2024 Spring Technical Meeting of the Central States Section of the Combustion Institute

May 12-14, 2024

Cleveland Ohio

Central States Section of The Combustion Institute's Code of Conduct

The Board of Advisors of the Central States Section of The Combustion Institute approved this Code of Conduct on January 8, 2022. This document complements the Code of Ethics adopted by the Board of Directors of The Combustion Institute, March 23, 2017

The Central States Section of The Combustion Institute (CSSCI) is committed to providing a safe environment for all its members and meeting attendees free from harassment. Harassment in any form—including that based on sex, gender, gender identify and expression, sexual orientation, age, disability, race, ethnicity, religion (or lack thereof), medical condition, pregnancy, or any other protected characteristics recognized by law—is a violation of this Code of Conduct. Everyone should be treated with respect. No one should fear discrimination. This policy applies to all CSSCI members and covers behaviors that takes place at any programs or activities associated with The Combustion Institute.

Reporting an Incident or Violation of the Code of Conduct

The CSSCI has established a standing committee to deal with reports of harassment. This committee will hereafter be referred to as the Committee. The Committee will consist of the Chair, Chair-Elect, Secretary, and Treasurer of the CSSCI.

The CSSCI takes all reports of behavior prohibited by the Code of Conduct seriously and encourages any individual who experiences or witnesses such behavior to report, including anonymously, such violations to the Committee, including by email. The CSSCI encourages the prompt reporting of such matters to ensure timely and constructive resolutions.

The Committee will evaluate each report to determine the most appropriate response, including both informal and formal responses, in accordance with the rights of each party and may undertake further investigation as the Committee considers necessary. The desired response of the reporting party will be taken into account but cannot be determinative of the CSSCI's response. In meeting with the reporting party, the Committee will explain that reports will be handled with sensitivity and kept as confidential as possible to respect the privacy of all parties.

Informal and formal responses are initiated to stop the prohibited behavior and prevent its recurrence. Possible responses and outcomes include, but are not limited to, issuing a warning to cease the behavior before further sanctions are pursued; separation of the involved persons; exclusion from the remainder of the current and/or future programs and activities; and revoking membership. The CSSCI will maintain a record of the report and corresponding response.

Any person who experiences or witnesses prohibited behavior also has reporting options outside of the CSSCI, including fi ling a report with their home institution or law enforcement agencies.

Retaliation

The CSSCI does not tolerate any kind of retaliation against an individual fi ling a report or assisting in the resolution of a report of prohibited behavior (even if no responsive action is taken). Retaliation is a violation of the Code of Conduct. The CSSCI takes reports of retaliation very seriously. Anyone who experiences or witnesses retaliation in any form should report it immediately to the Committee that will determine further actions as needed.

Program Overview

May 12, 2024

4:00 – 6:30 Registration: Nord Hall Atrium at Case School of Engineering

6:00 – 8:00 Welcome Reception: Nord Hall Atrium at Case School of Engineering

May 13, 2024

7:30 – 4:00 Registration: Second-Floor Grand Ballroom Foyer, Tinkham Veale University Center

7:00 – 8:00 Continental Breakfast: Second-Floor Grand Ballroom, Tinkham Veale University Center

8:00 – 8:15 Opening Remarks and Announcements: Second-Floor Grand Ballroom, Tinkham Veale University Center

8:15 - 9:15 James E. Peters Plenary Lecture: Second-Floor Grand Ballroom, Tinkham Veale University Center

- **Carlos Fernandez-Pello**, University of California Berkeley
  Title: Wildland Fire Spot Ignition and Subsequent Growth

9:25 – 10:45 Technical Sessions I

10:45 – 11:00 Morning Coffee Break: Second-Floor Grand Ballroom Foyer, Tinkham Veale University Center

11:00 – 12:20 Technical Sessions II

12:30 – 1:30 Lunch and CSSCI Business Meeting: Second-Floor Grand Ballroom, Tinkham Veale University Center

1:30 – 2:30 Plenary Lecture: Second-Floor Grand Ballroom, Tinkham Veale University Center

- **Ajay Agrawal**, The University of Alabama
  Title: From Optical Spray Diagnostics to Peripheral Fuel Injection (PeFI): Advancing Diesel Combustion for High-Efficiency and Low-Emissions

2:40 – 4:00 Technical Sessions III

4:00 – 4:15 Afternoon Coffee Break: Second-Floor Grand Ballroom Foyer, Tinkham Veale University Center

4:15 – 5:35 Technical Sessions IV

6:00 – 9:00 Banquet: Cleveland Museum of Natural History

- 6:00 – 6:30 Social Hour
- 7:00 – 8:00 Banquet Lecture: **Prof. Harsha Chelliah,** University of Virginia
  Title: From Fire Research to High-Speed Propulsion Systems – Fundamental Combustion Research
  Supported by National Science Foundation

May 14, 2024

7:30 – 11:00 Registration: Second-Floor Grand Ballroom Foyer, Tinkham Veale University Center

7:00 – 8:00 Continental Breakfast: Second-Floor Grand Ballroom, Tinkham Veale University Center

8:00 – 8:05 Announcements: Second-Floor Grand Ballroom, Tinkham Veale University Center

8:05 – 9:05 Plenary Lecture: Second-Floor Grand Ballroom, Tinkham Veale University Center

- **Sayan Biswas**, The University of Minnesota
  Title: Plasma in Energy Research

9:15-10:35 Technical Sessions V

10:35-10:50 Morning Coffee Break: Second-Floor Grand Ballroom Foyer, Tinkham Veale University Center

10:50-12:10 Technical Sessions VI

12:10: Boxed Lunch: Second-Floor Grand Ballroom Foyer, Tinkham Veale University Center

1:30-3:30: Optional Tours (Bus leaves CWRU at 1:00): 11038-11112 Bellflower Rd

- The Fives North American Combustion, Inc. Tour
- The Nasa Glenn Research Tour

Planning Committee

Organizing Committee:

Ya-Ting Liao (CWRU) Bryan Schmidt (CWRU)
Kathleen M. Tacina (NASA GRC)

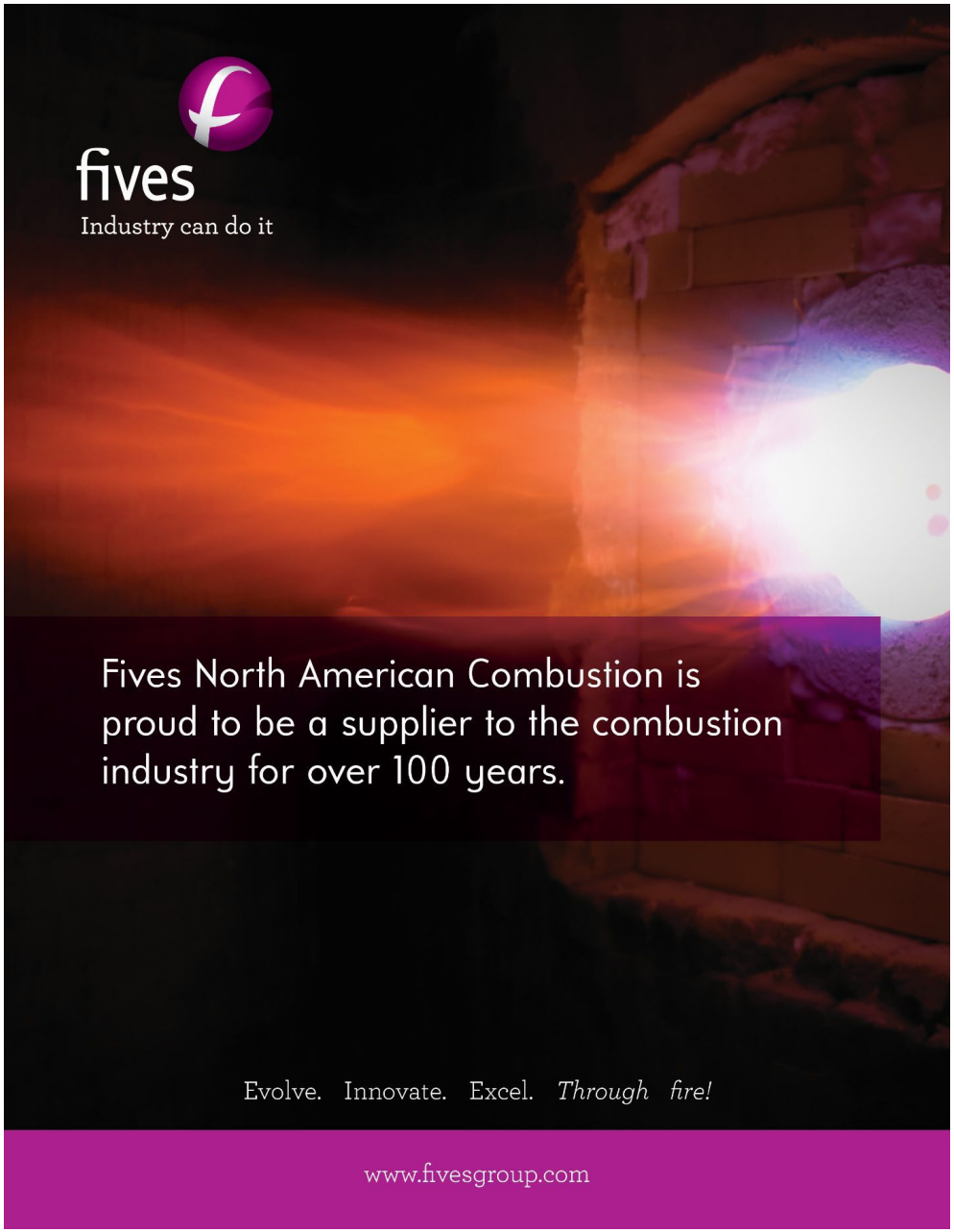
Organizing Sub-Committee:

David Urban (NASA GRC) Paul Ferkul (NASA/USRA)
Michael Johnston (NASA GRC) Rosa Padilla

Program Committee:

Chair: Kalyan Srinivasan
Co-Chair: Babak Shotorban
Combustion Art Competition: Ya-Ting Liao
Undergraduate Student Research Competition: Omid Samimi-Abianeh

2024 Spring Technical Meeting of the Central States Section of The Combustion Institute's Sponsor



2024 Spring Technical Meeting of the Central States Section of The Combustion Institute
Case Western Reserve University, Cleveland, OH
12 – 14 May 2024

Sunday, 12 May 2024

4:00 – 6:30 Registration: Nord Hall Atrium at Case School of Engineering
6:00 – 8:00 Welcome Reception: Nord Hall Atrium at Case School of Engineering

Monday, 13 May 2024

All Technical Sessions are held at the Tinkham Veale University Center

7:30 - 4:00 Registration: Second-Floor Grand Ballroom Foyer
7:00 - 8:00 Continental Breakfast: Second-Floor Grand Ballroom
8:00 – 8:15 Opening Remarks and Announcements in Second-Floor Grand Ballroom
Waruna Kulatilaka, Chair, CSSCI; **Robert Gao**, Department Chair, CWRU MAE; and **Ya-Ting Liao**, Local Host

8:15 - 9:15 James E. Peters Plenary Lecture in Second-Floor Grand Ballroom**: Prof. Carlos Fernandez- Pello,** University of California, Berkeley
Title: *Wildland fire spot ignition and subsequent growth*

9:15 - 9:25	**Transition to Morning Sessions**			
	Reaction Kinetics Ballroom A	**Diagnostics Ballroom B**	**Fire Ballroom C**	**Internal Combustion Engines Senior Classroom**
9:25 - 9:45	**1A01: Chemical kinetic study of the flame-retardant effect of bis(2,2,2-trifluoroethyl) carbonate on ethyl methyl carbonate combustion** *C. Grégoire, Y.M. Almarzooq, M. Khan-Ghauri, P. Diévart, L. Catoire, E.L. Petersen, O. Mathieu*	**1B01: The use of NH radical as a heat release rate surrogate for atmospheric ammonia-hydrogen flames** *A.P. Hardaya, M. Hay, B.S. Soriano, J.H. Chen, W.D. Kulatilaka*	**1C01: Limiting oxygen volume fraction for flame spread extinction** *C. Liveretou, C. Scudiere, J. Rivera, L. Estenbach, C. Fernandez-Pello, M. Gollner*	**1D01: Investigation on effectiveness and misfire behaviors of pre-chamber combustion at idle speed** *C. Zhu, A. Diagne, M.S. Wooldridge*
9:45 - 10:05	**1A02: High-pressure shock-tube ignition of syngas under high-CO_2 dilution** *M. Abulail, M. Intardonato, M. Hay, S.P. Cooper, O. Mathieu, W.D. Kulatilaka, E.L. Petersen*	**1B02: Flame flashback investigations in hydrogen-enriched low swirl flames using high-speed OH planar laser-induced fluorescence** *P. Parajuli, P. Strakey*	**1C02: Numerical simulation of fire and thermal runaway propagation of lithium-ion batteries** *B. Wang, P. Kannan, Y.-T. Liao, M. Parhizi, B. Kwon, S. Madhi, V. Premnath, J. Jeevarajan*	**1D02: Predictive zero-dimension combustion modeling in internal combustion engines with residual fraction and exhaust gas recirculation** *C. Feyijimi, C. Depcik*

	Reaction Kinetics Ballroom A	Diagnostics Ballroom B	Fire Ballroom C	Internal Combustion Engines Senior Classroom
10:05 - 10:25	**1A03: Assessing the homogeneity of propane/air ignition behind reflected shock waves** *M.G. Sandberg, D. Nativel, S.P. Cooper, M. Intardonato, M.K. Hay, M. Fikri, J. Herzler, W.D. Kulatilaka, E.L. Petersen, C. Schulz*	**1B03: Evaluation of UNIFAC group composition of gasoline using two-dimensional gas chromatography** *J.P. Chethalan, P.T. Lynch, K. Brezinsky*	**1C03: Lateral flame spread over thermally thin fuels in the presence of cross-flow due to forced or natural convection** *S. Bhattacharjee, F. Panzer*	**1D03: Evaluation of reduced order modelling of jet fuel combustion within military diesel engines** *J.A. Piehl, M. Tess*
10:25 - 10:45	**1A04: Enhancement of weak absorption signals in high throughput shock tube through ensemble averaging** *A. Moro, R.A. Shaik, A. Sutar, P. Lynch*	**1B04: Improving property predictions for jet fuels with NDIR channel optimization** *A. Sutar, K. Brezinsky, P.T. Lynch*	**1C04: Characterization of 18650 single and multi-cell thermal runaway** *P. Kannan, B. Wang, Y.-T. Liao, B. Kwon, M. Parhizi, S. Madhi, V. Premnath, J. Jeevarajan*	**1D04: Sensitivity of inlet port geometry on main chamber mixing study** *K. Beurlot, T. Jacobs*
10:45 - 11:00	**BREAK - Second-Floor Grand Ballroom Foyer**			
	Reaction Kinetics Ballroom A	**Combustion Theory and Modeling Ballroom B**	**Novel Combustion Techniques Ballroom C**	**Internal Combustion Engines Senior Classroom**
11:00 - 11:20	**1A05: Experimental and detailed kinetics modeling study of bis(2,2,2-trifluoroethyl) carbonate, a fire suppressant for lithium-ion batteries** *M. Khan-Ghauri, C.M. Grégoire, K. Kanayama, P. Diévart, S. Takahashi, T. Tezuka, H. Nakamura, L. Catoire, K. Maruta, E.L. Petersen, O. Mathieu*	**1B05: Revisiting the laminar methane/hydrogen/air counterflow diffusion flame** *K. Pempek, B.K. Murdock, J.P. Gore, R.P. Lucht*	**1C05: Non-intrusive flame structure identification strategy for flame type identification in a premixed swirl burner** *C. Goertemiller, W. Northrop*	**1D05: Turbulent jet ignition using nanosecond pulsed discharge in an optical constant volume chamber** *D. Sen, S. Biswas*
11:20 - 11:40	**1A06: Study of low-to-moderate temperature oxidation of 1,2,4-trimethylbenzene/n-heptane blends** *S. Hossain, M. Abdulrahman, P. Lynch, K. Brezinsky*	**1B06: Analysis of coupled radiative flamelet generated manifolds for solid fuel opposed flow flame spread in microgravity** *K.L. Budzinski, P.E. DesJardin*	**1C06: Wood stove with forced convection for rich quench lean combustion** *A. McClinton, A.K. Agrawal*	**1D06: Optical investigation of propane-dimethyl ether (DME) fuel blends under compression-ignition engine conditions** *S. Doyle, D.A. Rothamer*

	Reaction Kinetics Ballroom A	Combustion Theory and Modeling Ballroom B	Novel Combustion Techniques Ballroom C	Internal Combustion Engines Senior Classroom
11:40 - 12:00	**1A07: Autoignition characteristics of ammonia-dimethyl ether blends** *T. Goyal, J. Klein, O. Samimi-Abianeh*	**1B07: A localized kernel ridge regression approach for estimating chemical reaction rates** *O. Ukorigho, O. Owoyele*	**1C07: Multidimensional modeling of plasma assisted ignition using Gaussian process regression** *I. Kabil, C. Xu, T. Lu*	**1D07: 235ICEQ-0076 BTEX emissions from a gasoline direct injection engine operating on non-oxygenated gasoline and E10** *T.S. Patil, B.M. Wilmer, W.F. Northrop*
12:00 - 12:20	**1A08: OUT-21 Toward predictive pressure-dependent kinetics for non-adiabatic reactions** *C.R. Mulvihill, A.W. Jasper, Y. Georgievskii, S.J. Klippenstein*	**1B08: Towards integration of a Pareto-efficient combustion modeling framework into high-order Nek5000 spectral element CFD solver** *T. Kumar, P. Sharma, M. Ameen, P. Pal, C. Xu, M. Ihme*	**1C08: Design and analysis of a constant-volume strand burner apparatus** *T.G. Swindell, T.E. Sammet, F.A. Rodriguez, E.L. Petersen*	
12:30 - 1:30	**LUNCH – Second-Floor Grand Ballroom** **CSSCI Business Meeting - Second-Floor Grand Ballroom**			
1:30 - 2:30	**Plenary Lecture** in Second-Floor Grand Ballroom**: Prof. Ajay Agrawal,** The University of Alabama **Title:** *From Optical Spray Diagnostics to Peripheral Fuel Injection (PeFI): Advancing Diesel Combustion for High-Efficiency and Low-Emissions*			
2:30 – 2:40	**Transition to Afternoon Sessions**			
	Reaction Kinetics Ballroom A	**Diagnostics Ballroom B**	**Fire Ballroom C**	**Industrial & Applied Combustion Senior Classroom**
2:40 - 3:00	**1A09: Initiation and secondary reactions in the pyrolysis of tetramethylsilane** *R. Sivaramakrishnan, A.W. Jasper, R.S. Tranter*	**1B09: Simultaneous imaging of OH* and CH* chemiluminescence in the exhaust of a rotating detonation engine** *A. James, A.K. Agrawal*	**1C09: Effects of ambient pressures and oxygen on upward flame spread** *R. Neupane, Y.-T. Liao*	**1D09: Assessing slagging impact and optimizing coal blends in coal-fired boilers: A combined CFD evaluation and optimization method** *A.D. Gutierrez, S. Saenz, J.J. Acuña*
3:00 - 3:20	**1A10: A physics-constrained autoencoder-NeuralODE framework for learning complex hydrocarbon fuel chemistry: Methane combustion kinetics** *T. Kumar, A. Kumar, P. Pal*	**1B10: Temperature imaging in H_2 blended NH_3 flames using femtosecond NO LIF** *M.K. Hay, M. Suarez, S. Pias, W.D. Kulatilaka*	**1C10: Study of flaming firebrand using numerical modeling and background oriented Schlieren visualization** *A.A. Naqvi, B.E. Schmidt, Y.-T.T. Liao*	**1D10: In pursuit of multifunctional composites for energetic and pressure sensing applications** *M. Örnek, C.T. V. Nunes, T.A. Hafner, S.F. Son*

	Reaction Kinetics Ballroom A	Diagnostics Ballroom B	Fire Ballroom C	Industrial & Applied Combustion Senior Classroom
3:20 - 3:40	**1A11: Experimental and fuel-surrogates modeling study of the oxidation of specialty jet fuels** *M. Abdulrahman, S. Hossain, M. Sheyyab, P.T. Lynch, K. Brezinsky*	**1B11: Applicability of flame chemiluminescence in liquid-fueled flames: Sensing and modelling** *J. Schihl, A. Gandomkar, P.M. Allison*	**1C11: Spacecraft habitability results from the Saffire VI experiment** *D.L. Urban, G.A. Ruff, P. Ferkul, J. Easton, M. Johnston, J. Owens, S. Olson, C. Fortenberry, J. Graf, O. George, B. Toth, F. Meyer, C. Eigenbrod, J.S. T'ien, Y.-T. T. Liao, C. Fernandez-Pello, G. Legros, A. Guibaud, N. Smirnov, O. Fujita, U. Rojas Alva, G. Jomaas*	**1D11: Flame characteristics of ammonia-dimethyl ether blends at high gas temperature and pressure** *T. Goyal, O. Samimi-Abianeh*
3:40 - 4:00	**1A12: Measuring H abstraction rates in F + butene using absorption spectroscopy in a miniature shock tube** *R.A. Shaik, R. Sivaramakrishnan, S. Hossain, K. Brezinsky, P.T. Lynch*	**1B12: Simultaneous NO and H atom imaging in flames using femtosecond LIF** *M.A. Suarez, M.K. Hay, W.D. Kulatilaka*	**1C12: Effect of bed size on flammability of Indian tropical forest litter** *H.B. Gaikwad, A. Kumar*	**1D12: Flame speed of ammonia-hydrogen blends at high gas temperatures and pressures** *J. Douvry-Rabjeau, T. Goyal, J. Klein, P. Zoldak, O. Samimi-Abianeh*
4:00 - 4:15	**BREAK - Second-Floor Grand Ballroom Foyer**			
		Detonations Ballroom B	**Fire Ballroom C**	**Droplets and Sprays Senior Classroom**
4:15 - 4:35		**1B13: Cryogenic extension of NASA species polynomials using hydrogen and oxygen at stoichiometry** *R.P. Thacker, Z. Harris, B. Maxwell*	**1C13: Heat release rate and thermal runaway propagation in lithium-ion batteries using surrogate cells** *K. Cartwright, P. Kannan, Y. Gu, C. Yuan, Y.-T. Liao*	**1D13: Droplet combustion dynamics of liquid fuels enhanced with carbon dots** *A.S.M. Sazzad Parveg, A. Ratner*
4:35 - 4:55		**1B14: Supersonic deflagration of hydrogen-air mixture** *J. Klein, T. Goyal, O. Samimi-Abianeh*	**1C14: Experimental and numerical approaches to optimize heat blocking efficiency in intumescent coatings.** *T. Hafiz, J. Covello, G. Wnek, Y.-T. Liao, A. Yousefi, A.K. Melaiye*	**1D14: Exploring the potential of nanocellulose as an additive in liquid fuels to improve combustion performance** *R. Mollick, A. Ratner*

		Detonations Ballroom B	Fire Ballroom C	Droplets and Sprays Senior Classroom
4:55 - 5:15		**1B15: Comparison of upstream-normal and upstream-angled fuel injection schemes in a generic scramjet combustor** *E.L. Braun, S.D. Hammack, T.M. Ombrello*	**1C15: Near-surface thermometry of solid fuel polyoxymethylene counterflow diffusion flame using hybrid fs/ps CARS** *S. Bidwai, G. Young, J.B. Michael*	**1D15: Investigating the influence of fueling strategies and spark on combustion instability for a single cylinder two-stroke natural gas engine** *F. Pommier, E. Stewart, T. Jacobs*
5:15 - 5:35		**1B16: Model of traversing turbulent jet ignition in a wave rotor combustor** *M. Jamshidnejad, S. Ghadiri, M.R. Nalim*	**1C16: Dual-pump coherent anti-Stokes Raman scattering thermometry and major species concentration measurements of H_2/CH_4 counterflow diffusion flames** *B.K. Murdock, K. Pempek, V. De La Trinidad, J.P. Gore, R.P. Lucht*	**1D16: Experimental investigation of water addition effects on diesel/kerosene/butanol spray combustion instability** *A. Kumar, S.M. Basha, S. Yang*
6:00 - 9:00	**Banquet at the Cleveland Museum of Natural History** 1 Wade Oval Dr, Cleveland, OH 44106 **Banquet Lecture: Prof. Harsha Chelliah,** University of Virginia **Title:** *From Fire Research to High-Speed Propulsion Systems – Fundamental Combustion Research Supported by National Science Foundation*			

Tuesday, 14 May 2024

All Technical Sessions are held at the Tinkham Veale University Center

7:30 - 11:00 **Registration:** Second-Floor Grand Ballroom Foyer
7:00 - 8:00 **Continental Breakfast:** Second-Floor Grand Ballroom
8:00 - 8:05 **Announcements** in Second-Floor Grand Ballroom
Bryan Schmidt, Local Host

8:05 - 9:05 **Plenary Lecture** in Second-Floor Grand Ballroom**: Prof. Sayan Biswas,** The University of Minnesota
Title: *Plasma in Energy Research*

9:05 - 9:15	**Transition to Morning Sessions**			
	Laminar Flames Ballroom A	**Industrial and Applied Combustion Ballroom B**	**Alternative Fuels and Emissions Ballroom C**	**Particulates and Multiphase Flows Senior Classroom**
9:15 - 9:35	**2A01: Experimental measurements of ammonia flame thickness from spherically propagating flames** *Y.M. Almarzooq, M. Hay, W.D. Kulatilaka, E.L. Petersen*	**2B01: An engineering approach to explosion vent sizing** *B. O'Bryan, C. Engebretson, C. Allen*	**2C01: Impact of fuel properties on lean blow out for sustainable aviation fuels** *D. Dasgupta, S. Som*	**2D01: Particle-scale simulation for co-firing biomass with coal to study interactions between two particles with realistic morphology** *D. Liang*
9:35 - 9:55	**2A02: Near-limit quenching behavior of low stretch diffusion flames in microgravity** *C. Li, J.S. T'ien, P.V. Ferkul, S.L. Olson, M.C. Johnston*	**2B02: Influence of blowoff procedure on flowfield and combustion phenomena near lean blowout in a swirl-stabilized liquid spray combustor** *N.C. Guntapalli, M. Gurunadhan, S. Menon*	**2C02: Review of sustainable aviation fuels and their combustion properties** *U.L. Costa, E.L. Petersen*	**2D02: On the development of non-intrusive diagnostics for a slab burner experiment** *E. Katz Ismael, K. Retfalvi, P.E. DesJardin*
9:55 - 10:15	**2A03: Measurement of MTBE and ETBE laminar flame speeds in air** *J.E. Jacobs, Y. Almarzooq, I. Parvez, E.L. Petersen*	**2B03: Cantera reactor network modeling of a domestic wood stove and comparisons to measurement** *L.G. Shankar, P.E. DesJardin*	**2C03: 235AFEQ-0071 A multifidelity machine learning approach for predicting NOx emissions in a double-staged combustor** *P. John, V. Viswamithra, M. Gurunadhan, S. Menon, O. Owoyele*	**2D03: Flame propagation in stratified dust-air mixtures** *C. Engebretson, C. Allen*
10:15 - 10:35	**2A04: The ignition stage of dynamic flame behaviors in the mesoscale sudden-expansion** *S.-Y. Hsu, J.-H. Huang, C.-H. Tsai*		**2C04: A numerical study of NO_X and soot emissions in *n*-heptane/methyl decanoate counterflow diffusion flames** *R. Suresh, C. Xu, S.K. Aggarwal*	**2D04: Measurements of soot emissions in high-pressure non-premixed n-heptane flames** *F.J. Guzman, J. Kojima, J. Klettlinger*

10:35 - 10:50	BREAK - Second-Floor Grand Ballroom Foyer		
	Laminar Flames **Ballroom A**	**Turbulent Combustion** **Ballroom B**	**Alternative Fuels and Emissions** **Ballroom C**
10:50 - 11:10	**2A05: Development of high efficiency heat extraction system to be used with wood fired heating systems** *A. Ghorashi, A.K. Agrawal, B. Khandelwal*	**2B05: Turbulent spherical flames in a constant-volume fan-stirred vessel** *N. Lindblade, M. Turner, Y. Almarzooq, E.L. Petersen*	**2C05: CFD evaluation of radial airflow lean direct injectors for commercial supersonics technology** *K. Ajmani*
11:10 - 11:30	**2A06: Hexamethyldisiloxane (HMDSO) impact on spherical propagating methane flame speeds** *Q. Meng, P. Dunphy, R. Ramesh, M. Gamba, M. Wooldridge*	**2B06: Turbulent burning velocity of lean premixed hydrogen/air flames at engine-relevant conditions** *Y. Wang, C. Xu, R. Scarcelli*	**2C06: Comparison of high-speed images of lean blowout for four national jet fuel combustion program fuels** *K.M. Tacina, T.G. Capil, Y.R. Hicks*
11:30 - 11:50	**2A07: The effects of pressure and optical thickness on radiative losses in spherical diffusion flames in microgravity** *K.A. Waddell, D.L. Dietrich, V. Nayagam*	**2B07: Investigating combustion dynamics through an optical pre-chamber** *A. Dhotre, S. Biswas*	**2C07: Design, calibration and validation of a robust and reliable nanofuel stability analyzing device** *W. Steiner, N. Nagarkar, R. Mollick, A. Ratner*
11:50 - 12:10	**2A08: Ammonia-hydrogen flame extinction at low and intermediate temperatures** *D.E. Thomas, J.C. Jarosz, W. Schutte*	**2B08: Flame characterization of a NASA Glenn natural gas and oxygen burner rig facility** *T.G. Capil, M.J. Presby, Y.R. Hicks*	**2C08: Development of an experimental apparatus for the study of fuel deposits at high temperatures** *A. Lira, R. Juárez, C. Loebick, E.L. Petersen*
12:10	**Box Lunches – Second-Floor Grand Ballroom Foyer** **Adjourn**		
1:00	**Facility Tours NASA Glenn and Fives North American Combustion Inc. Tours for those who registered.** **Bus leaves CWRU at 1:00** **11038-11112 Bellflower Rd**		

2024 CSSCI SPRING TECHNICAL PAPER OVERVIEW AUTHORS

Author	*Paper #*
Abdulrahman, M.	1A06, 1A11
Abulail, M.	1A02
Acuña, J.J.	1D09
Aggarwal, S.K.	2C04
Agrawal, A.K.	1C06, 1B09, 2A05
Ajmani, K.	2C05
Allen, C.	2B01, 2D03
Allison, P.M.	1B11
Almarzooq, Y.M.	1A01, 2A01, 2A03, 2B05
Ameen, M.	1B08
Basha, S.M.	1D16
Beurlot, K.	1D04
Bhattacharjee, S.	1C03
Bidwai, S.	1D05, 1C15, 2B07
Braun, E.L.	1B15
Brezinsky, K.	1B03, 1B04, 1A06, 1A11, 1A12
Budzinski, K.L.	1B06
Capil, T.G.	2C06, 2B08
Cartwright, K.	1C13
Catoire, L.	1A01, 1A05
Chen, J.H.	1B01
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Ghadiri, S.	1B16
Ghorashi, A.	2A05
Goertemiller, C.	1C05
Gollner, M.	1C01
Gore, J.P.	1B05, 1C16
Goyal, T.	1A07, 1D11, 1D12, 1B14
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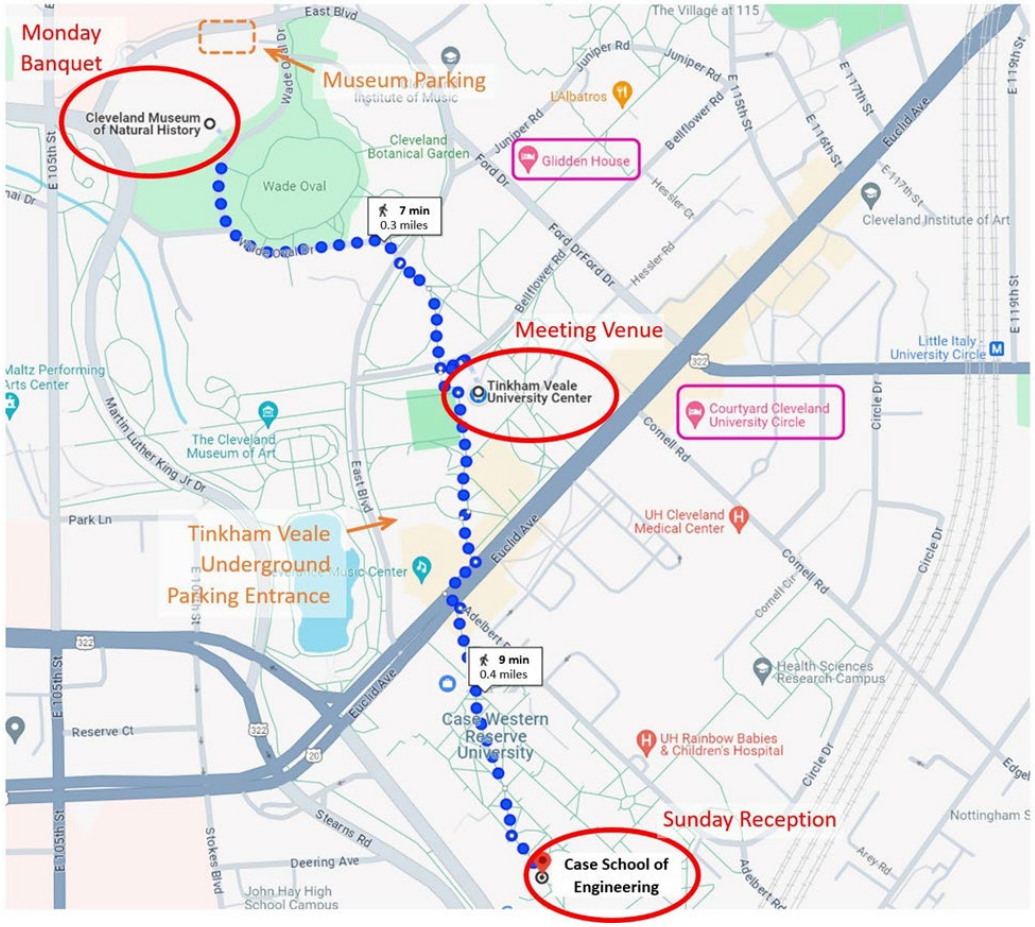
Campus Map

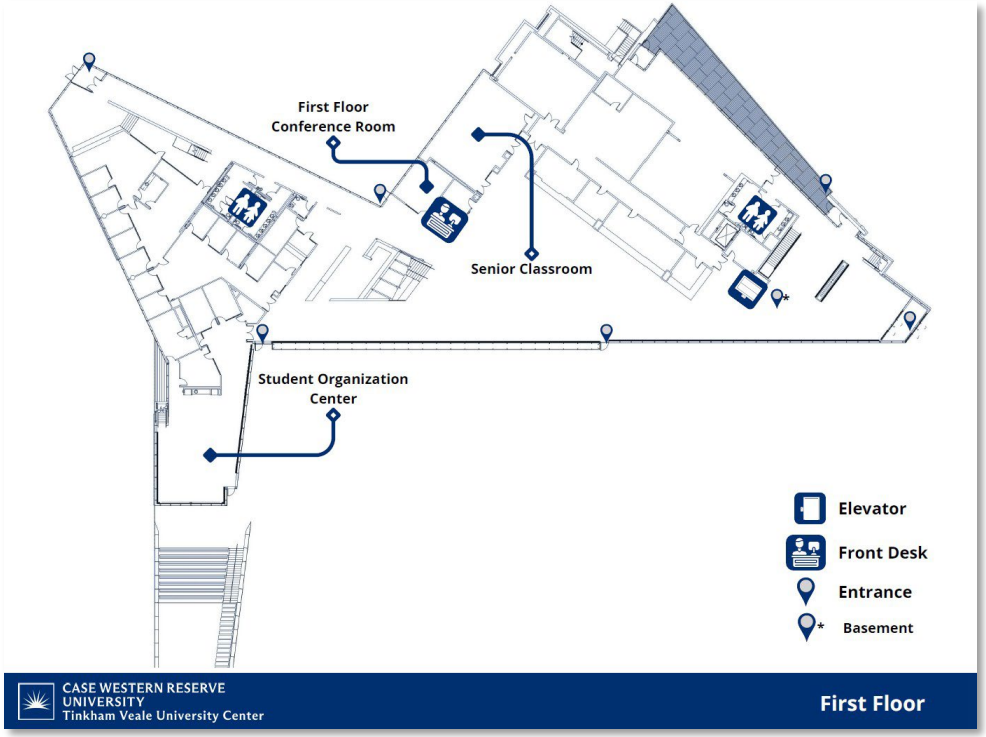


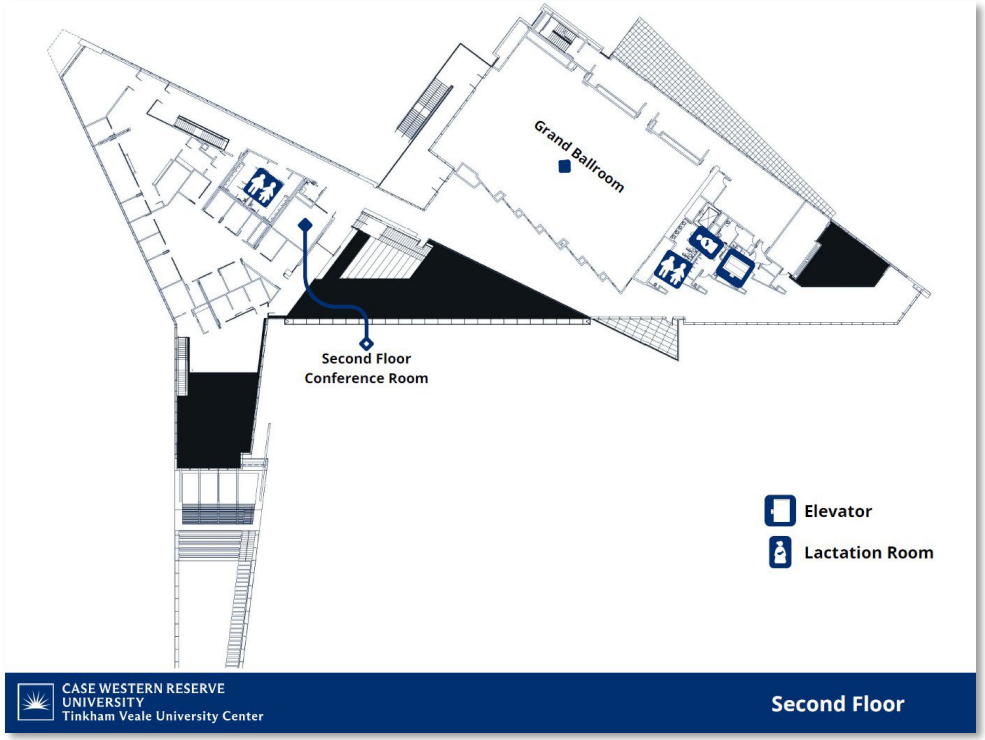
Tinkham Veale University Center - 11038 Bellflower Road, Cleveland, OH 44106 https://case.edu/universitycenter/
Parking: underground garage located at 11172 East Boulevard, Cleveland, Ohio 44106. (Maximum:$10/day).

Cleveland Museum of Natural History - 1 Wade Oval Drive, Cleveland, OH 44106 https://www.cmnh.org/
Parking: garage entrance located on Wade Oval Drive near the corner of East Boulevard (free for banquet guests).

Case School of Engineering - Nord Hall, 2095 Martin Luther King Jr Dr Rm 500, Cleveland, OH 44106

Tinkham Veale University Center Facility Map





James E. Peters Plenary Lecture, May 13, 8:15-9:15 AM

Wildland Fire Spot Ignition and Subsequent Growth

Carlos Fernandez-Pello, Distinguished Professor, University of California, Berkeley

Abstract: Wildland fires are becoming more frequent all around the world in a drier climate. Some of these fires may have catastrophic consequences with extensive damage to land, property, ecosystems, and lives. It is expected that under the drier weather patterns related to overall climate change, the problem will only intensify. Wildland fires are often initiated by small ignition sources (spot fire ignition) either caused by human intervention or by natural events. These ignition sources could be hot metal particle/sparks, embers, pilot flames, lightning, all of which cause a small and localized area of wildfire ignition that subsequently spreads to wider and larger areas. Sparks can be generated by power line interaction, hot work (welding, grinding, friction), ejected from the generating source, and transported forward by the wind landing on vegetation where they can start a wildland fire. Once the wildfire has been ignited it may grow exponentially by surface fire spread, and can also propagate rapidly through ember spotting, where embers are lofted by the plume of the fire and then transported forward by the wind and igniting spot fires downwind. The development of a wildland fire can be separated into ignition, initial fire growth and large-scale propagation. The spotting ignition and the subsequent initial spread of fire is a complex problem involving multiple physicochemical processes in the solid and gas phases. These processes depend on many factors, including: the generation of the particles; the size and thermo-chemical state of the particles (inert or burning); the trajectories of the particles from their generation to their landing; characteristics of the shower of particles (dense or light) at landing; the fuel bed where they land (fuel type, porosity, moisture content, temperature); environmental conditions (temperature, humidity, wind velocity). By characterizing these distinct individual processes, it is possible to attain the required information to develop predictive, physics-based wildfire spotting models. The models together with topographical maps and wind models could be added to existing landscape-scale wildfire spread models to improve their predictive capabilities. The enhanced wildfire spread models would provide land managers and government agencies with better tools to prescribe preventive measures and fuels treatments before a fire, and allocate suppression resources and issue evacuation orders during a fire. Here an attempt is made to summarize the research issues of the wildfire spotting and initial growth problem by describing the distinct individual processes involved in the problem and by discussing their know-how status. Emphasis is given to those areas that the author is more familiar with, due to his work on the subject.

Bio: Dr. Carlos Fernandez-Pello is a Distinguished Professor of the Graduate School in Mechanical Engineering at the University of California, Berkeley, USA. He received degrees of Doctor Aeronautical Engineer from the University of Madrid, Spain, and a Ph.D. in Engineering Sciences from the University of California, San Diego. He was a Postdoctoral Fellow at Harvard University, and a Research Faculty at Princeton University. He joined the University of California, Berkeley, in 1980, where he teaches and conducts research in thermal sciences with emphasis in fire related combustion. He held the Maynard Chair Professorship in Mechanical Engineering and became an over-scale distinguished professor. He also was Associate Dean of the Graduate Division, where he supervised several units related to university

wide graduate studies. He is a member of the Royal Academy of Engineering of Spain, a Fellow of the Combustion Institute and of the ASME International. He is an Honorary Dr. of Engineering from the Universidad Nacional San Marcos, Peru. He has been awarded numerous awards including, the “2022 Microgravity and Space Processes Award” from the AIAA, the “Howard Emmons Award” at the 12th International Symposium of the IAFSS, the “Philip Thomas Medal of Excellence” at the 6th IAFSS symposium, the “International Prize” and the “Journal Award” from the Combustion Society of Japan, the “Pi Tau Sigma Award” for excellence in teaching” at UCB. He has been an Invited Visiting Professor at universities and research laboratories in Australia, Chile, China, France, Italy, Japan, and Spain. His recent research emphasizes material flammability in earth and spacecraft environments, and wildland fire development. Throughout his career he has studied ignition, smoldering and transition to flaming, micro-scale combustion, external effects on flames, among others. His research is, or has been funded by NASA, NSF, NIST, DARPA, DOE and ARO. He is co-author of the book “Fundamental of Combustion Processes” and of five book chapters. He has over 270 publications in peer reviewed journals and over 300 hundred non-reviewed papers.

Plenary Lecture, May 13, 1:30-2:30 PM

From Optical Spray Diagnostics to Peripheral Fuel Injection (PeFI): Advancing Diesel Combustion for High-Efficiency and Low-Emissions

Ajay Agrawal, Robert Barfield Endowed Chair, The University of Alabama

Abstract: Diesel engines are an important part of modern infrastructure including heavy- and light-duty transport vehicles, large tanker ships, off-road vehicles, agricultural machines, construction equipment, and distributed power generation. Next generation diesel engines must achieve higher fuel efficiency and lower air-borne emissions to keep pace with the increasingly stringent emissions regulations and rise of electrification in propulsion and power generation sectors. These conflicting, two-fold requirements require fundamental insight into diesel combustion processes and develop modern concepts that can be incorporated into existing engine hardware without significant development efforts. This presentation will explore fundamental and applied aspects of diesel combustion to address the above challenges. Multiple research groups have used optical spray diagnostics to investigate diesel combustion. In the first part, an overview of key results and advancements, especially within authors' research group will be provided. These include a constant pressure test rig for repeated fuel injection experiments, schlieren deflectometry (RSD) to simultaneously quantify liquid length as well as first and second stage ignition events, and two-color pyrometry to acquire spatially resolved soot measurements. Spray combustion physics within the framework of these diagnostics will be discussed. In the second part, Peripheral Fuel Injection (PeFI) developed recently in authors' group will be introduced. In PeFI, fuel is injected from multiple single-hole injectors located at the periphery of the cylinder head, as opposed to Conventional Diesel Combustion (CDC) supplying fuel radially outwards from a centrally located multi-hole injector. PeFI was implemented in a single cylinder research engine to demonstrate its ability retrofit in existing hardware. Test results show inherent benefits of PeFI: lower coolant heat loss, higher fuel efficiency, and large reductions in soot and CO emissions. Findings of the operational engine are consistent with the cold flow experiments and detailed non-reacting and reacting simulations. Design improvements underway will allow PeFI to also reduce NOx and unburned hydrocarbon emissions in future designs, which is profound in curtailing role of after-treatment systems in diesel engines.

Bio: Dr. Ajay Agrawal has conducted fundamental and applied research on combustion and fluid flows for NASA, the Department of Defense, and the Department of Energy. He has published more than 100 papers in technical journals and conferences, and he is a Fellow of the American Society of Mechanical Engineers. He seeks to advance his research in areas such as combustion and fluid flow in power generation, propulsion and space systems, and work in environmentally benign energy utilization. His current research and teaching interests include, Combustion and fluid flow in microgravity, Combustion and fluid flow in gas turbine systems, Lean premixed, hydrogen-enriched and alternate fuels, Combustion inside porous materials, auto-ignition, and combustion control, Quantitative Rainbow Schlieren Deflectometry for optical diagnostics, Applied computational fluid dynamics, Design of thermal fluid systems.

Banquet Lecture, May 13, 7:00-8:00 PM

From Fire Research to High-Speed Propulsion Systems – Fundamental Combustion Research Supported by National Science Foundation

Harsha Chelliah, Professor, University of Virginia
Program Director Combustion & Fire Systems NSF

Abstract: While the characteristic times scales associated with fire propagation/suppression and high-speed reacting flows differ by orders of magnitude, the same fundamental transport and finite-rate chemical kinetic principles can be applied to address challenging issues in both systems. During this presentation, the breadth of fundamental reacting flow investigations supported by the NSF Combustion and Fire Systems Program will be highlighted. More importantly, often overlooked collaborative and cross-cutting funding opportunities available for researchers in engineering will also be discussed.

Bio: Dr. Harsha Chelliah is the Program Director of the Combustion and Fire Systems at the National Science Foundation. He is also a Professor of Mechanical and Aerospace Engineering at the University of Virginia (UVa). Prior to joining UVa, he received his PhD in Mechanical and Aerospace Engineering from Princeton University in 1988. His research is focused on fundamental interactions between finite-rate kinetics and fluid flow using both experimental and modeling approaches. He was the Director of the Commonwealth Center for Aerospace Propulsion Systems (from 2011-2014), established by the Commonwealth of Virginia and Rolls-Royce. In addition, he also served as Director of the Graduate Studies in Mechanical and Aerospace Engineering (from 2011-2015). He is an active member of the American Institute of Aeronautics and Astronautics (AIAA), the American Society of Mechanical Engineers (ASME), and the Combustion Institute. He is a Fellow of ASME, a Fellow of the Combustion Institute, an Associate Fellow of AIAA, and a Visiting Fellow at Peterhouse College, Cambridge University.

Plenary Lecture, May 14, 8:05-9:05 AM

Plasma in Energy Research

Sayan Biswas, Benjamin Mayhugh Assistant Professor, The University of Minnesota

Abstract: Plasma – ionized gases comprised of ions, electrons, excited species, etc., holds the key to our future energy and environment. Even though plasma research has existed for more than a century, the recent technological innovations in power electronics and advanced manufacturing have opened the door to a new world for energy researchers. Biswas and his Plasma Power Propulsion Laboratory (3P Lab) at the University of Minnesota Twin Cities uses low-temperature, non-equilibrium plasmas as a tool to access unconventional chemical pathways for clean energy production, high-efficiency propulsion, and cleaner transportation. In this talk, Biswas will present a brief history of plasmas in combustion, highlight our contemporary state of understanding, and explore the immense future potential of non-equilibrium plasmas often under-researched at higher pressures relevant for energy applications. Biswas will discuss the diverse applications of plasma technology in energy and propulsion, including a) enhancing the efficacy of combustion through plasma-assisted chemical reforming of hydrocarbon fuels, b) utilizing plasmas for 'sensing and control' of combustion instability, c) investigating the effects of plasma discharge on the mixing of liquid jets in supersonic crossflow, d) harnessing laser-induced plasma and air shock from energetic materials to develop tailored innovative solid energetic propellants. The aim of this talk is to familiarize the audience with the fascinating world of uncharted and intricate non-equilibrium plasma physics and its potential influence on combustion science, sparking (pun intended, we will steer clear of sparks! i.e., equilibrium plasmas) their interest.

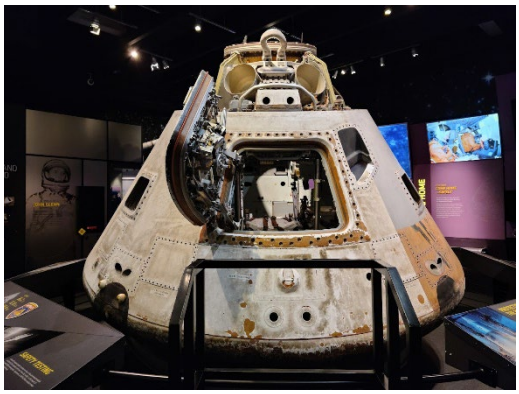
Bio: Dr. Sayan Biswas is an Assistant Professor in Mechanical Engineering at the University of Minnesota Twin Cities. Previously, he was a postdoctoral researcher at Sandia National Laboratories Combustion Research Facility. He earned a Ph.D. in Aerospace Engineering from Purdue University in 2017. He received masters from the University of Connecticut in 2012 and bachelors from Jadavpur University, India, in 2010, both in Mechanical Engineering. At the University of Minnesota, Sayan leads Plasma Power Propulsion Laboratory – 3P Lab, developing innovative and sustainable technologies for clean and efficient future energy. His research utilizes low-temperature plasmas in next-generation of engines, carbon-neutral E-fuels for aviation and transportation, explores advanced energetic materials, and studies the fundamentals of high-speed propulsion.

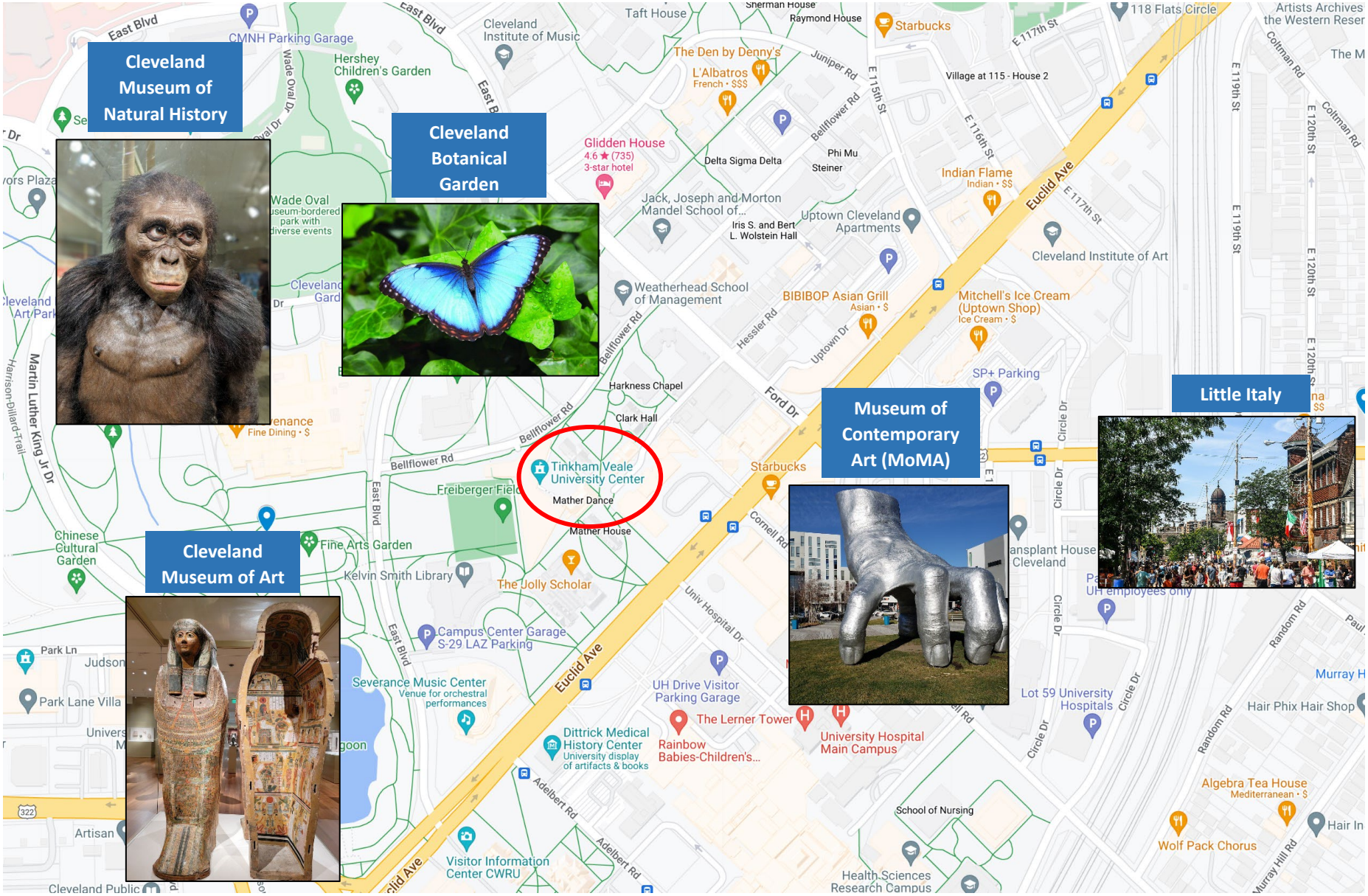
Walking Distance Nearby Attractions

- **Cleveland Museum of Art (0.2 miles)**
  https://www.clevelandart.org/
  11150 East Boulevard, Cleveland, OH 44106
- **Cleveland Botanical Gardens (0.2 miles)**
  https://www.holdenfg.org/
  11030 East Blvd, Cleveland, OH 44106
- **Cleveland Museum of Natural History (0.3 miles)**
  https://www.cmnh.org/
  1 Wade Oval Drive, Cleveland, OH 44106
- **MoMA Cleveland (0.3 miles)**
  https://www.mocacleveland.org/
  11400 Euclid Ave., Cleveland, OH 44106
- **Little Italy (0.6 miles)**
  https://littleitalycle.com/
  Little Italy, Cleveland, OH 44106
- **Courtyard by Marriott Cleveland University Circle (0.3 miles)**
  2021 Cornell Rd, Cleveland, OH 44106
- **Glidden House (0.2 miles)**
  1901 Ford Dr, Cleveland, OH 4410

Driving Distance Nearby Attractions

- **West Side Market (6 miles)**
  https://westsidemarket.org/
  1979 West 25th Street, Cleveland, OH 44113
- **Rock & Roll Hall of Fame (7.1 miles)**
  https://rockhall.com/info/
  1100 E 9th St, Cleveland, OH 44114
- **Great Lakes Science Center (7.3 miles)**
  https://greatscience.com/
  601 Erieside Ave, Cleveland, OH 44114
- **Edgewater Beach (10.1 miles)**
  https://www.clevelandmetroparks.com/parks/visit/parks/lakefront-reservation/edgewater-beach
  Edgewater Beach, Cleveland, OH 44102




Cleveland Museum of Natural History
Cleveland Botanical Garden
Cleveland Museum of Art
Museum of Contemporary Art (MoMA)
Little Italy
East Blvd
CMNH Parking Garage
Hershey Children's Garden
Cleveland Institute of Music
Taft House
Sherman House
Raymond House
Starbucks
118 Flats Circle
Artists Archives the Western Reser
The Den by Denny's
L'Albatros
French • $$$
Juniper Rd
E 115th St
Village at 115 - House 2
E 117th St
Coltman Rd
E 119th St
E 120th St
Bellflower Rd
E 116th St
Glidden House
4.6 ★ (735)
3-star hotel
Delta Sigma Delta
Phi Mu
Steiner
Indian Flame
Indian • $$
Euclid Ave
Jack, Joseph and Morton Mandel School of...
Iris S. and Bert L. Wolstein Hall
Uptown Cleveland Apartments
Cleveland Institute of Art
Wade Oval
Weatherhead School of Management
BIBIBOP Asian Grill
Asian • $
Mitchell's Ice Cream (Uptown Shop)
Ice Cream • $
Hessler Rd
Uptown Dr
SP+ Parking
Harkness Chapel
Clark Hall
Ford Dr
Circle Dr
Tinkham Veale University Center
Mather Dance
Mather House
Freiberger Field
Fine Arts Garden
Chinese Cultural Garden
Kelvin Smith Library
The Jolly Scholar
Martin Luther King Jr Dr
Harrison Dillard Trail
Campus Center Garage S-29 LAZ Parking
Severance Music Center
Venue for orchestral performances
Univ Hospital Dr
UH Drive Visitor Parking Garage
The Lerner Tower
Rainbow Babies-Children's...
University Hospital Main Campus
Dittrick Medical History Center
University display of artifacts & books
Adelbert Rd
Cornell Rd
Lot 59 University Hospitals
Random Rd
Hair Phix Hair Shop
Murray H
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