# TT 22: Other Low Temperature Topics: Poster Session

Time: Monday 15:00–18:00 Location: Poster B

TT 22.1 Mon 15:00 Poster B

**Quantum Monte Carlo Results for the Breathing Mode of Trapped Bosons** — •Tobias Dornheim, Alexei Filinov, and Michael Bonitz — Institut für Theoretische Physik und Astrophysik der Christian-Albrechts-Universität zu Kiel, Leibnizstraße 15, 24098 Kiel, Germany

The quantum breathing mode (QBM, e.g. [1]) is of fundamental interest for the investigation of harmonically confined systems since it might serve as a tool of diagnostics [2]. We perform ab initio path integral Monte Carlo (PIMC) [3] simulations for up to N=1000 particles in TD equilibrium and investigate the QBM for both dipole- and Coulomb-interacting bosons using a recently developed improved sum-rule formalism [4]. We study the dependence on the particle number $N$ and coupling strength $\lambda$ for 2D and 3D systems and observe a transition towards the classical limit with increasing system size and interaction.

[1] J. W. Abraham and M. Bonitz, Contrib. Plasma Phys. **54**, 27-99 (2014)

[2] C. R. McDonald et al., Phys. Rev. Lett. **111**, 256801 (2013)

[3] M. Boninsegni et al., Phys. Rev. E **74**, 036701 (2006)

[4] J. W. Abraham et al., New J. Phys. **16**, 013001 (2014)

TT 22.2 Mon 15:00 Poster B

**Metallic Coplanar Microwave Resonators for Cryogenic Applications** — •Mojtaba Javaheri[1], Conrad Clauss[1], Daniel Bothner[2], Dieter Koelle[2], Reinhold Kleiner[2], Martin Dressel[1], and Marc Scheffler[1] — [1]1. Physikalisches Institut, Universität Stuttgart, Stuttgart, Germany — [2]Physikalisches Institut and Center for Collective Quantum Phenomena in LISA$^+$, Universität Tübingen, Tübingen, Germany

Microwave (MW) spectroscopy based on resonator measurements can reveal important information about charge and spin dynamics in solids. Recently superconducting coplanar resonators, which are commonly used in quantum information science, have successfully been compatibilized and applied for cryogenic magnetic resonance studies. However, they feature certain disadvantages arising from the magnetic-field dependence of the superconductivity and also diamagnetic field repulsions. To avoid this, we now study metallic (non-superconducting) coplanar resonators as an alternative approach for applications at cryogenic temperatures and finite magnetic fields.

We have prepared coplanar MW resonators made of either copper or gold (thin) films with various geometrical specifications. Their MW performance in the frequency range of 1 GHz to 18 GHz and at temperatures between 5 K and 300 K are measured. We find the temperature dependence of the resonator quality factor corresponds to the dc conductivity. We present some strategies to optimize the MW properties of the metallic films and the actual resonator device. The results are compared to some previous studies on superconducting resonators.

TT 22.3 Mon 15:00 Poster B

**Compact 11 mK scanning tunneling microscope** — •Timofey Balashov and Wulf Wulfhekel — Physikalisches Institut, Karlsruhe Institute of Technology, Karlsruhe, Germany

A new scanning tunneling microscope (STM) working at 11 mK with low noise, high stability and high energy resolution was developed for the measurement of magnetic and vibronic excitations.

Advances in dilution refrigerator technology allow for a compact design with direct transfer under vision of both tip and sample into the STM, as well as material deposition at low temperature. An additional vacuum chamber serves for in-situ preparation of tips and samples.

The cryostat reaches the operating temperature in less than 5 hours after sample transfer, and has a low helium consumption of less than 200 ml/hour. A superconducting coil provides an out-of-plane magnetic field of up to 8 Tesla (projected). The vertical stability of the tunnel junction is below 1 pm (peak to peak) and the electric noise floor of tunneling current is about $2\,\mathrm{fm}/\sqrt{\mathrm{Hz}}$.

TT 22.4 Mon 15:00 Poster B

**Pulse Tube Cryocoolers at 4 K: Optimized Design for Low Vibrations and Temperature Oscillations** — •Jens Falter[1], Bernd Schmidt[1,2], Andreas Euler[1], Marc Dietrich[1,2], André Schirmeisen[1,2], and Günter Thummes[1,2] — [1]TransMIT-Center for Adaptive Cryotechnology and Sensors, Giessen, Germany — [2]Institute of Applied Physics (IAP), Justus-Liebig-University Giessen, Germany

Since their invention [1] two-stage 4 K pulse tube cryocoolers (PTCs) have evolved as an excellent technique for "dry" cooling of cryogenic experiments without need for liquid helium, operating even below 4 K. PTCs have no cold moving mechanical parts, which is a main advantage over conventional Gifford-McMahon coolers. This results in a lower vibration level and long operation times. These properties make PTCs very attractive as the main cooling system for applications with high demands for low vibrations and high temperature stability. However, PTCs still exhibit two intrinsic effects due to the cyclic compression and expansion of the working fluid (He) in the cold head: (a) a periodic elastic deformation ("breathing") of the thin walled pulse- and regenerator-tubes, which leads to residual vibrations and (b) a periodic variation in temperature. Here, we present optimized applications of two-stage 4 K PTC cold heads to reduce these effects. First, both intrinsic effects are minimized by adapting the input power of the compressor. Remaining vibrations are reduced by mechanical decoupling of the experiment from the cold flange. Also, a temperature damping unit is implemented for a reduction of the temperature variations.

[1] C. Wang, G. Thummes, C. Heiden, Cryogenics 37, 159-164 (1997)