Session 23EP

Thermoacoustic effect in a Gifford-McMahon refrifgerator **23EP1**

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The heat exchange process between the working heilum gas and the regenerator materials in a Gifford-McMahon refrigerator is examined from the viewpoint of thermoacoustic phenomena, by measuring the cooling power as a function of the phase angle between pressure and displacement oscillations of the gas. When the operating temperature is above 20K, the optimum phase angle maximizing the cooling power is close to 90 degree, corresponding to that for the maximum expansion work done by the oscillating piston. However, the optimum phase angle increases to about 140 degree with decreasing temperature. This behavior can be attributed to the irreversible heat exchange process due to the reduction in the thermal diffusivity of the helium gas.

Non-contact Current Measurement System Using SQUID **23EP2**

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We have developed a current measurement system using DC-SQUID for inspection of solar cell, semiconductor device and etc. The system converts magnetic flux distribution into current distribution. The flowing current can be quantitatively obtained by the system. The DC-SQUID is composed of $\mathrm{Nb/AlO_x/Nb}$ junctions with high thermal reliability, and the pickup coil with 200 $\mu\mathrm{m}$ diameter. The spatial resolution is higher than 500 $\mu\mathrm{m}$, and the current resolution is 6.8 $\mathrm{nA/Hz^{0.5}}$. We applied the system to a solar cell, in order to examine the possibility of the inspection.

23EP3 Miniature Single-cycle Helium-4 Evaporation Cooler

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The cooler is fabricated from ¡100¿ single crystal silicon that has been etched in a potassium hydroxide solution, KOH. A layer of borosilicate glass is anodically bonded to an overlying silicon nitride layer. The resulting enclosed cavity, 4He pot, is connected to a pumping line by use of a 0.67 mm diameter, O.D., glass capillary which also serves to thermally isolate the pot from the pumping connections. The planar pot has dimensions of 10 mm x 10 mm x 1.2 mm and the capillary has a length 30 mm. The single-cycle cooler has a calculated cooling power of 0.8 mW at 4.2 K and the lowest reachable temperature is calculated to be 1.8 K. The cooling cycle duration is estimated to be about 45 s. Experiments are currently in progress in order to measure the cooling power and minimum temperature obtainable.

23EP4 Magnetic Entropy Change of a Rare Earth Garnet $(Dy_{0.5}Gd_{0.5})_3(Ga_{0.875}Fe_{0.125})_5O_{12}$

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Rare earth garnet is frequently used as magnetic refrigerant in the temperature range from 2 K to 15 K. However, several Tesla magnetic field cannot give large Zeeman energy enough to obtain full reduction of entropy above 10 K. Gadolinium iron garnet has large magnetic entropy change in the high temperature region, because Fe ions enhance the internal field to rare earth ions. In order to increase the entorpy change with small magnetic field, substitution of Dy for Gd is expected to be useful because of larger g-facter of Dy than Gd. The magnetization of Dy-Gd iron garnet was measured and the entorpy change was calculated.

23EP5 LT Peltier Cooler with Electric Field Effect Induced p- and n-arms

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In a recent paper [1] we presented the theory of an Electric-Field-Effect (EFE)induced increase of the thermoelectric figure of merit M of a thin film (thickness less than the screening length) thermoelectric TE plate in a capacitive structure. This can be applied to the case of a LT Peltier cooler where the p- and n-arms are EFE induced. We analyze a construct of the form: thin film TE (e.g. $PbTe_3$)$-$buffer layer (e.g.BaF_2)$-$dielectric layer (e.g. $SrTiO_3$)$-$buffer layer$-$thin film TE. Under EFE, the positively charged TE plate becomes $p-$type while the negatively charged TE plate becomes $n-$type semiconductor. We present estimates of the cooling power at different temperatures for optimally chosen buffer and dielectric.
[1] V. Sandomirsky, A. V. Butenko, R. Levin and Y. Schlesinger, J. of Appl. Phys. 90, (2001) 2370-2379

Cluster Orbital for Granular Superconductivity of Underdoped Bi2212 **23EP6**

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Davis et al. [1] found a granular superconductivity (SC) in underdoped Bi2212. We have carried out a quantum chemical calculation with model clusters of infinite layer crystals [2] in which the dopants (vacant sites) are placed on particuar sites in the two regions, heavily and lightly doped. The highest occupied molecular orbital (HOMO) of the heavily doped cluster is responsible for appearance of SC. A characteristic of HOMO is discussed and the coupling of O 2pπ orbital with Cu 3d$_{x^2-y^2}$ orbital is shown to be most important.
[1] K.M Lang et al., Nature 415, 412 (2002).
[2] M. Takano et al., Physica C 176, 441 (1991).

Local density of states for normal-superconducting proximity contact systems with arbitrary concentration of impurities **23EP7**

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The superconducting order in the normal layer induced by the proximity effect has considerable influence on the local density of states of the normal layer. It has been found that, if the normal metal forms a thin layer, a mini-gap in the density of states appears in the dirty limit. We therefore study the local density of states for normal-superconducting proximity contact systems with arbitrary concentration of impurities by the quasi-classical Green's function method. It is found that the local density of states has a mini-gap in intermediate concentration of impurities as well as in the dirty limit.

Fulde-Ferrel-Larkin-Ovchinnikov phases **23EP8**

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We have investigated the nature of the transition to the FFLO superfluid phases in homogeneous fermionic systems. In the vicinity of the tricritical point, where FFLO phases begin to appear, one can make an expansion of the free energy up to six order, both in the order parameter and amplitude which are still small. Restricting ourselves to a particular subspace for the order parameter, made of superposition of plane waves with same vector modulus (we call it the LO subspace), we first obtain analytically the form of the order parameter which minimizes the energy : we find a $\cos(\vec{q}\cdot\vec{r})$ form appearing in a first order transition. Moreover, going out of the particular LO subspace, combining analytical and numerical studies, we show that the real order parameter at the transition is very close to the simple $\cos(\vec{q}\cdot\vec{r})$ form.

23EP9 Effect of inter-band nesting on superconductivity in stacked honeycomb lattices

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In order to exemplify our idea that inter-band nesting can favor superconductivity arising from electron repulsion in layered, non-Bravais lattices, we have looked into the two-band Hubbard model on a stack of honeycomb lattices with the fluctuation exchange (FLEX) method. By systematically varying the band filling and transfers, the inter-band nesting is indeed found to give rise to gap functions that change sign across the bands with s or d intra-band symmetry. Possible relevance to MgB_2 and graphite intercalation compounds are also discussed.

23EP10 Spontaneous spin current near the interface between ferromagnets and unconventional superconductors

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Proximity effect between a ferromagnet and a superconductor (SC) with broken time-reversal symmetry ($\mathcal{T}$) is examined theoretically. For the latter we consider a chiral $(p_x + ip_y)$-wave SC, and a $d_{x^2-y^2}$-wave SC which can form $\mathcal{T}$-breaking surface state, i.e., $(d_{x^2-y^2} + is)$-state. The Bogoliubov de Gennes equation which describes the spatial variations of the superconducting order parameter and the magnetization is derived and solved numerically. It is found that a spontaneous spin current flows along the interfaces between the $(p_x + ip_y)$-wave superconductor and the ferromagnet. On the contrary, in the case of a [110] interface of the $d_{x^2-y^2}$-wave SC, the surface state has a $(d + p_x + p_y)$-wave (or $(d_{x^2-y^2} + is)$-wave) symmetry, and thus no (only charge) spontaneous current flows.

23EP11 Upper Critical Field and Field-Induced Superconductivity in Layered Superconductors with Antiferromagnetic Subsystems

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The upper critical field and a field-induced superconductivity (FISC) are examined in layered superconductors with antiferromagnetic subsystems on the basis of a generalized Kondo lattice model in parallel magnetic fields. The temperature dependence of the upper critical field is calculated. The FISC occurs for strong Kondo coupling by the Jaccarino-Peter mechansim. The experimental phase diagram of λ-$(\mathrm{BETS})_2\mathrm{FeCl}_4$ is semi-quantitatively reproduced by taking into account the Fulde-Ferrell-Larkin-Ovchinnikov state with an order-parameter mixing effect. On the other hand, for weak Kondo coupling, the upper critical field of the low field superconductivity is enhanced, while the FISC does not occur. In this case, very large areas of the superconductivity are obtained in the temperature-field phase diagram.

Kondo Effect in Superconductors in the Magnetic Field. 23EP12

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We investigate the magnetic-impurity effect in the superconductors in the magnetic field theoretically. When $T_{\rm K} \ll T_{\rm C0}$, there appear two transition temperatures $T_{\rm C1}$ and $T_{\rm C2}$ above $T_{\rm K}$ for some region of the impurity concentration $n_{\rm imp}$: i.e., with decreasing temperature a system first becomes superconducting at $T_{\rm C1}$ and then becomes normal again at $T_{\rm C2}$. Here $T_{\rm K}$ and $T_{\rm C0}$ denote the Kondo temperature and the transition temperature of a superconductor with no magnetic impurities, respectively. We show the magnetic field, the pair-breaking parameter, $T_{\rm K}$ and $n_{\rm imp}$ dependence of $T_{\rm C1}$ and $T_{\rm C2}$.

Superconductivity in Orbitally Degenerate System 23EP13

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Recently, the orbital degree of freedom attracts much attention since rich physics is expected with coupling it with the spin degree of freedom in orbitally degenerate system. Especially, it is considered that the superconducting transition in orbitally degenerate region is one of the most interesting phenomena. We discuss the mechanism of superconductivity in the orbitally degenerate system with using RPA and FLEX approximation where later is useful to study dynamical properties of spin and orbital fluctuations.

Doppler shift of zero energy Andreev bound state 23EP14

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Doppler shift of zero energy Andreev bound state is studied in detail for p-wave superconductor junction extending our previous theory. Due to the parity of the p-wave pair pteotnial, the magnitude of Doppler shift is quite small as compared to that of d-wave. Tuuneling spectroscopy in the presence of magnetic field become a key experiment to distinguish the parity of the Cooper pair.

[1]Y. Tanaka, et al, J. Phys. Soc. Jpn. Vol. 71 271 2002.

23EP15 Tail states in superconductors with magnetic impurities

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We analyse the density of states in an s-wave superconductor with magnetic impurities. By combining the method of optimal fluctuation with a self-consistent treatment of the local suppression of the superconducting order parameter, we demonstrate how rare fluctuations of magnetic impurity potential and local concentration create localized states below the mean-field gap at arbitrarily low energies for any impurity concentration. We explore the nature and the properties of these low energy "tail" states for different models of impurity potential.

23EP16 Shot noise in normal metal/$d_{x^2-y^2}$ superconductor junctions

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We calculate the shot noise in a voltage biased junction between a d-wave superconductor and a normal metal. In the clean limit the shot noise is suppressed to zero near zero voltage because of resonant Andreev reflection through zero-energy bound states. We report calculations of the effects of impurity scattering and screening currents, which modify Andreev reflection and enhance the shot noise.

23EP17 Plastic flow of periodic structures

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Collective transport of macroscopic condensed objects in quenched random media, such as a driven vortex lattice and CDW, has attracted much attention. An elastic manifold model has been well studied, which treats these systems as elastically deformable objects obeying to classical dynamics (e.g. Fukuyama-Lee-Rice model for CDW). There are some experimental facts, however, that it cannot explain. We have numerically investigated a simple model which allows plastic deformation such as "phase slip" and reflects a periodicity of the systems. The model is equivalent to a random-field XY model with torque.

We find that as a driving force grows, a moving state changes from a plastic flow which consists of spatially nonuniform dc current to a uniform elastic flow. The transition shows hysteresis and switching. A growth of a (quasi) long range order of phases is also observed.

Quantum transport in disordered normal metal/ unconventional superconductor junctions **23EP18**

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Effect of randomness on the electrical transport in junctions with a superconductor is studied in numerical simulations. It is shown that, in metallic diffusive regime, the electrical resistance of disordered normal metal / unconventional (p-wave and d-wave) superconductor junctions is quite different from that of junctions with s-wave superconductor due to the anisotropy and the internal phase in the superconducting order parameter. Transport properties in weak localization regime are also discussed.

Local magnetic moments in vortex cores and around nonmagnetic impurities in two-dimensional t-J model **23EP19**

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Local antiferromagnetic moments in the vortex cores of high-T_c superconductors are studied using the two-dimensional t-J model. It is found that the doping dependence is important and the local moment develops only near half-filling. We find that the absence of the large resonance peak in the local density of states reported in the scanning tunneling spectroscopy (STS) is due to the smallness of the core size. Theoretical predictions about the vortex charge and the effects of the antiferromagnetism on NMR relaxation rate are also discussed. The similar phenomena around nonmagnetic impurities are compared with the vortex case. Doping dependences and the effect of local charge around the impurities are clarified.

π Phase Magnetism in Ferromagnetic Metal/Superconductor Superlattices **23EP20**

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For the ferromagnetic metal/superconductor (FM/S) superlattices, new 0π and $\pi\pi$ Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) states with antiferromagnetic ordering of the FM layers magnetizations are found. If the S layer thickness d_s is less than the threshold value d_s^π, these FFLO states have a higher critical temperature T_c than the earlier known ferromagnetic states 00 and $\pi 0$. Therefore, the known T_c oscillations origin at $d_s < d_s^\pi$ is due to the 0π-$\pi\pi$-0π phase transitions cascade, whereas at $d_s > d_s^\pi$ it is ralated to the sequence of transitions 00-π0-00. New type of logical device combining the advantages of the superconducting and magnetic recording channels in one sample is offered.

23EP21 New varieties of order parameter symmetry in quasi-one-dimensional superconductors

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The symmetries of the superconducting order parameter in quasi-one-dimensional systems are investigated by the renormalization-group method in a model characterized by backward scattering g_1 and forward scattering g_2. Various types of pairing can be realized for different sets of (g_1, g_2). In the case of $g_2 > g_1 > 0$, for example, the order parameter both for singlet and for triplet has node just on the Fermi surface. The transition temperature for singlet $T_c^{\rm s}$ and that for triplet $T_c^{\rm t}$ are almost degenerate, though $T_c^{\rm s}$ is a little higher. This implies that $T_c^{\rm t}$ becomes higher than $T_c^{\rm s}$ under moderately large Zeeman magnetic field. This feature seems to explain anomalous properties of $(TMTSF)_2PF_6$.

23EP22 Theory of Resistive Behaviors in Vortex States Induced by Strong Quantum Fluctuation in Type II Superconductors

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On the basis of our recent theory[1] on phenomena suggesting the field-tuned superconductor-insulator transition, resistivity data in nonzero fields in thin superconducting films, underdoped high T_c cuprates, and organic superconductors are examined in details.

[1] H. Ishida and R. Ikeda, J. Phys. Soc. Jpn. 71, 254 (2002)

23EP23 Quasi-Particles in the Mixed State of d-Wave Superconductors

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We investigate the extended quasi-particle states in the mixed state of d-wave superconductors on the basis of the Bogoliubov-de Gennes equation. We prove that the quaisi-particle eigen-states can be classified in terms of new topological quantum numbers in the presence of vortices. The quantum numbers are related to the homotopy class of the orbits of the quasi-particles in the multi-connected systems. On the basis of this observation the phase of the order parameter is carefully eliminated in the Bogoliubov-de Gennes equation. We solve numerically this transformed equation in the d-wave case. It is shown that the quasi-particle eigen-states reveal the crossover behavior from gapless to gapped states as the flux-density increases. In the strong field region quantum oscillations appear in the excitation energy of the quasi-particles, which leads to the de Haas-van Alphen effect.

Polaronic features in the Su-Schrieffer-Heeger model **23EP24**

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Polaronic features have been envisaged in several classes of complex materials [1], most notably in High Tc Superconductors, CMR compounds and conducting polymers. We attack the Su-Schrieffer-Heeger model by a diagrammatic perturbative method and study i) effective mass and ii) electron spectral function versus the adiabatic parameter. When zone boundary phonons energetically compete with band electrons we observe a sizeable mass enhancement and a spread of the spectral weight associated with an increased relevance of multiphonons contributions at larger e-ph couplings. Accordingly an onset of polaron formation is favoured, particularly in two dimensions. A comparison with the Holstein model is presented. The pertinence of both models for some systems is discussed. [1] M.Zoli, Phys.Rev.B **61**, 14523 (2000); ibid. **63**, 174301 (2001)

Quasi-Particle density of states of disordered d-wave superconductors **23EP25**

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We present a numerical study of the quasi-particle density of states (DoS) of two-dimensional d-wave superconductors in the presence of disorder. We find qualitatively different behavior for smooth and short-ranged disorder. In the former case, we find power law scaling of the DoS with an exponent depending on the strength of the disorder and the superconducting order parameter in quantitative agreement with the theory of Nersesyan *et al.* (Phys. Rev. Lett. **72**, 2628 (1994)). For strong disorder, a qualitative change to an energy independent DoS occurs. In contrast, for short-ranged disorder of sufficient strength, we find localization and derive the dependence of the localization length on the disorder strength from the system size dependence of the micro gap in the DoS near zero energy.

Quasiclassical Theory of Superconducting Multi-Layers **23EP26**

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We use the theory of quasiclassical Green's functions to treat multi-layer systems containing superconductors and normal metals as well as magnetic materials. The interfaces are taken into account by Zaitsev's boundary conditions for ideal scattering [A.V. Zaitsev, Sov. Phys. JETP **59**, 1015 (1984)]. We apply a recently developed technique [A. Shelankov and M. Ozana, Phys. Rev. B **61**, 7077 (2000)] to study systems with several interfaces of arbitrary transmission. In our approach impurities are also considered which enables us to study the clean case as well as the dirty limit; superconducting order parameters of arbitrary symmetry can be included self-consistently. In particular we examine the influence of magnetism (induced by magnetic materials in the multi-layer system) on the superconducting behaviour.

23EP27 Anisotropy of Upper Critical Field for High Temperature Superconductors

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The anisotropy of high T_c superconductors arises both from the coupling constant and the Fermi surface in the Ginzburg-Landau framework. The anisotropy of the former is expressed by $d_{x^2-y^2}$ symmetry. The shapes of the Fermi surface of high T_c superconductors are various and depend on materials and doping ratio. In this paper, we study the anisotropy of the upper critical field in the $a-b$ plane with $d_{x^2-y^2}$ symmetry and with typical shapes of the Fermi surface.

23EP28 Charge Fluctuation in the CuO Double Chains of $PrBa_2Cu_4O_8$

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We calculate the optical conductivity of the CuO double chains of $PrBa_2Cu_4O_8$ by the mean-field approximation for the coupled two-chain Hubbard model around quarter filling. We show that the $\sim$40 meV peak structure, spectral shape, and small Drude weight observed in experiment are reproduced well by the present calculation provided that the stripe-type charge ordering is present. We argue that the observed anomalous optical response may be due to the presence of stripe-type fluctuations of charge carriers in the CuO double chains; the fast time scale of the optical measurement should enable one to detect slowly fluctuating order parameters as virtually a long-range order.

23EP29 Bound State of Holes and Interchain Electron-Lattice Interaction in the Two Chains with the Interchain Alternate Interactions

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The two chains with the interchain alternate interactions are proposed to research the organic superconductors[1,2] with spin gaps. The binding energy of two holes, $E_{\rm B}$, has been computed by using a mean-field approximation and periodic boundary conditions. The $E_{\rm B}$ with negative values increases linearly as the interchain electron-lattice interaction increases. Two holes between two chains form the bound state with the spin singlet. It turns out that the increase of the interchain electron-lattice interaction does not more stabilise the bound state of two holes between two chains.

[1] J.H. Schön, Ch. Kloc and B. Batlogg, Nature 406, 702(2000) .
[2] A. Mishima and M. Kimura, Synth. Met. 11, 75(1985).

Impurities of Arbitrary Range and Strength in d-Wave Superconductors **23EP30**

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The selfconsistent T-matrix approximation (SCTMA) for an alloy model of defects, described by scattering potentials of arbitrary range, is used to calculate quasiparticle lifetime effects as well as the order parameter renormalization in 2D d-wave superconductors. We also consider the case of coexisting strong and weak scatterers. First application is to the density of states and the temperature dependent gap structure as seen in ARPES. The study has been motivated by measurements of the microwave conductivity at low temperatures of extremely high quality samples of YBCO, the results of which do not really fit into the widely accepted d-wave picture. Poorly screened defects outside the CuO_2-planes could be the cause of the discrepancy. Apart from changing the single particle properties, the finite range of the defects affects the conductivity through vertex corrections, which project out forward scattering.

Triplet superconductivity in the repulsively interacting electron system on a triangular lattice: a possibility of magnetic-field-induced superconductivity **23EP31**

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A dilute, repulsive electron system on the triangular lattice has been theoretically shown by Kuroki and Arita to have a strong tendency toward spin-triplet pairing, which is a combined effect of strong ferromagnetic spin fluctuations and a disconnected Fermi surface. Here we propose that a relatively small magnetic field can ensure the realization of the triplet superconductivity, which is due to anisotropic ferromagnetic fluctuations and the coupling of longitudinal fluctuations with the ferromagnetic spin wave. We have confirmed this for the Hubbard model with a quantum Monte-Carlo study in combination with the dynamical cluster approximation, where the pairing in the $\uparrow\uparrow$ channel is enhanced in magnetic fields.

Quasiparticle spectrum in vortex state in nodal superconductors **23EP33**

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The symmetry of superconductivity is the central issues in nodal superconductors. We have shown the angular dependent thermal conductivity in the vortex state provides a new window to look the superconducting order parameter $\Delta(\mathbf{k})$. Here we shall review our work on d-wave, f-wave and $s+g$ wave superconductors. Making use of the angular dependent magnetothermal conductivity Izawa *et al.* succeeded in identifying $\Delta(\mathbf{k})$ in Sr_2RuO_4, $CeCoIn_5$ and more recently κ-$(ET)_2Cu(NCS)_2$.

23EP34 Influence of antiferromagnetic order on the surface barrier in layered superconductor

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Using the image method it is predicted that creation of spin-flop domain in the Josephson vortices in layered antiferromagnetic superconductor alters surface energy barrier making flux entrance as a two-stage process. Below H_{en2} - a second critical field for flux penetration, the flux enters a sample in the form of the well-known Josephson vortices, whereas above this field in the form of Josephson vortices possesing magnetic domain structure. It is also predicted that magnetization M as a function of an applied field H should have a second negative slope. The surface energy barrier for flux entry and exit as a function of applied field, for values higher then H_{en2}, is calculated.

23EP35 Fulde-Ferrell-Larkin-Ovchinnikov State of d-wave superconductors

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Recently a few works have been reported on Fulde-Ferrell-Larkin-Ovchinnikov(FFLO)state of d-wave superconductors in layered compounds. In strong contrast to 3D s-wave superconductors where the stripe like state appears, the square lattice like state is formed in d-wave superconductors in quasi-2D system with a magnetic field parallel to the conducting plane. Indeed there have been reported that FFLO state in κ-$(ET)_2$ salts and λ-$(BETS)_2GaCl_4$, though they are not conclusive. We review our recent works on this subject. We propose NMR, STM or transport measurement will provide a definitive test for FFLO state.

23EP37 Interplay of Ferromagnetism and Superconductivity: Domain Structure

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In materials with coexistence of superconductivity and ferromagnetism the equilibrium domain structure is absent in the Meissner state, but it does exist in the spontaneous vortex phase. Metastable domain walls can exist even in the Meissner state. Observation of domain structure can be an effective method of studying ferromagnetism-superconductivity coexistence and the phase diagram for these materials. Another example for interplay of ferromagnetism and superconductivity is a superconductor-ferromagnet bilayer. Though in this case superconductivity and ferromagnetism are separated in space, they strongly interact via magnetic fields. In the limit of the short London penetration depth the exact solution for the stripe domain structure in the bilayer has been found using the method of complex variables. The superconducting layer shrinks ferromagnetic domains, but not so drastically as was predicted recently.

The Critical Temperature of a Ferromagnetic Superconductor. 23EP38

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We consider a Hubbard model with an attractive, nearest neighbour, effective pairwise interaction potential in the presence of exchange splitting. We examine the temperature dependence of the superconducting critical temperature in the state based on triplet pairing. The critical temperature is found to increase in the presence of finite exchange splitting. We also examine the temperature and field dependence of thermodynamic functions, including specific heat, magnetization and spin only susceptibility. This will be used to interpret experiments performed on $ZrZn_2$, which has been discovered to superconduct in the ferromagnetic state.

Magnetic relaxation in superconductors with rotating flux lines 23EP39

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Magnetic relaxation in a superconducting plate placed in an external magnetic field parallel to its plane is analyzed in the following situation: The external field is switched on and then rotated through some angle in the plane of the plate without changing its magnitude, and then its magnitude and direction are kept fixed. Since the rotation causes flux-line cutting, the so-called general critical state is established in the sample, characterized by two critical current densities and two activation barriers. We investigate the relaxation of this state and obtain expressions for the electric fields and for the relaxation rates of the magnetic field components and currents in the plate. It is shown that by measuring the decay of magnetic flux one can find the effective height of the activation barrier against flux-line cutting.