Walther-Meißner-Institut
Bayerische Akademie der Wissenschaften

WS 2025/26

Walther-Meißner-Seminar

Walther-Meißner-Institute, Seminar Room 143

Date: **Friday, January 16th 2025, 11:15 h**

Speaker: **Matthijs De Jong**

Aalto University, Finland

Title: **Measurement of the Casimir force between superconductors**

Zoom: **620 0077 3814 (passkey: 792462)**

Abstract:

The Casimir force follows from quantum fluctuations of the electromagnetic field and yields a nonlinear attractive force between closely spaced conductive objects. Its magnitude depends on the conductivity of the objects up to optical frequencies. Measuring the Casimir force between superconductors should allow to isolate frequency-specific contributions to the Casimir effect, as frequencies below the superconducting gap energy are expected to contribute differently than those above it. There is significant interest in this contribution as it is suspected to contribute to an unexplained discrepancy between predictions and measurements of the Casimir force between normal metals, which questions the basic principles on which estimates of the magnitude are based. We have observed the Casimir force between superconducting objects through the nonlinear dynamics it imparts to a superconducting drum resonator in a microwave optomechanical system. There is excellent agreement between the experiment and Casimir force magnitude for this device across three orders of magnitude of displacement. Furthermore, the Casimir nonlinearity is intense enough that, with a modified design, this device type should operate in the single-phonon nonlinear regime. Accessing this regime has been a long-standing goal that would greatly facilitate quantum operations of mechanical resonators.