I²CNER Seminar Series

International Institute for Carbon-Neutral Energy Research (WPI-I²CNER)
Kyushu University

Title **Boiling Heat Transfer Experimental Research at MIT: Accomplishments, Open Questions, and Future Directions**

Speaker Prof. Matteo Bucci
Department of Nuclear Science and Engineering, Massachusetts Institute of Technology, USA

Time& Date 4:00 PM(JST), Wednesday, January 10th, 2024

Venue Hybrid (#217, Conference Room, 2F, I²CNER Building 1, Ito Campus / Zoom Webinar)

Abstract

In every field of science, the possibility of discovering and understanding new phenomena, or testing new hypotheses, is strongly related to and limited by the capability of observation.

Here, we will discuss recent advances in experimental boiling heat transfer research made possible by unique experimental facilities and non-intrusive high-resolution optical diagnostics, e.g., high-speed infrared thermometry and phase detection techniques.

We will analyze these techniques' capabilities and limitations in supporting the understanding of fundamental two-phase heat transfer problems. Examples are the growth and departure of bubbles from a heated surface, the distribution of the dry area fraction, the partitioning of heat flux, and the boiling crisis. Notably, we will discuss experiments conducted in prototypical LWR conditions, presenting first-of-a-kind observations of the boiling process and the boiling crisis.

The use of these diagnostics has been instrumental in providing an answer to some long-standing fundamental physical questions. However, access to these techniques is not sufficient. Nowadays, new understanding is hindered by our capability to analyze data, i.e., we can produce much more data than we can possibly analyze. This issue is critical for highly non-linear phenomena, e.g., boiling heat transfer, whose complexity is hidden beyond what a human eye can hardly see or a human brain can timely analyze. We will discuss how artificial intelligence can alleviate this issue and, possibly, enable the development of autonomous, self-learning testing capabilities.

About the Speaker

Matteo Bucci is the Esther and Harold E. Edgerton Associate Professor of Nuclear Science and Engineering at the Massachusetts Institute of Technology (MIT). He has published over 40 journal articles and 70 conference papers. His research group studies two-phase heat transfer mechanisms in nuclear reactors and space systems, develops high-resolution non-intrusive diagnostics and surface engineering techniques to enhance two-phase heat transfer, and creates machine learning tools to accelerate data analysis and conduct autonomous heat transfer experiments. He has won several awards for his research and teaching, including the MIT Ruth and Joel Spira Award for Excellence in Teaching (2020), ANS/PAI Outstanding Faculty Award (2018 and 2023), the UIT-Fluent Award (2006), the European Nuclear Education Network Award (2010), and the 2012 ANS Thermal-Hydraulics Division Best Paper Award. Matteo serves as the Editor of Applied Thermal Engineering, is the founder and coordinator of the NSF Thermal Transport Café, and works as a consultant for the nuclear industry.

Registration https://forms.office.com/r/WwH2AE3gYd
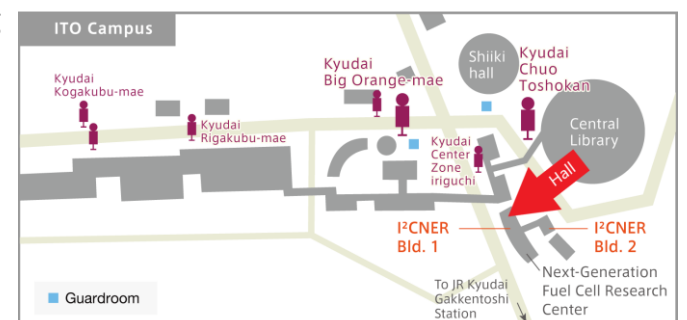
Host Prof. Shoji Mori

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