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NOTA BENE:

Season's Greetings and Best Wishes for the New Year – from Sreeparna, John, Barb, Charyl, and Peter – the *High-T_C Update* editors and staff.

Readers please note: *High-T_C Update* accepts only papers mailed to us as hard copy or faxed to us. Please do not send us electronically mailed manuscripts. Thank you!

Junctions

A complete scenario of high-T_C superconductivity based on experimental data from electron-tunneling spectroscopy on break junctions in underdoped, overdoped, and *Ni*-doped $Bi_2Sr_2CaCu_2O_{8+\delta}$ *(Bi-2212)* single crystals over the temperature range 14-290 K is proposed by A. Mourachkine (Brussels). Below T_C, the author observed four different gaps: (a) a spin-density-wave (SDW) gap due to antiferromagnetic correlations, (b) a superconducting gap due to spinon-up - spinon-down pairing, (c) a d-wave superconducting gap, and (d) a small superconducting gap most likely having g-wave symmetry. The author finds that d-wave superconductivity is mediated by spin waves and that the magnitude of the superconducting gap due to pairing of spinons most likely has s-wave symmetry. The maximum magnitudes of the SDW, spinon, and d-wave gaps are located at $(\pi/2,\pi/2)$, $(\pi/2,\pi/2)$, and $(\pi,0)$, respectively.

The behavior of a Josephson junction in which two BCS superconductors are coupled through an Anderson impurity has been analyzed nonperturbatively by A. V. Rozhkov and D. P. Arovas (UC-San Diego). The authors recover earlier perturbative results that a $\delta = \pi$ phase difference is preferred when the impurity is singly occupied and the on-site Coulomb interaction is large. They also find a novel intermediate phase in which either $\delta = 0$ or $\delta = \pi$ is stable, while the other is metastable and the energy $E(\delta)$ has a kink for δ between 0 and π. As a consequence, the current-voltage (I-V) characteristics of the junction are modified at low voltages.

A preprint by T. Löfwander et al. (Chalmers University of Technology and Göteborg University) reports a theoretical study of the ac Josephson effect in voltage-biased planar junctions of d-wave superconductors. For some orientations of the superconductors a current peak is found at finite voltage in the I-V characteristics. The authors show that a midgap state acts as a resonance and produces the peak. The authors also present a possible explanation for the zero-bias conductance peak, recently found in experiments on grain-boundary junctions of high-temperature superconductors, in terms of resonant transmission via a midgap state of quasiparticles undergoing multiple Andreev reflections. Two additional preprints from the same institutions, one by N. I. Lundin et al. and the other by G. Johansson et al., analyze further effects of Andreev reflections upon the properties of voltage-biased superconducting junctions.

A theory of spin- and charge-transport properties of ferromagnet/insulator/d-wave-superconductor (F/I/S) junctions has been developed by S. Kashiwaya (Stanford and ETL) et al. The authors present a formulation that gives the spin current and charge current as a function of the applied voltage and spin polarization of the ferromagnet for arbitrary barrier heights. Surface bound states are found not to contribute to the spin current. The authors also clarify several anomalous properties of Andreev reflection at the interface due to the exchange field.

Measurements of the surface impedance of *Nb/CuMn* (superconducting/spin-glass) bilayers at 10 GHz obtained using a parallel-plate resonator have been carried out by L. V. Mercaldo (Maryland) et al. to study the order parameter in superconducting/magnetic proximity systems. The authors find that the data differ strongly from the superconducting/normal-metal case, showing the magnetic nature of the *CuMn* layer, which acts as a weak ferromagnet.

As noted in a preprint by H. Grabert (Freiburg) and G.-L. Ingold (Augsburg and Saclay), in the classical Josephson effect, the phase difference across the junction is well defined, and the supercurrent is reduced only weakly by phase diffusion. For mesoscopic junctions with small capacitance, however, the phase undergoes large

quantum fluctuations, and the current is also decreased by Coulomb blockade effects. The authors theoretically describe the behavior of the I-V characteristics of such junctions over a wide range of parameters, and they study the transition from the phase-diffusion regime with coherent Josephson current to the Coulomb-blockade regime, which shows a supercurrent peak due to incoherent Cooper-pair tunneling.

Vortices

Transport measurements in fixed applied field have been made by S.F.W.R. Rycroft (IRC-Cambridge) et al. on $Bi_2Sr_2CaCu_2O_{8+\delta}$ *(Bi-2212)* single crystals in the Corbino disk geometry, where vortices travel in circles and do not cross the sample edges. The authors compared the results directly with the standard striplike geometry by cutting the disk into a strip and remeasuring the sample using the same electrical contacts. Pronounced differences were observed in measurements of both the resistive transition and the I-V characteristics in these two geometries. The critical current density in the vortex-solid phase is shown to be at least 20 times smaller than usual estimates for the strip geometry. The authors conclude that the transport properties of *Bi-2212* samples in the strip geometry are dominated by surface barriers in both the solid- and liquid-vortex phases over a wide range of fields and temperatures.

The three-dimensional uniformly frustrated XY model has been used by P. Olsson (Umeå) and S. Teitel (Rochester) to model a high-temperature superconductor in an applied magnetic field and to explicitly measure the longitudinal correlation length ξ_z in the vortex-line-liquid phase. The authors determined the scaling of ξ_z with magnetic field and system anisotropy close to the vortex-lattice melting transition. The authors also applied their results to determine the extent of longitudinal correlations in $YBa_2Cu_3O_{7-\delta}$ *(YBCO)* just above melting.

Details of flux-line-lattice melting in anisotropic high-T_c superconductors in **B**||c have been studied by Y. Nonomura et al. (NRIM) using Monte Carlo simulations of the 3D frustrated XY model. The authors found that the percentage of entangled flux lines abruptly changes at the melting temperature T_m, while no sharp changes were found in the number of loop excitations around T_m. The authors conclude that the origin of the melting transition is the entanglement of flux lines. The authors find that the Lindemann number is $c_L \approx 0.30$ independent of anisotropy, which confirms the validity of the Lindemann criterion for this melting transition.

A preprint by B. Y. Zhu (Nanjing and Beijing) et al. reports numerical solutions of the overdamped equation of vortex motion in a two-dimensional driven vortex lattice with disordered pinning, in which the driving Lorentz force, the pinning force due to point defects, the intervortex interaction force, and the thermal fluctuation force are all taken into account. The authors report the different conditions under which first-order melting transitions or second-order glass transitions are observed.

The angular dependence of the c-axis magnetoresistance $\rho_c(B)$ of *Bi-2212* irradiated with heavy ions has been studied by N. Morozov (Los Alamos) et al. The authors found that at temperatures near 68 K, the scaling of $\rho_c(B)$ with the c-axis magnetic field component $B_\perp$ is broken, and the in-plane field $B_{||}$ affects ρ_c. At this temperature, at a specific field $B_{cr} \approx B_\phi/2$, the magnetoresistance becomes independent of field orientation. This crossing point allowed the authors to estimate the correlation length L of pancake positions along the c axis. The authors found L/s ~ 60 at $B = B_{cr}$, where s is the interlayer space. The authors emphasize that this provides evidence of strong enhancement of pancake alignment in the vortex liquid in crystals with columnar defects.

As noted in a preprint by M. A. Moore (Manchester) and A. Pérez-Garrido (Murcia), vortices in thin-film superconductors are often modeled as a two-dimensional system of particles interacting via a repulsive logarithmic potential. The authors present arguments showing that the Abrikosov crystalline state is unstable at any finite temperature against proliferation of screened disclinations. The authors find that the correlation length of crystalline order grows as $T^{-1/2}$ as the temperature is reduced to zero, in excellent agreement with their simulations.

The effect of vortices on quasiparticle transport in cuprate superconductors has been investigated by M. Chiao et al. (McGill) in measurements of the low-temperature thermal conductivity of $YBa_2Cu_3O_{6.9}$ in magnetic fields up to 8 T. The residual linear term (as $T \rightarrow 0$) is found to increase with field, directly reflecting the occupation of extended quasiparticle states. A study for different *Zn* impurity concentrations reveals good agreement with calculations for d-wave superconductors, which sheds light on the nature of scattering by both impurities and vortices.

A preprint by R. P. Huebener et al. (Tübingen) presents a phenomenological discussion of the origin of two intrinsic steps recently observed in the flux-flow resistance of the cuprate superconductor $Nd_{2-x}Ce_xCuO_4$. The explanation involves two characteristic energies, the minigap ε_0 for states in the vortex core and the superconducting energy gap parameter Δ.

Detailed measurements of the electronic specific heat C(H) in the s-wave superconductor $NbSe_2$, which has been predicted to be proportional to the magnetic field H, are reported by J. E. Sonier (Los Alamos) et al. At low magnetic fields, the authors observed a downward curvature similar

to that reported in high-T_c superconductors, where such behavior has been attributed to $d_{x^2-y^2}$-wave symmetry. In *$NbSe_2$,* the authors find that the low-field anomaly in C(H) is well accounted for by the expansion of the vortex cores recently measured by μSR. The result provides a simple explanation for puzzling reports of $H^{1/2}$ behavior for C(H) in s-wave superconductors.

$RBa_2Cu_3O_{7-\delta}$

Measurements of the temperature-dependent *^{63}Cu* NMR spin-lattice relaxation rate for near optimally doped *$YBa_2Cu_3O_{7-\delta}$ (YBCO),* near and above T_c, are reported by K. Gorny (Ohio State) et al. in magnetic fields of 0 T, 8.8 T, and 14.8 T. In sharp contrast to previous work, the authors find no magnetic field dependence. The authors discuss experimental issues arising in measurements of this required precision, and they discuss the implications of their experiment with regard to the spin gap or pseudo-gap. For example, in a scenario involving dynamical pairing correlations or preformed pairs, the results call for relatively large energy scales and short length scales.

Three papers in this issue report results from time-resolved femtosecond optical spectroscopy bearing upon the evolution of the gap structure with doping in *$YBa_2Cu_3O_{7-\delta}$.* Two papers by D. Mihailovic (Ljubljana) et al. and one by J. Demsar (Ljubljana) et al. find that the underdoped state is characterized by a temperature-independent energy gap E_g, which exists at all temperatures and has a magnitude that appears to be inversely proportional to doping. This implies the existence of preformed pairs. Close to optimum doping, another gap simultaneously becomes visible; this gap has a BCS-like temperature dependence and closes at T_c.

A preprint by C. Bernhard (MPI-Stuttgart) et al. reports that the far-infrared electronic c-axis conductivity σ_{1c}^{el} of underdoped to overdoped *$Y_{1-x}Ca_xBa_2Cu_3O_{7-\delta}$* crystals has been studied by ellipsometry. The authors report that the peculiar temperature and frequency dependence of σ_{1c}^{el}, including the appearance of the normal-state gap, are determined by the *CuO_2* planes and their hole-doping state. In addition, the authors find that the spectral gap in the c-axis conductivity exhibits a very similar temperature and doping dependence to the gap that has been observed by angle-resolved photoemission experiments around the X point of the 2D Brillouin zone (the so-called hot spots). This finding suggests that the c-axis transport may be determined mainly by the carriers around the hot spots.

An extensive study of the field and temperature dependence of the critical current density $J_c(B,T)$ for a flux-grown *$NdBa_2Cu_3O_{7-\delta}$ (NBCO)* single crystal and melt-textured samples of *NBCO* and *YBCO* are reported by T. Higuchi (Railway Technical Research Institute and SRL-ISTEC) et al. The authors identify regimes in B-T space where different pinning mechanisms are dominant.

A preprint by T. Kimura (Nagoya Institute of Technology) et al. reports measurements of the transport critical current density $J_c(B,T)$ of filamentary *NBCO* prepared by a solution-spinning method using an aqueous solution of mixed acetates of *Nd, Ba, Cu,* polyvinyl alcohol, and organic acids. The highest values of J_c, 3.5×10^4 A/cm^2 at 77 K and 0 T and more than 10^4 A/cm^2 at 77 K and 2 T, were achieved for *$Nd_{1.18}Ba_{2.12}Cu_{3.09}O_{7-\delta}$* by controlling the oxygenation conditions.

Volume pinning forces $F_p = J_cB$ measured at different temperatures in *$NdBa_2Cu_3O_{7-\delta}$ (NBCO)* have been found by M. R. Koblischka et al. (SRL-ISTEC) to scale as functions of $b_f = B_a/B_{fp}$ or $h = H_a/H_{irr}$ (B_a or H_a = applied field, B_{fp} = peak position of $F_{p,max}$, and H_{irr} = irreversibility field). The authors use this procedure to make estimates of $F_{p,max}$, B_{fp}, and H_{irr} at zero temperature.

A preprint by P. Schätzle et al. (Dresden) reports the development of a melt-crystallization process with reduced processing temperatures and process times to produce *YBCO/Ag* monoliths (diameter 26 mm) with a homogeneous distribution of small *Ag* inclusions. The mechanical properties are improved, but the superconducting properties at 77 K (trapped flux density B_0 = 480 mT and levitation force F_N = 40 N) are slightly reduced compared with *YBCO* monoliths without *Ag* additions (750 mT and 65 N). The maximum trapped flux, however, increased to the value B_0 = 9.4 T at 26.5 K instead of 8.4 T in the *Ag*-free bulk monolith.

Custom-shaped monoliths of *YBCO* have been produced by M. Ullrich et al. (Göttingen) by applying the top-seeded-melt-growth (TSMG) method. The trapped magnetic induction at 77 K usually exceeds 600 mT, and the zero-field-cooled levitation forces of standard samples (38 mm × 38 mm × 12 mm) at 77 K typically are in the range 60-70 N.

Bi Cuprates

A preprint by W. Chen et al. (Alberta) reports the observation of new features in the normal-state resistivity of underdoped *$Bi_2Sr_2Ca_2Cu_3O_{10+\delta}$ (Bi-2223)* single crystals, in which an upturn deviation from the linear ρ vs T, rather than the usual downturn drop, appeared below T* ~ 250 K. The authors suggest that the behavior may result from structural transformations and charge dynamics similar to those in the stripe phases.

As reported by Y. C. Guo (NRIM) et al., the addition of a small amount of *SiC* (0.15 wt%) to *$(Bi,Pb)_2Sr_2Ca_2Cu_3O_{10+\delta}$ [(Bi,Pb)-2223]* improves the critical current I_c and its behavior in a magnetic field as a result of enhancements in density,

grain alignment, grain connectivity, and flux pinning of the tapes.

The effects of tension rolling of monocore (*Bi,Pb)-2223* tapes prepared by the oxide-powder-in-tube method have been studied by H. Utsunomiya et al. (Osaka). The authors found that the optimum tension is ~5 MPa, which suppresses the sausaging of the *Ag*/oxide interface, improves the oxide grain alignment, and results in higher J_c.

The normal- and superconducting-state c-axis transport properties of $Bi_2Sr_2CaCu_2O_{8+\delta}$ *(Bi-2212)* single crystals have been measured by A. Yurgens (Göteborg) et al. as a function of doping and magnetic fields parallel and perpendicular to the CuO_2 planes using mesa structures containing a small number of atomic unit-cell layers. For low current bias, the peak in the magnetic-field-dependent c-axis resistance was found to scale approximately inversely with the zero-field critical current. The critical current I_c was found to depend strongly on the temperature T and the field $B_\perp$ perpendicular to the CuO_2 planes.

The c-axis I-V characteristics of *Bi-2212* show strong hysteresis with many branches. A preprint by H. Matsumoto (Seikei) et al. theoretically studies the origin of hysteresis jumps using a model consisting of a stack of Josephson junctions. Charging effects on the superconducting layers produce a coupling between the phase differences of next-nearest-neighbor junctions, thereby strongly affecting the structure of hysteresis branches.

Other Cuprates

Polarized XAFS measurements by V. Polinger et al. (Washington) on powders of $La_{2-x}Sr_xCuO_4$ with aligned c axes show that apical oxygens neighboring only the *Sr* dopants have a double-site distribution. This result requires that the doped holes reside in impurity states peaked on the CuO_6 octahedron neighboring the dopant (denoted as *Sr*-octahedrons). The authors present a model of the double site involving two coexisting spin-differentiated (singlet and triplet) Jahn-Teller distortions of the *Sr*-octahedrons induced by an extrinsic doped hole pairing with the intrinsic hole. The authors speculate that Bose condensation of the singlet pairs, bound by ≥0.1 eV, produces superconductivity.

The ab-plane optical spectra of two single crystals of underdoped $La_{2-x}Sr_xCuO_4$ have been investigated by T. Startseva (McMaster) et al. The reflectivity of $La_{1.87}Sr_{0.13}CuO_4$ has been measured in the frequency range 30 cm^{-1} - 9000 cm^{-1} (0.004 eV - 1 eV) both parallel and perpendicular to the CuO_2 planes, while $La_{1.86}Sr_{0.14}CuO_4$ was studied only in the ab plane. Using the extended Drude model, the authors find that the frequency-dependent effective scattering rate $1/\tau(\omega,T)$ is strongly suppressed below the high-frequency straight-line extrapolation, a signature of the pseudogap state. This suppression can be seen from temperatures below the superconducting transition up to 400 K.

Measurements of the temperature (T) dependence of the magnetic penetration depth λ of grain-aligned $YBa_2Cu_4O_8$ along the ab plane and the c axis are reported in two preprints by C. Panagopoulos (IRC-Cambridge) et al. Both $\lambda_{ab}(T)$ and $\lambda_c(T)$ vary as $T^{1/2}$ up to ~0.4 T_c, indicating a square-root density of states as predicted, but not previously observed, by the proximity model of alternating stacked superconducting and normal layers. The authors discuss the ab-plane anisotropy and temperature dependence in terms of proximity-induced pair condensation on the chains.

A single crystal of $Hg_{1.44}Re_{0.5}Ba_4Ca_5Cu_7O_{20}$ [*(Hg,Re)-2457,* T_c = 83 K] has been grown by H. Schwer et al. (ETH-Zürich) using a gas-phase high-pressure technique at 10 kbar. An x-ray single-crystal structure analysis showed that the crystal is composed of alternating blocks of *1223* and *1234* units. Until now, such intergrowth structures in the *Hg*-based series have been observed only on a small submicron scale or as a defect.

The preparation of $(B_{1-x}C_x)(Sr_{1-y}Ba_y)_2Ca_2Cu_3O_z$ has been studied by A. Iyo and M. Tokumoto (ETL) using high-pressure synthesis techniques to improve sample quality. The authors found a maximum T_c = 120 K for a sample with the starting composition $(B_{0.65}C_{0.35})$-$(Sr_{0.3}Ba_{0.7})_2Ca_2Cu_3O_{9+\delta}$. From magnetization measurements, the authors estimated the J_c at 77 K in a field of 1 T to be about 1.1×10^4 A/cm^2, and H_{irr} at 77 K to be about 2.5 T.

Other Superconductors

As noted in a preprint by C. Bergemann (Cambridge) et al., Sr_2RuO_4 is the only known layered perovskite oxide superconductor without *Cu;* there is strong evidence for an unconventional (p-wave) pairing mechanism in this material; and Sr_2RuO_4 recently has been shown to possess a cylindrical, quasi-two-dimensional Fermi surface. The authors have used a highly sensitive piezolever torque magnetometry technique in a dilution refrigerator to detect quantum magnetization oscillations on all three Fermi surface sheets in a Sr_2RuO_4 crystal of microgram mass.

A preprint by F. Marsiglio (Alberta) summarizes some well-known properties of the optical reflectance (and the derived conductance), and then demonstrates how a recently derived inversion procedure can be used to infer the magnitude of the electron-phonon interaction from the optical properties. The author applies this procedure to K_3C_{60} and finds that the electron-phonon interaction is sufficiently strong to explain the transition temperature in this material.

A study of the microwave properties of superconducting YNi_2B_2C and $ErNi_2B_2C$ has been carried out by A. Andreone (Napoli) et al. The measurements were performed using a microstrip resonator (f = 2 GHz) and a microwave cavity (f = 87 GHz). Analysis of the temperature dependence of the surface impedance Z_S confirms that YNi_2B_2C is a conventional BCS (s-wave) superconductor, but reveals that $ErNi_2B_2C$ shows anomalous behavior in both the surface resistance and penetration depth. The authors tentatively ascribe this to pair-breaking effects on the superconducting density of states.

Thin Films

The effects of temporal pulse width and target density on the deposition of thin $YBa_2Cu_3O_{7-\delta}$ *(YBCO)* films has been studied by S. Vikram (Iowa State) et al. A 248 nm excimer laser and an 825 nm *Ti*-sapphire laser were used to conduct the experiments with pulse widths of 27 ns, 16 ns, and 150 fs and target densities of 80% and 90%. Scanning electron microscope photomicrographs and profilometer traces showed a striking difference between nanosecond and femtosecond laser irradiation. Shortening the pulse width reduced particulate formation, provided stoichiometry, and improved the film properties. Decreasing the target density raised the ablation rate, produced thicker but nonuniform films, and reduced particulate formation.

A preprint by T. Schmauder (Wisconsin and EPFL-Lausanne) et al. describes a new pulsed-laser-deposition system linked to an angle-resolved photoemission (ARPES) chamber at the Synchrotron Radiation Center at the University of Wisconsin. The authors discuss first results on epitaxially grown *YBCO* films. The core-level photoemission data indicate that a *BaO* layer is the dominant surface layer. Since the authors were not able to reproducibly detect a sharp Fermi edge in the photoemission spectra, they conclude that the surface layer is nonmetallic, probably due to oxygen loss at the surface.

The magnetic flux distributions in samples consisting of five parallel strips of $NdBa_2Cu_3O_{7-\delta}$ *(NBCO)* thin films arranged in an x-array have been visualized by Z. W. Lin et al. (New South Wales) using a magneto-optical technique. The external magnetic field was applied perpendicular to the sample surface, held at 40 K. The magnetic flux profiles were calculated taking into account the sample thickness and the distance between the sample surface and the indicator film. The experimental results showed excellent agreement with the calculated flux distribution and revealed that for the central strip, flux penetrates deeper into the strip than for a single isolated strip. This is due to field compression resulting from the shielding of the superconducting strips on each side.

Atomic-layer-controlled molecular beam epitaxy (ALC-MBE) has been applied by H. Ota et al. (ETL) for preparing ultrathin films of $Bi_2Sr_2CaCu_2O_{8+\delta}$ *(Bi-2212).* Precise control of the composition by ALC-MBE enables the growth of particle-free films. Superconducting zero-resistance transitions were observed for films of thickness greater than 3.0 nm. The authors also found that growth of a $Bi_2Sr_2CuO_6$ *(Bi-2201)* buffer layer between the film and the $SrTiO_3$ (100) substrate helps in the preparation of particle-free ultrathin films with good superconducting properties.

Theory

The two-dimensional t-J model has been investigated by C. S. Hellberg (NRL) and E. Manousakis (Florida State) at a hole doping of x = 1/8 and J/t = 0.35 using exact diagonalization. The authors find that the low-energy states are uniform (not striped) but also find numerous excited states with charge-density-wave structures, which may be interpreted as striped phases. Some of these are consistent with neutron scattering data on the cuprates and nickelates.

It is known that in the vicinity of hole density 1/8, the *La*-based high-T_c superconductors exhibit long-range order of incommensurate antiferromagnetism (IC-AF). Using a Ginzburg-Landau free energy based on a mean-field theory of the t-J model, H. Yamase et al. (Tokyo) have found numerically that three kinds of charge-density modulation (CDM), including a stripe pattern, can stabilize IC-AF ordering.

The dispersion relation of a doped hole in the half-filled 2D Hubbard model has been shown by F. F. Assaad (Stuttgart) and M. Imada (Tokyo) to follow a $|\mathbf{k}|^4$ law around the $(0,\pm\pi)$ and $(\pm\pi,0)$ points in the Brillouin zone. Upon addition of pair-hopping processes, this dispersion relation is unstable towards a $|\mathbf{k}|^2$ law. The authors discuss finite dopings and argue that the added term restores coherence to charge dynamics and drives the system towards $d_{x^2-y^2}$ superconductivity.

According to a theory by M. Opel (Walther Meissner Institut, Garching) et al., the buckling of the CuO_2 planes in certain cuprate systems can be explained in terms of an electric field across the planes originating from different valences of atoms above and below the plane. The authors find direct experimental support for their ideas in studies of $YBa_2Cu_3O_{6+x}$ and $Bi_2Sr_2(Ca_{1-x}Y_x)Cu_2O_8$ with different oxygen and yttrium doping, respectively, including antiferromagnetic samples. In the latter compound, symmetry breaking by replacing *Ca* partially by *Y* leads to an enhancement of the electron-phonon coupling by an order of magnitude.

The low-temperature surface resistance R_S of d-wave superconductors has been calculated by C. T. Rieck et al. (Hamburg) as a function of frequency, assuming normal-state quasiparticle mean free paths ℓ in excess of the penetration depth. The size of nonlocal corrections,

which can be positive or negative depending on frequency, decreases for given ℓ as the scattering phase shift δ_N is increased. However, except in the unitarity limit $\delta_N = \pi/2$, nonlocal effects should be observable.

A preprint by T. Schneider and J. M. Singer (Zürich) establishes a criterion to test theories for layered superconductors relying on a substantial interlayer contribution. This criterion is based on the ratio of the interlayer contribution to the total superfluid density, which is traced back to the inverse squared effective mass anisotropy. The authors conclude that models relying on interlayer pairing cannot be considered as serious candidates for the mechanism of superconductivity in cuprate superconductors. A second preprint by the same authors discusses the occurrence of crossing points in the magnetization vs temperature (M-T) plane within the framework of critical phenomena.

A preprint by M. C. Bønsager and A. H. MacDonald (Indiana) reports on an exploration of the mean-field phase diagram for Pauli-limited superconductivity in small metallic grains. The authors emphasize the crossover to the bulk thin-film phase diagram as the single-particle level spacing in the grain decreases. They find that the maximum Zeeman coupling strength compatible with superconductivity in small grains exceeds the Clogston paramagnetic limit.

The magnetoresistance of a granular superconductor in a strong magnetic field destroying the gap in each grain is considered in a preprint by I. S. Beloborodov (Bochum) and K. B. Efetov (Bochum and Landau Institute). The authors show that the magnetoresistance of a granular metal in a strong magnetic field at low temperature must be negative because of superconducting fluctuations.

Other Activities

Neutron scattering has been used by H. A. Mook (Oak Ridge) et al. to study the spin fluctuations in $YBa_2Cu_3O_{7-\delta}$ and $Bi_2Sr_2CaCu_2O_{8+\delta}$. The authors find evidence for both incommensurate fluctuations and a commensurate resonance excitation. Measurements of the lattice dynamics in $YBa_2Cu_3O_{6.9}$ show incommensurate structure that appears to stem from charge fluctuations associated with the spin fluctuations.

An angle-resolved photoemission (ARPES) study of insulating $Ca_2CuO_2Cl_2$, a parent compound of the high-T_c superconductors, has been carried out by F. Ronning (Stanford) et al. Analysis of the electron occupation probability n(**k**) from the spectra shows a steep drop in spectral intensity across a contour that is close to the Fermi surface predicted by the band calculation, revealing a Fermi-surface remnant even though $Ca_2CuO_2Cl_2$ is a Mott insulator. Furthermore, the lowest energy peak exhibits a dispersion of approximately the $|\cos k_x a - \cos k_y a|$ form along this remnant Fermi surface. As emphasized by the authors, these results, together with the data from *Dy*-doped $Bi_2Sr_2CaCu_2O_{8+\delta}$, suggest that this d-wave-like dispersion of the insulator is the underlying reason for the pseudogap in the underdoped regime.

A model of conduction in polycrystalline high-T_c superconductors, involving weak links at grain boundaries, has been developed by R. Haslinger and R. Joynt (Wisconsin). The model can be reduced to a nonlinear resistor network, which the authors solve by both analytical approximations and a new numerical technique. The authors show that an unambiguous connection can be made between link-strength distributions at the microscopic level and electrical properties at the macroscopic level.

Preprints by S. S. Banerjee (TIFR-Mumbai) et al. and G. Ravikumar (BARC-Mumbai) et al. report on features in the magnetization of 2H-$NbSe_2$, which they associate with an order-disorder transformation across the peak-effect region.

A paper by Y. Bruynseraede and V. V. Moshchalkov (Leuven) reports on flux-confinement effects in superconducting line, loop, and dot structures. The authors note that the critical temperature versus applied field $T_c(H)$ is the energy of the lowest Landau level $E_{LLL}(H)$ measured in temperature units, and that $E_{LLL}(H)$ is altered when the sample geometry or topology is changed. The authors demonstrate that in all studied submicron structures the shape of the $T_c(H)$ phase boundary is determined by the confinement topology in a unique way.

Overviews

A preprint by M. Darula (Jülich) et al. reviews the status of discrete Josephson-junction arrays for applications as sub-mm wavelength radiation sources. The authors discuss the fundamental aspects of Josephson junctions for oscillator applications and introduce the different possible array types. They also discuss fabrication issues and experimental results on both low-T_c and high-T_c superconductors (144 refs.).

A review summarizing the microstructural variations that result from the addition of Y_2BaCuO_5 *(Y-211)* to melt-processed $YBa_2Cu_3O_{7-\delta}$ *(Y-123)* has been prepared by C.-J. Kim and G.-W. Hong (KAERI). The authors discuss the size distribution of *Y-211* particles, the microdefects around them, and the effects of chemical doping by PtO_2 and CeO_2 (115 refs.).

Basic applications of Rutherford backscattering spectrometry (RBS) in cuprate superconductors are reviewed in a preprint by W.-K. Chu et al. (TCSUH). The authors discuss the use of RBS for stoichiometry measurement

and for the characterization of films (thickness, elemental depth profiling, interface diffusion, uniformity, radiation damage, crystallinity, and strain measurement). The authors also discuss extensions of this technique to measure thermal-vibration-induced atomic displacements vs temperature, and to study specific oxygen sites via ^{18}O labeling (47 refs.).

Ph.D. Thesis

Investigations of the elastic and dissipative forces in superconducting levitation are reported in the Regensburg Ph.D. thesis of R. Grosser, who studied the oscillations of a small permanent magnet levitating between two horizontal superconductors. The author studied the behavior with different samples of $YBa_2Cu_3O_{7-\delta}$, including sintered and melt-textured bulk samples and epitaxial films of thickness 190 nm and 450 nm. Dissipation in the thin-film samples was found to be much smaller than in the bulk samples over nearly the entire temperature range (70 refs.).

Contributed by John R. Clem

Contents:

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Hideki Matsumoto, Shoichi Sakamoto, Fumihiro Wajima, Tomio Koyama, and Masahiko Machida, "Simulation of I-V Hysteresis Branches in an Intrinsic Stack of Josephson Junctions in High-T_c Superconductors." Department of Applied Physics, Seikei University, Kichijoji Kitamachi 3-3-1, Musashino-Shi, Tokyo 180, JAPAN; e-mail matumoto@apm.seikei.ac.jp.

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1001 Ljubljana, SLOVENIA; telephone +386 61 1773 729; telefax +386 61 1251 077; e-mail dragan.mihailovic@ijs.si.

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A. Yurgens, D. Winkler, T. Claeson, G. Yang, I.F.G. Parker, and C. E. Gough, "*2212-BSCCO* Intrinsic Josephson Junctions in a Magnetic Field." Department of Microelectronics and Nanoscience, Chalmers University of Technology, S-41296 Göteborg, SWEDEN; e-mail yurgens@fy.chalmers.se. 74.50.+r; 74.60.Jg; 74.60.Ge; 74.72.Hs.

B. Y. Zhu, D. Y. Xing, Jinming Dong, and Bairu Zhao, "Dynamical Phase Transition of a Driven Vortex Lattice with Disordered Pinning." To be published in Physica C (in press). National Laboratory of Solid State Microstructures and Department of Physics, Nanjing University, Nanjing 210093, PEOPLE'S REPUBLIC OF CHINA; phone +86 1 6255 9131, ext. 513; fax +86 1 0256 2605; e-mail byzhu@ssc.iphy.ac.cn. Key words: vortex lattice, pinning, phase transition. 74.60.Ge; 74.60.-w; 74.25.Dw.

COMING EVENTS

*(An * indicates a previously listed event.)*

Feb. 19, 1999: Commercialization of Cryoelectronics Technologies in Microelectronics, San Francisco, Calif. Key areas that will be addressed include packaging, refrigeration, and cost-effectiveness.

Abstract deadline, January 15, 1999. For information, contact The Knowledge Foundation, Inc., 101 Merrimac Street, Boston, MA 02114; telephone (617) 367-7979; telefax (617) 367-7912; e-mail custserv@knowledgefoundation.com.

June 21 - 25, 1999: The 7th International Superconductive Electronics Conference (ISEC'99), Berkeley, Calif. One in a series of biennial conferences specifically on superconductive electronics. Topics cover all electronics applications, including underlying theory and practical realization. No parallel oral sessions in the main conference. Appended to the conference this year will be a day of parallel optional workshops (June 25), in which details of particular applications and the related technologies will be discussed in depth. Attendance at the workshops requires an additional registration fee. **Abstract deadline, February 15, 1999; early registration deadline, April 30, 1999.** For information, contact Ted Van Duzer, Conference Chair, EECS Dept., U. of California, Berkeley, CA 94720-1770; phone (510) 642-3306; fax (510) 643-8194; e-mail vanduzer@eecs.berkeley.edu.

June 27 - 30, 1999:* 1999 International Workshop on Superconductivity (4th Joint ISTEC/MRS Hawaii Workshop), Kauai, Hawaii. Co-sponsored by ISTEC and MRS. Fourth in the series. Theme will be "High-Temperature Superconducting Materials and Devices for Electronics Applications." In particular, topics concerning thin films and processing, and HTS junctions and integration technology will be emphasized. Workshop will consist mainly of a series of single-session meetings with a significant amount of time allotted for the discussion of each paper and extra amounts of time put aside to encourage informal interactions among the participants. Topics of interest (including, but not restricted to the following) are: HTS superconducting materials; characterization (surface roughness, surface resistance, etc.) and processing of thin films (MOCVD, LEP, sputtering, laser ablation, evaporation, etc.); substrates; HTS junctions; devices (microwave & mm-wave devices, SQUIDs, RSFQ/SFQ, JJs, etc.); applications (telecommunication, computing, switching devices, medical, etc.); and others. **Contributed Summary deadline, January 15, 1999. For information, contact Tetsuji Kobayashi, Director, International Affairs Department, International Superconductivity Technology Center (ISTEC), Eishin Kaihatsu Bldg. 6F, 34-3, Shinbashi 5-chome, Minato-ku, Tokyo, 105-0004 Japan; telephone +81 3341 4044; e-mail t-kobayashi@istec.or.jp.

July 7 - 10, 1999:* Ninth International Workshop on Critical Currents (IWCC9-99), University of Wisconsin, Madison, Wisc. IWCC9-99 will be the ninth in a series of workshops devoted to study and discussion of the critical current density in superconductors. This three and one-half day workshop will be organized around keynote talks on flux pinning, grain-boundary properties, and the current-limiting mechanisms of single- and polycrystalline superconductors. Extensive discussion time will be given to these key topics. **Abstract deadline, January 31, 1999. For further information, contact M. M. Adams, Conference Coordinator, 1500 Engineering Drive, Room 917 ERB, Madison, WI 53706; telephone (608) 263-5029; telefax (608) 263-1087; e-mail iwcc@engr.wisc.edu.

Aug. 17 - 20, 1999: 1999 Taiwan International Conference on Superconductivity (TICS'99) & 6th Workshop on Low Temperature Physics (WLTP6), Kenting, Taiwan, Republic of China. Contributions within superconductivity and low-temperature-physics-related topics are welcome. For information, contact H. D. Yang, Department of Physics, National Sun Yat-Sen University, Kaohsiung, 804 Taiwan; telephone +886 7 5253701; telefax +886 7 5253709; e-mail yang@mail.phys.nsysu.edu.tw; Web site http://www2.nsysu.edu.tw/physics/tics99.

**Aug. 29 - Sept. 10, 1999:*
NATO Advanced Study Institute (ASI) on Microwave Superconductivity, The Pyrenees Mountains, Spain. This ASI will cover microwave properties of superconductors, the fabrication and measurement of superconducting devices, circuits which operate at microwave frequencies, and technological issues and market potential of all current and emerging microwave applications. Financial awards are available to some students and recent Ph.D.s who are residents of NATO and selected Eastern European countries. Directors: Martin Nisenoff, NRL and Harold Weinstock, AFOSR. **Application deadline, January 15, 1999.** For application visit Web site www.geocities.com/Pentagon/Quarters/9088 or contact Sandy Ronayne, 110 Duncan Ave., Bolling AFB, DC 20332-8050; e-mail sandy.ronayne@afosr.af.mil.

Sept. 5 - 7, 1999:* International Conference on Solid State Spectroscopy (ICSSS), Schwäbisch Gmünd, Germany. To be held in honor of the scientific achievements of Prof. Manuel Cardona. Will consist of oral presentations of 30-45 mins. given by invited speakers. Participants are expected to contribute posters which will be on display throughout the meeting. Ample time will be reserved for casual discussions and the exchange of ideas. No parallel sessions. Conference language is English. Proceedings will be published in a special issue of Phys. Stat. Solidi (b). Participation is limited to 160 participants. Reduced fees will be available for young scientists, who are encouraged to participate. Topics are: Methods – optical spectroscopy, Raman spectroscopy, electron spectroscopy, x-ray and neutron scattering, and nanoprobes; Materials – semiconductors, surfaces, heterostructures, interfaces, and low-dimensional systems, high-temperature superconductors, and magnetic oxides. **Abstract deadline, January 15, 1999. For information, contact Sabine Birtel, ICSSS, Max-Plank-Institut für Festkörperforschung, Heisenbergstr. 1, D-70569 Stuttgart, Germany; telefax +49 711 689 1712, e-mail icsss@cardix.mpi-stuttgart.mpg.de, Web site http://cardix.mpi-stuttgart.mpg.de/icsss/.

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