



# RPPR Final Report

## as of 12-Oct-2017

Agency Code:

Proposal Number: 71166EGCF

Agreement Number: W911NF-17-1-0272

### INVESTIGATOR(S):

**Name:** Hope A. Michelsen  
**Email:** hamiche@sandia.gov  
**Phone Number:** 9252942335  
**Principal:** Y

Organization: **Gordon Research Conferences, Inc.**

Address: 512 Liberty Lane, West Kingston, RI 028921502

Country: USA

DUNS Number: 075712877

EIN: 050300482

**Report Date:** 10-Sep-2017

Date Received: 06-Oct-2017

**Final Report** for Period Beginning 11-May-2017 and Ending 10-Sep-2017

**Title:** 2017 Laser Diagnostics in Combustion GRC/GRS

**Begin Performance Period:** 11-May-2017

**End Performance Period:** 10-Sep-2017

**Report Term:** 0-Other

Submitted By: Hope Michelsen

Email: hamiche@sandia.gov

Phone: (925) 294-2335

**Distribution Statement:** 1-Approved for public release; distribution is unlimited.

**STEM Degrees:**

**STEM Participants:** 6

**Major Goals:** The goal of this project was to organize the 2017 Laser Diagnostics in Combustions Gordon Research Conference (GRC) and associated Gordon Research Seminar (GRS) for emerging scientists and engineers. The goal of GRC was to bring together scientists and engineers with a strong interest in laser-based combustion diagnostics to discuss current approaches, latest developments, promising opportunities, and unaddressed needs for measurement techniques for probing combustion processes. The GRS, held the weekend before the GRC, was organized to bring together emerging leaders in the field at an early stage in their careers to exchange new ideas.

Advanced non-invasive optical diagnostics are critical to the development of a detailed understanding of complex and coupled multi-scale combustion processes. The GRC on Laser Diagnostics in Combustion was designed to bring together scientists and engineers working at the leading edge of combustion research. Combustion is associated with a variety of physical phenomena with wide ranging applications and impact. Combustion is responsible for providing the majority of global energy needs and generating a large fraction of atmospheric pollutants and greenhouse gases. Improving the energy efficiency of combustion sources while reducing undesirable by-products requires an understanding of combustion chemistry and physics and related phenomena. A goal of this GRC was to focus on the most recent scientific advances in optical diagnostics and their demonstrated or expected impact, in addition to diagnostic needs, with an emphasis on improving sensitivity, precision, spatial resolution, and specificity.

**Accomplishments:** The Gordon Research Conference on Laser Diagnostics in Combustion was held at Mount Snow in West Dover, VT August 6-11, 2017, and the associated Gordon Research Seminar for emerging combustion researchers was held the previous weekend, August 5-6, 2017. Both meetings were a success. They were well attended (170 attendees for the GRC, 54 attendees for the GRS) with a diverse distribution representing 11 countries (see below) and a diverse mix of attendees from government labs (19%), industry (7%), and academics (74%).

Of the attendees for the 2017 GRC, 14.7% were female (an increase from 11.9% for 2015 and 7.8% for 2013). The GRS had an impressive 22.2% attendance by women. In addition to these gains in gender diversity, GRC has offered chairs the option of including a 1-hr session entitled "The Power Hour" that allows for discussion of how to address issues related to women in science. This year was the first year that it was offered for our GRC, and it went extremely well. The most significant criticism of the session was that an hour is not long enough.

The talks were very dynamic and exciting and focused on impact of new diagnostics developments. They included

## RPPR Final Report as of 12-Oct-2017

topics related to high-pressure applications, ultra-fast CARS for temperature and species measurements, internal combustion and aircraft engine diagnostics, emissions measurements, particle diagnostics, turbulent flow diagnostics, high-speed imaging, and spectroscopic detection. The poster sessions were also very popular, and the posters were extremely high quality. At the GRC, there were 135 posters, 21 full talks, and 3 short hot-topics talks. The GRS included 10 talks (the keynote by a senior mentor, but the others by students and postdocs), 51 posters, and a mentoring panel session with the keynote speaker and the chair and vice chair for the GRC.

**Training Opportunities:** Mentoring was a significant part of the outreach to emerging scientists, specifically graduate students and postdocs. During the GRS, we held a panel discussion with the keynote speaker and the chair and vice chair for the GRC. We also held a mentoring session for graduate students and postdocs during the GRC. Mentors included several senior members of the community, and the session was successful.

**Results Dissemination:** Nothing to Report

**Honors and Awards:** Nothing to Report

**Protocol Activity Status:**

**Technology Transfer:** Nothing to Report

### **PARTICIPANTS:**

**Participant Type:** PD/PI

**Participant:** Hope A Michelsen

**Person Months Worked:** 1.00

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

**Funding Support:**

**Participant Type:** Co PD/PI

**Participant:** Christof Schulz

**Person Months Worked:** 1.00

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

**Funding Support:**

Outcome of the 2017 Gordon Research Conference and Gordon Research Seminar  
on Laser Diagnostics in Combustion

The Gordon Research Conference on Laser Diagnostics in Combustion was held at Mount Snow in West Dover, VT August 6-11, 2017, and the associated Gordon Research Seminar for emerging combustion researchers was held the previous weekend, August 5-6, 2017. Both meetings were a success. They were well attended (170 attendees for the GRC, 54 attendees for the GRS) with a diverse distribution representing 11 countries (see below) and a diverse mix of attendees from government labs (19%), industry (7%), and academics (74%).

GRC	GRS	
USA	77	20
Germany	41	9
Sweden	22	13
France	9	2
UK	8	3
Canada	3	1
S. Korea	3	2
Netherlands	2	2
Japan	2	1
Saudi Arabia	2	
Australia	1	1
Total	170	54
Female	25 (15%)	12 (22%)
Academic	125	
Government	33	
Industry	12	

Of the attendees for the 2017 GRC, 14.7% were female (an increase from 11.9% for 2015 and 7.8% for 2013). The GRS had an impressive 22.2% attendance by women. In addition to these gains in gender diversity, GRC has offered chairs the option of including a 1-hr session entitled “The Power Hour” that allows for discussion of how to address issues related to women in science. This year was the first year that it was offered for our GRC, and it went extremely well. The most significant criticism of the session was that an hour is not long enough.

The talks were very dynamic and exciting and focused on impact of new diagnostics developments. They included topics related to high-pressure applications, ultra-fast CARS for temperature and species measurements, internal combustion and aircraft engine diagnostics, emissions measurements, particle diagnostics, turbulent flow diagnostics, high-speed imaging, and spectroscopic detection. The poster sessions were also very popular, and the posters were extremely high quality. At the GRC, there were 135 posters, 21 full talks, and 3 short hot-topics talks. The GRS included 10 talks (the keynote by a senior mentor, but the others by students and

postdocs), 51 posters, and a mentoring panel session with the keynote speaker and the chair and vice chair for the GRC. The programs for the GRC and GRS are attached.

ARO funding supported partial registration for six assistant professors, eight graduate students/post docs, and one early-career research scientist from industry. Of the people supported by ARO, three are female, and two are underrepresented minorities.

# **Laser Diagnostics in Combustion**

*Gordon Research Conference*

Expanding the Impact of Optical Diagnostics Development for Combustion

August 6-11, 2017

Mount Snow

West Dover, VT

Chair: Hope A. Michelsen

Vice Chair: Christof W. Schulz

# Meeting Program

---

## Sunday

- 2:00 pm - 9:00 pm Arrival and Check-in
- 6:00 pm Dinner
- 7:30 pm - 7:40 pm Welcome / Introductory Comments by GRC Site Staff
- 7:40 pm - 9:30 pm **Keynote Session: Diagnostics for Natural Biomass Combustion and Its Atmospheric Impact**
- Discussion Leader: **Christof Schulz** (IVG, University of Duisburg-Essen, Germany)
- 7:40 pm - 7:45 pm Introduction by Discussion Leader
- 7:45 pm - 8:25 pm **James Roberts** (ESRL Chemical Sciences Division, National Oceanic and Atmospheric Administration, USA)  
"Just Say NO to Forest Fires: The Unusual Nitrogen Chemistry of Wildfires"
- 8:25 pm - 8:40 pm Discussion
- 8:40 pm - 8:50 pm **Megan Paciaroni** (Fort Lewis College, USA)  
"Backscatter Particle Image Velocimetry via Photon Time-of-Flight Depth Ranging"
- 8:50 pm - 8:55 pm Discussion
- 8:55 pm - 9:05 pm **Florian Zentgraf** (Technische Universitaet Darmstadt, Germany)  
"Application of Structured Illumination to Gas-Phase Phosphor Thermometry – From Mean to Quasi-Instantaneous Imaging"
- 9:05 pm - 9:10 pm Discussion
- 9:10 pm - 9:20 pm **Davide Giassi** (Yale University, USA)  
"Time-Resolved Averaging for the Improvement of Signal-to-Noise Ratio in Laser-Based Imaging Experiments"
- 9:20 pm - 9:25 pm Discussion
- 9:25 pm - 9:30 pm General Discussion

## Monday

7:30 am - 8:30 am Breakfast

### 9:00 am - 12:30 pm **Diagnostics for High-Pressure Applications**

Discussion Leader: **William Roberts** (King Abdullah University of Science and Technology (KAUST), Saudi Arabia)

9:00 am - 9:10 am Introduction by Discussion Leader

9:10 am - 9:50 am **Margaret Wooldridge** (University of Michigan, USA)  
"You Want to Put What, Where? Challenges and Opportunities for Laser Diagnostics in Fundamental Fuel Ignition Studies"

9:50 am - 10:00 am Discussion

10:00 am - 10:30 am Coffee Break

10:30 am - 11:10 am **Christian Willert** (German Aerospace Center (DLR), Germany)  
"Optical Diagnostics in High Pressure Gas Turbine Combustor R&D: The Tricky Balance Between Customers' Wishes, Cost, and the Limits of Physics"

11:10 am - 11:30 am Discussion

11:30 am - 12:10 pm **Andreas Bräuer** (Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany)  
"*In Situ* Diagnostics for High-Pressure Process Technology"

12:10 pm - 12:30 pm Discussion

12:30 pm Lunch

1:30 pm - 4:00 pm Free Time

3:00 pm - 4:00 pm Power Hour

*The GRC Power Hour is an optional informal gathering open to all meeting participants. It is designed to help address the challenges women face in science and support the professional growth of women in our communities by providing an open forum for discussion and mentoring.*

Organizers: **Simone Hochgreb** (University of Cambridge, United Kingdom) and **Mark Linne** (University of Edinburgh, United Kingdom)

4:00 pm - 6:00 pm Poster Session

6:00 pm Dinner

### 7:30 pm - 9:30 pm **CARS for Temperature and Species Measurements**

Discussion Leader: **Terrence Meyer** (Purdue University, USA)

7:30 pm - 7:40 pm Introduction by Discussion Leader

7:40 pm - 8:20 pm **Sean Kearney** (Spectral Energies / Air Force Research Laboratory, USA)  
"Fired Up! Probing Fire Environments and Particle-Laden Flames Using Nanosecond and Femtosecond CARS"

8:20 pm - 8:35 pm Discussion

8:35 pm - 9:15 pm **Alexei Sokolov** (Texas A&M University, USA)  
"Applications of Molecular Coherence to Stand-Off Spectroscopy"

9:15 pm - 9:30 pm Discussion

## Tuesday

- 7:30 am - 8:30 am Breakfast
- 8:30 am Group Photo
- 9:00 am - 12:30 pm **Engine Combustion and Emissions**  
Discussion Leader: **Paul Danehy** (Langley Research Center, NASA, USA)
- 9:00 am - 9:10 am Introduction by Discussion Leader
- 9:10 am - 9:50 am **Andrew Cutler** (George Washington University, USA)  
"Diagnostics for Scramjets and Supersonic Combustion"
- 9:50 am - 10:00 am Discussion
- 10:00 am - 10:30 am Coffee Break
- 10:30 am - 11:10 am **Steven Wagner** (Technical University of Darmstadt, Germany)  
"Robust Diagnostics for Practical Combustion Systems"
- 11:10 am - 11:30 am Discussion
- 11:30 am - 12:10 pm **Scott Herndon** (Aerodyne Research, Inc., USA)  
"In-Use Aircraft Emissions Measurements: Will Inventories Make the Connection?"
- 12:10 pm - 12:30 pm Discussion
- 12:30 pm Lunch
- 1:30 pm - 4:00 pm Free Time
- 4:00 pm - 6:00 pm Poster Session
- 6:00 pm Dinner
- 7:30 pm - 9:30 pm **Diagnostics for Internal Combustion Engine Applications**  
Discussion Leader: **Stina Hemdal** (Volvo Group Trucks Technology, Sweden)
- 7:30 pm - 7:40 pm Introduction by Discussion Leader
- 7:40 pm - 8:20 pm **Volker Sick** (University of Michigan, USA)  
"Optical Diagnostics for Engines Going Fast, Small, and Long"
- 8:20 pm - 8:35 pm Discussion
- 8:35 pm - 9:15 pm **Isaac Ekoto** (Sandia National Laboratories, USA)  
"Quantitative Measurement of Important Low-Temperature Plasma-Generated Radicals at Engine-Relevant Conditions"
- 9:15 pm - 9:30 pm Discussion

## Wednesday

- 7:30 am - 8:30 am Breakfast
- 9:00 am - 12:30 pm **Particle Diagnostics**  
Discussion Leader: **Houston Miller** (George Washington University, USA)
- 9:00 am - 9:10 am Introduction by Discussion Leader
- 9:10 am - 9:50 am **Chris Sorensen** (Kansas State University, USA)  
"Thirty Years of Soot Fractal Aggregate Light Scattering: What Next?"
- 9:50 am - 10:00 am Discussion
- 10:00 am - 10:30 am Coffee Break
- 10:30 am - 11:10 am **Jérôme Yon** (CORIA, France)  
"On the Advantage of Coupling Different Diagnostics for a More Complete Characterization of Soot Particles"
- 11:10 am - 11:30 am Discussion
- 11:30 am - 12:10 pm **Klaus-Peter Geigle** (German Aerospace Center (DLR), Germany)  
"Combination of Different Laser-Based Diagnostics for Better Understanding of Soot Formation in Turbulent, Pressurized Flames"
- 12:10 pm - 12:30 pm Discussion
- 12:30 pm Lunch
- 1:30 pm - 4:00 pm Free Time
- 4:00 pm - 6:00 pm Poster Session
- 6:00 pm Dinner
- 7:00 pm - 7:30 pm Business Meeting  
*Nominations for the Next Vice Chair; Fill in Conference Evaluation Forms; Discuss Future Site and Scheduling Preferences; Election of the Next Vice Chair*
- 7:30 pm - 9:30 pm **Diagnostics for Reacting and Non-Reacting Flows**  
Discussion Leader: **Noel Clemens** (University of Texas at Austin, USA)
- 7:30 pm - 7:40 pm Introduction by Discussion Leader
- 7:40 pm - 8:20 pm **Pascale Domingo** (CORIA, CNRS, France)  
"Introduction of Detailed Chemistry in Large Eddy Simulation of Turbulent Combustion and Validation Process"
- 8:20 pm - 8:35 pm Discussion
- 8:35 pm - 9:15 pm **Andreas Schröder** (German Aerospace Center (DLR), Germany)  
"Shake-the-Box: Dense Lagrangian Particle Tracking for Turbulence Research"
- 9:15 pm - 9:30 pm Discussion

## Thursday

- 7:30 am - 8:30 am Breakfast
- 9:00 am - 12:30 pm **Spectroscopic Detection and Complementary Diagnostics**  
Discussion Leader: **David Osborn** (Sandia National Laboratories, USA)
- 9:00 am - 9:10 am Introduction by Discussion Leader
- 9:10 am - 9:50 am **Tina Kasper** (University of Duisburg-Essen, Germany)  
"Diagnostics Options for Identifying Small and Large Molecules in Mass Spectrometry"
- 9:50 am - 10:00 am Discussion
- 10:00 am - 10:30 am Coffee Break
- 10:30 am - 11:10 am **Gregory Rieker** (University of Colorado Boulder, USA)  
"Frequency Combs in Combustion"
- 11:10 am - 11:30 am Discussion
- 11:30 am - 12:10 pm **Joakim Bood** (Lund University, Sweden)  
"Photofragmentation and Laser-Radar Concepts for Combustion Diagnostics"
- 12:10 pm - 12:30 pm Discussion
- 12:30 pm Lunch
- 1:30 pm - 4:00 pm Free Time
- 4:00 pm - 6:00 pm Poster Session
- 6:00 pm Dinner
- 7:30 pm - 9:30 pm **High-Speed Imaging for Turbulent Flows**  
Discussion Leader: **Adam Steinberg** (University of Toronto, Canada)
- 7:30 pm - 7:40 pm Introduction by Discussion Leader
- 7:40 pm - 8:20 pm **Sébastien Ducruix** (EM2C Laboratory, CNRS, France)  
"High Speed Diagnostics for the Analysis of Flame Dynamics"
- 8:20 pm - 8:35 pm Discussion
- 8:35 pm - 9:15 pm **Campbell Carter** (Air Force Research Laboratory, USA)  
"High-Speed Imaging for the Study of Tough, Practical Problems"
- 9:15 pm - 9:30 pm Discussion

## Friday

7:30 am - 8:30 am      Breakfast

9:00 am                      Departure

---

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army or U.S. Government position, policy, or decision, unless so designated by other documentation.

This material is based upon work supported by the Air Force Office of Scientific Research under award number FA9550-17-1-0281. Any opinions, finding, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the United States Air Force.

This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Science, under Award Number DE-SC0017596.

---

## Poster List

There are two poster sessions: Mon/Tue and Wed/Thu. Display your poster at the board # noted in the first column below, in your assigned session. Within each session, be available by your poster to present your work on the day indicated in the second column. If your name does not appear in the list, consult with the conference chairs.

### Posters displayed on Monday and Tuesday

#		Authors	Affiliation	Title
1	MO	<u>Joshua Herzog</u> , David Rothamer	University of Wisconsin-Madison	Spectroscopic study of the potential for formaldehyde PLIF temperature imaging
2	TU	<u>Daniel Reese</u> , J. Oakley, D. Rothamer, R. Bonazza	NASA Langley Research Center	Simultaneous direct-measurements of concentration and velocity in shock-driven flows
3	MO	<u>Christopher Abram</u> , Benoit Fond, Miriam Pougín, Frank Beyrau	Princeton University	Development and application of methods for characterizing phosphor particles for flow temperature measurements
4	TU	<u>Benoit Barviau</u> , F. Berthillier, S. Legros, F. Grisch	CORIA	Single-shot 1kHz CPP fs CARS: Insight in parameter dependences and experiments in methane/air premixed flames
5	MO	C. Du, S. Andersson, <u>Mats Andersson</u>	Chalmers University	Characterization of evaporating and reacting Diesel sprays with high-speed video imaging
6	TU	<u>Robin Doddema</u> , N.J. Dam, N.G. Deen	Eindhoven University	Spatially-resolved species concentration measurements in a pure heptane and heptane/toluene laminar diffusion flame using spontaneous Raman scattering
7	MO	<u>Benjamin Halls</u> , P.S. Hus, N. Jiang, S. Roy, T.R. Meyer, J.R. Gord	Air Force Research Laboratory	Tomographic measurements of temperature and species in turbulent flames
8	TU	<u>Daniel Richardson</u> , N. Jiang, H. Stauffer, S. Kearney, S. Roy, J.R. Gord	Spectral Energies, LLC	Femtosecond two-photon absorption laser-induced fluorescence (fs TALIF) imaging of CO and Kr for reacting and non-reacting flows
9	MO	<u>Paul Hsu</u> , N. Jiang, J. Mance, Y. Wu, M. Gragston, Z. Zhang, J. Miller, J.R. Gord, S. Roy	Spectral Energies, LLC	High-speed, two-dimensional, multi-species Raman imaging for combustion and flow diagnostics
10	TU	<u>Hans Stauffer</u> , K. Rahman, K. Patel, M. Slipchenko, S. Roy, J.R. Gord, T.R. Meyer	Spectral Energies, LLC	Hybrid fs/ps vibrational coherent anti-Stokes Raman scattering thermometry in high-pressure flames
11	MO	M.M. Gu, L.M. Thomas, A. Satija, <u>Robert Lucht</u>	Purdue University	Advances in chirped probe pulse fs CARS
12	TU	<u>Arafat Rahman</u> , K. Patel, M. Slipchenko, Y. Wu, Z. Zhang, T.R. Meyer, S. Roy, J.R. Gord	Purdue University	Femtosecond two-photon laser-induced fluorescence of carbon monoxide and atomic oxygen in high-pressure flames
13	MO	<u>Chloe Dedic</u> , J. Michael, T.R. Meyer	Iowa State University	Accurate measurement of vibrational/rotational non-equilibrium using hybrid fs/ps CARS
14	TU	<u>James Michael</u> , C.E. Dedic, T.R. Meyer, T.R. Sippel	Iowa State University	Study of energy distributions behind a detonation wave using hybrid fs/ps CARS
15	MO	<u>Yi Gao</u> , S. Lowe, A. Hayakawa, L. Fan, S. Hochgreb	Shanghai Jiao Tong University	Quantitative temperature study of NO in non-reacting flows using laser-induced thermal grating spectroscopy (LITGS)
17	MO	<u>Davide Giassi</u> , Marshall Long	Yale University	Time-resolved averaging for the improvement of signal-to-noise ratio in laser-based imaging experiments

#		Authors	Affiliation	Title
18	TU	<u>Akihiro Hayakawa</u> , S. Lowe, T. Yamagami, K. Takeuchi, T. Kudo, Y. Gao, S. Hochgreb	Tohoku University	Quantitative measurements of temperature using laser-induced thermal grating spectroscopy with OH or NO excitation
19	MO	<u>Christopher Betrancourt</u> , F. Liu, P. Desgroux, X. Mercier, A. Faccinetto, M. Salamanca, L. Ruwe, K. Kohse-Höinghaus, D. Emmrich, A. Beyer, A. Gölzhäuser, T. Tritscher	Lille University - CNRS	Experimental evidence of the size of incandescent incipient soot particles in flat premixed sooting and nucleation flames of n-butane obtained from LII, HIM, and 1nm-SMPS
20	TU	<u>Ze Wang</u> , Scott Sanders	University of Wisconsin-Madison	H <sub>2</sub> O absorption tomography in a Diesel aftertreatment system using a polymer film for optical access
21	MO	<u>Robert Barlow</u> , R. Van Winkle, S. Hartl, C. Hasse, D. Geyer, A. Dreizler, G. Magnotti, H. Chutcher, M. Dunn, A. Masri	Sandia National Laboratories	Reaction zone detection and characterization in partially premixed methane flames
22	TU	<u>J.H. Frank</u> , B.D. Patterson, E. Huang, B. Zhou, C.J. Kliewer	Sandia National Laboratories	Simultaneous temperature and velocity field measurements with 2D-CARS and PIV
23	MO	<u>Daniel Guildenbecher</u>	Sandia National Laboratories	Three-dimensional diagnostics of ultra-high-speed particle fields
24	TU	<u>Elise Hall</u> , D. Guilden- becher, B. Thurow	Auburn University	Recent advancements in particle tracking using 3D plenoptic diagnostics
25	MO	<u>Timothy Haller</u> , N. Clemens, P. Varghese	University of Texas at Austin	Thermometry in high-pressure gases using spontaneous Raman scattering
26	TU	<u>Megan Paciaroni</u> , Y. Chen, K. Lynch, D. Guildenbecher	Fort Lewis College	Backscatter particle image velocimetry via photon time-of-flight depth ranging
27	MO	<u>Rachelle Jacobson</u> , M. Bailey, E. Adkins, H. Miller	George Washington University	Extinction measurements near 3.0 $\mu\text{m}$ in nitrogen-diluted, ethylene, non-premixed flames
28	TU	J.D.M. Cirtwill, S. Kheirkhah, P. Saini, K. Venkatesan, <u>Adam Steinberg</u>	University of Toronto	Measurement and analysis of thermoacoustic oscillations in a liquid fueled aeronautical combustor
29	MO	<u>Kevin Dieter</u> , A. Dreizler, D. Geyer	Hochschule Darm- stadt	Experimental Raman spectra of hydrocarbons for temperatures up to 1300 K
30	TU	<u>Peter Fendt</u> , T. Werblinski, S. Kämmerle, L. Zigan, S. Will	FAU Erlangen- Nürnberg	Multi-parameter correlation for broadband absorption spectra under fired IC engine conditions
31	MO	<u>Simon Aßmann</u> , M. Altenhoff, F. Huber, S. Will	FAU Erlangen- Nürnberg	Two-dimensional soot-particle sizing in a premixed flat flame by a combination of multi-angle light scattering and laser-induced incandescence
32	TU	<u>Matthias Kögl</u> , B. Hofbeck, S. Will, L. Zigan	FAU Erlangen- Nürnberg	Volumetric high-speed soot volume fraction measurements within a DISI-engine for ethanol and butanol fuel blends at varying EGR-rates
33	MO	<u>Daniel Bassing</u> , Andreas Bräuer	FAU Erlangen- Nürnberg	Simultaneous visualization of the mixture composition on the macro- and the microscale in high-pressure jets via Raman spectroscopy
34	TU	<u>Ulrich Retzer</u> , T. Wer- blinski, R. Pan, C. Rabe, T.R. Meyer, M. Slipchenko, L. Zigan, S. Will	FAU Erlangen- Nürnberg	Towards high-speed LIF for investigation of mixture formation and combustion employing a burst-mode laser

#		Authors	Affiliation	Title
35	MO	<u>Rongchao Pan</u> , T. Werblinski, U. Retzer, M. Slipchenko, T.R. Meyer, L. Zigan, S. Will	FAU Erlangen- Nürnberg	Performance of a newly developed burst-mode dye laser system for OH-PLIF studies in turbulent premixed flames
36	TU	<u>Jürgen Schorr</u> , J. Bode, B. Böhm	Daimler AG	Multi-plane high speed PIV measurements in a DISI engine via laser scanning technique
37	MO	C.-P. Ding, A. Renaud, R. Honza, A. Dreizler, <u>Benjamin Böhm</u>	TU Darmstadt	Characterization of near-wall flows in a SI engine using high-speed PIV and high-resolution PIV/PTV
38	TU	<u>Ayane Johchi</u> , J. Pareja, A. Dreizler	TU Darmstadt	Towards quantitative planar mixture fraction and temperature measurements of auto-igniting methane jets
39	MO	<u>Johannes Kiefer</u> , J. Stahl, R. Reisenhofer, E.J. King, J. Zetterberg, M. Aldén, Z. Li	University of Bremen	Flame front geometry by shearlet transform analysis of PLIF images
40	TU	<u>Malik Nafa</u> , M. Scherman, A. Bresson, B. Attal-Tretout, P. Joubert	ONERA	Simulation of hybrid ps/fs-CARS profiles in the spectral domain
41	MO	<u>Gabrielle Martinez</u> , C. Genzale, G. Magnotti, B. Knox, K. Matusik, D. Duke, C. Powell, A. Kastengren	Georgia Tech	Quantification of Sauter mean diameter using scattering absorption extinction measurements in Diesel sprays
42	TU	<u>Torsten Endres</u> , T. Benzler, T. Baranowski, T. Dreier, C. Schulz	IVG, University of Duisburg-Essen	Toluene fluorescence model for combustion-relevant environmental conditions
43	MO	<u>Robin Chrystie</u> , T. Dreier, C. Schulz	IVG, University of Duisburg-Essen	Towards absolute <i>in situ</i> measurements of SiO during synthesis of silica nanoparticles for kinetics model validation
44	TU	<u>Niklas Jüngst</u> , Sebastian Kaiser	IVG, University of Duisburg-Essen	Multi-diagnostic imaging of evaporating fuel wall-films in combustion as a source of PAH and soot
45	MO	<u>Sebastian Kaiser</u> , Syahar Shawal	IVG, University of Duisburg-Essen	Image processing for endoscopic imaging of early premixed combustion in IC engines
46	TU	T. Endres, M. Fikri, S. Görs, M. Shahbaz, S. Shawal, P. Niegemann, T. Dreier, S. Kaiser, <u>Christof Schulz</u>	IVG, University of Duisburg-Essen	Endoscopic combustion diagnostics: bridging the gap between application and science
47	MO	<u>Kyle Daun</u> , S.T. Moghaddam, T. Sipkens, J. Menser	University of Water- loo	Optical modeling of low-fluence laser-induced breakdown spectroscopy: Effect of plasma formation
48	TU	<u>Yasin Abul-Huda</u> , Mirko Gamba	University of Michi- gan	PLIF-based imaging of highly complex flow and combustion phenomena
49	MO	<u>Logan White</u> , Mirko Gamba	University of Michi- gan	Under-resolved absorption spectroscopy of OH radicals in flames using broadband UV LEDs
50	TU	<u>Markus Köhler</u> , F. Herrmann, T. Schripp, M. Mühlberg, P. Oßwald	German Aerospace Center (DLR)	Advances in soot emissions from novel jet fuels: Combined MBMS study with advanced soot particle measurements on full scale jet engines
51	MO	<u>Christoph Arndt</u> , Y. Gao, M. Severin, W. Meier	German Aerospace Center (DLR)	Multi-parameter high repetition rate laser diagnostics for the study of stratified combustion in a dual-swirl gas turbine model combustor
52	TU	<u>Patrick Nau</u> , Z. Yin, K.-P. Geigle, O. Lammel, R. Lückcrath, W. Meier	German Aerospace Center (DLR)	Thermographic phosphors for wall temperature measurements in gas turbine combustors
53	MO	<u>Jennifer Giaccai</u> , Houston Miller	George Washington University	Analysis of soot-based carbon inksticks through Raman spectroscopy

#		Authors	Affiliation	Title
54	TU	A. Hosseinnia, H. Fatehi, J. Bood, <u>Per-Erik Bengtsson</u>	Lund University	Rotational CARS for simultaneous thermometry and relative concentration measurements of ethane and nitrogen in ethane diffusion flames
55	MO	<u>Fahed Abou Nada</u> , M. Aldén, M. Richter	Lund University	Application of phosphor thermometry for remote temperature sensing in biomass
56	TU	<u>Christian Brackmann</u> , H. Kim, J. Gao, E. Heimdal-Nilsson, Z. Li, M. Aldén	Lund University	Raman spectroscopy investigations of hydrogen addition to flames at elevated pressure
57	MO	<u>Yupan Bao</u> , J. Bood, W. Weng, K. Larsson, M. Aldén, A. Ehn	Lund University	Investigation of OH using pico-second laser system
58	TU	<u>Dina Hot</u> , A.-L. Sahlberg, D. Kozlov, M. Aldén, Z. Li	Lund University	Fundamental investigation of mid-infrared laser-induced thermal grating spectroscopy for detection of small hydrocarbons
59	MO	<u>Alexios Matamis</u> , S. Lönn, Zh. Wang, L. Luise	Lund University	Methanol injection and combustion optical diagnostics
60	TU	<u>Maria Ruchkina</u> , Joakim Bood	Lund University	Single-shot two-photon laser-induced fluorescence imaging of atomic hydrogen in CH <sub>4</sub> /air flame
61	MO	<u>Yogeshwar Nath Mishra</u> , M. Kögl, C. Conrad, B. Schmitt, E. Kristensson, L. Zigan, S. Will, E. Berrocal	Lund University	3D mapping of size and concentration of droplets in transient sprays using two-phase SLIPI-scan
62	TU	<u>Johan Sominsson</u> , N.-E. Olofsson, P.-E. Bengtsson	Lund University	Influence of metal salts on soot formation through measurements of soot volume fractions and particle sizes using imaging LII, ELS and TEM techniques
63	MO	<u>Arman Ahamed Subash</u> , A. Kundu, R. Collin, J. Klingmann, M. Aldén	Lund University	Laser-based investigation of hydrogen-enriched methane flames in a dry low-emission industrial prototype burner under atmospheric pressure conditions
64	TU	<u>Anna-Lena Sahlberg</u> , A. Luers, P. Ewart	University of Oxford	Flame temperature measurements using laser-induced thermal grating spectroscopy in nitric oxide at 226 nm
65	MO	<u>Anand Makwana</u> , S. Iyer, M. Linevsky, R. Santoro, T. Litzinger, J. O'Connor	Penn State University	Application of LIF-LII to investigate the effects of premixing on aromatic species and soot distributions in laminar, co-flow flames at atmospheric pressure
66	TU	<u>Frank Beyrau</u> , P. Dragomirov, A. Mendieta, C. Abram, B. Fond	Magdeburg University	Surface temperature measurements during spray impingement using thermographic phosphors
67	MO	<u>Taesung Kim</u> , Hyunchang Lee, Myunggeun Ahn, Youngbin Yoon	Seoul National University	Simultaneous measurement with high repetition rate OH-PLIF and PIV in a non-premixed jet flame with acoustic forcing
68	TU	<u>Waruna Kulatilaka</u> , Yejun Wang, A. Jain	Texas A&M University	Ultrashort pulse kilohertz-rate LIF imaging of OH in flames
69	MO	<u>Jeonghoon Lee</u>	Korea University of Technology and Education	The estimation of relative emissivity and temperature for non-absorbing particles synthesized in flames

## Posters displayed on Wednesday and Thursday

#		Authors	Affiliation	Title
1	WE	<u>Dustin Witkowski</u> , David Rothamer	University of Wisconsin-Madison	Investigation of thermographic phosphors for high-temperature gas thermometry
2	TH	<u>Alfredo Tuesta</u> , B. Fisher, S. Tuttle	Naval Research Laboratory	Dual-pump coherent anti-Stokes Raman scattering temperature and major species concentration measurements in a turbulent spray flame
3	WE	E. Salaun, P. Malbois, J. Apeloig, F. Frindt, G. Cabot, B. Quevreux, L. Bouheraoua, H. Verdier, S. Richard, B. Renou, G. Cabot, <u>Frédéric Grisch</u>	CORIA	Experimental study on NO pollutant formation in high-pressure swirl-stabilized premixed kerosene/air flames using NO-, OH- and kerosene-PLIF
4	TH	B.E. Schmidt, <u>Jeffrey Sutton</u>	Ohio State University	High-resolution velocimetry in turbulent and reacting flows using a wavelet-based optical flow method
5	WE	<u>Noud Maes</u> , P.-C. Bakker, N. Dam	Eindhoven University	Unambiguous formaldehyde imaging in Diesel sprays
6	TH	<u>Ankit Tyagi</u> , I. Boxx, S. Peluso, J. O'Connor	Penn State University	Simultaneous OH-PLIF and stereoscopic-PIV on interacting, premixed-turbulent flames
7	WE	<u>Benjamin Halls</u> , J.R. Gord, T.R. Meyer, A.L. Kastengren	Air Force Research Laboratory	Pandimensional x-ray measurements of mass distribution in optically complex sprays
8	TH	<u>Tongxun Yi</u> , N. Jiang, G.H. Gunaratne, I. Chterev, B. Emerson, T. Lieuwen, A.W. Caswell, S. Roy, J.R. Gord	Spectral Energies, LLC	Insights in turbulent swirling combustion via high-speed PIV/OH-PLIF measurements
9	WE	<u>Anil Patnaik</u> , P. Hsu, Y. Wu, M. Gragston, Z. Zhang, J.R. Gord, S. Roy	Spectral Energies, LLC	Comparison of ns, ps and fs LIBS for fuel-air ratio measurement
10	TH	<u>Michael Smyser</u> , M. Slipchenko, A. Rahman, S. Roy, J.R. Gord, T.R. Meyer	Purdue University	Development of a 5–100 kHz compact 14-J Nd:YAG burst-mode laser for diagnostics in propulsion systems
11	WE	<u>Garrett Mathews</u> , C. Goldenstein, Yuzhe Zhou	Purdue University	Single-ended, fiber-coupled diode-laser sensors for characterizing combustion gases
12	TH	<u>Aman Satija</u> , D. Han, J. Gore, R. Lucht	Purdue University	Application of dual-pump vibrational CARS in turbulent and laminar flames
13	WE	<u>Mikhail Slipchenko</u> , M. Smyser, T.R. Meyer, S. Roy, J.R. Gord	Spectral Energies, LLC	Development of a fs/ps burst-mode laser: towards MHz-rate non-linear optical diagnostics
14	TH	<u>Rodrigo Sanchez-Gonzalez</u> , Z. Norberg, M. Pearce, S. Hoops, O. Dmytrenko, M. Richey	St. Olaf College	A method for the analysis of molecular tagging velocimetry images based on full grid parameterization
15	WE	<u>Keke Zhu</u> , C. Dedic, S. Barkley, T. Sippel, J. Michael	Iowa State University	Laser-induced fluorescence in microwave-assisted solid propellant flames
16	TH	<u>David Salazar</u> , M. MacDonald, C. Strand, J. Jeffries, R.K. Hanson	Stanford University	Laser-based arc-jet flow thermometry: challenges and opportunities
17	WE	<u>Aamir Farooq</u>	KAUST	Temperature measurements in a rapid compression machine

#		Authors	Affiliation	Title
18	TH	<u>Ryan Cole</u> , P. Schroeder, A. Torres, G. Rieker	University of Colorado	Dual-frequency comb absorption spectroscopy at 100 bar and 1000°C: Towards model improvement for laser diagnostics in harsh environments
19	WE	<u>Barney Ellison</u> , J. Daily, J. Baraban, J. Porterfield, C. Rodgers, N. Labbe	University of Colorado	Combination of laser spectroscopy and photoionization mass spectroscopy in miniature flow reactor studies
20	TH	<u>Amanda Makowiecki</u> , N. Hoghooghi, N. Wimer, J. Daily, P. Hamlington, G. Rieker	University of Colorado	Cavity-enhanced dual-frequency comb spectroscopy for characterization of biomass pyrolysis
21	WE	<u>Karl Olof Johansson</u> , F. El Gabaly, P.E. Schrader, M.F. Campbell, H.A. Michelsen	Sandia National Laboratories	Study of the evolution of particle surface and bulk maturity level during soot growth and oxidation in a flame
22	TH	<u>Yi Mazumdar</u> , Daniel Guildenbecher	Sandia National Laboratories	Simultaneous high-speed digital inline holography and pyrometry measurements of aluminized solid rocket propellants
23	WE	<u>Christopher Klierer</u> , T. Courtney, A. Bohlin, B.D. Patterson	Sandia National Laboratories	Ultrabroadband coherent Raman for pure-rotational H <sub>2</sub> thermometry
24	TH	<u>Bo Zhou</u> , J. Frank	Sandia National Laboratories	Strategy for background-free measurements of high speed OH in turbulent flames using SLIPI
25	WE	<u>Brian Thurow</u> , T. Fahringer, C. Clifford, K. Johnson, J. Klemkowsky, E. Hall, C. Jones	Auburn University	Recent developments in plenoptic camera-based 3D flow diagnostics
26	TH	<u>Zhiwei Sun</u>	University of Adelaide	Simultaneous measurements of flame temperature, soot volume fraction, primary soot particle diameter in unsteady flames and the challenges
27	WE	<u>Simone Hochgreb</u> , Luming Fan	University of Cambridge	Thermographic PIV: from phosphorescence to incandescence
28	TH	<u>Subith Vasu</u>	University of Central Florida	Recent advances in time-resolved laser absorption diagnostics enable revealing fundamental chemical kinetics inside shock tubes
29	WE	Timothy Wabel, <u>Adam Steinberg</u> , Peiyu Zhang, Xinyu Zhou	University of Toronto	Pseudo-PLIF measurements derived from DNS data of a high-Ka jet flame
30	TH	<u>Ellen Hertle</u> , Lars Zigan, Stefan Will	FAU Erlangen-Nürnberg	Laser-induced phosphorescence for high temperature thermometry (TBD)
31	WE	<u>Tobias Klima</u> , Andreas Bräuer	FAU Erlangen-Nürnberg	Fuel distribution and phase transition in high pressure sprays
32	TH	<u>Lars Zigan</u> , U. Retzer, W. Fink, S. Will	FAU Erlangen-Nürnberg	Quantitative analysis of mixture formation in a Diesel spray by using 1-methylnaphthalene PLIF
33	WE	<u>Stefan Will</u> , Franz Huber	FAU Erlangen-Nürnberg	Comprehensive optical characterization of soot particles sampled with a suction probe
34	TH	<u>Jonathan Retter</u> , N. Glumac, G. Elliott, S. Kearney	University of Illinois at Urbana-Champaign	Spatially correlated temperature, oxygen, and fuel measurements in a plasma-assisted hydrogen diffusion flame by one-dimensional fs/ps rotational CARS imaging
35	WE	<u>Robert Pitz</u> , C. Hall, M. Ramsey, D. Knaus	Vanderbilt University	Imidogen tagging velocimetry (ITV)
36	TH	<u>Brian Peterson</u> , C. Karakanas, A. Khan, E. Baum, A. Dreizler, B. Böhm	University of Edinburgh	Detailed analysis of flame propagation in a spark-ignition engine using simultaneous dual-plane OH-LIF and stereoscopic PIV
37	WE	<u>Hidemasa Kosaka</u> , F. Zentgraf, <u>B. Böhm</u> , A. Dreizler	TU Darmstadt	Experimental characterization of wall-heat flux and thermochemical states during side-wall quenching

#		Authors	Affiliation	Title
38	TH	<u>Florian Zentgraf</u> , M. Stephan, E. Berrocal, B. Böhm, A. Dreizler	TU Darmstadt	Application of structured illumination to gas-phase phosphor thermometry – from mean to quasi-instantaneous imaging
39	WE	<u>Andrew Williamson</u> , Johannes Kiefer	University of Bremen	Single-shot temperature measurements in flames by time-resolved laser-induced breakdown monitoring
40	TH	<u>Thomas Seeger</u> , Christian Meissner	University of Siegen	Automatic identification of spatially-averaged pure rotational CARS spectra
41	WE	<u>Mathieu Roussillo</u> , P. Scouflaire, S. Candel, B. Franzelli	CentraleSupélec	Laser-induced incandescence measurements of soot in a premixed swirled flame operating under rich conditions in a confined configuration
42	TH	<u>Igor Rahinov</u> , H. Janbazi, J. Sellmann, A. Fomin, A. Pilipodi-Best, S. Kluge, P. Fjodorow, O. Hasemann, S. Cheskis, A. Kempf, C. Schulz, H. Wiggers, I. Wlokas	The Open University of Israel	Intracavity laser absorption spectroscopy study of gas phase iron oxide formation in buoyancy opposed nanoparticle synthesis flame reactor
43	WE	Timothy Sipkens, P. Hadwin, S.J. Grauer, <u>Kyle Daun</u>	University of Waterloo	Bayesian model selection for time-resolved laser-induced incandescence
44	TH	Raphael Mansmann, T. Terheiden, P. Schmidt, <u>Torsten Endres</u> , C. Schulz	IVG, University of Duisburg-Essen	LII-Sim – A modular signal processing toolbox for laser-induced incandescence measurements
45	WE	<u>Patrick Kranz</u> , C. Schulz, S. Kaiser	IVG, University of Duisburg-Essen	LIF-based visualization of preferential evaporation of a multi-component fuel in an SIDI engine
46	TH	<u>Thomas Dreier</u> , J. Menser, C. Hou, K. Daun, C. Schulz	IVG, University of Duisburg-Essen	Novel technique for refining thermo-physical properties by a coupled LII/LIBS approach
47	WE	<u>Marc Lubnow</u> , R. Pan, C. Brocksieper, T. Dreier, C. Schulz	IVG, University of Duisburg-Essen	Diode laser-based standoff absorption measurement of water film thickness in retro-reflection
48	TH	<u>Aaron Skiba</u> , C. Carter, S. Hammack, J. Driscoll	University of Michigan	Preheat zone characterization in premixed methane-air flames subjected to extreme levels of turbulence
49	WE	<u>Mohammad Alzuabi</u> , Volker Sick	University of Michigan	Imaging of temperature variations in the near-wall region of an internal combustion engine
50	TH	<u>Huanchang Lee</u> , Youngbin Yoon	Seoul National University	Liquid nitrogen density field at supercritical state measured by Raman scattering
51	WE	<u>Yejun Wang</u> , W. Kulatilaka, A. Jain	Texas A&M University	Femtosecond two-photon LIF (fs-TPLIF) measurements of carbon monoxide (CO) in sooting spray flames
52	TH	<u>Patrick Nau</u> , P. Kutne, G. Eckel, W. Meier, C. Hotz, S. Fleck	German Aerospace Center (DLR)	Temperature and concentration measurements in a gasifier with IR absorption spectroscopy
53	WE	<u>Wolfgang Meier</u> , J. Grohmann, L. Cantu, T. Mosbach	German Aerospace Center (DLR)	Characterization of fuel effects in turbulent swirling spray flames
54	TH	<u>Andreas Ehn</u> , J. Bood, Zh. Li, E. Berrocal, M. Aldén, E. Kristensson	Lund University	FRAME – Femtosecond videography
55	WE	<u>Christian Binder</u> , Fahed Abou Nada, Mattias Richter	Lund University	Effect of flame luminescence on phosphor thermometry measurements using the lifetime decay method
56	TH	<u>Xin Liu</u> , A. Ahamed Subash, S. Yu, Z. Li, R. Collin, M. Aldén, X. Bai	Lund University	Investigation of a new CECOST swirl burner flame using high-speed flame chemiluminescence imaging and simultaneously OH/CH <sub>2</sub> O PLIF

#		Authors	Affiliation	Title
57	WE	<u>Jim Larsson</u> , W. Wenig, Z. Li, J. Bood	Lund University	Hydrochloride and water vapor detection using wave-length modulation spectroscopy at 1.74 $\mu\text{m}$
58	TH	A. Matamis, S. Lönn, Zh. Wang, <u>Ludovica Luise</u> , B.M. Vaglieco, M. Richter, M. Aldén	Lund University	Optical and laser diagnostics of alternative fuels
59	WE	<u>Manu Naduvil Mannazhi</u> , J. Simonsson, D. Bäckström, A. Gunnarsson, R. Edland, K. Andersson, P.-E. Bengtsson	Lund University	Laser-induced incandescence and extinction measurements of soot in an oxy-fuel reactor
60	TH	<u>Elin Mlamqvist</u> , M. Brydegaard, M. Aldén, J. Bood	Lund University	Demonstration and applications of CW laser radar in combustion diagnostics
61	WE	<u>Panagiota Stamatoglou</u> , Z. Wang, J. Gao, C. Kong, A. Ehn, M. Richter	Lund University	High-speed planar laser-induced fluorescence in a gliding arc
62	TH	<u>Johan Zetterberg</u> , J. Zhou, S. Blomberg, E. Lundgren	Lund University	Simultaneously 2D spatially resolved activity and surface roughness of a Pd(100) single crystal during CO oxidation
63	WE	<u>Benjamin Williams</u> , M. Zulkifli, F. Beyrau	University of Oxford	Structural survey of turbulent oxy-fuel combustion
64	TH	<u>Christopher Willman</u> , Paul Ewart	University of Oxford	Multi-point temperature measurements in gas flows using 1-D Laser-Induced Grating Scattering
65	WE	<u>Benoit Fond</u> , A. Ojo, C. Abram, F. Beyrau	Magdeburg University	Simultaneous measurements of temperature and velocity in fluids by probing individual thermographic phosphor particles with continuous wave lasers
66	TH	<u>Masayasu Shimura</u> , S. Yoshida, Y. Minamoto, T. Yokomori, T. Seo, M. Tanahashi	Tokyo Institute of Technology	Micro-PIV investigation of turbulence characteristics at an ignition point in an IC engine

# Laser Diagnostics in Combustion (GRS)

*Gordon Research Seminar*

Recent Advances in Laser-Based Diagnostics for Combustion Research and Their Applications

August 5-6, 2017  
Mount Snow  
West Dover, VT

Chairs: Christoph M. Arndt & Dina Hot

## Meeting Program

---

### Saturday

- |                   |   |
|-------------------|---|
| 2:00 pm - 5:00 pm | Arrival and Check-in  |
| 3:30 pm - 3:45 pm | Introductory Comments by GRC Site Staff / Welcome by the GRS Conference Chair   |
| 3:45 pm - 4:30 pm | <b>Keynote Session: Diagnostic Challenges for Fundamental Understanding of Turbulent Combustion</b><br>Discussion Leader: <b>Christoph Arndt</b> (German Aerospace Center (DLR), Germany) |
| 3:45 pm - 4:15 pm | <b>Robert Barlow</b> (Sandia National Laboratories, USA)<br>"Diagnostic Challenges for Fundamental Understanding of Turbulent Combustion"   |

4:15 pm - 4:30 pm	Discussion
4:30 pm - 6:00 pm	<u>Poster Session</u>
6:00 pm	Dinner
7:30 pm - 9:30 pm	<b>Soot and Spray Diagnostics / Mentorship Component: Career Panel</b>
	Discussion Leaders: <b>Zhiwei Sun</b> (University of Adelaide, Australia) and <b>Dina Hot</b> (Lund University, Sweden)
7:30 pm - 7:50 pm	<b>Robin Doddema</b> (Eindhoven University of Technology, The Netherlands) "Spatially Resolved Species Concentration Measurements in a Pure Heptane and Heptane/Toluene Laminar Diffusion Flame Using Spontaneous Raman Scattering"
7:50 pm - 8:00 pm	Discussion
8:00 pm - 8:20 pm	<b>Noud Maes</b> (Eindhoven University of Technology, The Netherlands) "Unambiguous Formaldehyde Imaging in Diesel Sprays"
8:20 pm - 8:30 pm	Discussion
8:30 pm - 8:50 pm	<b>Anand Makwana</b> (The Pennsylvania State University, USA) "Application of LIF-LII to Investigate the Effects of Premixing on Aromatic Species and Soot Distributions in Laminar Co-Flow Flames at Atmospheric Pressure"
8:50 pm - 9:00 pm	Discussion
9:00 pm - 9:30 pm	<u>Panel Discussion</u> "Career Perspectives and Insight in Peer Reviewed Publishing" <ul style="list-style-type: none"> <li>▪ <b>Christof Schulz</b> (IVG, University of Duisburg-Essen, Germany)</li> <li>▪ <b>Hope Michelsen</b> (Sandia National Laboratories, USA)</li> </ul>

## Sunday

7:30 am - 8:30 am	Breakfast
9:00 am - 11:00 am	<b>Novel Approaches for Laser Diagnostics and Modelling</b>
	Discussion Leader: <b>Florian Zentgraf</b> (Technische Universitaet Darmstadt, Germany)
9:00 am - 9:20 am	<b>Christopher Abram</b> (Princeton University, USA) "Development and Application of Methods for Characterizing Phosphor Particles for Flow Temperature Measurements"
9:20 am - 9:30 am	Discussion
9:30 am - 9:50 am	<b>Andrew Williamson</b> (University of Bremen, Germany) "Single-Shot Temperature Measurements in Flames by Time-Resolved Laser-Induced Breakdown Monitoring"
9:50 am - 10:00 am	Discussion

10:00 am - 10:20 am **Elin Malmqvist** (Lund University, Sweden)  
"Demonstration and Applications of CW Laser Radar in Combustion Diagnostics"

10:20 am - 10:30 am Discussion

10:30 am - 10:50 am **Timothy Wabel** (University of Toronto, Canada)  
"Pseudo-PLIF Measurements Derived from DNS Data of a High-Ka Jet Flame"

10:50 am - 11:00 am Discussion

11:00 am - 12:30 pm Poster Session  
*Coffee will be served in the poster area from 11:00 am - 11:30 am*

12:30 pm Lunch

1:30 pm - 2:30 pm **Application of Laser Diagnostics in Unusual Combustion Environments**

Discussion Leader: **Timothy Haller** (University of Texas at Austin, USA)

1:30 pm - 1:50 pm **Patrick Nau** (German Aerospace Center (DLR), Germany)  
"Temperature and Concentration Measurements in a Gasifier with IR Absorption Spectroscopy"

1:50 pm - 2:00 pm Discussion

2:00 pm - 2:20 pm **Jonathan Retter** (University of Illinois at Urbana-Champaign, USA)  
"Spatially Correlated Temperature, Oxygen, and Fuel Measurements in a Plasma-Assisted Hydrogen Diffusion Flame by One-Dimensional fs/ps Rotational CARS Imaging"

2:20 pm - 2:30 pm Discussion

2:30 pm - 3:00 pm Evaluation Period  
*Fill in GRS Evaluation Forms*

3:00 pm Seminar Concludes

---

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army or U.S. Government position, policy, or decision, unless so designated by other documentation.

This material is based upon work supported by the Air Force Office of Scientific Research under award number FA9550-17-1-0281. Any opinions, finding, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the United States Air Force.

This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Science, under Award Number DE-SC0017596.

---

# Poster List

Display your poster at the board # and session indicated below. If your name does not appear in the list, display your poster at the next available board in the session which seems most appropriate, or consult with the conference chairs about which session to present in. There is plenty of space available for additional posters.

#	Name	Organization	Co-Authors	Poster Title	Session
1	<b>Abou Nada, Fahed J</b>	Lund University	Marcus Aldén, Mattias Richter	Phosphor Thermometry for Remote Temperature Sensing in Biomass	Saturday
2	<b>Abram, Christopher M</b>	Princeton University	Benoit Fond, Miriam Pougin, Frank Beyrau	Development and application of methods for characterising phosphor particles for flow temperature measurements	Saturday
3	<b>Abul-Huda, Yasin M</b>	University of Michigan	Yasin M. Abul-Huda and Mirko Gamba	PLIF-Based Imaging of Highly Complex Flow and Combustion Phenomena	Saturday
4	<b>Alzuabi, Mohammad</b>	University of Michigan - Ann Arbor	Mohammad Alzuabi, Volker Sick	Imaging of Temperature Variations in the Near-Wall Region of an Internal Combustion Engine	Saturday
5	<b>Arndt, Christoph M</b>	German Aerospace Center (DLR)	Yawei Gao, Michael Severin, Wolfgang Meier	Multi-parameter high repetition rate laser diagnostics for the study of stratified combustion in a dual-swirl gas turbine model combustor	Saturday
6	<b>Bao, Yupan</b>	Lund University	Joakim Bood, Wubin Weng, Kajsa Larsson, Marcus Alden and Andreas Ehn	Investigation of OH using pico-second laser system	Saturday
7	<b>Binder, Christian</b>	Lund University	Christian Binder, Fahed Abou Nada, Mattias Richter	Effect of Flame Luminescence on Phosphor Thermometry Measurements Using the Lifetime Decay Method	Saturday
8	<b>Dieter, Kevin</b>	Hochschule Darmstadt	Andreas Dreizler, Dirk Geyer	Experimental Raman spectra of hydrocarbons for temperatures up to 1300 K	Saturday
9	<b>Doddema, Robin</b>	Eindhoven University of Technology	N.J. Dam, N.G. Deen	Spatially resolved species concentration measurements in a pure heptane and heptane/toluene laminar diffusion flame using spontaneous Raman scattering.	Saturday
10	<b>Falgout, Zachary T</b>	University of Edinburgh	Mark Linne	LITA in a Transitional Surface Flow	Saturday
11	<b>Fond, Benoit</b>	Otto-von-Guericke Universität Magdeburg	Anthony Ojo, Christopher Abram, Frank Beyrau	Simultaneous measurements of temperature and velocity in fluids by probing individual thermographic phosphor particles with continuous wave lasers	Saturday

#	Name	Organization	Co-Authors	Poster Title	Session
12	<b>Giaccai, Jennifer</b>	George Washington University / Smithsonian Institution	J. Houston Miller (George Washington University)	Analysis of Soot-Based Carbon Inksticks through Raman Spectroscopy	Saturday
13	<b>Giassi, Davide</b>	Yale University	Marshall B. Long	Time-Resolved Averaging for the Improvement of Signal-to-Noise Ratio in Laser-Based Imaging Experiments	Saturday
14	<b>Hall, Elise M</b>	Auburn University	Daniel Guildenbecher, Brian Thurow	Recent advancements in particle tracking using 3D plenoptic diagnostics	Saturday
15	<b>Haller, Timothy W</b>	University of Texas at Austin	Dr. Noel Clemens and Dr. Philip Varghese	Thermometry in High-Pressure Gases using Spontaneous Raman Scattering	Saturday
16	<b>Hammack, Stephen D</b>	Air Force Research Laboratory	Stephen D. Hammack, Aaron W. Skiba, Constandinos M. Mitsingas, Tonghun Lee, Campbell D. Carter	Recent Advancements in C-X (0,0) CH-PLIF Imaging	Saturday
17	<b>Hayakawa, Akihiro</b>	Institute of Fluid Science, Tohoku University	Akihiro Hayakawa, Steven Lowe, Tomohisa Yamagami, Kiyonori Takeuchi, Taku Kudo, Yi Gao, Simone Hochgreb	Quantitative measurements of temperature using Laser Induced Thermal Grating Spectroscopy with OH or NO excitation	Saturday
18	<b>Herzog, Joshua M</b>	University of Wisconsin - Madison	David A. Rothamer	Spectroscopic Study of the Potential for Formaldehyde PLIF Temperature Imaging	Saturday
19	<b>Jüngst, Niklas</b>	University of Duisburg-Essen	Niklas Jüngst, Sebastian Kaiser	Multi-diagnostic imaging of evaporating fuel wall-films in combustion as a source of PAH and soot	Saturday
20	<b>Kim, Taesung</b>	Seoul National University	Hyunchang Lee, Myunggeun Ahn, Youngbin Yoon	Simultaneous measurement with high repetition rate OH-PLIF and PIV in a non-premixed jet flame with acoustic forcing	Saturday
21	<b>Kranz, Patrick</b>	University of Duisburg-Essen	Christof Schulz, Sebastian A. Kaiser	LIF-based visualization of preferential evaporation of a multi-component fuel in an SIDI engine	Saturday
22	<b>Larsson, Jim</b>	Lund University	Jim Larsson, Wubin Weng, Zhongshan Li, Joakim Bood	Hydrochloride and water vapor detection using wavelength modulation spectroscopy at 1.74 $\mu\text{m}$	Saturday
23	<b>Lee, Hyunchang</b>	Seoul National Univ.	Youngbin Yoon	Liquid nitrogen density field at supercritical state measured by Raman scattering	Saturday

#	Name	Organization	Co-Authors	Poster Title	Session
24	<b>Luise, Ludovica</b>	Lund University	A.Matamis, S.Lönn, Zh.Wang, L.Luise, B.M. Vaglieco, M.Richter, M.Alden	Optical and Laser Diagnostics of Alternative Fuels	Saturday
25	<b>Maes, Noud</b>	Eindhoven University of Technology	Peter-Christian Bakker, Nico Dam	Unambiguous formaldehyde imaging in diesel sprays	Saturday
1	<b>Makowiecki, Amanda</b>	University of Colorado Boulder	Nazanin Hoghooghi, Nicholas T. Wimer, John W. Daily, Peter E. Hamlington, Gregory B. Rieker	Cavity Enhanced Dual Frequency Comb Spectroscopy for Characterization of Biomass Pyrolysis	Sunday
2	<b>Makwana, Anand</b>	The Pennsylvania State University	S. Iyer, M. Linevsky, R. Santoro, T. Litzinger, J. O'Connor.	Application of LIF-LII to investigate the effects of premixing on aromatic species and soot distributions in laminar, co-flow flames at atmospheric pressure.	Sunday
3	<b>Malmqvist, Elin</b>	Lund University	Mikkel Brydegaard, Marcus Alden, Joakim Bood	Demonstration and applications of CW laser radar in combustion diagnostics	Sunday
4	<b>Martinez, Gabrielle</b>	Georgia Tech	Caroline L. Genzale, Gina M. Magnotti, Benjamin W. Knox, Katarzyna E. Matusik, Daniel J. Duke, Christopher F. Powell, Alan L. Kastengren	Quantification of Sauter Mean Diameter using Scattering Absorption Extinction Measurements in Diesel sprays	Sunday
5	<b>Matamis, Alexios</b>	Lund University	A.Matamis, S.Lönn, Zh.Wang, L.Luise, M.Richter, M.Alden	Optical and Laser Diagnostics of Alternative Fuels	Sunday
6	<b>Mecker, Nils T</b>	The University of Edinburgh		Development of models for ultrashort pulse CARS spectroscopy in reactive gases	Sunday
7	<b>Naduvil Mannazhi, Manu</b>	Lund University	Johan Simonsson, Daniel Bäckström, Adrian Gunnarsson, Rikard Edland, Klas Andersson, Per-Erik Bengtsson	Laser-induced incandescence and extinction measurements of soot in an oxy-fuel reactor.	Sunday
8	<b>Nafa, Malik</b>	ONERA	Michael Scherman, Alexandre Bresson, Brigitte Attal-Tretout (ONERA), Pierre Joubert (Institut UTINAM, Besançon, France)	Simulation of hybrid fs/ps-CARS profiles in the spectral domain	Sunday
9	<b>Nau, Patrick</b>	German Aerospace Center (DLR)	Peter Kutne, Georg Eckel, Wolfgang Meier, Christian Hotz, Sabine Fleck	Temperature and concentration measurements in a gasifier with IR absorption spectroscopy	Sunday
10	<b>Retter, Jonathan</b>	University of Illinois at Urbana-Champaign	Nick Glumac, Greg Elliott, and Sean Kearney	Spatially correlated temperature, oxygen, and fuel measurements in a plasma-assisted hydrogen diffusion flame by one-dimensional fs/ps rotational CARS imaging	Sunday

#	Name	Organization	Co-Authors	Poster Title	Session
11	<b>Roussillo, Mathieu</b>	CentraleSupelec	Mathieu Roussillo, Philippe Scouflaire, Sébastien Candel et Benedetta Franzelli	Lased Induced Incandescence measurements of soot in a premixed swirled flame operating under rich conditions in a confined configuration	Sunday
12	<b>Ruchkina, Maria</b>	Lund University	Joakim Bood	Single – shot two photon laser induced fluorescence imaging of atomic hydrogen in CH <sub>4</sub> /air flame	Sunday
13	<b>Sahlberg, Anna-Lena</b>	University of Oxford	Andrew Luers and Paul Ewart	Flame temperature measurements using laser-induced thermal grating spectroscopy in nitric oxide at 226 nm	Sunday
14	<b>Simonsson, Johan</b>	Lund University	Johan Simonsson, Nils-Erik Olofsson, Per-Erik Bengtsson	Influence of metal salts on soot formation through measurements of soot volume fractions and particle sizes using imaging LII, ELS and TEM techniques	Sunday
15	<b>Skiba, Aaron W</b>	University of Michigan	Campbell D. Carter, Stephen D. Hammack, James F. Driscoll	Preheat zone characterization in premixed methane–air flames subjected to extreme levels of turbulence	Sunday
16	<b>Stamatoglou, Panagiota</b>	Lund University	P. Stamatoglou, Z. Wang, J. Gao, C. Kong, A. Ehn, M. Richter	High-speed planar laser-induced fluorescence in a gliding arc	Sunday
17	<b>Subash, Arman Ahamed</b>	Lund University	Atanu Kundu, Robert Collin, Jens Klingmann and Marcus Aldén.	Laser Based Investigation of Hydrogen Enriched Methane Flame in a Dry Low Emission Industrial Prototype Burner under Atmospheric Pressure Conditions	Sunday
18	<b>Sun, Zhiwei</b>	University of Adelaide		Simultaneous measurements of flame temperature, soot volume fraction, primary soot particle diameter in unsteady flames	Sunday
19	<b>Tuesta, Alfredo D</b>	Naval Research Laboratory	Brian T. Fisher and Steven G. Tuttle	Dual-pump Coherent Anti-Stokes Raman Scattering Temperature and Major Species Concentration Measurements in a Turbulent Spray Flame	Sunday
20	<b>Tyagi, Ankit</b>	Penn State University	Isaac Boxx, Stephen Peluso, Jacqueline O'Connor	Simultaneous OH-PLIF and stereoscopic-PIV on interacting, premixed-turbulent flames	Sunday
21	<b>Wabel, Timothy M</b>	University of Toronto	Peiyu Zhang, Xinyu Zhou, Adam Steinberg	Pseudo-PLIF Measurements Derived From DNS data of a High-Ka Jet Flame	Sunday

#	Name	Organization	Co-Authors	Poster Title	Session
22	<b>White, Logan W</b>	University of Michigan	Mirko Gamba	Underresolved Absorption Spectroscopy of OH Radicals in Flames Using Broadband UV LEDs	Sunday
23	<b>Williamson, Andrew P</b>	University of Bremen	Johannes Kiefer	Single-shot temperature measurements in flames by time-resolved laser-induced breakdown monitoring	Sunday
24	<b>Zentgraf, Florian</b>	Technische Universitaet Darmstadt	Florian Zentgraf, Michael Stephan, Edouard Berrocal, Benjamin Böhm, Andreas Dreizler	Application of Structured Illumination to Gas Phase Phosphor Thermometry – From Mean to Quasi-Instantaneous Imaging	Sunday
25	<b>Zhou, Bo</b>	Sandia National Laboratories	Jonathan Frank	Strategy for background-free measurements of high speed OH in turbulent flames using SLIPI	Sunday
26	<b>Hot, Dina</b>	Lund University	Anna-Lena Sahlberg, Dimitrii Kozlov, Marcus Aldén, Zhongshan Li	Fundamental investigation of mid-infrared LITGS for detection of small hydrocarbons	Sunday