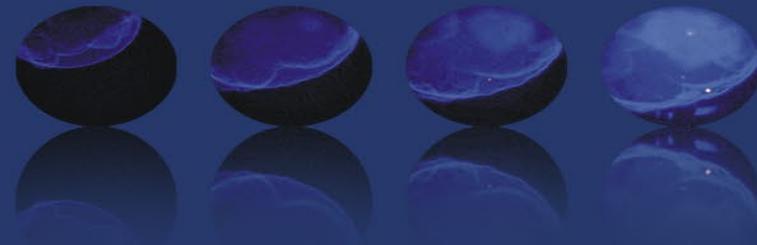




University of California at Irvine
Combustion Summer School
August 24, 2023



STRETCHING OUR ENERGY RESOURCES AND WALKING LIGHTLY: a team event

Margaret Wooldridge

Director, Institute for Energy Solutions at the University of
Michigan

Walt J. Weber, Jr., Professor of Sustainable Energy,
Environmental, and Earth Systems Engineering

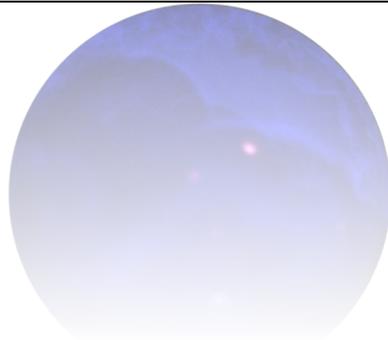
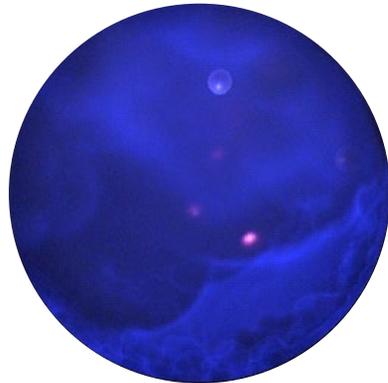
Arthur F. Thurnau Professor,

Departments of Mechanical and Aerospace Engineering,
University of Michigan, Ann Arbor



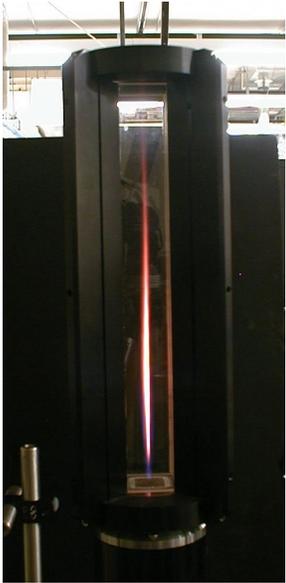
Part I. Introductions

- Tell us
 - How you like us to address you, including pronouns
 - Where you are from academically and geographically
 - One thing you have enjoyed doing this summer

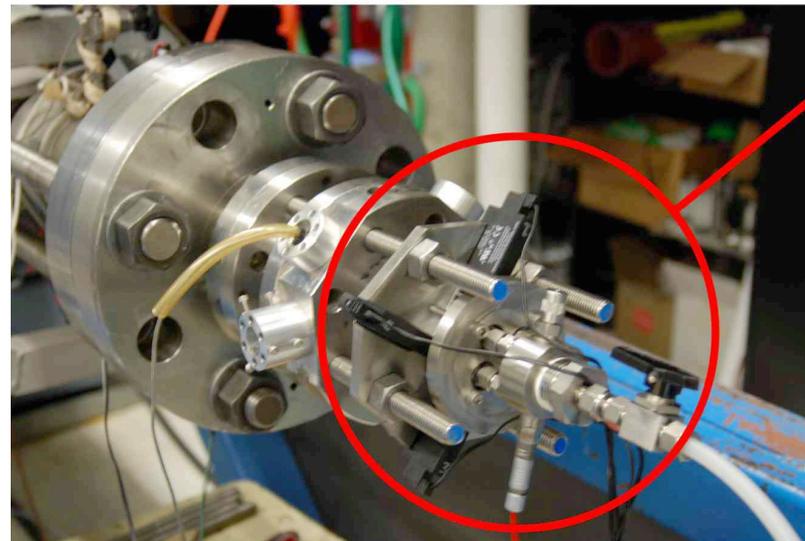
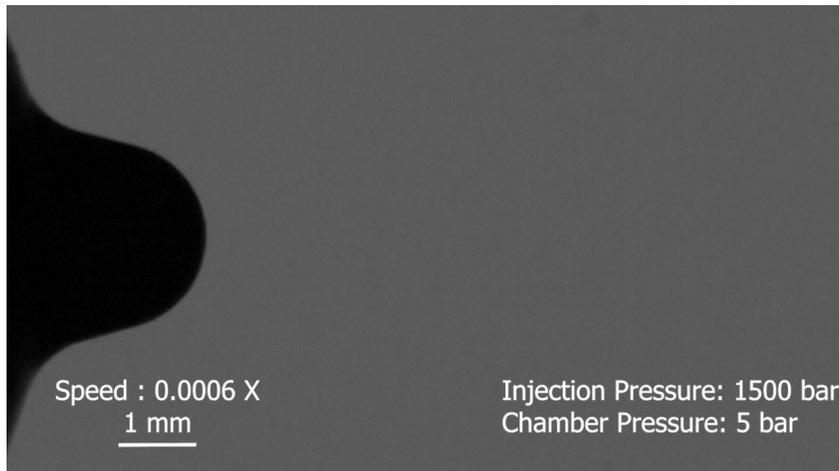


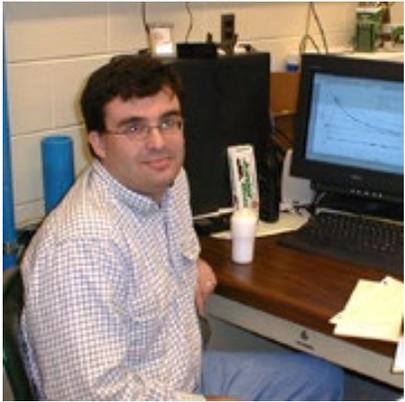
Pillars of a Fruitful Journey

- *My research team*
 - *What we do*
 - *Who does the actual work*
 - *Some examples*
- *My teaching team*
- *My service team*
- *My home team*

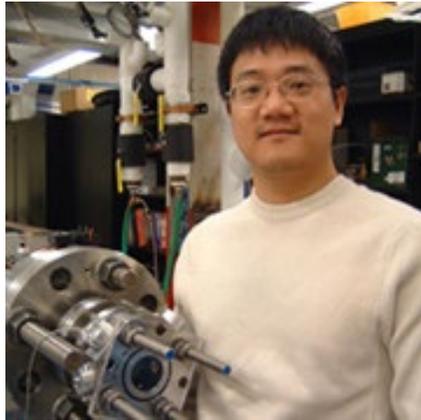


- *We develop new tools and methods to interrogate harsh* thermal systems*
 - *We develop new processes to improve energy efficiencies and performance*
 - *We use many different experimental platforms to create systems that isolate the important chemistry and physics.*
- *high temperature, high pressure, chemically reacting, turbulent, etc.*

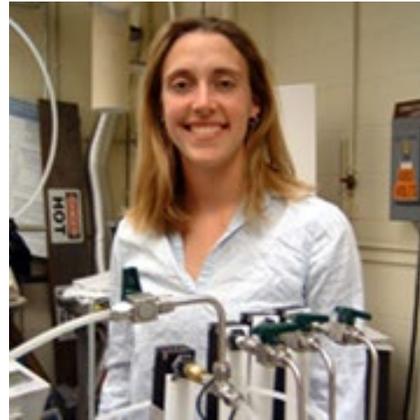




Dr. Michael Donovan



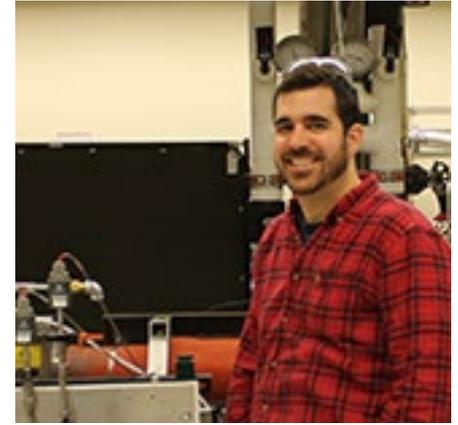
Dr. Xin He



Dr. Tiffany Miller



Professor Smitesh Bakrania



Professor Andrew Mansfield

**IN THE BEGINNING...THERE WERE NO FACILITIES.
SO THESE SMART PEOPLE BUILT THEM**

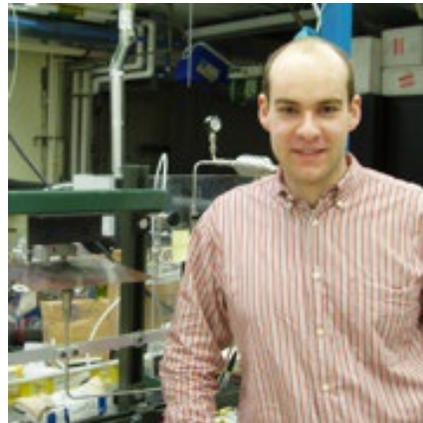
Dr. Stephen Walton



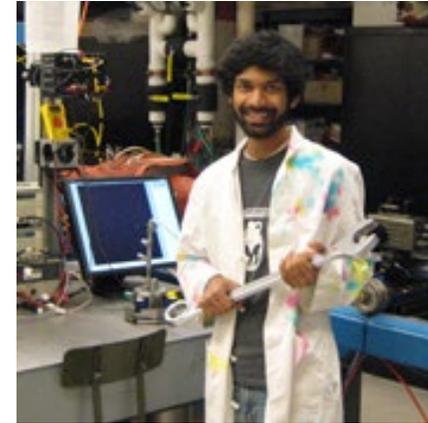
Dr. Bradley Zigler



Dr. Jim Wiswall



Professor Darshan Karwat



Dr. Ethan Eagle



My research team – the early 201x years

Dr. Mohammad Fatouraie

Dr. Luis Gutierrez



Dr. Scott Wagnon



Dr. Rob Middleton

Dr. Ripudaman
Singh

Professor Cesar Barraza Botet

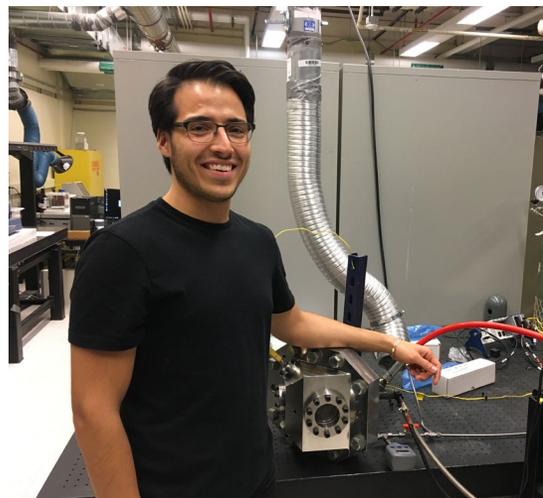
**THEN THESE SMART PEOPLE STEADILY
IMPROVED THE TOOLS**

Dr. Elliot Ortiz-
Soto





Dr. Miles Burnett

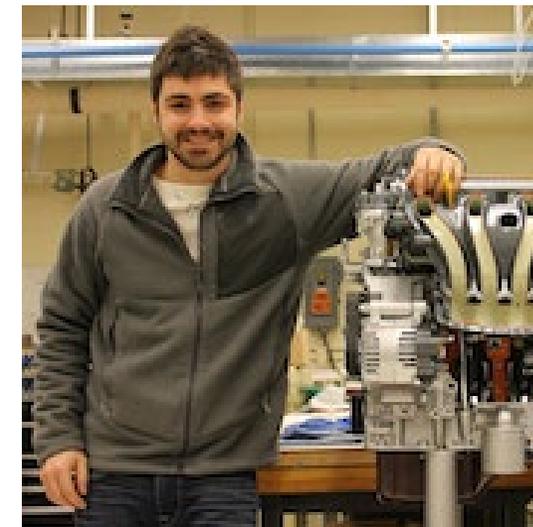


Professor Mario Medina

Not pictured (with apologies)
Dr. Laura Olesky
Dr. Luke Hagen
Dr. Chul Kim
Dr. Matthew Younkens
Dr. Sang Jin Hong



Dr. Pinaki Pal



Professor Dimitris Assanis



Dr. Rachel Schwind

AND THESE SMART PEOPLE TOOK US TO EVEN MORE EXTREME CONDITIONS

**AND THESE SMART PEOPLE ARE TAKING US
TO NEW SYSTEMS AND APPLICATIONS**



John
Kim

Chenyi
Zhu



Varun
Chakrapani

Jenna
Stolzman

Aksel
Ahituv

Dr. Nanta
Sophonrat

Qinghui
Meng



Jeremy
Babinet

Fuels are like a box of chocolates... some taste better to your engine than others.

Fuel: E0 (gasoline)



Fuel: E50 (50% ethanol/50% gasoline)



Fuel: E85 (85% ethanol)



video credit: M. Fatouraie, 2013

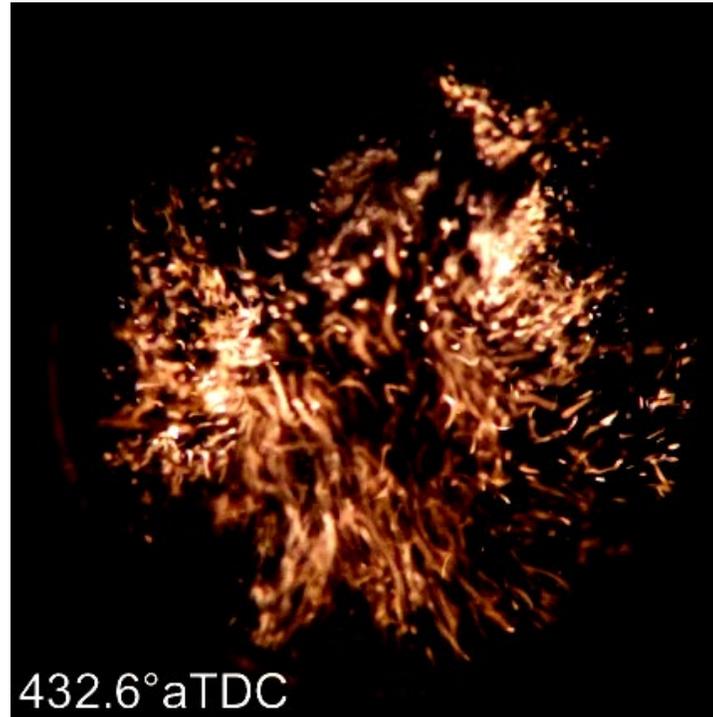
Incandescence = soot
Blue = clean combustion

That O-atom in ethanol, C_2H_5OH , really helps!

Simple changes in fuel injection timing have incredible impact.

Pause here to note, these experiments are really hard.

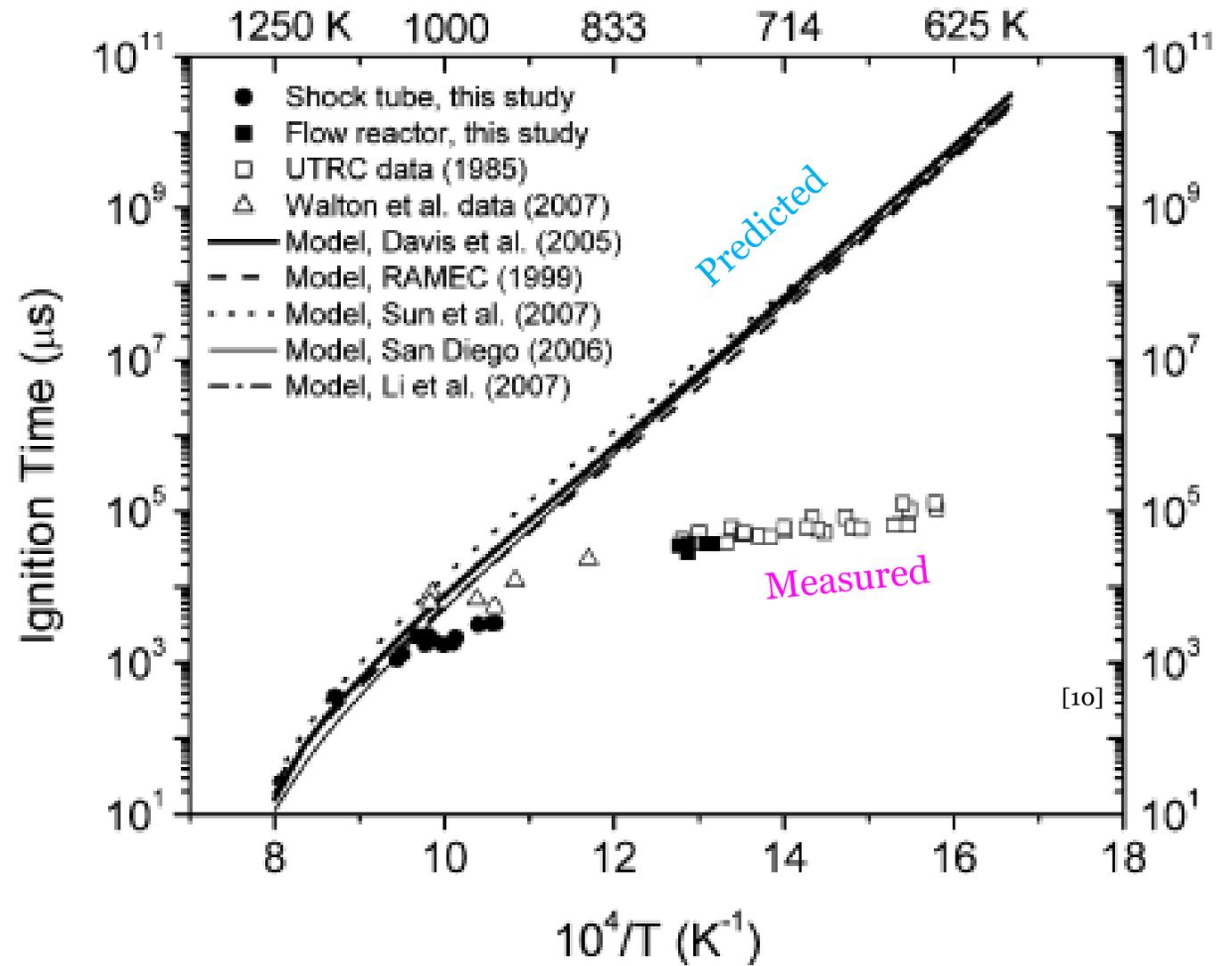
+Stratified



+Homogeneous



For a simple molecule, H₂ behavior has been remarkably difficult to predict.

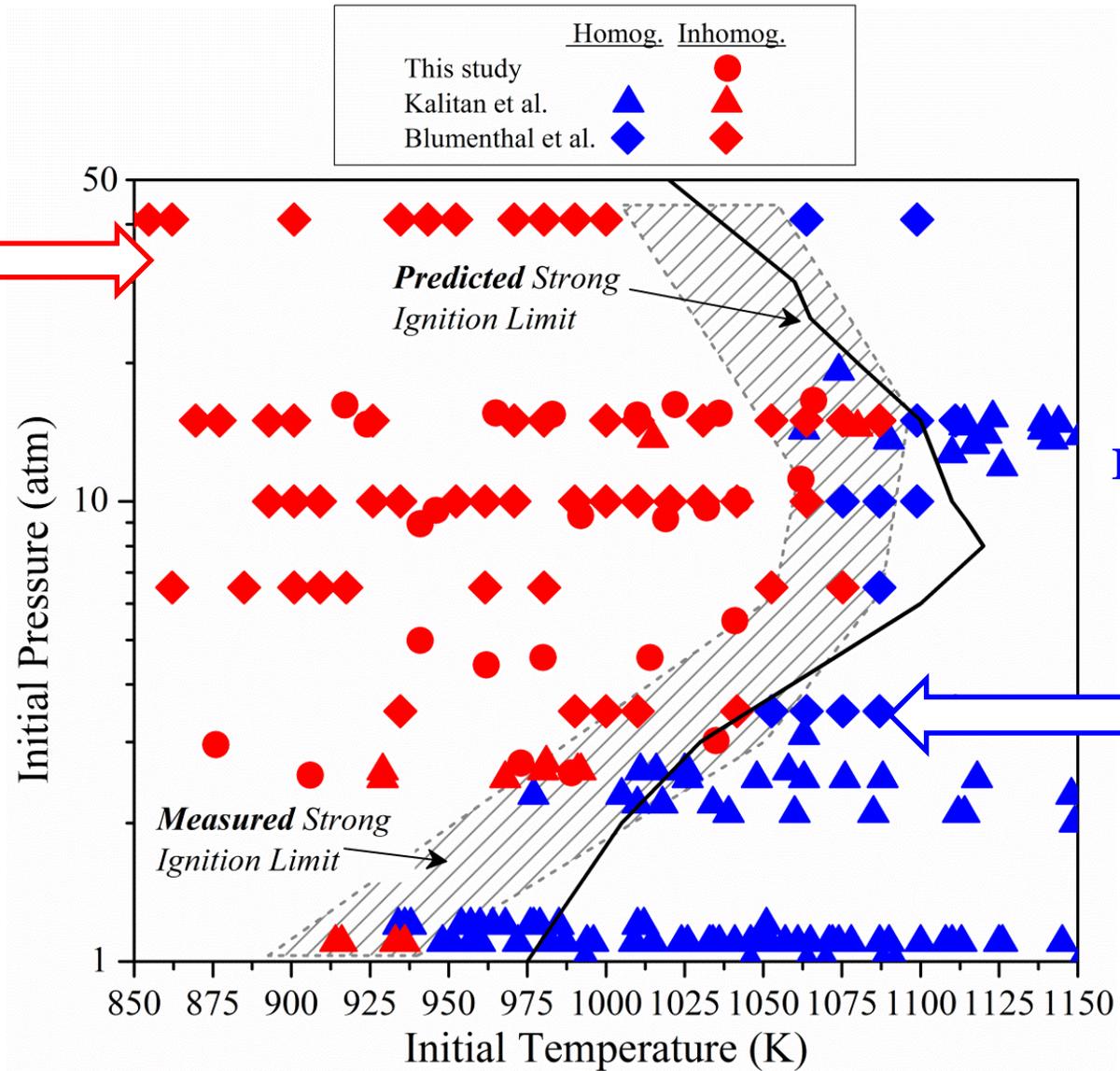


Inhomogeneous ignition

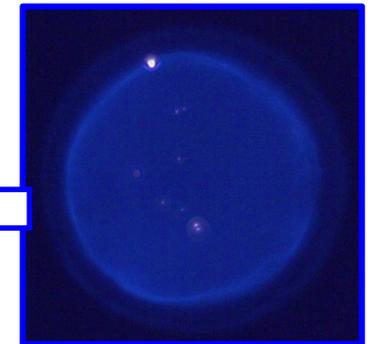


$P = 9.2 \text{ atm}, T = 1019 \text{ K}, \phi = 0.5$

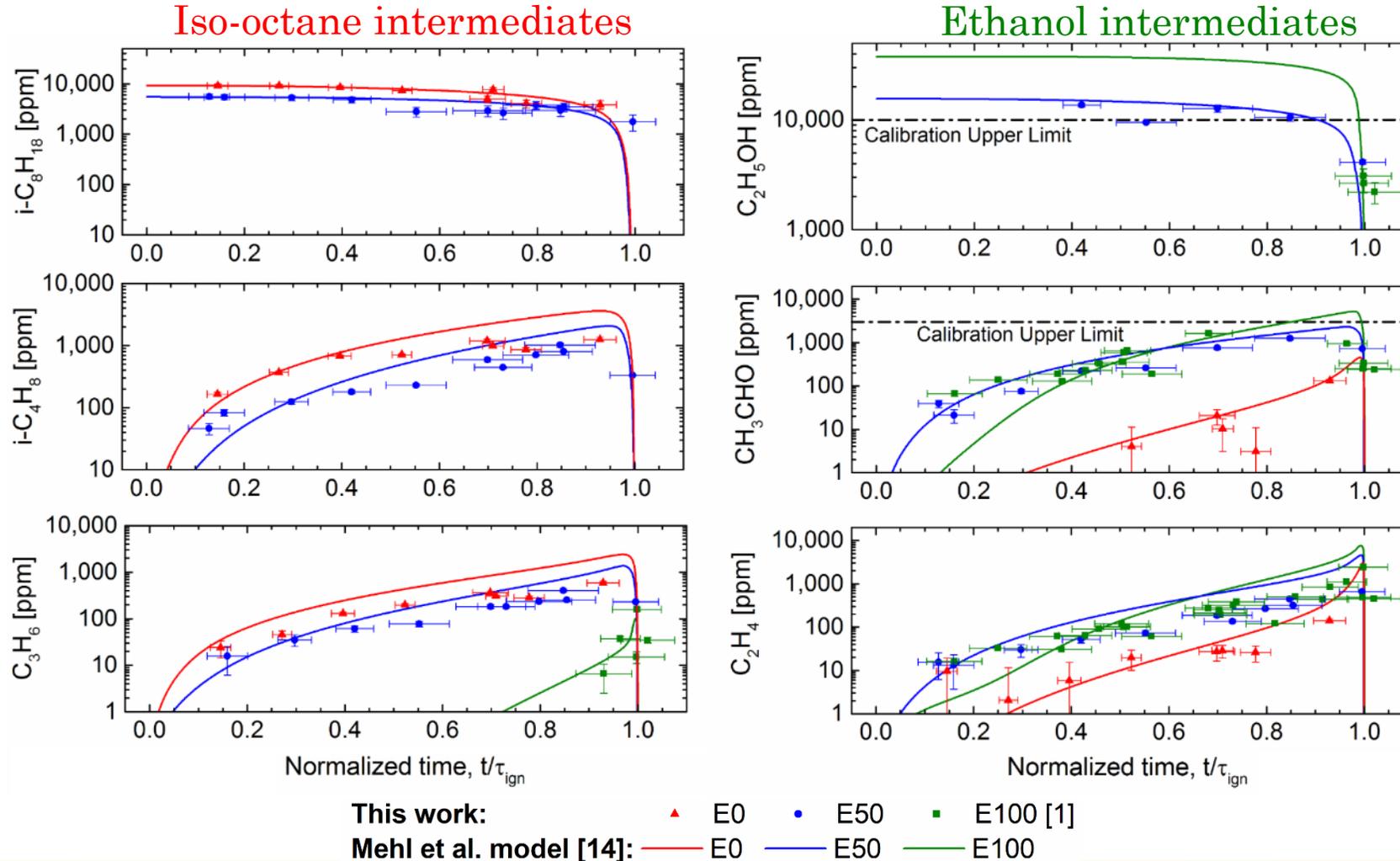
Here be dragons!



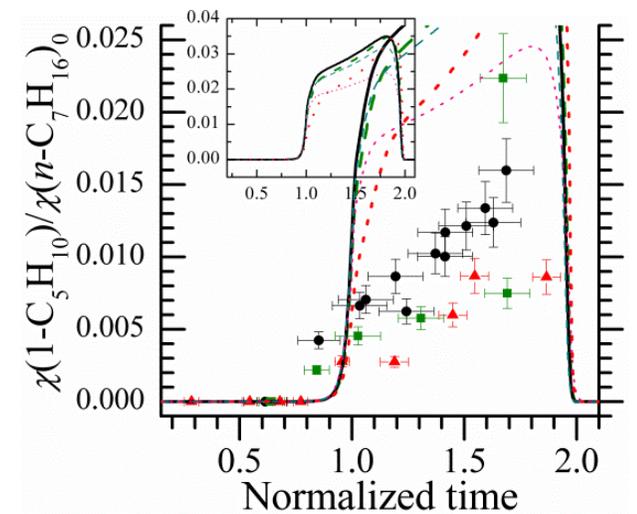
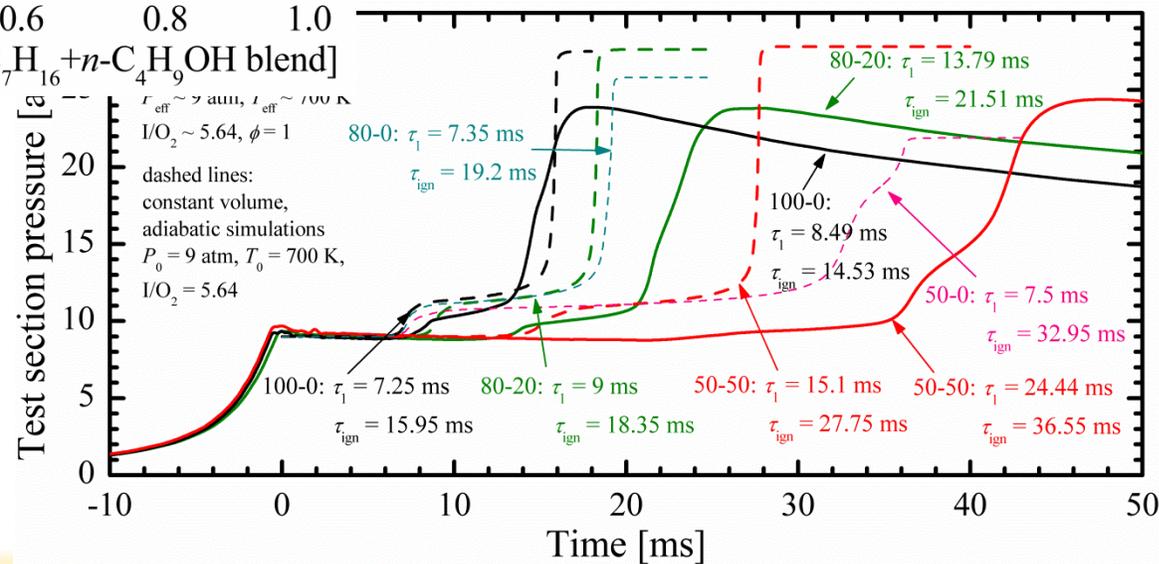
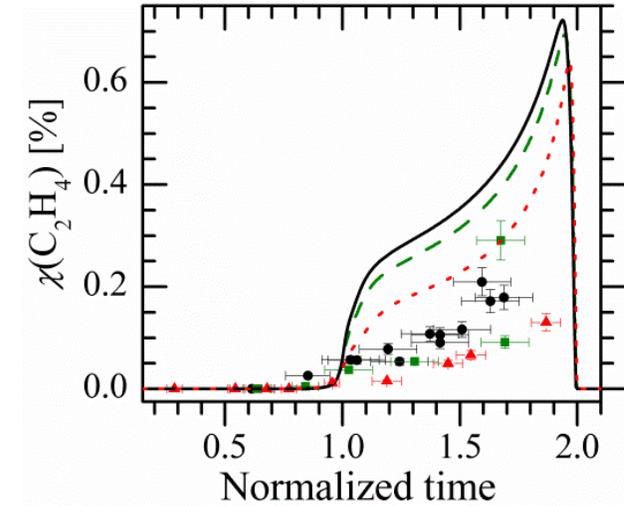
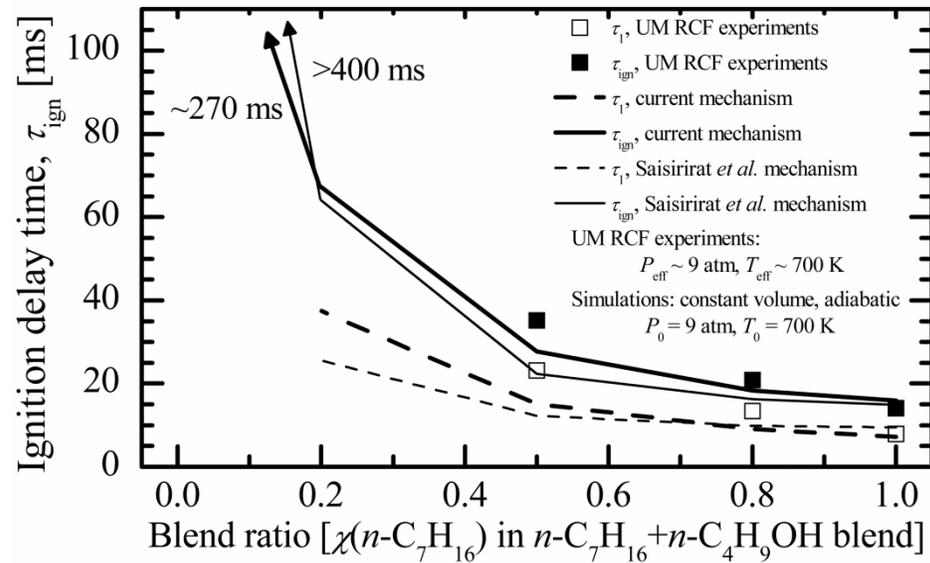
Here be safe sailing.
Homogeneous ignition



We are the only group in the world to measure high-fidelity reaction chemistry at “intermediate” conditions



We focus on fuels critical to all sectors – aviation, ground transportation, power generation, manufacturing, renewable, sustainable, waste derived...all are welcome!



Did I mention
this work is hard
to do?

I am grateful to my research collaborators



Dennis Assanis



Jyoti Mazumder



Charlie Westbrook



Arvind Atreya



Angela Violi



Robert
Tranter



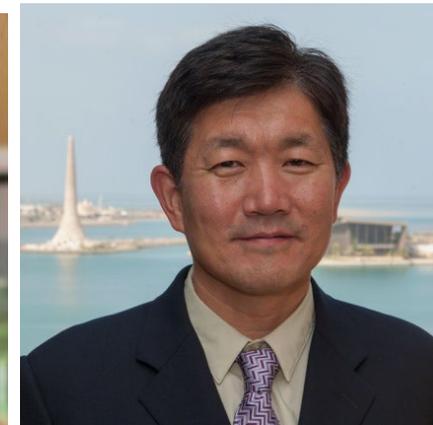
George
Lavoie



André
Boehman



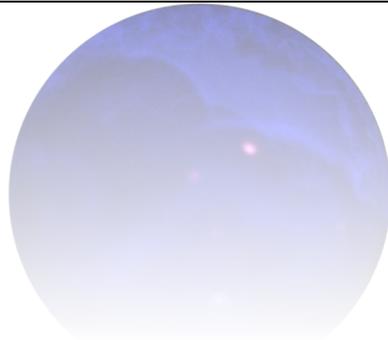
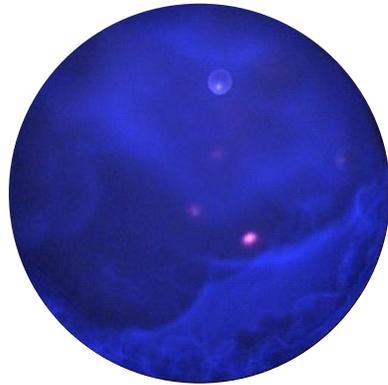
Jesse
Capecelatro



Hong Im



Ann Marie
Sastry



Pillars of a Fruitful Journey

- *My research team*
- *My teaching team*
- *My service team*
- *My home team*

I am grateful to my teaching collaborators...



Rohini Bala Chandran



Neil Dasgupta



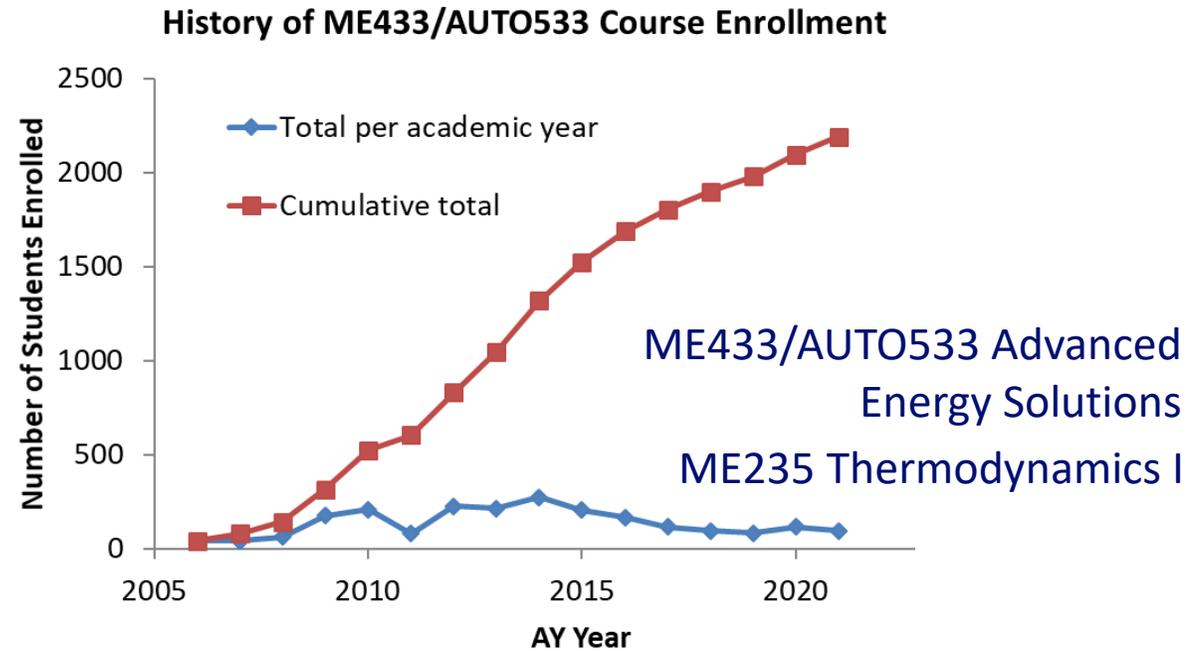
André Boehman



David Kwabi



Don Siegel

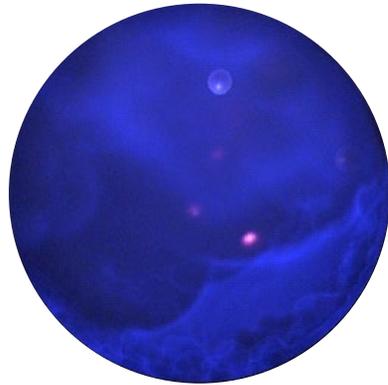


Hong Im

Who are mindful and help us all walk lightly



Video Credit: 2014 Brandon Bartneck (Fall 2014, ME433)



Pillars of a Fruitful Journey

- *My research team*
- *My teaching team*
- *My service team*
- *My home team*



Drew Horning

Program director since 2017

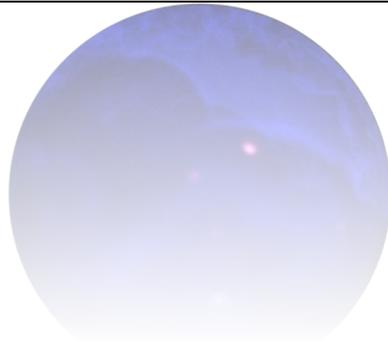
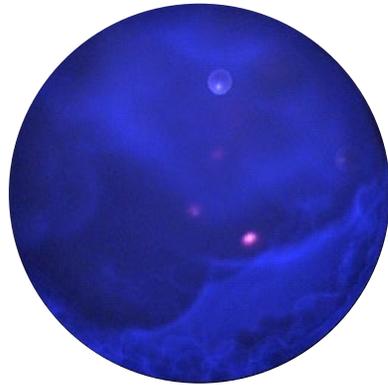


Elizabeth LaPorte



Jennifer Havercamp

\$3M Received from Dow to continue the program 1/2021



Pillars of a Fruitful Journey

- *My research team*
- *My teaching team*
- *My service team*
- *My home team*



combustion LABORATORY

The home team







Partner with one other person

- Think about your journey and your pillars of support
 - Who are your strongest pillars (family, roommates, partners, etc.)?
 - Where do you want to expand your support? And how might you do that? Share your ideas with your partner, as you feel comfortable.
- You are developing skills in research. What are examples of your skills you are developing in outreach, collaboration, teaching? These can be co-curricular or curricular, organized or ad hoc, anything! Share your strengths with your partner.



Thank you!

