



## FEATURED LECTURE

PLENARY LECTURE BY PROF. MARGARET WOOLDRIDGE

On Friday morning, we attended the last Plenary Lecture of the 40th Symposium, delivered by Prof. **Margaret Wooldridge** from the University of Michigan (United States). Prof. Wooldridge discussed the latest findings on flaring in the oil and gas industry and the associated challenges. She also emphasized the crucial role of combustion scientists in developing strategies for methane mitigation, and enlightened the audience about her research passion- flares. Following her talk, we had the opportunity to ask her a few questions.



### **What challenges will need to be faced by collaboration between experimentalists and modelers for methane mitigation?**

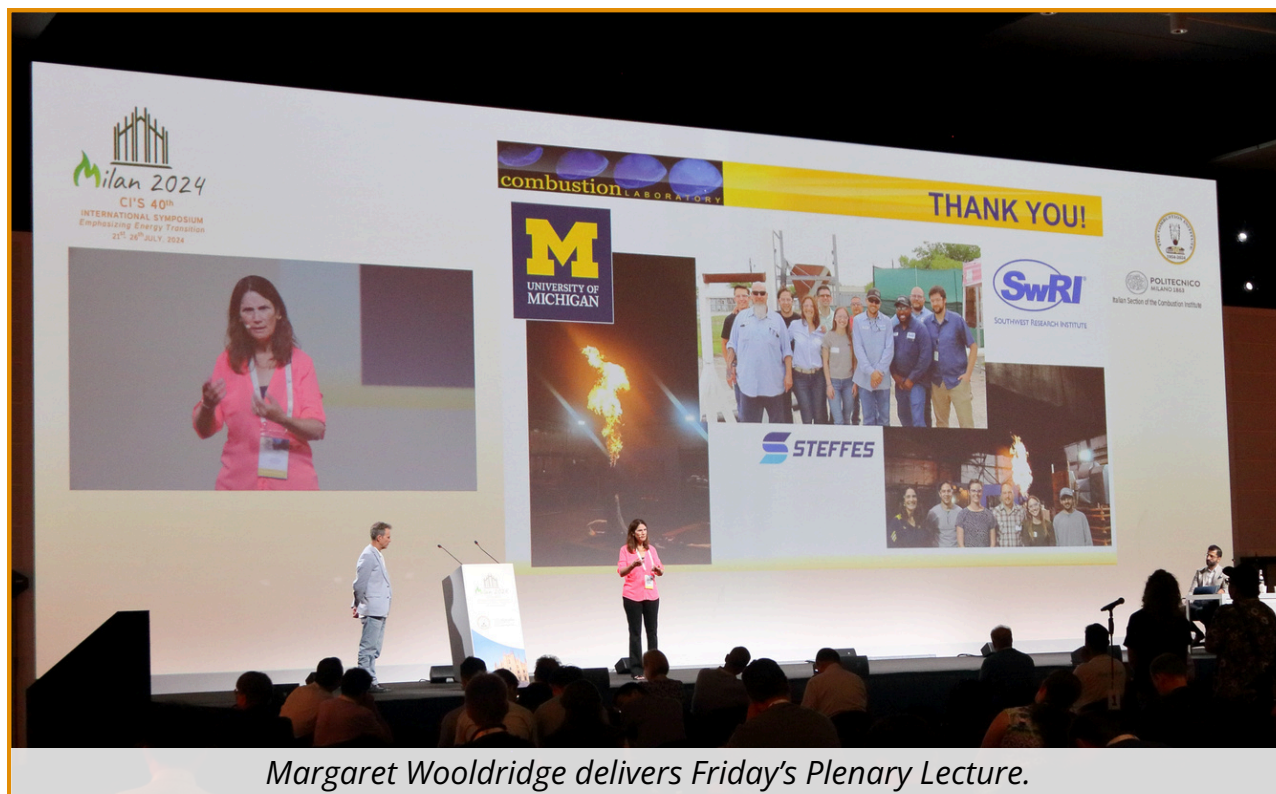
Considering that each experiment takes about a week and we need to cover a wide range of environmental conditions, there is an urgent need for computations to explore parameter variations and obtain a more comprehensive set of results. In terms of chemical modeling, a collaborative effort is essential to understand the combustion efficiency and the formation of small hydrocarbons and soot. Collaboration with climate scientists is also important to assess the potential negative impacts of new synthetic fuels, such as hydrogen and ammonia, applied in different types of technologies.

### **In your talk you discussed results obtained with machine learning (ML), what do you think will be the impact of ML in the next years?**

I see many opportunities with machine learning. Machine learning techniques can provide real-time control and can serve as robust tools for data interpretation. However, the datasets currently available are quite heterogeneous and difficult to integrate. We need to work towards identifying standards for sharing this data.

### **What advice would you give to young researchers for a successful career?**

The young researcher panel we participated in yesterday was great, and I fully agree with the insights shared. My advice is to believe in your work and actively engage with stakeholders, industry professionals, and fellow scientists. Communicate your ideas, listen to feedback, and explore how you can implement your ideas effectively.



Margaret Wooldridge delivers Friday's Plenary Lecture.



## COFFEE TALKS

SCIENTIFIC HIGHLIGHTS, AS CHOSEN BY ATTENDEES

During the coffee break, we asked attendees about their favorite talks and topics heard during the morning session:

**Niccolò Fanari** (Politecnico di Milano, Italy): I enjoyed a talk by Raghu Sivaramakrishnan and Stephen Klippenstein ("Resolving discrepancies between theory and experiment for the  $\text{NCN} + \text{H}$  reaction"). It was nice to see an effort toward more accurate kinetics with the inclusion of a theoretically motivated fall-off regime. The Q&A following the talk was very lively as well, and thought provoking questions about data-fitting best practices in chemical kinetics were raised.

Prof. **Alexander Mebel** (Florida International University) : The talk on styrene thermal decomposition (A. Hamadi, R. Sivaramakrishnan, F.E. Cano Ardila, R.S. Tranter, S. Abid, N. Chaumeix, A. Comandini) was very good. As I am interested in mechanisms for PAHs, this talk was highly relevant. These results will allow us to benchmark theoretical work, especially given that it is difficult to find data on these species, so I am glad to have seen this presentation.



## SOCIAL EVENTS: THE BANQUET

### *GOOD FOOD AND AWARDS AT THE ALFA ROMEO MUSEUM!*

Thursday night's banquet was held at the Museo Storico Alfa Romeo, exhibiting a wide range of historical and contemporary vehicles produced by the legendary Italian automaker. Attendees were surprised and delighted to see not just cars, but also planes and boats. The evening allowed for plenty of time to marvel at the engines with fellow combustion geeks before opening up to an 'aperitivo al fresco' - luckily, it wasn't too hot. Finger food was served together with Spritz, Wine, and, yes, also soft drinks. Later in the evening, dinner promoted lively conversation between guests after a full day of talks at the conference center. Even on the fourth day of the Symposium, the large number of attendees ensured that new connections could still be made, and guests took full advantage of the opportunity to network. Against the backdrop of Alfa Romeo's many engineering marvels, guests could be heard discussing which upcoming conferences they would reunite at.

While taking in the rich heritage of Alfa Romeo, one couldn't help but reflect on the parallels to the history of combustion:

- The need to adapt (to the war effort, to the global warming crisis/energy transition)
- A commitment to innovation (in pioneering new automotive technologies, in advancing combustion research)
- A legacy of excellence (building iconic cars, contributing groundbreaking research to the field of combustion)

And of course, the challenge of competition! Hopefully, this experience was both relaxing and inspiring for all of us!

During the night, our focus shifted back to the current Symposium (and the previous one in Vancouver) during the presentations of the night's awards. Announcements were directed by Profs. **Asaad Masri** (the CI's next Vice President), **Philippe Dagaut** (on his last night as President!), and **Nils Hansen**. The recipients were on the stage, however - for the sake of time management - their pre-recorded videos were broadcasted, where they expressed their gratitude for the recognition from the community. They also made live comments and took pictures. The crowd was extremely supportive and cheerful, and at times emotional. Afterwards, the crowd lined up to shake hands with the awardees. Of course we couldn't help but interview them - read more in the next pages! Unfortunately, we didn't get a chance to interview Prof. **Ahmed F. Ghoniem** (MIT, United States), who won the prestigious **Bernard Lewis Gold medal**. Hopefully you will read more about him soon on the CI website! (We can also confirm that we weighed the medals, and they're really heavy!)

The night left us with a sense of accomplishment for all our hard work in advancing the field of combustion, and a balanced mix of cultural appreciation, networking, and recognition of academic excellence.

# ATTENDEES ENJOY THE MUSEUM AND BANQUET!





## THE SILVER COMBUSTION MEDAL

SELECTED FROM THE DISTINGUISHED PAPERS OF THE 39TH SYMPOSIUM...

The 2024 Silver Combustion Medal (recognizing an outstanding distinguished paper from the previous Symposium) was awarded to the work, "Water vapor in hydrogen flames measured by time-resolved collisional dephasing of the pure-rotational N<sub>2</sub> CARS signal" by Drs. **Leonardo Castellanos**, **Francesco Mazza** (TU Delft, Netherlands) and **Alexis Bohlin** (Lulea University of Technology, Sweden). This paper presents a novel technique to measure water vapor in hydrogen flames, where it is usually invisible due to its low signal. On Thursday, we stopped the reunited group of awardees for a couple of curiosities about their work.

### Why do you think your paper stood out amongst all?

Obtaining quantitative data on the concentration of water vapor with Coherent anti-Stokes Raman spectroscopy (CARS) presents a formidable challenge to this technique. The fact is that water is effectively invisible in the pure-rotational CARS spectrum, which makes it impossible to measure its concentration in flames as it is usually done with other major species (i.e. N<sub>2</sub>, O<sub>2</sub>, H<sub>2</sub>...). With this work, we took up the challenge of probing the invisible. Using time-resolved spectroscopy, we measured the water vapour concentration by observing its collisional energy transfer on nitrogen, which occur in a picosecond time-scale. By this approach we could simultaneously measure with extremely high spatial resolution temperature as well as all the major combustion species, both in laminar and in turbulent hydrogen flames.

### What is the immediate application of your new technique?

The immediate benefit of this new technique is that it allow us to measure the complete set of major scalar fields in hydrogen flames. In the future, these measurements could be coupled to novel machine-learning tools to predict the formation of minor species for detailed kinetic analyses. In addition, our technique can be used to directly observe molecular transport processes (preferential and differential diffusion), which are unique for hydrogen as compared to other fuels. Our achievement can thus benefit our colleagues working on the numerical modelling of hydrogen flames.

### Have you been using this technique since your publication?

We have been exploring the possible extension of this technique to other typeS of combustion environments involving blends between hydrogen and hydrocarbon fuels. For instance, this technique has been used to characterize a canonical Hydrogen diffusion flames known as the H<sub>2</sub> flame developed by TU Darmstadt and DLR Stuttgart using 1D-CARS imaging. This data will be incorporated into the TNF Workshop for canonical flames and can therefore be used as a reference for kinetic simulations as well. The potential of this technique can also be extended to other fields when collisional energy transfer between molecules is relevant.

## JÜRGEN WARNATZ GOLD MEDAL

The Jürgen Warnatz Gold Medal was awarded to Prof. **Tiziano Faravelli** (Politecnico di Milano, Italy). Our warmest congratulations! Also, his wife was quite surprised and moved - she didn't know! Here are Prof. Faravelli's replies to some of our curiosities.

### **Which research contributions are you most excited to further develop?**

I am convinced that in the coming years there will be a rapid shift towards a "carbon society", i.e., an increase in *materials based on carbon atoms*. Pyrolysis and rich flames are processes of growing importance that enable products such as nanotubes or organic quantum dots to be produced relatively inexpensively. Therefore, we are further developing our soot mechanism to describe the morphology of carbon nanoparticles, with the aim of predicting their physical characteristics. I have also started to work on machine learning to automatically derive data-driven kinetic models for complex molecules and mixtures.

### **Jürgen Warnatz was known for his approach to modeling and simulation of chemical reactive flows. How has his work influenced your research methodology?**

I first met Jürgen about 35 years ago. I (a young researcher, taking my first steps in the field of combustion) arrogantly confronted Jürgen (an impressive man already well-known and rather rigid at first sight) to challenge his statements on kinetics. He looked at me sternly, and said, "You're wrong, you just didn't understand what I said," before departing. The next times we met were much better. We exchanged ideas and I gained a great deal of insight. His famous book (written with Maas and Dibble) is one of the best in the field, and I refer to it often. Regrettably, he left us too soon and we are all the poorer without his valued contributions to the community.



Assaad Masri (Left) and Philippe Dagaut (Right), present Tiziano Faravelli (Middle) his Gold Medal.



*From L to R: Francesco Mazza, Leonardo Castellanos, and Alexis Bohlin are presented the Silver Combustion Medal by Nils Hansen.*



*Assaad Masri (Left) and Philippe Dagaut (Right), present Ahmed F. Ghoniem (Middle) his Gold Medal.*



*Assaad Masri (Left) and Philippe Dagaut (Right), present A. Carlos Fernandez-Pello (Middle) his Gold Medal. (Read our interview with him on the next page!)*

## ALFRED C. EGERTON GOLD MEDAL

Prof. **A. Carlos Fernandez-Pello** was greeted with a warm round of applause when announced as the 2024 Alfred C. Egerton Gold Medal recipient. He thanked his students and collaborators from all over the world for the award and for giving him a fantastic and enjoyable career. Afterwards, he replied to some questions!

### **Which technical contribution are you most excited to further advance?**

The study of the *flammability limits of solid combustible materials* on Earth and Spacecraft, particularly the determination of the limiting oxygen concentration for flame spread and steady burning of solid fuels. In the context of this award, I am grateful to Prof. Alfred C. Egerton as his methodologies have helped me in studying material flammability.

### **How does it feel to be recognized with an award named after Alfred C. Egerton, and what does this recognition mean to you?**

It is one of the highlights of my research career. I think it recognizes the research that my students and collaborators from all over the world have accomplished with me through the years, particularly in fire-science-related combustion.

### **What advice would you give to others who are striving for similar accomplishments in your field?**

To keep an open mind and not be afraid of exploring new research areas, to listen to what colleagues are doing, and if found interesting and innovative, to think about how to extend their work to other areas of potential social impact.

### **Are there any mentors who played key roles in supporting you?**

Yes, I was very lucky to be mentored by some of the giants in the field, including Carlos Sanchez Tarifa, Forman Williams, Howard Emmons, Irvin Glassman, Tony Oppenheim, and Bob Sawyer. I also feel very lucky that I was able to interact and work with very talented researchers from many countries.

### **What are the implications/applications of your work?**

Through the years, I have worked in multiple areas of combustion/fire, many with practical applications. However, I think that material flammability, wildland fire ignition, and initial growth are perhaps the areas with the most social impact.

### **What are future areas of research to extend your work?**

I think the problem of wildland fires will become more and more important with climate change but also in batteries. Other exciting challenges will involve flammability issues of composite materials, solar panels, and electronic boards. Establishing habitats on the Moon and Mars will also bring many fire/combustion issues in unfamiliar environments.



## YA. B. ZELDOVICH GOLD MEDAL

Prof. **Heinz Pitsch** (RWTH Aachen University) was awarded the Ya B. Zeldovich Gold Medal. Quite a good fit - Prof. Pitsch mentioned Zeldovich in his Hottel Lecture too! He accepted the award via a video recorded earlier that afternoon, in which the beautiful Duomo adorned his background, in striking contrast to “rainy Aachen” to which his wife graciously followed him. Recording the video atop a stack of furniture (as per his kids’ suggestion), he wished the audience a pleasant dinner.

**Your doctoral supervisor, Norbert Peters, received the same gold medal 22 years ago. What does it mean to you personally to follow in his footsteps?**

Norbert Peters was my doctoral supervisor, but he was also a mentor providing advice for difficult choices at different stages of my career, and most importantly,, he was a very good friend. So I was very happy to receive the same medal.

**How did the different institution you worked at influence some of your key results?**

Every new position brings new questions and opportunities and there are many examples for how this has influenced my research. For instance, I went to Stanford to do LES, which for combustion simulations was new at the time. At Stanford, we also started working on electrochemistry for fuel cells because of a colleague's connection with a company interested in the topic. In Aachen, we have good experimental facilities, which tremendously helped our chemical kinetic modeling work on new bio- and e-fuels.



*Assaad Masri (Left) and Philippe Dagaut (Right), present Heinz Pitsch (Middle) his Gold Medal.*

## CHILDCARE SERVICE!

Similar to the last Symposium, in Milan families had the opportunity to utilize a childcare service, which was - for the first time - largely sponsored by the CI. Located at the conference center to facilitate logistics, it covered the whole week (Monday through Friday) from 8:30 am to 6:30 pm - with the exception of Wednesday afternoon, when the picnic was held and no talks were running. Parents (mostly mothers) were quite happy with the service and said that everything ran very smoothly. It also seems like their kids enjoyed - look at a couple of them in the picture below! This year, four kids were taken care of, a one year old and three in approximately the same age range (6-8). When asked, they said they're looking forward to meeting new friends in Kyoto in two years! In fact, the organizers of the next Symposium already confirmed that they are organizing a similar service in Kyoto. While four kids might not sound like a lot, this initiative is relatively new and we are confident that as the community spreads the word and women and families in the combustion community grows, the childcare service and the number of kids will grow accordingly.



## A Note on Sustainability at This Symposium!

Sustainability is important for us! During this Symposium, we made sure that we took steps to avoid waste and plastic when possible. We just wanted to let you all know that all the plates, cups and cutlery used for the catering and breaks at the MiCo, and the picnic on Lake Como, were sustainable and biodegradable, and therefore will be added to the compost with the food waste. All left over food (coffee break items, packed lunches, etc.) from the MiCo are collected by a charity and distributed to the local soup kitchens. We also avoided printing as much as possible to be as mindful as we could!

## SPOTLIGHT ON... WHAT'S NEXT?

### Ready for Kyoto 2026?

We are already excited about it! During the banquet, the two Program Co-Chairs of the next symposium were announced: They are Profs. Osamu Fujita (Hokkaido University, Japan) and Venkat Raman (University of Michigan, United States). Let's see what changes the next Symposium brings! During the dinner, we briefly stopped Prof. Raman for a couple of curiosities on the organization and feedback on this year's event:

### Did you enjoy the Symposium? What's your overall feedback?

I thoroughly enjoyed the Symposium, meeting old friends and making new ones. I congratulate the Local Host Team and the Program Co-Chairs for their extraordinary effort in making this event successful.

### What do you think about the new bulletin initiative? Will we see something similar at the next Symposium?

I have not fully thought about the bulletin, but sending such information would be useful, I feel. We will certainly consider such options for the next Symposium, based on resources and effectiveness.

### What are the key themes and focus areas for the next symposium, and will technical changes such as the OPP/PPP format be maintained?

These questions are currently being discussed, by Prof. Fujita and myself, but also with members of the combustion community. We will develop a compelling program for the 2026 Symposium that reflects the trends in combustion science and technology, as well as the needs of the members and their preferences.

**WE HOPE YOU HAD FRUITFUL SCIENTIFIC EXCHANGES AND A GREAT TIME HERE IN MILAN!**

**SEE YOU AT THE NEXT SYMPOSIUM, AND GOOD LUCK WITH YOUR RESEARCH!**

*IF YOU ARE STAYING IN ITALY ON VACATION, DON'T HESITATE TO GET IN TOUCH WITH THE LOCAL HOST TEAM FOR ADVICE!*

*What is the Symposium Tribune? It's a daily bulletin that will keep you updated on all the key highlights and events happening at the Symposium, including interesting scientific talks and interviews to speakers, organizers, awardees. You will also find opinions from participants, and insights into social events in case you can't make it!*

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**Feedback is always welcome, and can be submitted via Telegram: <https://t.me/CombustionSymposium2024/2>**