Spectrometry Modeling under Saturated Absorption
Dorothy	Fibiger	First Aircraft Measurements of NO _y by Cavity Ring-Down Spectroscopy
Al	Fischer	A UV-visible Broadband Cavity Enhanced Spectrometer for Atmospheric Aerosol Extinction
Adam	Fleisher	Cavity Ring-Down Spectroscopy in the Quantum-Noise Limit
Aleksandra	Foltynowicz	Cavity-Enhanced Optical Frequency Comb Spectroscopy of High-Temperature Water in a Flame
Elizabeth	Foreman	High Resolution Spectroscopy of CH ₂ O and the Kinetics of its Reactions with Inorganic Acids
Timothy	Gordon	Design Of A Novel Open-Path Aerosol Extinction Cavity Ringdown Spectrometer and Data From Recent Field Deployments
James	Hargrove	A Portable NX and particle analyzer
Thomas	Hausmaninger	Doppler-broadened mid-infrared NICE-OHMS system based on an optical parametric oscillator
John	Hoffnagle	CRDS with cavity mode-based frequency axis for ppm-level quantitative spectroscopy
Tara	Kahan	Cavity-enhanced measurements of hydrogen peroxide absorption cross sections at long wavelengths: Implications for hydroxyl radical production indoors and outdoors
Jay	Kroll	Cavity Ring-Down Spectroscopy in Exploration of the Reactivity of Atmospheric Systems
Norbert	Lang	RES-Q-Trace: a mobile CEAS-based demonstrator for multiple-component trace gas detection in the MIR
Olivier	Laurent	ICOS ATC Metrology Lab: a facility for metrological performance assessment of prototypes and commercialized GHG analyzers
Mingyun	Li	Fiber Loop Supercontinuum Cavity Enhanced Absorption Spectroscopy
Elizabeth	Lunny	Frequency-Stabilized Cavity Ring-Down Spectroscopy of CO ₂ in Support of Remote Sensing

Poster Session Thursday 18 June 2015, 4 - 6pm at NCAR Mesa Lab

Presenter		Abstract Title
Georgia	Mansell	An in-vacuum optical parametric oscillator squeezer for gravitational wave detectors
Davide	Mazzotti	High-Q resonant cavities in the terahertz range: optical feedback effects on quantum cascade lasers
Hendrik	Nahler	CELIF: Cavity-enhanced laser-induced fluorescence
Chris	Nichols	Pre-excitation CRDS for Mercury
Hans	Osthoff	Vapor detection of nitrogen oxide containing explosives by catalytic thermal dissociation blue diode laser cavity ring-down spectroscopy
Bin	Ouyang	An airborne three-channel LED-based broadband cavity enhanced absorption spectrometer for measurements of atmospheric trace gases
Inga	Piller	A novel NIR ew-cw-CRD spectrometer for investigating heterogeneous processes at the quartz-air/water interface: Characterization and first measurements
Mary	Rad	Detection of S-nitrosocompunds in biological samples
Lucile	Rutkowski	Noise-Immune Cavity-Enhanced Optical Frequency Comb Spectroscopy
Linhan	Shen	Laboratory Measurements of Temperature Dependent ¹³ C and D Kinetic Isotope Effect in The Oxidation of CH ₄ by O(¹ D) and OH
Matthew	Smarte	Simultaneous Kinetics and Ringdown Study of Peroxy Radical Reactions
Jean-Pierre	van Helden	Optical feedback cavity-enhanced absorption spectroscopy with a 3.24 μm interband cascade laser
Nick	Wagner	Analysis of multi-exponential decays in cavity ringdown spectroscopy
Haichao	Wang	Broadband absorption spectrometers using LED for the detection of NO ₂ , NO ₃ and N ₂ O ₅
Rebecca	Washenfelder	Measurements of formaldehyde using broadband cavity enhanced spectroscopy at 315 - 360 nm
Jonas	Westberg	Cavity-enhanced Faraday rotation spectroscopy for oxygen detection
Robert	Wild	Cavity ring-down system for measurement of trace gases in high vibration environments
Nick	Yordanov	A cyan-light-emitting diode cavity-enhanced absorption spectrometer for the measurement of reactive iodine species
Kyle	Zarzana	Aerosol Optical Properties Derived using Optical Spectroscopy