UNIVERSITY OF MARYLAND

The Burgers Program for Fluid Dynamics Twenty First Annual Symposium

Friday, October 4th, 2024, 1:00 to 6:00 pm
AJC Forum (Room 1101)
A. James Clark Hall (Building 429)
University of Maryland, College Park, MD

Institute for Physical Science and Technology
College of Computer, Mathematical and Natural Science and the
A. James Clark School of Engineering
University of Maryland, College Park

Program:

1:00 – 1:05 **Welcoming Remarks,** James Duncan**,**
Director of the Burgers Program for Fluid Dynamics, Department of Mechanical Engineering and the Institute for Physical Science and Technology, University of Maryland.

1:05 – 1:50 ***Progress in Modeling Stratified Turbulence for Geophysical and Astrophysical Applications***
Pascale Garaud,
Applied Mathematics and Statistics, Baskin School of Engineering, University of California, Santa Cruz.
https://users.soe.ucsc.edu/~pgaraud/Research.html

1:50 – 2:15 **Break, informal discussions**

2:15 – 3:00 ***The Impact of a Boiling Liquid***
Devaraj van der Meer,
Physics of Fluids Group, University of Twente, Amsterdam, The Netherlands.
https://people.utwente.nl/d.vandermeer

3:00 – 3:45 **Graduate student and post-doctoral poster session. Refreshments served.**

3:45 – 4:30 ***The Good, the Bad and the Beautiful, Leonardo's Studies of Turbulence.***
Ugo Piomelli,
Department of Mechanical and Materials Engineering, Queen's University, Kingston (ON), Canada.
https://www.queensu.ca/research/researchers/ugo-piomelli

4:30 – 6:00 ***Reception and Announcement of Best Posters***

ABSTRACTS and BIOGRAPHIES

Pascal Garaud

Abstract: In this talk, I will present recent progress in understanding the properties of stratified turbulence made using a combination of multiscale asymptotic analysis and Direct Numerical Simulations, with a focus on quantifying the vertical turbulent transport of momentum and buoyancy. The asymptotic analysis reveals the existence of multiple regions of parameter space depending on the relative sizes of the Reynolds, Peclet and Froude number. Scaling laws can be inferred from the analysis in each parameter regime, which are then tentatively verified using the DNS.

Biography: Garaud completed her undergraduate studies in Physics at the Universite Louis Pasteur in Strasbourg, France before moving to Cambridge (UK) to pursue Part III of the Mathematical Tripos, followed by a PhD in Astrophysics with Profs. D.O. Gough and N.O.Weiss. After two postdoctoral fellowships, both at the University of Cambridge, she joined UC Santa Cruz as Assistant Professor in Applied Mathematics. She is now full professor, and Chair of the department. She was elected as a Fellow of the American Physical Society in 2019, and is presently on the Editorial Board of Physical Review Fluids. She is also the founding director of the Summer Program in Astrophysics, and on the executive committee of the Woods Hole Geophysical Fluid Dynamics summer program. Her research interests lie at the intersection of astrophysical and geophysical fluid dynamics, which she studies using a combination of modern analytical and numerical tools.

Devaraj van der Meer

Abstract: The impact of a liquid mass onto a solid has been well-studied in fluid mechanics, but generally in the context of a liquid surrounded by a non-condensable gas, such as water in air. This may become a problem when trying to apply results to large-scale industrial impact problems dealing with cryogenic liquids, such as sloshing in LNG carriers, where typically the liquid is in thermal equilibrium with its own vapor, i.e., it is a boiling liquid. The key question that arises is a fundamental one: Does phase change lead to crucial differences that need to be accounted for during impact of a boiling liquid? Using two small-scale and one large-scale experimental setup we show that the answer to this question is yes. We find that rapidly condensing vapor may cause liquid mass to hit surfaces harder than expected and even may cause entrapped vapor layers to violently collapse, creating pressures that can be orders of magnitude larger than the ones observed in comparable water-air experiments. Using a mixture of experiment and theoretical arguments we give quantitative estimates of when these situation may occur.

Biography: Devaraj R.M. van der Meer is a granular and fluid physicist who was educated in Leiden and Twente in the Netherlands, leading to a PhD in the dynamics of dry granular matter in 2004 (highest honors). In 2012, Devaraj van der Meer became full professor in the Physics of Fluids group in Twente and has been working on a variety of soft matter and fluid dynamics topics, ranging from the dynamics of dry granular matter to bubble growth on wetted substrates, from the impact of elastic solids and droplets onto granular substrates, impact of liquids on solids, with focus on the subtle role of the intervening medium. The latter is often a gas or vapor, but sometimes a liquid as in the case of dense suspensions. In his work, he uses a combination of experiment, numerics, and theory, a strategy that leads to a thorough understanding of the underlying physics. Devaraj van der Meer is a Vidi and Vici laureate, Fellow of APS DSOFT, and was elected Chair of the Gordon Research Conference on granular matter in 2018. He also serves the community as Member of the Editorial Board of Physical Review E, as Member of the Dutch Physics Council, as Chair of the Physics Department in Twente, and as member and chair of various scientific panels and committees.

Ugo Piomelli

Abstract: Aspects of fluid dynamics appear often in Leonardo da Vinci's notebooks: sketches of water flow, plans for flying machines, studies of bird flight. He seemed fascinated by the eddying movement of water, and designed ingenious experiments to try and understand the causes of these complex motions. He lacked the advanced mathematical tools required to study this subject properly, however, and his attempts to use geometrical reasoning for the analysis of fluid flows were unsuccessful. This limitation is reflected in many of the machines he designed, which we now know cannot work. His observational powers, however, allowed him to make some exceptionally perceptive remarks that foreshadow techniques used today, both in the experimental and the theoretical analysis of flow problems, observations illustrated by striking drawings and sketches. In this talk, some of Leonardo's reflections on turbulence will be discussed, vis a vis the present understanding of this captivating but baffling subject, perhaps the last unsolved problem in classical physics.

Biography: Ugo Piomelli obtained a Laurea in Ingegneria Aeronautica from the Università di Napoli "Federico II" in 1979. He then earned a Master of Science Degree in Aerospace Engineering from the University of Notre Dame in 1984 and a PhD in Mechanical Engineering from Stanford University in 1988. From 1987 to 2008 he was on the faculty of the Department of Mechanical Engineering at the University of Maryland, first as Assistant, then Associate and finally Full Professor. He served as Associate Chair and Director of Graduate studies from 2002 to 2007. In August 2008 he joined the Department of Mechanical and Materials Engineering at Queen's University in Kingston, Ontario, where he held, from 2008 to 2022, the Tier 1 Canada Research Chair in Turbulence Simulation and Modelling.

Professor Piomelli has published over 100 refereed journal articles in the fields of turbulence and transition modelling and simulation. His work has been cited over 24,500 times, and he has an h-index of 55 (Google Scholar). He was elected Fellow of the Royal Society of Canada in 2015, of the Canadian Academy of Engineering in 2021, of the American Society of Mechanical Engineers in 2009, of the Institute of Physics (UK) in 2004 and of the American Physical Society in 2002. Since 2015, he has been the Editor-in-Chief of the Journal of Turbulence. His present research includes studies of the flow in rivers and lakes, turbulent boundary layers over smooth and rough surfaces, model development for large-eddy simulations, and flows in hydro-electric turbines and aeronautical applications.