TT 7: Matter at Low Temperature: Poster Session

Time: Monday 14:00–18:00 Location: Poster B

TT 7.1 Mon 14:00 Poster B

Combined experimental and computational study of structure and electronic properties of the chalcogenide-free phase-change material Ge_xSb_{100-x} — •Peter Zalden, Dominic Lencer, Michael Klein, Martin Salinga, and Matthias Wuttig — I. Physikalisches Institut (IA), RWTH Aachen, 52056 Aachen

Phase Change Random Access Memory (PCRAM) has turned out to be the most promising candidate for future non-volatile memory cells. A PCRAM cell features a reversibly switchable phase change material, whose electrical resistance differs significantly between the crystalline and a melt-quenched amorphous phase. Suitable materials need to be capable of ultrafast switching between the two phases. $Ge_{15}Sb_{85}$ has been reported to be such a material, that - unlike conventional phase change materials, like $Ge_2Sb_2Te_5$ - is free of chalcogenides.

In this study, structural modifications in sputtered thin films during the phase change from the as-deposited amorphous to the crystalline phase are analysed, employing a combination of Differential Scanning Calorimetry (DSC) and X-Ray Diffraction (XRD). This survey includes a determination of transition temperatures, an investigation of crystallization kinetics and structural properties of polycrystalline films. Complementary, the structure of crystalline compositions of Ge_xSb_{100-x} is object of an *ab initio* study. Density Functional Theory (DFT) is employed allowing to study the variation of structural and electronic properties upon the addition of germanium. A comparison to conventional tellurium based phase change materials is presented and in conclusion the suitability for PCRAMs is evaluated.

TT 7.2 Mon 14:00 Poster B

Measurements of amorphous and nanocrystalline ferromagnetic materials at low temperatures — •René Geithner, Alexander Steppke, Ralf Neubert, Wolfgang Vodel, and Paul Seidel — Institut für Festkörperphysik, Friedrich-Schiller-Universität Jena, Helmholtzweg 5, 07743 Jena, Deutschland

For high-precision measurements of voltages and currents at low temperatures low-temperature superconducting DC SQUID sensors are successfully used in a wide range of applications. For an efficient coupling between the transducer and the readout DC SQUID superconducting transformers can be used. The transformer core should have a high relative permeability, even at temperatures below 4.2 K, to miniaturise the sensor. Additionally transfomers can directly be used to pickup electromagnetic fields, where the sensitivity is directly coupled to the core material. As the permeability of standard iron powder cores decreases rapidly for temperatures below 50 K we are investigating amorphous and nanocrystalline materials. We show first results of the permeability of Vitrovac, Vitroperm (VAC Hanau) and Nanoperm (Magnetec GmbH) over a wide temperature range from 300 K to 2 K. Measurements on the magnetic losses and associated noise figures are presented in respect to the permeability.

TT 7.3 Mon 14:00 Poster B

High mechanical Q-factor measurements on silicon bulk material — •Christian Schwarz[1], Ronny Nawrodt[1], Daniel Heinert[1], Anja Schroeter[1], Ralf Neubert[1], Matthias Thürk[1], Wolfgang Vodel[1], Andreas Tünnermann[2], and Paul Seidel[1] — [1]Institut für Festkörperphysik, Helmholtzweg 5, D-07743 Jena, Germany — [2]Institut für Angewandte Physik, Albert-Einstein-Straße 15, D-07745 Jena, Germany

The direct observation of gravitational waves is one of the biggest challenges in science. Current detectors are limited by different kinds of noise. One of the fundamental noise sources is thermal noise arising from the optical components. One of the most promising attempts to reduce the thermal noise contribution in future detectors will be the use of high Q-factor materials at cryogenic temperatures. Silicon seems to be the most interesting material due to its excellent optical and thermal properties. We present high Q-factor measurements on bulk samples of high purity silicon in a temperature range from 5 to 300 K. The sample dimensions vary between ⌀76.2 mm × 12...75 mm. The Q-factor exceeds $4 \cdot 10^8$ at 6 K. The influence of the crystal orientation, doping and the sample preparation on the Q-factor is discussed.

This work is supported by the German science foundation under contract SFB Transregio 7.

TT 7.4 Mon 14:00 Poster B

Mechanical loss mechanisms in crystalline quartz — •Daniel Heinert[1], Anja Schroeter[1], Christian Schwarz[1], Ronny Nawrodt[1], Ralf Neubert[1], Matthias Thürk[1], Wolfgang Vodel[1], Andreas Tünnermann[2], and Paul Seidel[1] — [1]Institut für Festkörperphysik, Helmholtzweg 5, D-07743 Jena, Germany — [2]Institut für Angewandte Physik, Albert-Einstein-Straße 15, D-07745 Jena, Germany

Crystalline quartz is an excellent material to study internal dissipation mechanisms. Low loss materials are in great demand for future gravitational wave detectors reducing their thermal noise level within the detection band. Therefore, a deeper understanding of the loss mechanisms is necessary which depend on different parameters like the crystal orientation or the concentration of impurities. We present a detailed investigation of crystalline quartz samples (⌀45 mm × 50 mm) at temperatures between 5 and 300 K. Two different crystal orientations (x-cut and z-cut) are compared. The influence of the impurities on the mechanical losses is discussed.

This work is supported by the German science foundation under contract SFB Transregio 7.

TT 7.5 Mon 14:00 Poster B

Energy Fluctuations in Glasses at very low Temperatures — •Lena Maerten, Loredana Fleischmann, Andreas Fleischmann und Christian Enss — Kirchhoff-Institut für Physik Heidelberg

Coupling a system thermally to a heat reservoir, its energy content fluctuates according to statistical mechanics. In glasses these fluctuations are mainly caused by energy absorbing and releasing tunnelling systems. Measuring the energy content and investigating its variation should give information about relaxation times and whether or not the tunnelling processes are correlated. In our experiment we use a paramagnetic temperature sensor sputtered onto the quartz glass sample to be measured. The paramagnetic material changes its magnetization with temperature according to the Curie-Law. This change in magnetization is read out by a low noise double stage SQUID-magnetometer. In addition to the energy fluctuations described above, the time resolved heat release can be measured with this setup. Rapidly cooling the heat bath to a constant temperature, one can observe the energy dripping out of excited tunnelling systems while the sample gradually thermalizes. A detailed description of the experimental setup and first results will be presented.

TT 7.6 Mon 14:00 Poster B

New information on the microscopics of tunneling systems from mixtures of glycerol and deuterated glycerol. — •Celine Rüdiger, Masoomeh Bazrafshan, Gudrun Fickenscher, Andreas Fleischmann, and Christian Enss — Kirchhoff-Institut Für Physik,Universität Heidelberg

The properties of amorphous materials at temperatures below 1K are genrally described by localized groups of atoms or molecules, cooperatively moving between two configurations with comparable energy (Tunneling Systems).However, barely anything is known about the microscopic nature of these TS. Recently we have shown, that the microscopic nature of TS can be probed by the 2-pulse polarisation echo experiments, since the coupling of nuclear electric qudrupole moment to the tunneling motion leads to a quantum beating of the echo amplitude, as well as a dependence of the echo amplitude on magnetic field. Our investigations on partially deuterated amorphous glycerol revealed that the tunneling motion has a rotational component. The observed effects can e.g. be described by the rotation of one molecule by an average angle of 15°. However, also the assumption of a coherent tunneling of a large group of molecules by a fraction of this angle would explain the observed behavior. We started a series of measurements on mixtures of glycerol and partially deuterated glycerol in order to study the cooperative nature of TS and determine the average number of molecules that are involved in a TS as well as the typical angle by which they rotate. We show the first experimental results and discuss microscopic models that are able to describe the observed behavior.

TT 7.7 Mon 14:00 Poster B

Magnetic Field Dependence of Dielectric Polarization Echoes in — •Florian Klotz[1], Andreas Fleischmann[1], Manfred v.

Schickfus[1], Peter Nagel[2], and Christian Enss[1] — [1]University of Heidelberg, Kirchhoff- Institute für Physik, Im Neuenheimer Feld 227, 69210 Heidelberg; Germany — [2]IFP, Forschungszentrum Karlsruhe, PO Box 3640, 76021 Karlsruhe, Germany

Since long certain point defects in alkali halides crystals have been regarded as a model system for the tunnelling of atoms in solids. In recent measurements of the dielectric properties of non-magnetic structural glasses strong magnetic field effects have been observed. These effects are caused by atoms that are involved in tunnelling processes and carry a nuclear magnetic or quadrupolar moment. We have studied the phenomenon in dielectric two pulse polarization echo experiments on KCl crystals doped with Li. In this material the fine structure of the energy levels of the tunneling systems introduced by the nuclear moments leads to a quantum beating in echo decay measurements and to a non-monotonic dependence of the echo amplitude on magnetic fields. Since the microscopic nature of Li tunnelling centres in KCl is well known, this system can be used to compare experimental results with calculations based on a detailed microscopic model. We present the experimental data and discuss the role of nuclear magnetic moments of the KCl host material in the vicinity of tunnelling Li ions on the observed magnetic field effects.

TT 7.8 Mon 14:00 Poster B

High resolution X-ray diffraction and surface/interface scattering beamline NANO coming up in 2009 at ANKA — •Thorsten Schwarz[1], Sondes Bauer[1], and Tilo Baumbach[1,2] — [1]Institut für Synchrotronstrahlung / ANKA, Forschungszentrum Karlsruhe, 76021 Karlsruhe — [2]Laboratorium für Applikationen der Synchrotronstrahlung, Universität Karlsruhe, 76128 Karlsruhe

NANO at ANKA is a future synchrotron beamline on a superconducting undulator source, specialized on high-resolution x-ray diffraction, surface and interface X-ray scattering investigations. The beamline optic has been optimized to deliver a monochromatic and highly collimated beam with sufficient flux to investigate the structure changes and the strain evolution during the growth of epitaxial films and superlattices. In order to carry out real time measurements, different types of environmental chambers, e.g., for molecular beam epitaxy, will be mounted on a heavy duty diffractometer which could support up to 500 kg. It rotates the sample and the environmental parts in all directions in space. With two different detection systems on the diffractometer, it is possible to perform two measurements simultaneously: like Grazing Incidence Small Angle X-ray Scattering (GISAXS) to determine the shape, size, position and correlation in nanostructures and Grazing Incidence Diffraction (GID) to characterize the surface-patterned structure. One of the main issues of the beamline is to study the interface properties like roughness and correlation even for less scattered materials like organic semi-conductors. For that reason, it will be possible to use a multilayer monochromator to get two orders of magnitude more flux with an energy resolution of 1

TT 7.9 Mon 14:00 Poster B

Development of a very low temperature scanning tunneling microscope — •Michael Marz[1,2], Gernot Goll[1], and Hilbert v. Löhneysen[1,2,3] — [1]Physikalisches Institut Universität Karlsruhe (TH), 76128 Karlsruhe — [2]DFG-Centrum für Funktionelle Nanostrukturen der Universität Karlsruhe (TH), 76128 Karlsruhe — [3]Institut für Festkörperphysik Forschungszentrum Karlsruhe, 76021 Karlsruhe

Scanning tunneling microscopy (STM) and spectroscopy (STS) are well known techniques. STM allows to study topological surface properties of conductive materials. With STS one can measure the energy dependence of the local density of states (LDOS), as the tunneling current is a function of the LDOS and energy. In order to use the technique at very low temperatures and high magnetic fields, we installed a home-built scanning tunneling microscope into a dilution refrigerator, where we can reach temperatures down to 30 mK and apply magnetic fields up to 13 T. In order to improve both spatial and energy resolution, considerable efforts were taken to electrical filtering and mechanical damping of our system. First test measurements were done with a commercially available AuPd grid with a lattice constant of 160 nm. We also achieved atomic resolution on HOPG and $NbSe_2$ at room temperature and on $NbSe_2$ at 50 mK.

TT 7.10 Mon 14:00 Poster B

Design of a 300 mK UHV 9 T scanning tunnelling microscope — •Danny Baumann[1], Paul Sass[1], Torben Hänke[1], Grzegorz Urbanik[1], Christian Hess[1], Marko Kaiser[2], Ralf Voigtländer[2], Dirk Lindackers[2], and Bernd Büchner[1] — [1]Institut für Festkörperforschung, IFW Dresden — [2]Bereich Forschungstechnik, IFW Dresden

We present our progress in assembling an ultra high vacuum (UHV) Scanning Tunneling Microscope (STM) for operating temperatures down to 300 mK and magnetic fields up to 9 T. The microscope will be mounted in a UHV ^{3}He cryostate which is connected with a three-chamber UHV system. The system will comprise in-situ tip exchange, a coarse xy-sample positioning system and five electrical leads on the sample holder for combining STM with transport measurements. In this work we will present the characterization of the actual STM unit.

TT 7.11 Mon 14:00 Poster B

Dynamics of liquid ^{3}He-^{4}He-mixtures studied with Neutron Radiography — •Mark Faist[1], Hartmut Abele[2], Roland Gähler[3], and Andreas Van Overberghe[3] — [1]Physikalisches Institut, Universität Heidelberg — [2]E18, Technische Universität München — [3]Institut Laue-Langevin, Grenoble

Using a Neutron Radiography setup, we visualize the dynamics in superfluid ^{3}He-^{4}He-mixtures and the process of phase separation. These measurements give a deeper insight into critical phenomena and universal scaling laws and with our method we have also direct access to transport processes in He-II driven by temperature gradients.

We perform a measurement of the mass diffusion coefficient of ^{3}He in superfluid ^{4}He for a wide temperature range of 0.5-1.3K, where only poor data exists. Using a scintillator and CCD-Camera as detector, we map the ^{3}He concentration with a spatial resolution of 0.5 mm by measuring the neutron absorption. The concentration distribution varies as a function of applied heating power and distance from the heater, so the mass diffusion coefficient can be determined directly. There is also some need for understanding these processes in a search for a permanent electric dipole moment of the neutron.

Even time-resolved measurements up to 20 fps are possible and has been be used for the observation of phase separation in ^{3}He-^{4}He mixtures with higher ^{3}He concentration. The transitions from the superfluid and the normalfluid mixtures into the phase separation zone could be observed, where inconsistent experiments and theories exist.

This work was funded by the German Federal Ministry for Research and Education under Contract No. 06HD187.

TT 7.12 Mon 14:00 Poster B

The Bose-Hubbard Model with Polaritons — •Michael Hartmann[1,2], Fernando Brandao[1,2], and Martin Plenio[1,2] — [1]Institute for Mathematical Sciences, Imperial College London, 53 Exhibition Road, London, SW7 2PG, United Kingdom — [2]QOLS, The Blackett Laboratory, Imperial College London, Prince Consort Road, London, SW7 2BW, United Kingdom

Artificial structures that can be well controlled and manipulated in the laboratory have become an important tool for the study of quantum many-particle systems.

Here we show that the Bose-Hubbard model can be generated with polaritons in arrays of coupled cavities. In particular, the scheme allows to generate a two component model in a parameter range which is not accessible with alternative approaches.

Most importantly, our scheme allows for single-site addressing.

TT 7.13 Mon 14:00 Poster B

Phase diagram for interacting Bose gases — •Michael Männel[1], Klaus Morawetz[1,2], and Michael Schreiber[1] — [1]Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany — [2]Max Planck Institute for the Physics of Complex Systems, Nöthnitzer Str. 38, 01187 Dresden, Germany

From the many-body T-matrix we obtain the condition for a medium-dependent bound state in a Bose gas with contact interaction. This condition, i.e. the phase diagram, is derived from the medium-dependent scattering length and scattering phase as well as from the pole of the T-matrix. Also the binding energy is calculated. By separating the Bose pole from the distribution function the influence of a Bose condensate is measured too.

TT 7.14 Mon 14:00 Poster B

Hardcore Bosons on a Square Lattice with Nearest- and Next Nearest Neighbour Interactions — •Ansgar Kalz, Andreas Honecker, Sebastian Fuchs, and Thomas Pruschke — Institut für Theoretische Physik, Georg-August-Universität Göttingen

The behaviour of hardcore bosons on a square lattice with competing nearest- and next nearest neighbour interactions is an interesting subject because of the application of the model to cold atoms on an optical lattice.

In the static limit the model maps onto a classical Ising system, which has Néel- and collinear ordered phases, separated by a critical point where the competing interactions yield a degeneracy of the groundstate. We calculate structure factors, specific heat and other quantities. We use Monte-Carlo simulations with parallel tempering and line flip algorithms to avoid freezing problems near the critical point.

We present the resulting phase diagram for the classical model and give an outlook for the case with quantum mechanical hopping terms.

TT 7.15 Mon 14:00 Poster B

Bosonic Dynamical Mean-Field Theory — •Krzysztof Byczuk and Dieter Vollhardt — Theoretical Physics III, Center for Electronic Correlations and Magnetism, Institute for Physics, University of Augsburg, D-86135 Augsburg, Germany

We present the first comprehensive, thermodynamically consistent theory of correlated lattice boson systems, namely a bosonic dynamical mean-field theory (B-DMFT), which is applicable for arbitrary values of the coupling parameters and temperatures [1]. B-DMFT includes all local, dynamical correlations of the many-boson system and becomes exact in the limit of infinite space dimensions in analogy with its successful fermionic counterpart. In contrast to previously formulated mean-field theories for bosons it treats normal and condensed bosons on equal footing and is thus able to describe their dynamical coupling. We discuss in detail various limits of B-DMFT where exact and well-known approximate results are recovered. In particular we elucidate the relation between B-DMFT and the static mean-field theories of Bogoliubov and that of Fisher et al. [2]. A lattice model of itinerant and localized, interacting bosons ("Bosonic Falicov-Kimball model") is solved explicitly within B-DMFT. The local correlations are found to enhance both the BEC transition temperature and the condensate fraction relative to the non-interacting system.

[1] K. Byczuk and D. Vollhardt, arXiv:0706.0839

[2] M.P. Fisher, P.B. Weichman, G.Grinstein, and D.S. Fisher, Phys. Rev. B 40, 546 (1989).

TT 7.16 Mon 14:00 Poster B

Mott transition of fermionic atoms in a three-dimensional optical trap — •Rolf Helmes[1], Theo Costi[2], and Achim Rosch[1] — [1]Institute of Theoretical Physics, University of Cologne, 50937 Cologne — [2]Institute of Solid State Research, Research Center Jülich, Germany

We study theoretically the Mott metal-insulator transition for a system of fermionic atoms confined in a three-dimensional optical lattice and a harmonic trap. We describe an inhomogeneous system of several thousand sites using an adaptation of dynamical mean field theory solved efficiently with the numerical renormalization group method. Above a critical value of the on-site interaction, a Mott-insulating phase appears in the system. We investigate signatures of the Mott phase in the density profile and in time-of-flight experiments. Moreover, the incompressible Mott phase can be detected by squeezing the trap, where we keep track of the thermodynamic quantities during this adiabatic process.

TT 7.17 Mon 14:00 Poster B

Competition between Interaction and Binary Disorder in Ultracold Fermions — •Denis Semmler[1], Krzysztof Byczuk[2], and Walter Hofstetter[1] — [1]Institut für Theoretische Physik, J. W. Goethe-Universität, D-60438 Frankfurt, Germany — [2]Institute of Theoretical Physics, Warsaw University, ulica Hoża 69, PL-00-681, Poland

The interplay of interaction and disorder is of key importance for the electronic properties of realistic materials. Both effects can induce metal-insulator transitions [1]. More recently, optical lattices have given access to disordered fermionic quantum systems with a high degree of control. As interaction and disorder compete in a subtle way, obtaining new insight into this interplay is of large current interest.

We investigate a single band Anderson-Hubbard model by means of dynamical mean-field theory (DMFT), extended to include localization phenomena [2]. We consider binary disorder in the onsite energies, relevant e.g. for 2-species mixtures of cold gases. As the arithmetic averaged local density of states is not critical at the Anderson localization we calculate the geometric mean [2]. Our resulting phase diagram includes a disordered Fermi liquid, a Mott insulator at general filling, and an Anderson-localized phase.

[1] K. Byczuk, W. Hofstetter, D. Vollhardt, Phys. Rev. Lett. 94, 056404 (2005)

[2] V. Dobrosavljević, A. A. Pastor, B. K. Nikolić, Europhys. Lett. 62, 76 (2003)

TT 7.18 Mon 14:00 Poster B

Collective dynamics of ultracold atoms in optical lattices — •Michiel Snoek and Walter Hofstetter — J. W. Goethe-Universität, Frankfurt am Main, Deutschland

We analyze the collective dynamics of ultracold atoms in optical lattices induced by a sudden change of the underlying harmonic trapping potential. In order to study the effect of strong interactions, dimensionality and lattice topology on dynamical properties, we consider bosonic atoms with arbitrarily strong repulsive interactions, on a two-dimensional square lattice and a hexagonal lattice. We apply dynamical Gutzwiller mean-field theory.

A shift in the center of the potential invokes dipole oscillations for small amplitudes of the shift. Changing the strenght of the harmonic confinement invokes monopole and quadrupole oscillations. We investigate the frequency of the collective modes as a function of interaction strength and study the coupling and damping of those modes.

Applying a large shift in the center of the potential brings the system far out of equilibrium. We then find insulating behavior for weakly interacting atoms on the square lattice. For strong interactions the center of mass slowly relaxes, even when a Mott plateau is present, which in one dimension blocks the dynamics. On the hexagonal lattice the center of mass relaxes to the new equilibrium position for any interaction strength.

TT 7.19 Mon 14:00 Poster B

Charge-density-waves of trions in an optical lattice — •Csaba Toke[1], Akos Rapp[2], Walter Hofstetter[1], and Gergely Zarand[2] — [1]J. W. Goethe-Universit\"at, Frankfurt am Main, Deutschland — [2]Technologische Universit\"at, Budapest, Ungarn

When fermions of three hyperfine state are loaded into an optical lattice, they provide an almost perfect implementation of the SU(3) Hubbard model. For the case of attractive interactions it was shown in previous work [Rapp et al., PRL 98, 160405 and arXiv:0707.2378] that with increasing interaction strength the color superfluid state goes over to a trionic phase in infinite dimensions. We extend this study to experimentally relevant finite dimensions, and analyze the additional structure that emerges due to the inter-trionic repulsion, which is due to suppression of quantum fluctuations for nearby trions. This interaction is derived, and the resulting density ordering instability is studied on the RPA level.

TT 7.20 Mon 14:00 Poster B

Hubbard Model for Imbalanced Fermi-Mixtures on Optical Lattices — •Tobias Gottwald and Peter G. J. van Dongen — KOMET 337, Institut für Physik, Johannes Gutenberg-Universität, Staudingerweg 7, 55099 Mainz, Germany

In order to understand the properties of imbalanced ultracold fermionic quantum gases on optical lattices, we analyze a Hubbard model with attractive interaction strength, spin-dependent hopping amplitudes and/or a Zeeman-term at low temperatures in the weak-coupling (mean-field) approximation. In experiment, interactions can be tuned via Feshbach resonances, different hopping amplitudes arise from different atomic masses or different hyperfine states, and the Zeeman-term is used to control the population imbalance. We investigate this generalized Hubbard model between two extremes, on the one hand the Falicov-Kimball model, where charge density wave phases are dominating, and on the other the standard Hubbard model with equal hopping amplitudes for each pseudo-spin species, where superfluid phases occur.

TT 7.21 Mon 14:00 Poster B

Macroscopic self-trapping regimes in Bose-Fermi mixtures with double well confinement — •Santiago Francisco Caballero Benitez[1], Miklos Gulacsi[1], Yuri S. Kivshar[2], and Elena A. Ostrovskaya[2] — [1]MPIPKS, Dresden, Germany — [2]NPC RSPhysSE ANU, Canberra, Australia

Effects of fermions in quasi one dimensional mixtures of bosons and fermions with double well confinement are discussed. It is argued that the dynamical regime where macroscopic self trapping occurs in a pure bosonic system is modified by the inclusion of fermions, leading to a change of symmetry of the wave function that evolves nonmonotonically as the separation of the wells is increased. We relate our work with current experiments on ^{40}K and ^{87}Rb.

TT 7.22 Mon 14:00 Poster B

Collective quantum modes of parabolically confined mesoscopic Fermi systems — •Karsten Balzer, Christian Henning, and Michael Bonitz — Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universität Kiel, Leibnizstrasse 15, 24098 Kiel, Germany

For interacting few particle systems, the internal dynamics in terms of normal modes is of broad interest in many fields of research—e.g. in complex plasmas, (dilute) quantum Fermi gases/liquids or BEC-BCS systems, the normal mode spectrum is directly linked to interesting system properties and to the response to external electromagnetic fields.

Here, we go beyond linear response theory and study collective modes in the quantum regime by applying Nonequilibrium Green's function (NEGF) techniques at zero and finite temperatures [1,2]. In particular, we investigate the quantum breathing mode for fermionic 1D and 2D systems (being confined in harmonic traps) interacting via a $1/r^{\alpha}$ pair-potential [3]. The dependence of the breathing frequency and the time-dependent density on the relative interaction strength is discussed for a wide range of parameters including nonlinear effects [4].

[1] M. Bonitz, K. Balzer, and R. van Leeuwen, Phys. Rev. B **76**, 045341 (2007).

[2] "Nonequilibrium Green's function approach to artificial atoms", K. Balzer, Diploma thesis, Kiel University (2007).

[3] see poster "NEGF approach to correlated trapped fermions", K. Balzer, M. Bonitz, N.E. Dahlen, and R. van Leeuwen.

[4] B. Partoens, F.M. Peeters, J. Phys.: Cond. Mat. **9**, No. 25 (1997).

TT 7.23 Mon 14:00 Poster B

Nonequilibrium Green's function approach to correlated trapped fermions: Equilibrium properties and nonequilibrium behavior — •Karsten Balzer[1], Michael Bonitz[1], and Robert van Leeuwen[2] — [1]Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universität Kiel, Leibnizstrasse 15, 24098 Kiel, Germany — [2]Department of Physics, University of Jyväskylä, 40014 Survontie 9, Jyväskylä, Finland

Using a Nonequilibrium Green's function approach, we investigate small arrangements of parabolically confined fermions interacting via a repulsive $1/r^{\alpha}$ pair-potential in 1D and 2D. Such reduced systems are of relevance for quantum dots and wells, metal clusters or ions in traps.

The equilibrium [1] and dynamical properties [1,2] are obtained by numerically solving the Keldysh/Kadanoff-Baym equations for the two-time Green's functions [3], where initial correlations at finite temperatures are included self-consistently starting from a correlated equilibrium Green's function. The consideration of a wide range of relative interaction strengths allows us, in particular, to observe the transition from almost ideal Fermi liquid states to Wigner crystal behavior.

[1] "Nonequilibrium Green's function approach to artificial atoms", K. Balzer, Diploma thesis, Kiel University (2007).

[2] see also poster "Collective modes of parabolically confined mesoscopic Fermi systems", K. Balzer, C. Henning, and M. Bonitz.

[3] "Introduction to Computational Methods in Many Body Physics", M. Bonitz, D. Semkat (Eds.), Rinton Press (2006).