PennState Physics Colloquium

Comparative neurobiology of vocal communication

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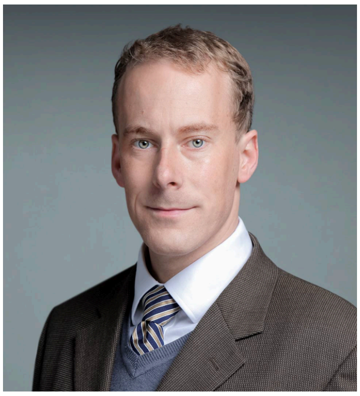
Speaker Biographic Summary



Dr. Michael Long is

Research Interests

Dr. Long's research focuses on [1]

Decomposition of spin correlations, diagonal hole pair. [2]

Talk Abstract

More than 30 years ago, Richard Feynman outlined his vision of a quantum simulator for carrying out complex calculations on physical problems. Today, his dream is a reality in laboratories around the world. This has become possible by using complex experimental setups of thousands of optical elements, which allow atoms to be cooled to Nanokelvin temperatures, where they almost come to rest. Recent experiments with quantum gas microscopes allow for an unprecedented view and control of artificial quantum matter in new parameter regimes and with new probes. In our atomic fermionic quantum gas microscope, we can detect both charge and spin degrees of freedom simultaneously, thereby gaining maximum information on the intricate interplay between the two in the Fermi Hubbard model. In my talk, I will show how we can reveal hidden magnetic order, directly image individual magnetic polarons, probe the fractionalisation of spin and charge in dynamical experiments and reveal the crossover from a polaronic metal to a Fermi liquid when continuously increasing the doping in the system. For the first time we thereby have access to directly probe non-local 'hidden' correlation properties of quantum matter and to explore its real space resolved dynamical features also far from equilibrium. Finally, I will discuss experiments on the first realization of the Haldane phase in Hubbard ladder systems. Both edge states and bulk string correlators enable us to reveal the special topological features of this paradigmatic phase of matter.

Brief Background

Electrons interacting in conventional metals are described by Fermi-Liquid (FL) theory, which uses adiabaticity and the Pauli exclusion principle to relate the simple Fermi gas model to an interacting system. Violations of these concepts is a key feature of strongly-correlated quantum materials. [2]

Doped antiferromagnetic Mott insulators are particularly interesting since they behave like non-FL materials for weak doping, but become normal FL materials for high doping. The combined effect of hole motion and antiferromagnetism produces magnetic polarons, or heavily dressed dopants. [2]

References

[1] C. Weitenberg, M. Endres, J. F. Sherson, M. Cheneau, P. Schauß, T. Fukuhara, I. Bloch, and S. Kuhr, Nature **471**, 319 (2011).

[2] J. Koepsell, D. Bourgund, P. Sompet, S. Hirthe, A. Bohrdt, Y. Wang, F. Grusdt, E. Demler, G. Salomon, C. Gross, and I. Bloch, arXiv:2009.04440 [cond-mat, physics:quant-ph] (2020), arXiv:2009.04440 [cond-mat, physics:quant-ph] .