MA 8: SKM Dissertation-Prize 2017

Time: Monday 10:30–12:10 Location: HSZ 04

Invited Talk MA 8.1 Mon 10:30 HSZ 04
Coherent Backscattering and Many-Body Spin Echo in Fock Space: Genuine Many-Body Interference vs. Equilibration — •Thomas Engl — Massey University, Auckland, New Zealand

Universal interference effects like coherent backscattering, which manifests itself as an enhancement of the return probability over its classical value in disordered media, play an important role in many different quantum systems. Those effects are accurately described by semiclassical methods in the spirit of Gutzwiller, where quantum coherent effects are characterized by interference between classical paths. In mesoscopic systems semiclassics has proofed to be a very powerful tool to explain and predict such universal interference effects.

We have transferred these methods into the realm of interacting many-body systems enabling us to predict genuine many-body interference effects that lie beyond mean field theories. One is the analog of coherent backscattering in Fock space which is a coherent enhancement of the return probability for many-body states. It implies that quantum interference gives rise to a systematic deviation from full thermalization that is generally assumed to take in for mesoscopic interacting many-body systems. Another example will is many-body spin echo characterized by an increase of the return probability echoing an intermediate sudden spin-flip. It is independent of the interaction strength within a large regime of parameters showing that the well known Hahn (spin) echo cannot be fully destroyed by interactions.

Invited Talk MA 8.2 Mon 10:55 HSZ 04
Magnetization Dynamics of Itinerant and Localized Electrons in Lanthanide Metals — •Björn Frietsch[1,2], Robert Carley[1,2], Martin Teichmann[1,2], Kristian Döbrich[2], John Bowlan[2], and Martin Weinelt[1,2] — [1]Freie Universität Berlin, Berlin, Germany — [2]Max-Born-Institut, Berlin, Germany

Laser induced magnetization dynamics is a very active field of research, not only because of its technological importance but also based on the insights it offers into the fundamental processes that contribute to the transfer of angular momentum from and to the spin system.

To investigate these processes during laser-driven demagnetization we chose the lanthanide metal gadolinium. Using time- and angle-resolved photoelectron spectroscopy we are able to follow the evolution of the exchange-split split valence band-structure which is a measure of the short-range magnetic order of the itinerant 5d6s electrons as well as the magnetization of the localized 4f core level via magnetic linear dichroism. This way we found strikingly different demagnetization time constants of 0.8 ps and 14 ps for the 5d6s and the 4f electrons, respectively. This remarkable difference demonstrates a perturbation even beyond the strong intra-atomic exchange interaction which - thus far - was believed to act on a timescale of a few femtoseconds.

Spin dynamics simulations based on an orbital-resolved Heisenberg Hamiltonian combined with first-principles calculations explain the particular dynamics of 5d6s and 4f spin moments well and suggest that the slow demagnetization of the 4f spin system is almost exclusively driven by phonon-magnon scattering.

Invited Talk MA 8.3 Mon 11:20 HSZ 04
Dynamics of Thin Smectic Films: From Viscous Fluid to Quasi Elastic Behaviour — •Kirsten Harth — Otto von Guericke Universtät Magdeburg

Thin films and their dynamics are involved in numerous physical processes reaching from protein motion in cell membranes to surface coating with thin fluid layers. Smectic liquid crystals are partially ordered fluids, possessing a layered structure, in our case paired with in-plane viscous fluid properties. Free-standing smectic films are stable, they can span areas of several square centimetres at few nanometres thickness. We investigate the relaxation and rupture dynamics of submillimetre to centimetre sized free-floating and sessile smectic bubbles experimentally. An unpreceded crossover from surface tension driven, low-viscosity fluid type relaxation to behaviour reminiscent of vesicles and elastic membranes is observed. A novel model involving multi-fluid flow, and the in-plane and out-of-plane properties of the smectic film is developed to explain the experimental findings.

Invited Talk MA 8.4 Mon 11:45 HSZ 04
Group IV Epitaxy for Advanced Nano- and Optoelectronic Applications — •Stephan Wirths — Peter Grünberg Institut (PGI 9), Forschungszentrum Jülich, 52425 Jülich, Germany — IBM Research - Zurich, 8803 Rüschlikon, Switzerland

The monolithic, large-scale integration of photonics on Si is limited by the inability of Si to emit light efficiently. In this context, Sn-based group IV semiconductors attracted increasing scientific interest during the last decades due to the possibility to pass the indirect-to-direct bandgap transition by alloying Ge with Sn. However, the quality of epitaxially grown GeSn and SiGeSn layers on Si substrates is limited by the low solid solubility of Sn in (Si)Ge ($<$ 1 at.%) and the large lattice mismatch ($>$ 15 %). Here, a low-temperature reduced pressure chemical vapor deposition process was developed for the growth of (Si)GeSn epilayers directly on Si(001) and on Ge-buffered Si(001). High growth rates ($>$ 50 nm/min) at low growth temperatures $< 400°$C are key for Si-Ge-Sn alloys with exceptionally high monocrystalline quality and Sn concentrations far beyond the solid solubility of Sn in (Si)Ge. It was shown that the plastic strain relaxation of these (Si)GeSn epilayers on Ge/Si(001) takes place mostly via edge dislocations rather than via threading dislocations. Furthermore, the indirect-to-direct bandgap transition was presented by means of temperature-dependent photoluminescence measurements. Strain relaxed, direct-gap $Ge_{0.875}Sn_{0.125}$ alloys grown on Si(001) substrates exhibited high modal gain values up to 110 cm^{-1} enabling the first demonstration of lasing action in direct bandgap group IV Fabry-Perot cavities.