SEMINAR

Physical Computing Based on Emerging Materials and Devices

Date: 23 February, 2026 (Monday)
Time: 11:00 a.m.
Venue: Room 7-34 & 7-35
Haking Wong Building
HKU

Speaker: Professor Feng Miao
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Abstract:

The continuous enhancement of computational power is crucial for driving societal progress. Currently, this improvement heavily relies on the integration of transistors. As this integration level nears its limit, marking the end of Moore's Law, the growth in hardware computational power has slowed and been struggling to meet the exponential data processing needs of the AI era. This presents a significant challenge. To overcome it, we need to explore entirely revolutionary computing approaches to process information. Unlike traditional digital computing, which relies on abstract symbolic representation and operates at the CMOS circuit level, physical computing processes information at the device level by leveraging material-specific physical processes, thus offering ongoing improvements in computational power. Two-dimensional (2D) quantum materials, with their atomic-layer thickness, enable precise control of physical properties using external fields, creating a superior platform for future physical computing. To begin, I will present our precise control approach over twist angles in graphene moiré heterostructures and experimental realization of quantum simulators for the extended Hubbard model with spin–valley isospins [1]. Then, I will showcase a range of neuromorphic devices built on these Lego structures, such as 2D moiré synaptic transistors and moiré ferroelectric devices [2]. These Lego structures also support the realization of retinomorphic vision sensor [3-5], perception of visual motion [6], in-sensor dynamic computing [7], and neuromorphic computing device arrays and chips [8]. Concluding the presentation, I will delve into our ongoing explorations of novel computing schemes and systems based on these advanced devices and chips [9-10], and share our vision for the future of this burgeoning field.

References

[1] ***Nature*** 609, 479 (2022).

[2] ***Nature Nanotechnology*** 19, 962 (2024).

[3] ***Science Advances*** 6, eaba6173 (2020).

[4] ***Nature Electronics*** 5, 248 (2022).

[5] ***National Science Review*** 8, nwaa172 (2021).

[6] ***Science Advances*** 9, eadi4083(2023).

[7] ***Nature Electronics*** 7, 225 (2024).

[8] ***IEDM*** 11353772 (2025).

[9] ***Nature Nanotechnology*** 16, 1079 (2021).

[10] ***Nature Electronics*** 6, 381 (2023).

Biography:

Feng Miao joined Nanjing University as a full Professor of Physics and a Principal Investigator at Nanjing National Laboratory of Microstructures in July 2012. He received his Ph.D. degree in physics from the University of California, Riverside, United States, in 2009. Then he worked with HP Laboratories, Palo Alto, California, as a research associate for three years. He is currently the director of Institue of Brain-inspired Intelligence (IBI), Nanjing University. He is also a NSFC (National Science Fund of China) Distinguished Young Scholar, and the Chief Scientist of a National Key Basic Research Program. He has published over 150 technical papers (with over 30000 citations, Web of Science; over 41000 citations, Google scholar) and is the inventor of over 40 granted/pending China/US patents. His awards include: Xplorer Prize (2024), CPS Huangkun Award (Chinese Physical Society) (2021), Clarivate Analytics "Highly Cited Researchers" (2018), etc.

ALL INTERESTED ARE WELCOME

For further information, please contact Prof. W.D. Li at 3917 8982.