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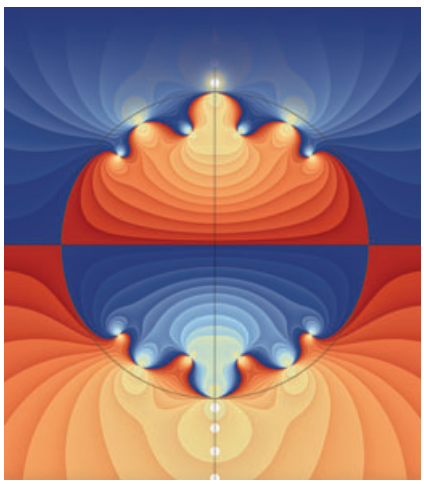
COVER PICTURE

Volume **524** | **2012** | **No. 3–4**

SPECIAL ISSUE

Quantum Dynamics of Nano-Structured Systems

edited by Gerd Schön, Cosima Schuster, and Peter Schwab



A spectral weight conserving formalism for Fermionic thermal Green's functions is presented. The formalism requires a generalization of the Dyson equation and the Baym-Kadanoff-Luttinger-Ward functional for the free energy. The figure shows the spectral function A (details are given in the article, see Fig. 2).
Picture: M. Granath et al., pp. 147–152 in this issue.

PHYSICS FORUM

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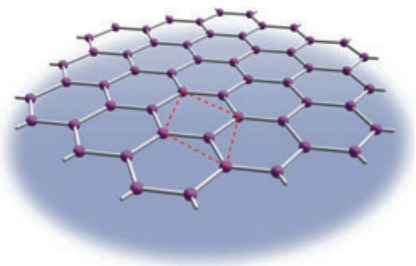
REVIEW ARTICLES

$$\phi_i = \arctan\left(\frac{y_i - y}{x_i - x}\right)$$

In Josephson junction arrays, vortices form stable topological excitations. A key step towards the understanding of their properties was the observation made by Eckern and Schmid that in low-capacitance junction arrays a vortex behaves as a massive particle moving in a periodic potential and is subject to dissipation. The present contribution provides a review of these properties.



In recent years, an increasing number of systems displaying exotic quantum states like unconventional superconductivity, quantum spin-liquids, or topological states were experimentally found. This work summarizes findings in quantum Monte Carlo simulations of correlated electrons on a honeycomb lattice, the structure of graphene, that revealed an unexpected spin-liquid emerging between a state described by massless Dirac fermions and an antiferromagnetically ordered Mott insulator.

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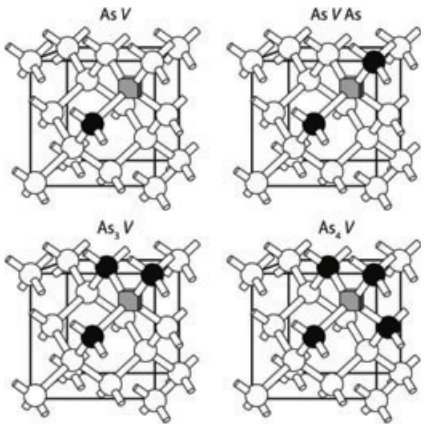
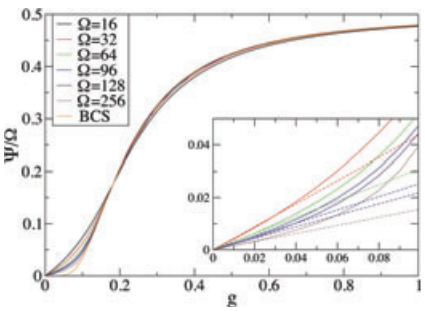
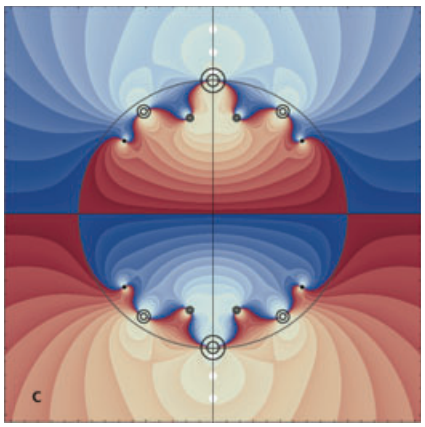


Germanium is emerging as a mainstream material that could have important applications in the microelectronics industry. The principle aim of this study is to review investigations of the diffusion of technologically important p- and n-type dopants as well as surface and interface passivation issues in germanium.



The exact treatment of the pairing correlation functions in the canonical ensemble is reviewed. The key for the calculations has been provided by relating the discrete BCS model to known integrable theories corresponding to the so called Gaudin magnets with suitable boundary terms.

ORIGINAL PAPERS



A spectral weight conserving formalism is presented for Fermionic thermal Green's functions that are discretized in imaginary time τ and thus periodic in imaginary ("Matsubara") frequency $i\omega_n$. The formalism requires a generalization of the Dyson equation and the Baym-Kadanoff-Luttinger-Ward functional for the free energy. A conformal transformation is used to analytically continue the periodized Matsubara Green's function to real frequencies. This allows numerical Green's function calculations of high precision.

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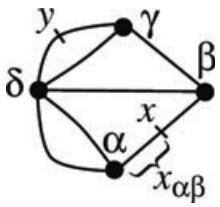
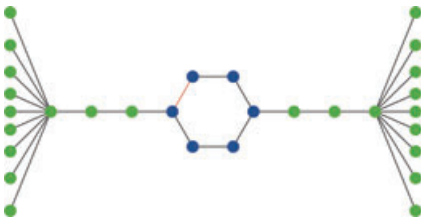
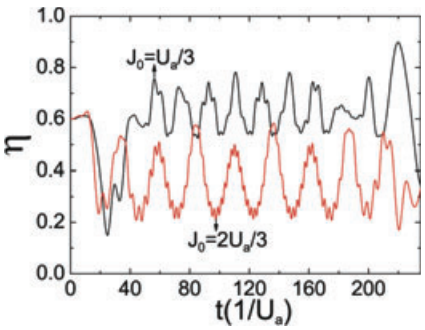


Using the theory of diffusion in graphs, a model is proposed to study mesoscopic transport through a diffusive quantum dot. The graph consists of three quasi-1D regions: a central region describing the dot, and two identical left and right- wires connected to leads, which mimic contacts of a real system. The authors find the exact solution of the diffusion equation for this graph and evaluate the conductance including quantum corrections.



A the study is presented of the linear conductance vs. applied gate voltage for an interacting six site ring structure, which is threaded by a flux of π and coupled to a left and a right lead. This ring structure is designed to have a vanishing conductance for all gate voltages and temperatures provided interactions are ignored. Therefore this system is an ideal testbed to study the interplay of interaction and interference.



Some dynamical features of partially coherent Bose-Einstein condensate systems confined in double-well potentials are investigated in the mean field approximation. For a one-component system, the phenomenon of self-trapping is studied and it is shown that the partially coherent system, like completely coherent one, can also exhibit self-trapping phenomena. For a two-component system, the time evolution of the degree of coherence for a time-dependent tunneling strength is investigated.

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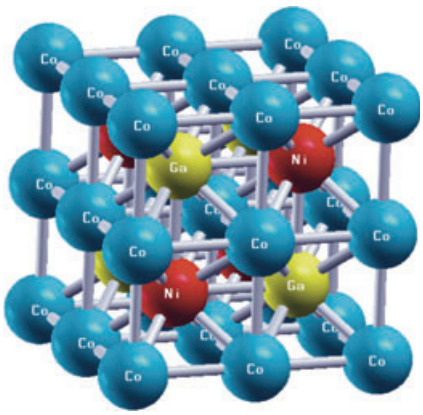
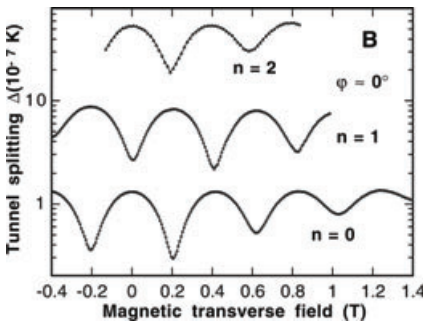
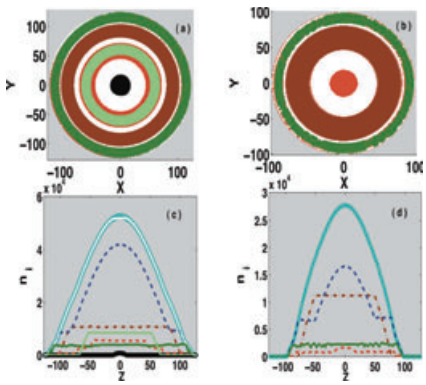


The Heisenberg exchange parameters for the Heusler compound Co_2NiGa with $L2_1$ structure were calculated using the Korringa-Kohn-Rostoker method and by employing the magnetic-force theorem to obtain the total energy changes associated with the local rotation of magnetization direction. The crystal structure was subjected to pressure and the corresponding dependence of the magnetic exchange couplings were determined.



A new mechanism is proposed for the magnetization reversal of molecular nanomagnets such as Fe_8. In this process the spin tunnels from the lowest state near one easy direction to the first excited state near the opposite easy direction, and subsequently decays to the second easy direction with the emission of a phonon, or it first emits a phonon and then tunnels to the final state.



An inhomogeneous mean-field theory is developed for the extended Bose-Hubbard model with a quadratic, confining potential. In the absence of this potential, the mean-field theory yields the phase diagram of the homogeneous extended Bose-Hubbard model. This phase diagram shows a superfluid phase and lobes of Mott-insulator, density-wave, and supersolid phases in the plane of the chemical potential μ and on-site repulsion U.

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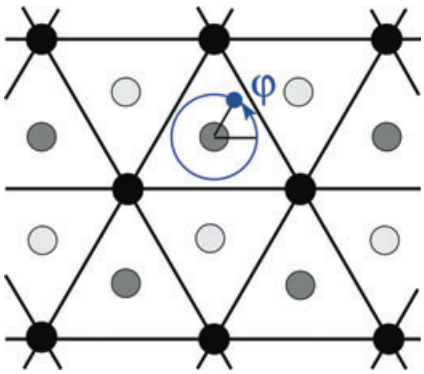
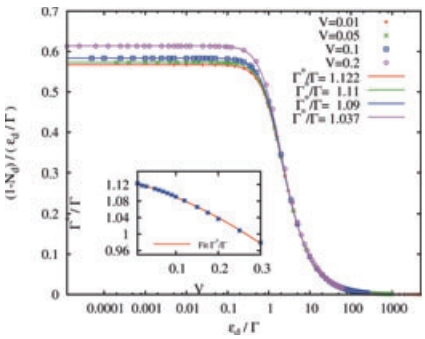


A three-level system with partially broken SU(3) symmetry immersed in a metal, comprised of a unique noninteracting ground state and two-fold degenerate excited states, exhibits a stable two-channel Kondo (2CK) fixed point within a wide range of parameters. The robustness of the 2CK fixed point is analyzed with respect to a level splitting of the excited states.

RAPID RESEARCH LETTER



In this brief communication, the charge susceptibility, $\chi_{c,imp}$, is calculated for the single impurity Anderson model in the Kondo regime with the density matrix renormalization group theory. The work is of methodological relevance, e. g., for studies of the Kondo-effect in molecular systems, in the sense that it prepares treatments of (spinful) few-orbital models in the Kondo regime.

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RETROSPECT – Highlights from recent Annalen der Physik issues

EINSTEIN LECTURE

Volume 524 | Issue 1 | Pages 1–19 (2012)

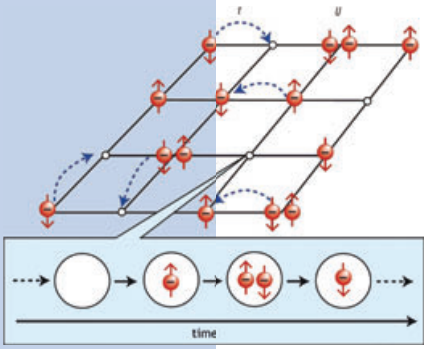
Dynamical mean-field theory for correlated electrons

(Open access article)

Dieter Vollhardt

DOI: 10.1002/andp.201100250

In this paper basic terms of the physics of correlated electrons are explained. In particular, some of the steps that led to the formulation of a comprehensive non-perturbative many-body approach to correlated quantum many-body systems – the dynamical mean-field theory (DMFT) – are described.



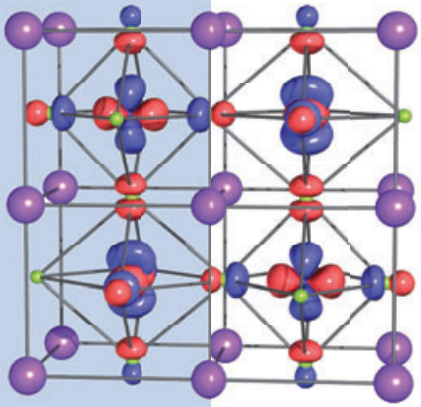
Volume 523 | Issue 8–9 | Pages 583–758 (2011)

Topical Issue: Electronic Correlations in Models and Materials

Eds.: Peter van Dongen, Marcus Kollar, Thomas Pruschke

http://onlinelibrary.wiley.com/doi/10.1002/andp.v523.8/9/issuetoc

Anderson's model for moment formation in impurities in metals and Hubbard's model for magnetism in solids, proposed in 1963, are the basis of a paradigm which today is known as electronic correlation in condensed matter physics. These correlation effects are at the heart of many interesting physical phenomena like magnetism or superconductivity, and also strongly influence technologically relevant properties such as electronic transport.



Volume 523 | Issue 1–2 | Pages 1–190 (2011)

Topical Issue: Optical and Vibrational Spectroscopy

Eds.: Aldo H. Romero and Jorge Serrano

http://onlinelibrary.wiley.com/doi/10.1002/andp.v523.1/2/issuetoc

Relevant review papers are reported here on the areas of superconductivity in iron pnictides, optical properties of nanostructures, electron holography in nitrides, and the quantum Boltzmann equation. The special issue has been prepared on the occasion of the seventy fifth birthday of Manuel Cardona.