TT 59: Transport: Poster

Time: Wednesday 15:00–18:00 Location: Poster E

TT 59.1 Wed 15:00 Poster E

Thermal noise and electrical characterization of mode coupled GaAs/AlGaAs quantum point contacts — •Daniel Nickel[1], Birkan Düzel[1], Olivio Chiatti[1], Sven S. Buchholz[1], and Saskia F. Fischer[1,2] — [1]Novel Materials Group,Humboldt-Universität zu Berlin,10099 Berlin, Germany — [2]Center for the Science of Materials Berlin, 12489 Berlin, Germany

Noise measurements are a useful tool to investigate intrinsic system properties in thermodynamic equilibrium. This work investigates the thermal noise and electrical properties of etched single and double quantum point contacts (QPCs) in GaAs/AlGaAs heterostructures at T = 4.2 K. Both QPCs exhibit conductance plateaus indicative of ballistic transport in one dimension. The transconductance as a function of the top and back gate voltages yields information regarding the degeneracies of the 1D subband energies of the double QPC. Crossings are observed when two energy levels are degenerate and anti-crossings are observed when a hybridization of the 1D wave functions occurs. The single QPC subband structure is well-detected in voltage noise measurements in accordance with the expected thermal noise using the Johnson-Nyquist theorem. For the double QPC, additional noise beyond the expected thermal noise is observed. This additional noise occurs in mode coupled states with hybridized wave functions and simultaneous phase-coherent transport, as well as in degenerate states. The increase in voltage fluctuations is discussed in relation to shot noise through the tunnel barrier and correlations between noise sources.

TT 59.2 Wed 15:00 Poster E

Quantum dots in suspended or graphite-gated MoS_2 nanotubes — •Stefan B. Obloh[1], Robin T. K. Schock[1], Jonathan Neuwald[1], Matthias Kronseder[1], Matjaž Malok[2], Maja Remškar[2], and Andreas K. Hüttel[1] — [1]Institute for Experimental and Applied Physics, University ofRegensburg, 93040 Regensburg, Germany — [2]Solid State Physics Department, Institute Jožef Stefan,1000 Ljubljana, Slovenia

MoS_2 as a semiconductor has attracted a lot of attention due to its 2D nature, strong spin-orbin coupling, broken inversion symmetry, and spin-split bands. By tuning the carrier density in MoS_2 with ionic liquid gating, intrinsic superconuctivity has been achieved [1]. Recent works were able to demonstrate single level transport in planar [2,3] and nanotube-based [4] devices. A remaining challenge lies in reducing the effects of substrate inhomogenity and surface charges, resulting in disordered quantum dots. To mitigate this, one can suspend the tubes above the substrate or shield them from the amorphous SiO_2. We show first measurements of nanotubes suspended between contacts as well as placed onto a hBN substrate back-gated with graphite.

[1] J. T. Ye *et al.*, Science **338**, 1193 (2012)
[2] R. Krishnan *et al.*, Nano Lett. **23**, 6171 (2023)
[3] P. Kumar *et al.*, Nanoscale **15**, 18023 (2023)
[4] R. T. K. Schock *et al.*, Adv. Mat. **35**, 13 (2023)

TT 59.3 Wed 15:00 Poster E

Nanomechanics with nanoassembled carbon nanotubes circuits — •Sophie Klingel[1], Tim Althuon[1], Tino Cubaynes[1,2], Aljoscha Auer[1], Christoph Sürgers[1], and Wolfgang Wernsdorfer[1,2] — [1]Physikalisches Institut (PHI), Karlsruhe Institute of Technology — [2]Institute for Quantum Materials and Technologies (IQMT), Karlsruhe Institute of Technology

Carbon nanotubes (CNT) are a one dimensional allotrope of elemental carbon which feature a unique combination of properties like low mass and high mechanical tensile strength, resulting in resonance frequencies suited for experiments. In combination with a high electronic tunability, these properties make CNT excellent components for nanoelectromechanical systems (NEMS). One possibility to create a NEMS is with a double quantum dot in a suspended CNT.

In our experiments, we connected a CNT grown on a separate chip to the contact electrodes via a mechanical nanoassembly technique. While this technique allows to select and place a single CNT on a precise location, the resistance between the CNT and the electrode was until now high, blocking access to the open quantum dot regime. We managed to drastically lower the resistance between the CNT and the electrode by developing a novel two-step annealing technique based on current-induced and radiative thermal annealing steps. Along with a more detailed presentation of this technique, some of our nanomechanical and quantum transport measurement results will be showcased.

TT 59.4 Wed 15:00 Poster E

Towards single-photon optomechanics using superconducting quantum interference — •Mohamad El Kazouini, Benedikt Wilde, Timo Kern, Christoph Füger, Kevin Uhl, Dieter Koelle, Reinhold Kleiner, and Daniel Bothner — Physikalisches Institut, Center for Quantum Science (CQ) and LISA^{+}, Universität Tübingen, Germany

Cavity optomechanics explores the coupling between mechanical oscillators and electromagnetic modes through radiation-pressure. Various milestone experiments have been reported, such as groundstate cooling or non-classical mechanical states preparation. All experiments so far, however, utilize only the first-order interaction in the linearized regime, mainly due to small single-quantum coupling rates. Increasing the single-photon coupling rates would not only unlock the optomechanical single-photon regime, but also grant access to higher-order terms of the interaction, enabling for instance mechanical cat-state preparation. Flux-mediated optomechanics (FMOM) is a strong candidate for achieving this groundbreaking regime. In FMOM, the mechanical oscillator is a microbeam integrated into a superconducting quantum interference device (SQUID), which is part of a microwave LC circuit. The single-quantum coupling rates in FMOM are proportional to an external magnetic field, but all FMOM implementations so far are based on Al, that has low magnetic-field-tolerance. Implementing it with high-field-compatible superconducting circuits is therefore the main challenge for maximized coupling rates. On our poster, we will present our progress in developing niobium-based FMOM devices.

TT 59.5 Wed 15:00 Poster E

Analysis of magnetism in monolayer graphene beyond half filling — •Maxime Lucas, Andreas Honecker, and Guy Trambly de Laissardière — Laboratoire de Physique Théorique et Modélisation, CY Cergy Paris Université / CNRS, France

Recent studies of twisted bilayer graphene (or other 2D materials) have been stimulated by the discovery of correlations between electronic flatband states due to a moiré pattern [1]. It is shown experimentally and theoretically that the filling of the flat bands affects their magnetic properties significantly. On the other hand, the effect of doping on a simple graphene layer is still unclear. Indeed, its half-filled case is well known and has been studied by various theoretical approaches (real-space mean-field theories (MFT), Monte Carlo) [2], but unlike other lattices [3] its magnetic properties beyond half filling are mostly unexplored [4]. Here, we present our analysis of graphene magnetism using a combination of the Hubbard model and MFT.

[1] Y. Cao et al., Nature **556**, 43 (2018); Nature **556**, 80 (2018)
[2] M. Raczkowski, R. Peters, T.T. Phùng, N. Takemori, F.F. Assaad, A. Honecker, J. Vahedi, Phys. Rev. B **101**, 125103 (2020), and Refs. therein.
[3] R. Scholle, P. M. Bonetti, D. Vilardi, W. Metzner, Phys. Rev. B **108**, 035139 (2023)
[4] S. Jiang, A. Mesaros, Y. Ran, Phys. Rev. X **4**, 031040 (2014)

TT 59.6 Wed 15:00 Poster E

Suspended carbon nanotube – superconducting coplanar resonator hybrid systems — •Akong N. Loh, Furkan Özyigit, Fabian Stadler, Nicole Kellner, Niklas Hüttner, and Andreas K. Hüttel — Institute for Experimental and Applied Physics, University of Regensburg, 93040 Regensburg, Germany

The combination of carbon nanotubes (providing quantum dots and beam-like nano-electromechanical systems) and superconducting coplanar electronics (providing GHz cavities, fast read-out, and potentially even qubits) enables a multitude of interesting low-temperature experiments. We have recently shown optomechanically induced transparency in such a combined system [1,2], where the nonlinearity of Coulomb blockade leads to an enhancement of the single photon coupling up to $g_0 \simeq 95\,\mathrm{Hz}$. The carbon nanotubes are grown separately and deposited into the prefabricated resonator geometries [3], leading to flexibility and increased fabrication yield. Our current work is directed towards achieving strong optomechanical coupling, and towards time-domain control of the combined hybrid system, with ongoing improvements of the microwave cavity [4], CNT growth and transfer.

[1] S. Blien *et al.*, Nat. Comm. **11**, 1636 (2020)
[2] N. Hüttner *et al.*, PR Applied, in press (2023), arXiv:2304.02748
[3] S. Blien *et al.*, PSS(B) **255**, 1800118 (2018)
[4] N. Kellner *et al.*, PSS(B) 2300187 (2023)

TT 59.7 Wed 15:00 Poster E

Coplanar on-chip resonators for kinetic inductance measurements on 2D-crystals — •Lorenz Bauriedl, Sami Campopiano, Alexander Kirchner, Nicola Paradiso, and Christoph Strunk — Institute for Experimental and Applied Physics, University of Regensburg, 93040 Regensburg, Germany

Experimental access to the small kinetic inductance of low-resistive metallic superconductors is traditionally achieved by increasing the ratio of sample length to cross section. This limits one to materials available at sufficient size and renders measurements on exfoliated 2D superconductors hardly possible. We devised a method to access the inductance signature of materials such as $NbSe_2$. Incorporating a $NbSe_2$ nanowire into a high Q-factor on-chip niobium resonator enables us to measure the inductive response, while DC ports allow simultaneous investigation of transport properties. Spiral inductors fabricated in tandem with the resonator serve as low-pass filters for the DC ports and create the high impedance enviroment necessary to detect even minute changes in the inductance.

TT 59.8 Wed 15:00 Poster E

Utilizing Scanning Nitrogen Vacancy Center for 2D Correlated Electron Systems — •Malik Lenger, Sreehari Jayaram, Ruoming Peng, Rainer Stöhr, and Jörg Wrachtrup — 3rd Physics Institute, University of Stuttgart, Germany

Visualization of nanoscale dynamics in superconducting materials provides a pathway to unravel the pairing mechanisms of interacting electrons. Here, we have employed the state-of-the-art scanning NV probe technique to explore the local magnetic response of the 2D superconductor, 2H-$NbSe_2$, in which we demonstrate full dynamic sensing of vortices with high sensitivity and spatial resolution. Utilizing this quantum probe, we present the first spatio-temporal dynamics of vortices in a 10 nm thin exfoliated 2H-$NbSe_2$, where the arrangement of the vortices show a strong correlation with the geometric confinement. Notably, we have observed the melting of vortex solids near critical temperature allowing the re-arrangement of the vortices that is governed by the cooling rate. Additionally, our study delves into the dynamics of vortex cores, superconducting-insulator edge dynamics, and phase transitions, all unveiled through spatial-temporal noise spectroscopy with the NV probe.

TT 59.9 Wed 15:00 Poster E

Adsorped or intercalated nickel atoms in graphene based materials: stability and electronic properties — •Daniel Dick[1,2,3], Florian Fuchs[1,2,3], and Jörg Schuster[1,2,3] — [1]Center for Microtechnologies, Chemnitz University of Technology, Chemnitz, Germany — [2]Fraunhofer Insitute for Electronic Nano Systems (ENAS), Chemnitz, Germany — [3]Center for Materials, Architectures and Integration of Nanomembranes (MAIN), Chemnitz University of Technology, Chemnitz, Germany

Graphene based materials such as graphene fibers or thin films offer promising electrical properties, which can be further improved by adsorption or by intercalation of dopants. A variety of electron donating species can be considered to fabricate intercalation compounds, many of which have not been studied yet.

We investigate atomic structure, stability and electronic structure of nickel doped graphene, bilayer graphene and graphite using density functional theory. Different positions of the nickel atom are compared. We demonstrate that the energetically optimal position of the nickel atom depends on the nickel concentration. While the nickel atom is in the middle of a hexagon in graphene, it is located at an off-center position in graphite. Furthermore, the stability of the nickel intercalant decreases with increasing nickel concentration. The nickel atom introduces additional bands in the band structure. These bands are located near the Fermi level, leading to improved conductance.

TT 59.10 Wed 15:00 Poster E

Quantum Monte Carlo simulations of electronic transport in finite-sized graphene sheets and its dependence on the boundary conditions. — •Adrien Reingruber, Maksim Ulybyshev, and Fakher Assaad — Institut für Theoretische Physik und Astrophysik, Universität Würzburg

The realization of ultra-clean graphene samples with predominant electron-electron scattering, opened the possibilities to study electron transport in hydrodynamic regime, where the electronic transport properties are characterized by viscous Poiseuille flow[1] or the breakdown of Wiedemann-Franz law[2]. Only recently these effects were measured experimentally. Furthermore, newly optimized quantum Monte Carlo (QMC) techniques[3] enable us to simulate experimentally relevant lattice sizes starting from microscopic models in order to reproduce and understand better the aforementioned effects. A major challenge is the implementation of correct boundary conditions that yield a vanishing current flow at the edge of finite-sized graphene samples. In this work we study the influence of disorder and various types of electronic interactions on the conductivity profiles inside thin graphene wires using unbiased QMC simulations and discuss the feasibility to achieve hydrodynamic transport from a microscopic perspective.

[1] M.J.H. Ku et al., Nature 583, 537 (2020)
[2] J. Crossno et al., Science 351, 1058 (2016)
[3] M. Ulybyshev, S. Zafeiropoulos, C. Winterowd, F. Assaad, arXiv:2104.09655 (2021)

TT 59.11 Wed 15:00 Poster E

Integer and fractional moiré Chern insulators in van der Waals bilayers — •Mirko Bacani, Rajarshi Bhattacharyya, and Florian Otto — attocube systems AG, Haar, Germany

Moiré van der Waals (vdW) materials have become established playground for exploring band topology and strong-correlations phenomena. Cryogenic nanopositioning and nanorotating setups of attocube systems are widely used in such nanoscale studies because they provide supreme stability and ultra-low-vibrations environment. These cryogenic scanning setups include confocal microscopes and various scanning probe microscopes.

We present here a selection of remarkable results achieved with attocube systems technology in labs of our customers with emphasis on integer and fractional moiré Chern insulators (MCIs) in vdW bilayers: Scanning magnetometry of an integer MCI $MoTe_2/WSe_2$ shows that its magnetization can be flipped with a very low current [1], which is appealing for utilization in energy-efficient magnetic memories. Magneto-optical study of the same heterostructure discovered a valley-nonpolarized quantum anomalous Hall state [2]. Magic angle twisted bilayer graphene (MATBG), identified as an integer MCI [3], reveals orbital magnetism induced by local Berry curvature as the function of the integer filling factor [4]. Moreover, MATBG can also exhibit fractional Chern insulating states (FCIS) even in low magnetic fields $B<12T$ [5]. FCIS that survive in B=0 have been identified magneto-optically in twisted bilayer $MoTe_2$ using trions as the local probe for real-space imaging of spin polarization [6].

TT 59.12 Wed 15:00 Poster E

Quantum diffusion in magic-angle twisted bilayer graphene — •Taher Rhouma, Ahmed Missaoui, and Guy Trambly de Laissardière — Laboratoire de Physique théorique et Modélisation, CY Cergy Paris Université / CNRS, Cergy-Pontoise, France.

The discovery of correlated insulators and superconductivity due to flat bands in twisted bilayer graphene (TBG) [1] at so-called “magic angles” has stimulated the study of their electronic properties. Here we present a theoretical study of the electronic structure and quantum transport properties of these flat-band states, considering as well as possible the structural effect of local defects, such as resonant and non-resonant scatterers. Our real space method [2,3] takes into account all the effects of defects on the electronic structure itself and the effects of multiple scattering on conductivity. It shows, among other things, that due to the incredibly low velocity of flat-band states, the usual Bloch-Boltzmann theories are no longer valid.

[1] Y. Cao et al., Nature **556**, 43 (2018); Nature **556**, 80 (2018)
[2] F. Triozon et al., Phys. Rev. B **65**, 220202 (2002)
[3] O. Faizy Namarvar et al., Phys. Rev. B **101**, 245407 (2020)

TT 59.13 Wed 15:00 Poster E

Z_n-periodic quasiparticle pump in quantum spin helices — •Anshuman Tripathi[1], Felix Gerken[1,2], Peter Schmitteckert[3], Mircea Trif[4], Michael Thorwart[1,2], and Thore Posske[1,2] — [1]1. Institut für Theoretische Physik, Universität Hamburg, Hamburg, Germany — [2]The Hamburg Centre for Ultrafast Imaging, Hamburg, Germany — [3]HQS Quantum Simulations GmbH, Karlsruhe, Germany — [4]International Research Centre MagTop, Institute of Physics, Polish Academy of Sciences, Warsaw, Poland

Various topologically degenerate spaces return to an initial state only after more than one cycle of external adiabatic manipulation, e.g., Majorana zero mode exhibits the 4π Josephson effect and more exotic anyons a higher order of cyclic periodicity. Here, we study the winding-up of easy-plane quantum spin helices in spin-1/2 chains by twisting the boundary fields. At Heisenberg anisotropy $\Delta = -|J|/2$, the system returns to the ground state after n cycles of the adiabatic time evolution, where n increases linearly in dependence on the chain length. This unifies arbitrary periodicities in a single system and connects the winding-up to adiabatically pumped helical quantum spin quasiparticles. Extrapolation to long spin chains reveals a universal linear scaling curve. Our work also connects phantom helices to adiabatically pumped spin-current maximizing helices.

TT 59.14 Wed 15:00 Poster E

Electrically and Acoustically Biased Resonators for Investigations of Dielectric Low Temperature Properties of Amorphous Solids — •Christian Ständer, Jan Blickberndt, Valentin Hell, Andreas Reifenberger, Andreas Fleischmann, Andreas Reiser, and Christian Enss — Kirchhoff-Institute for Physics, Heidelberg University, D-69120 Heidelberg

The low temperature properties of amorphous solids are governed by atomic tunnelling systems, which can be described as two-level systems (TLS) with a distribution of their energy splitting E, as assumed by the phenomenological standard tunnelling model. Recent interest in these systems due to their deteriorative effects on the performance of superconducting quantum devices lead to novel experimental investigations of atomic tunnelling systems driven by novel measurement techniques.

We use newly designed microfabricated superconducting LC-resonators to study the dielectric rf-response of the amorphous sample in the presence of an electric bias field. A novel method of applying this electrical bias field was introduced to the resonators. Compared to previous experiments, the bias field is applied via an electrode placed above the resonator chip. We present first results of this new way of introducing a bias, which modifies the energy splitting E of a TLS.

In addition we achieved a similar effect as with the electrical bias field with a mechanical strain field. To induce such a strain field, the amorphous substrate of the resonator chip was flexed by a piezo-actuator.

TT 59.15 Wed 15:00 Poster E

Dynamic Control of Dielectric Loss in a Bulk Glass by Manipulation of Atomic Tunneling Systems via Electric Bias Fields — •Jan Blickberndt, Christian Ständer, Lukas Münch, Marcel Haas, Andreas Reiser, Andreas Fleischmann, and Christian Enss — Kirchhoff-Institute for Physics, Heidelberg, Germany

Atomic tunneling systems (TSs) are inherent to disordered structures and strongly determine the low temperature dielectric properties of amorphous solids. However, they also manifest as parasitic surface defects in superconducting quantum devices, contributing significantly to noise and decoherence. Here we investigate the non-equilibrium dielectric loss of atomic tunneling systems in a bulk glass sample by measuring the quality factor of a superconducting microstructured LC-resonator. Our approach involves the application of an electric bias field via a cover electrode, which allows us to modulate the TSs energy splitting, inducing Landau-Zener transitions experimentally observed as an alteration of the resonator loss. We are able to control the loss by varying the bias rate via the amplitude or frequency of the bias signal. Our results indicate a constant loss for slow bias rates due to TS saturation. Increasing the bias rate disrupts the TS saturation and leads to an increased loss. In the limit of fast continuous bias sweeps, the bias frequency exceeds the TS relaxation rate, and interference of multiple coherent Landau-Zener transitions is possible, resulting in a decreasing dielectric loss and ultimately a return to the saturation limit. We are able to confirm our experimental findings with a Monte-Carlo based numerical simulation of the tunneling dynamics.

TT 59.16 Wed 15:00 Poster E

Non-linear Dynamics of Two-level Tunneling Systems in Non-equilibrium — •Anton Jarecka, Jan Blickberndt, Andreas Reiser, Andreas Fleischmann, and Christian Enss — Kirchhoff-Institute for Physics, Heidelberg, Germany

The performance of state-of-the-art superconducting quantum devices is predominantly limited by the dielectric loss as well as the related noise and decoherence effects, which are known to originate from atomic tunneling systems (TSs). In an effort to further understand the coupling of such TSs to superconducting quantum devices, we investigate their dielectric properties and non-equilibrium behavior under the influence of high frequency electric bias fields utilizing a novel resonator setup. The superconducting resonator consists of four identical interdigital capacitors (IDCs) microstructured on to a dielectric bulk glass sample, arranged in a Wheatstone bridge and two inductors, resulting in two decoupled resonance frequencies. A cover electrode is used to create the electrical bias field that modulates the TSs' energy splitting which allows to probe the non-linear behavior of the same ensemble of TS at two different resonator frequencies independently. This can be used to measure the dielectric loss of an excited TS by moving it from one resonance frequency to the other. Experiments of this type will give further insight into the non-linearities of an ensemble of TSs.

TT 59.17 Wed 15:00 Poster E

Relaxation dynamics of quantum many-body systems with phonon degrees of freedom using the multi-trajectory Ehrenfest method — •Heiko Georg Menzler, Suman Mondal, and Fabian Heidrich-Meisner — Georg-August-Universität Göttingen

As the primary goal of our research we want to study the delocalization of interacting electrons in the presence of disorder and phonons, that is the stability of many-body localization in a solid-state environment. However, large mixed bosonic-fermionic Hilbert spaces make full quantum solutions numerically costly. Therefore, we want to analyze the model in the multi-trajectory Ehrenfest (MTE) formalism in the limit of adiabatic (slow) phonons by treating the phonons classically. We apply this formalism to study the decay of spatially inhomogeneous particle distributions as a function of electron-phonon coupling. As a main result, we observe a delocalization at sufficiently long times and strong electron-phonon coupling. The core idea of the MTE method—which is a well established method in quantum chemistry—is to separate fast and slow degrees of freedom while the slow phononic environment is treated in the classical limit. In this project we extend the established methodology to deal with many-body electron subsystems by implementing time-dependent Lanczos and TEBD time evolution in conjunction with MTE and use this new take on the MTE method to analyze disordered system in the presence of phonons.

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TT 59.18 Wed 15:00 Poster E

Delocalization in a partially disordered interacting many-body system — •Suman Mondal and Fabian Heidrich-Meisner — Institut für Theoretische Physik, Georg-August-Universität Göttingen, Göttingen, Germany

We study a partially disordered one-dimensional system with interacting particles. Concretely, we only impose a disorder potential to every other site, followed by a clean site. The numerical analysis of finite systems reveals that the ergodic regime with a large entanglement extends to higher disorder strengths compared to a fully disordered system. More importantly, at large disorder, there exist eigenstates with large entanglement entropies and significant correlations between the clean sites. These states have almost volume-law scaling, embedded into a sea of area-law states, reminiscent of inverted scar states. These eigenstate features leave fingerprints in the nonequilibrium dynamics even at large disorder regime, with a significant initial state dependence. We demonstrate that certain types of initial charge density wave states decay significantly, while others preserve their initial inhomogeneity as is typical for many-body localized systems. This initial condition-dependent dynamics may give us extra control over the system to study delocalization dynamics at large disorder strength and should be experimentally feasible with ultracold atoms in optical lattices.

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TT 59.19 Wed 15:00 Poster E

Nonlinear Cavity Optomechanics for Enhanced Cooling — •Nicolas Diaz-Naufal[1], David Zoepfl[2,3], Lukas Deeg[2,3], Christian M. F. Schneider[2,3], Mathieu L. Juan[4], Gerhard Kirchmair[2,3], and Anja Metelmann[1,5,6] — [1]Dahlem Center for Complex Quantum Systems and Fachbereich Physik, Freie Universitaet Berlin, 14195 Berlin, Germany — [2]Institute for Quantum Optics and Quantum Information, Austrian Academy of Sciences, 6020 Innsbruck, Austria — [3]Institute for Experimental Physics, University of Innsbruck, 6020 Innsbruck, Austria — [4]Institut Quantique and Departement de Physique, Universite de Sherbrooke, Sherbrooke, Quebec, J1K 2R1, Canada — [5]Institute for Quantum Materials and Technology and Institute for Theory of Condensed Matter, Karlsruhe Institute of Technology, 76131 Karlsruhe, Germany — [6]Institut de Science et de Ingenierie Supramoleculaires (ISIS, UMR7006), University of Strasbourg and CNRS

Cavity optomechanics is fundamental for numerous quantum science and technology applications and recently the use of cavity nonlinearities has attracted a lot of interest. In this study, we show that in a nonlinear optomechanical system, the nonlinearity can be used to enhance the efficiency of backaction cooling of the mechanical mode in the unresolved sideband regime. In addition, we explore the enhancements in the cooling limits achieved when employing a nonlinear optomechanical system, as opposed to an identical linear system, driven by squeezed input light. Furthermore, we demonstrate the validity of this theory above bifurcation, aligning with experimental results.