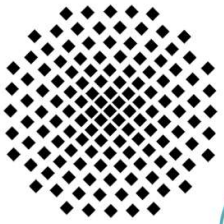
# Stuttgarter Physikalisches Kolloquium

Fachbereich Physik, Universität Stuttgart
Max-Planck-Institut für Festkörperforschung
Max-Planck-Institut für Intelligente Systeme

Ansprechpartner: Prof. Harald Giessen
E-Mail: giessen@physik.uni-stuttgart.de
Telefon: 0711 - 685-65111



| Dienstag, 16. Juni 2020 | 16:15 Uhr | Online-Vortrag |
|---|---|---|

**Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart-Vaihingen**

Gastgeber: Prof. Dr. Tilman Pfau, Universität Stuttgart, Telefon: 0711 - 685-68025

# The sound of fermions

**Martin Zwierlein**
*Massachusetts Institute of Technology*

## Abstract

Fermions, particles with half-integer spin like the electron, proton and neutron, obey the Pauli principle: They cannot share one and the same quantum state. This “anti-social” behavior is directly observed in experiments with ultracold gases of fermionic atoms: Pauli blocking in momentum space for a free Fermi gas, and in real space in gases confined to an optical lattice. When fermions interact, new, rather “social” behavior emerges, i.e. hydrodynamic flow, superfluidity and magnetism. The interplay of Pauli’s principle and strong interactions poses great difficulties to our understanding of complex Fermi systems, from nuclei to high-temperature superconducting materials and neutron stars. I will describe experiments on atomic Fermi gases where interactions become as strong as allowed by quantum mechanics – the unitary Fermi gas, fermions immersed in a Bose gas and the Fermi-Hubbard lattice gas. Sound and heat transport distinguish collisionally hydrodnamic from superfluid flow, while spin transport reveals the underlying mechanism responsible for quantum magnetism.