

Tamkang Clement and Carrie Chair Dr. Giulia Galli Invited by Physics Department: Harnessing Quantum Computing to Master Energy Materials

Campus focus

The Physics Department invited Professor Giulia Galli from the Pritzker School of Molecular Engineering at the University of Chicago to deliver a lecture as Tamkang Clement and Carrie Chair. The lecture, "Materials for Sustainable Energy Generation and Use from First Principles," was held at 2 PM on June 12 in the Chang Yeo Lan International Hall of the Hsu Shou-Chlien International Conference Center. She shared that the world is moving away from fossil fuels and seeking alternative energy sources. She explained that quantum computing algorithms are still developing but will eventually be used to predict energy materials. She encouraged everyone to consider the forward-looking nature of fundamental science, stating, "Those who can master materials will have a precise vision of the future." Professor Galli is a member of the National Academy of Sciences. She is currently a senior scientist at Argonne National Laboratory, where she is a group leader and the director of the Midwest Integrated Center for Computational Materials (MICCoM). Before joining UChicago, she was a professor of chemistry and physics at the University of California, Davis, and the head of the Quantum Simulations group at Lawrence Livermore National Laboratory (LLNL), successively.

Dean Shih Tseng-Lien of the College of Science mentioned that from last year to this year, the College of Science has organized 4 Tamkang Clement and Carrie Chair lectures, providing significant inspiration for faculty and students. He praised Professor Galli as a distinguished female scholar in physics. Dr. Hung-Chung Hsueh, Dean of Research and Development and professor of the Physics Department, commended her for her outstanding academic achievements, particularly in the theoretical and computational analysis of materials. He noted that her use of quantum computing brings forth crucial innovative insights.

Department Chair Cheng-Hao Chuang thanked Professor Galli for sharing her latest research cases and encouraging students to build a foundation for related studies. She was invited to sign a poster as a memento during the event. She was presented with a green "Kuai Kuai," a brand name of puffed corn snacks taken as a local talisman believed to ensure the smooth operation of computers and equipment because "kuai kuai" (乖乖) means "well-behaved" in Chinese. Professor Galli smiled and said, "I really like it." Students also asked her to sign the packaging of the talisman, and she invited the university's physics teachers to sign it together, happily planning to place it next to her computer. The friendly and engaging interactions between faculty and students fostered cultural exchange beyond scientific collaboration between Taiwan and the United States.

Professor Galli's lecture mainly focused on using quantum theory to calculate sustainable energy materials. Her research motivation stems from the pressures of global warming and the need for clean drinking water. Humans inventing new materials has already driven many technological and social advancements. For instance, the silicon semiconductor crystal developed by the 1956 Nobel Prize winners in Physics has led to the rapid development of smartphones. The lithium oxide battery invented by the 2019 Nobel Prize winners in Chemistry has successfully reduced the number of fuel vehicles and emissions worldwide.

She went on to point out that theoretical calculations should address 4 significant issues: the first is the application of clean water energy, the second is filtration membranes for pollution, the third is organic light-emitting diodes (OLEDs), and the fourth is more efficient low-power transistors. She introduced density algorithms and applications in quantum physics and quantum chemical methods to calculate the relationship between different liquid water molecules and the interface of solid energy materials at various temperatures. Additionally, by combining different interactions between light and electrons, using spectroscopic techniques such as light absorption, photoelectrons, photoluminescence, nonlinear optics, and ultrafast optics, it is possible to explore electrical and

magnetic properties, the operational potential of materials, and oxygen bonding types between novel materials.

Finally, Professor Galli noted that the use of artificial intelligence (AI) and machine learning (ML) remains limited. Her lab is pioneering neurocomputational methods to develop new materials that are faster, more efficient, and consume less energy. Yu-Hui Liang, a seventh-year doctoral student in the Physics Department, expressed relief at Professor Galli's statement that AI has not yet replaced scientific research. Liang also agreed with Galli's explanation that materials with defects can exhibit different physical properties.

On the afternoons of June 11 and 12, accompanied by Dean Tzeng-Lien Shih of the College of Science, Physics Department Chair Cheng-Hao Chuang, and Professor Hung-Chung Hsueh, Professor Giulia Galli from the Pritzker School of Molecular Engineering at the University of Chicago, who was the Tamkang Clement and Carrie Chair invited by the Physics Department, visited President Huan-Chao Keh and Chairperson Flora Chia-I Chang. President Keh and Chairperson Chang respectively presented her with the Panda trophy and a vase imprinted with calligraphy by Masters Chi-Mao Li and a painting by Master Ben-Hang Chang, featuring Tamkang campus scenery and the school anthem as commemorative gifts.

President Keh and Chairperson Chang welcomed Professor Galli and expressed their gratitude. They also explained the reasons behind the founding of the Tamkang Clement and Carrie Chair by the university's founder, Dr. Clement C.P. Chang, and his wife. They discussed the lecture topic and the semiconductor industry, including the university's arrangements for students to intern in the industry. Professor Galli praised the beautiful scenery of Tamsui and the Tamkang University campus on her first visit. She found the Artificial Innovative Intelligence College, the digitalization and community integration of the library, and the Qing Shui Zu Shi parade she coincidentally encountered upon arrival in Tamsui very interesting. Professor Galli also met with faculty and students from the Physics Department and planned future collaboration. She commended the outstanding theoretical and experimental teams in Tamkang's Physics Department and

promised to visit again soon, as she was deeply impressed by this place.





Giulia Galli
University of Chicago & Argonne

TAMKANG CLEMENT AND CARRIE CHAIR
*Materials for sustainable energy
generation and use from first principles*

Giulia Galli, Ph.D.
University of Chicago & Argonne National Laboratory, USA
Jun 12, 2024 | Wed. | 14:10 p.m. to 15:30 p.m.
Cheng Yee Lan International Conference Hall, Wu Shou Chuan
International Conference Center, HC210

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The Department of Physics, cordially invites you.

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