Walther-Meißner-Institut
Bayerische Akademie der Wissenschaften

WS 2023/24

Walther-Meißner-Seminar

Walther-Meißner-Institute, Seminar Room 143

Date: **Thursday, 11 April 2024, 11:15 h**

Speaker: **Tahereh Parvini**

Institut für Physik, Universität Greifswald

Title: **Cavity-Enhanced Optical Manipulation and Control of Antiferromagnetic Magnons**

Abstract:

Antiferromagnets (AFMs) offer a fascinating playground for exploring fundamental physics and building next-generation computing devices. Their rigidity to external magnetic fields and lack of stray fields, along with their ultrafast dynamics enabling information processing and storage devices operating at terahertz (THz) frequencies, make them ideal candidates. The true potential of AFM devices hinges on precise control of their magnetic state. Traditionally, this control is achieved through external stimuli like electrical current or short laser pulses. In our work, we propose a groundbreaking approach: utilizing light within optical quantum electrodynamic (QED) cavities for the manipulation and control of magnetic states in AFMs. These cavities establish a platform for coherent interaction between light particles (photons) and magnons through two primary mechanisms: one-magnon and two-magnon Raman scattering. One-magnon Raman scattering unlocks intriguing possibilities such as magnon cooling, heating, and even light-mediated communication between magnons, paving the way for quantum memory applications. Meanwhile, two-magnon Raman scattering introduces an intriguing phenomenon known as "squeezing" in magnon-pairs. Under specific conditions, this process drives spin fluctuations below the level of vacuum fluctuation, impacting diverse interactions including magnon-phonon and magnon-magnon scattering, and even superconductivity in cuprate superconductor AFMs in their insulating phase. Moreover, auto-oscillating limit cycles and chaotic behavior can be observed on this platform, depending on the characteristics of the driving laser. These developments open up promising avenues for future advancements in quantum information processing and communication.

gez:
R.Gross (Host)