CSU PHYSICS COLLOQUIUM

"Designing Electronic Quantum Matter Atom by Atom and Layer by Layer"

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120 Engineering (Hammond Auditorium)

Monday, October 16th at 4:00 PM

Abstract

"Ultimately – in the great future – we can arrange the atoms the way we want; the very atoms, all the way down." This vision by Feynman has become reality: we can realize novel quantum matter at the atomic scale, opening an experimental avenue to investigate fascinating electronic band structures on demand. Atomic-scale patterning of the 2D electron gas at a Cu(111) surface in a scanning tunneling microscope (STM) is a versatile method to realize and characterize 2D Hamiltonians at will. This tunable platform allows for periodic and aperiodic lattices. I will present flat bands in square and honeycomb geometries and how electrons encaged in a Sierpinski fractal geometry inherit a dimension of ~1.58 [1-4]. Additional functionality can be created with moiré superlattices of Van der Waals materials such as graphene. Tuning the number of layers, type of material and the twist angle between the stacked layers allows for precise engineering of the bands. I will demonstrate valley-contrasting orbital magnetism and orbital magnetic susceptibility in twisted double bilayer graphene that is sensitively tunable with electric and magnetic fields [5].

[1] M.R. Slot et al., Nature Physics 13, 672 (2017)

[2] M.R. Slot & S.N. Kempkes et al., Physical Review X 9, 011009 (2019)

[3] M.R. Slot & S.N. Kempkes et al., Nature Physics 15, 127 (2019)

[4] M.R. Slot & S.N. Kempkes et al., Nature Materials 18, 1292 (2019)

[5] M.R. Slot & Y. Maximenko et al., Science (2023)

Biography

Dr. Marlou Slot is a researcher in Quantum Materials and Quantum Sensing at the National Institute of Standards and Technology, USA. Her current work is on chip-scale atomic clocks and magnetometers based on atomic vapor cells. Previously, she focused on the experimental realization and characterization of novel electronic quantum matter using scanning probe techniques at ultra-low temperatures. To train the global quantum workforce and bring more talented women to this domain, Marlou organizes the Global Quantum Program partnering with Womanium, a DC-based foundation advancing women in STEM+E. The extensive program brings together CEOs, scientists and industry leaders to train more than 2000 people yearly (45% women) in Quantum Computing, Sensing and Communication. Marlou completed her PhD with highest distinction at Utrecht University (NL) focusing on analogue electronic quantum simulation. She was awarded the prestigious Rubicon grant from the Dutch Research Council for her postdoctoral research.