UCLA College | Physical Sciences
Physics & Astronomy

# Colloquium

Thursday, April 30th, 2026 at 4 p.m.
Physics & Astronomy Building (PAB) 1-434


## Martin Zwierlein
(MIT)


# Pairing and Superfluidity in a Fermi Gas


Quantum gases of atoms and molecules serve to realize paradigmatic models of many-body physics, enabling us to search for novel states of matter.
Strongly interacting atomic Fermi gases form a superfluid with the highest critical temperature relative to the Fermi energy of any fermionic system. They realize the crossover between Bose-Einstein condensation of tightly bound molecules and the Bardeen-Cooper-Schrieffer state of long-range Cooper pairs. Their thermodynamics constrain the equation of state of nuclear matter and transport of spin, sound and heat occurs at the quantum limit of diffusion: Planck's constant divided by the particles' mass.
I will present recent experiments with these Fermi gases: Heat transport measurements allowed us to observe second sound in the superfluid Fermi gas, the wave-like propagation of heat.
Using a novel microscope we can detect every single atom in a two-dimensional Fermi gas, directly revealing fermion pairing and their correlations.
Trapped in optical lattices, fermionic atoms realize the Hubbard model of strongly interacting electrons. For attractive interactions, pairing occurs even above the superfluid transition, in the "pseudo-gap" regime of preformed pairs. With spin imbalance, we explore signatures of exotic pairing in the search for the long-sought Fulde-Ferrell-Larkin-Ovchinnikov state.
Extensions of these studies are promising for the exploration of bosonic and fermionic quantum Hall states in rotating gases, as well as molecular gases with long-range dipolar interactions.


Hosted by Seth Putterman

Refreshments at 3:30 p.m. on the 3rd floor patio