[1] *Leggio B., Napoli A., and Messina A.*
Quantum phase transitions and heat capacity in a two-atoms bose-hubbard model.
arXiv.org **quant-ph**, 1107.1611 (2011).
We show that a two-atoms Bose-Hubbard model exhibits three different phases in the behavior of thermal entanglement in its parameter space. These phases are demonstrated to be traceable back to the existence of quantum phase transitions in the same system. Significant similarities between the behaviors of thermal entanglement and heat capacity in the parameter space are brought to light thus allowing to interpret the occurrence and the meaning of all these three phases.

[2] *Walter S., Schmidt T.L., Børkje K., and Trauzettel B.*
Detecting majorana bound states by nanomechanics.
arXiv.org **cond-mat.mes-hall**, 1108.2607 (2011).
We propose a nanomechanical detection scheme for Majorana bound states, which have been predicted to exist at the edges of a one-dimensional topological superconductor, implemented using a semiconducting wire placed on top of an s-wave superconductor. The detector makes use of an oscillating electrode, which can be realized using a doubly clamped metallic beam, tunnel coupled to one edge of the topological superconductor. We find that a measurement of the nonlinear differential conductance provides the necessary information to uniquely identify Majorana bound states.

[3] *Leppäkangas J., Marthaler M., and Schön G.*
Phase-dependent quasiparticle tunneling in josephson junctions: Measuring the $cos\varphi$ term with a superconducting charge qubit.
Phys. Rev. B **84**, 060505 (Aug 2011).
We investigate quasiparticle tunneling in a Cooper-pair box which is embedded in a superconducting ring to allow control of the total phase difference across the island. The phase affects the transition rate between different electron number parity states of the island, which can be observed in experiment by established means. The phase dependence also leads to what is known as the cos ϕ term in the tunneling characteristics of classical Josephson junctions. This effect has remained controversial for decades; the proposed scheme opens an independent way to probe it.

[4] *Hou C.Y., Hassler F., Akhmerov A.R., and Nilsson J.*
Probing majorana edge states with a flux qubit.
Phys. Rev. B **84**, 054538 (Aug 2011).
A pair of counterpropagating Majorana edge modes appears in chiral p-wave superconductors and in other superconducting systems belonging to the same universality class. These modes can be described by an Ising conformal field theory. We show how a superconducting flux qubit attached to such a system couples to the two chiral edge modes via the disorder field of the Ising model. Due to this coupling, measuring the backaction of the edge states on the qubit allows us to probe the properties of Majorana edge modes.

[5] *Taychatanapat T., Watanabe K., Taniguchi T., and Jarillo-Herrero P.*
Quantum hall effect and landau-level crossing of dirac fermions in trilayer graphene.
Nat Phys **7**, 621–625 (2011).
The physics of Dirac fermions in condensed-matter systems has received extraordinary attention following the discoveries of two new types of quantum Hall effect in single-layer and bilayer graphene.The electronic structure of trilayer graphene (TLG) has been predicted to consist of both massless single-layer-graphene-like and massive bilayer-graphene-like Dirac subbands, which should result in new types of mesoscopic and quantum Hall phenomena. However, the low mobility exhibited by TLG devices on conventional substrates has led to few experimental studies. Here we investigate electronic transport in high-mobility ($>$ 100000 $cm^2V^{-1}s^{-1}$) TLG devices on hexagonal boron nitride, which enables the observation of Shubnikov-de Haas oscillations and an unconventional quantum Hall effect. The massless and massive characters of the TLG subbands lead to a set of Landau-level crossings, whose magnetic-field and filling-factor coordinates enable the determination of the Slonczewski-Weiss-McClure (SWMcC) parameters used to describe the peculiar electronic structure of TLG. Moreover, at high magnetic fields, the degenerate crossing points split into manifolds, indicating the existence of broken-symmetry quantum Hall states.

[6] *Agarwal A., Polini M., Fazio R., and Vignale G.*
Persistent spin oscillations in a spin-orbit-coupled superconductor.
Phys. Rev. Lett. **107**, 077004 (Aug 2011).
Quasi-two-dimensional superconductors with tunable spin-orbit coupling are very interesting systems with properties

that are also potentially useful for applications. In this Letter we demonstrate that these systems exhibit undamped collective spin oscillations that can be excited by the application of a supercurrent. We propose to use these collective excitations to realize persistent spin oscillators operating in the frequency range of 10 GHz-1 THz.

[7] *Hofer S.G., Wieczorek W., Aspelmeyer M., and Hammerer K.*
Quantum entanglement and teleportation in pulsed cavity-optomechanics.
arXiv.org **quant-ph**, 1108.2586 (2011).
Entangling a mechanical oscillator with an optical mode is an enticing and yet a very challenging goal in cavity-optomechanics. Here we propose a pulsed scheme to create EPR-type entanglement between a travelling-wave light pulse and a mechanical oscillator. The entanglement can be verified unambiguously by a pump–probe sequence of pulses. In contrast to schemes that work in a steady-state regime under continuous wave drive our protocol is not subject to stability requirements, which normally limit the strength of achievable entanglement. The protocol can readily be extended to realize quantum state teleportation of states of light onto the mechanical oscillator. It is robust against mechanical decoherence and is shown to work in current state-of-the-art systems.

[8] *Siegel D.A., Hwang C., Fedorov A.V., and Lanzara A.*
Electron-phonon coupling in highly-screened graphene.
arXiv.org **cond-mat** (2011).
Photoemission studies of graphene have resulted in a long-standing controversy concerning the strength of the experimental electron-phonon interaction in comparison with theoretical calculations. Using high-resolution angle-resolved photoemission spectroscopy we study graphene grown on a copper substrate, where the metallic screening of the substrate substantially reduces the electron-electron interaction, simplifying the comparison of the electron-phonon interaction between theory and experiment. By taking the nonlinear bare bandstructure into account, we are able to show that the strength of the electron-phonon interaction does indeed agree with theoretical calculations. In addition, we observe a significant bandgap at the Dirac point of graphene.

[9] *Augusiak R., Stasińska J., Hadley C., Korbicz J.K., Lewenstein M., and Acín A.*
Bell inequalities with no quantum violation and unextendable product bases.
Phys. Rev. Lett. **107**, 070401 (Aug 2011).
The strength of classical correlations is subject to certain constraints, commonly known as Bell inequalities. Violation of these inequalities is the manifestation of nonlocality-displayed, in particular, by quantum mechanics, meaning that quantum mechanics can outperform classical physics at tasks associated with such Bell inequalities. Interestingly, however, there exist situations in which this is not the case. We associate an intriguing class of bound entangled states, constructed from unextendable product bases with a wide family of tasks, for which (i) quantum correlations do not outperform the classical ones but (ii) there exist supraquantum nonsignaling correlations that do provide an advantage.

[10] *Blatt S., Nicholson T.L., Bloom B.J., Williams J.R., Thomsen J.W., Julienne P.S., and Ye J.*
Measurement of optical feshbach resonances in an ideal gas.
Phys. Rev. Lett. **107**, 073202 (Aug 2011).
Using a narrow intercombination line in alkaline earth atoms to mitigate large inelastic losses, we explore the optical Feshbach resonance effect in an ultracold gas of bosonic 88Sr. A systematic measurement of three resonances allows precise determinations of the optical Feshbach resonance strength and scaling law, in agreement with coupled-channel theory. Resonant enhancement of the complex scattering length leads to thermalization mediated by elastic and inelastic collisions in an otherwise ideal gas. Optical Feshbach resonance could be used to control atomic interactions with high spatial and temporal resolution.

[11] *Mukherjee V., Dutta A., and Sen D.*
Quantum fidelity in tomonaga-luttinger liquid and kitaev model in the thermodynamic limit.
arXiv.org **cond-mat.stat-mech**, 1108.2597 (2011).
We study the scaling behavior of the fidelity (F) in the thermodynamic limit using the examples of a Tomonaga-Luttinger liquid in one dimension and the Kitaev model on a honeycomb lattice. We show that the thermodynamic fidelity inside the gapless as well as gapped phases follow power-law scalings, with the power given by some of the critical exponents of the system. The generic scaling forms of F for an anisotropic quantum critical point for both thermodynamic and non-thermodynamic limits have been derived and verified for the Kitaev model. The behavior of F inside the gapless phase of the Kitaev model is found to depend strongly on its distance from the anisotropic quantum critical point. Finally, we consider a rotation of each spin in the Kitaev model around the z axis and calculate F through the overlap between the ground states for angle of rotation η and $\eta + d\eta$, respectively. We thereby show that the associated geometric phase vanishes. We have supplemented our analytical calculations with numerical simulations wherever necessary.