HIGH T UPDATE

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Vortices

An analytical investigation has been carried out by Y. Mawatari (ETL) for the distributions of electric field and electric charge arising from the Hall effect in superconducting strip lines. Both a longitudinal field $E_y(x)$ (along the strip) and a transverse field $E_x(x)$ (across the strip) are induced by vortex motion via the Hall effect. The author analytically determined the electric-field distribution using a scaling law, $E_x \propto E_y^m$, and then derived the corresponding distribution of sheet charge q(x) using a nonlocal relationship between $E_x(x)$ and q(x). The author points out that the macroscopic charge arises from polarization of moving vortices.

Dislocations in a driven vortex lattice in a two-dimensional superconductor with random impurities have been considered theoretically by I. S. Aranson (Argonne) et al. The authors studied the structure and dynamics of dislocations starting from a coarse-grained equation of motion for the displacement field. The dislocations are found to lead to an anisotropic distortion of the vortex density that is controlled by a Kardar-Parisi-Zhang nonlinearity in the coarse-grained equation of motion. This nonlinearity implies a screening of the interaction between dislocations and thereby an instability of the vortex lattice to proliferation of free dislocations.

A paper by P. Benetatos and M. C. Marchetti (Syracuse) uses non-Gaussian hydrodynamics to study the magnetic response of a flux-line liquid in the mixed state of a type-II superconductor. Using a theory that incorporates the nonlocality of the intervortex interaction in the field direction, the authors focus on the response of the flux array to a transverse tilting field, which is controlled by the tilt modulus c_{44}. The authors find that interaction effects can enhance c_{44} even in infinitely thick clean materials. The enhancement can be interpreted as the appearance of a disentangled flux-liquid fraction.

As reported by L. Krusin-Elbaum (IBM-Yorktown) et al., strong vortex pinning by fission-induced uniformly splayed columnar tracks in anisotropic mercury cuprates has been demonstrated to result from rescaling of the pinning landscape by a large superconducting anisotropy. The effective narrowing of the splay distribution restores variable-range vortex hopping (VRH) expected for nearly parallel pins. VRH emerges as a distinctive peak in the vortex creep rate (~12% at low fields at $T/T_c \sim 0.5$) of $HgBa_2Ca_2Cu_3O_{8+\delta}$ *(Hg-1223),* a peak well described by a glassy dynamics with the characteristic exponent $\mu \sim 1/3$.

Using an extensive scaling analysis of the transport properties in twinned $YBa_2Cu_3O_{7-\delta}$ crystals, S. A. Grigera (Bariloche) et al. have found experimentally the predicted change in the universality class of the Bose glass to liquid transition when the magnetic field is applied at small angles relative to the direction of the correlated defects. The new dynamical exponent is $s' = 1.1 \pm 0.2$.

The scaling behavior of the current-voltage characteristics of chiral and gauge-glass models of disordered two-dimensional superconductors has been studied numerically by E. Granato (São José dos Campos). For both models, the author found that the linear resistance is nonzero at finite temperatures and that the scaling analysis of the nonlinear resistivity is consistent with a phase transition at T = 0, characterized by a diverging correlation length $\xi \propto T^{-\nu_T}$ and thermal critical exponent ν_T. The values of ν_T were found to be different for the chiral and gauge-glass models, suggesting different universality classes, in contrast to the result obtained recently in three dimensions.

High-resolution magnetic-torque studies by M. Willemin (Zürich) et al. on an untwinned $YBa_2Cu_3O_{7-\delta}$ single crystal near its critical temperature T_c reveal that the first-order vortex-lattice melting transition (VLMT) persists at least up to 0.5 K below T_c. The associated sharp discontinuity in magnetization is detectable even at temperatures where the torque signal deviates from mean-field behavior due to fluctuations. The magnetic irreversibility below the VLMT can be suppressed by applying a weak transverse ac magnetic field, enabling the irreversibility line to be separated from the melting line near T_c. The authors found that the melting entropy does not show any unusual temperature dependence near T_c as proposed by some theories. Around and below the VLMT, the authors found that the torque signal is characterized by noise, evidently related to the pinning or depinning of vortex bundles, which vanishes in the fluid phase.

The influence of oxygen stoichiometry on the field and temperature dependence of the magnetoresistance of $YBa_2Cu_3O_{7-\delta}$ near optimal doping ($0.05 < \delta < 0.09$) has been studied in fields up to 23 T by R. M. Langan (Southampton) et al. The authors found that the kink in the resistivity versus temperature, the signature of the first-order vortex-lattice melting transition, disappears when B exceeds the multicritical field B_{mc}, and that B_{mc} strongly increases with decreasing δ. The authors also demonstrate that variations of the oxygen stoichiometry in the range $0.05 < \delta < 0.09$ do not have a significant effect on the intrinsic parameters (such as anisotropy, coherence length, and penetration depth) but do have a large influence on the degree of vortex-line entanglement.

The developed stage of the helical instability of a vortex line in a thin film has been studied theoretically by Yu. A. Genenko (Göttingen and Donetsk) et al. The instability of a one-dimensional vortex lattice parallel to a thin superconducting film surface and to a transport current is modeled as a transformation of initially straight vortex lines into chains of vortex lines crossing the film and tilted in the field direction. The pitch length of the first unstable spiral-like chain structure is found to be of the order of the film thickness at all fields, and the calculated dissipation rate is found to be comparable in magnitude with that found experimentally.

The field distribution in a thin superconductor in which $J_c(B)$ exhibits a peak at intermediate fields (fish-tail effect) has been calculated by M. Chandran (Indore) using the model of a two-dimensional inductive Josephson-junction array subjected to a perpendicular applied field.

A preprint by J. X. Zhu (TCSUH) et al. reports the microscopic derivation of a set of coupled time-dependent Ginzburg-Landau equations (TDGL) for superconductors of mixed d- and s-wave symmetry from the Gor'kov equations, using the analytic continuation technique and accounting for both nonmagnetic and magnetic scattering effects. The authors find that the d- and s-wave components of the order parameter can have very different relaxation times in the presence of nonmagnetic impurities. They note that this result is contrary to the behavior of a set of phenomenological TDGL equations proposed by other authors.

Theory

A two-dimensional Fermi liquid with a Fermi surface containing the saddle points $(\pi,0)$ and $(0,\pi)$ has been studied by N. Furukawa et al. (ETH-Zürich). Including Cooper and Peierls channel contributions leads to a one-loop renormalization group flow to strong coupling for short-range repulsive interactions. In a certain parameter range, the characteristics of the fixed point, the opening of a spin and charge gap, and appearance of pairing correlations are similar to those of a two-leg ladder at half-filling. The authors note that this microscopic model has much in common with the results of ARPES experiments and some recent phenomenological models, and they believe it can form the basis for a theory of the cuprates.

An extensive examination of numerical results and analytical calculations devoted to the study of two holes doped into a two-dimensional square lattice described by the t-J model is reported by A. L. Chernyshev (Queen's) et al. The authors present exact-diagonalization numerical results for the ground state of two holes in a 32-site lattice. Using this exact wave function, the authors calculated various correlation functions, including the electron momentum distribution function (EMDF) and the hole-hole spatial correlation function. Comparing the numerical results with analytical expressions based on the canonical transformation approach to the t-J model, the authors find good agreement for the binding energy, the EMDF for one and two holes, and the hole-hole spatial correlation function.

To investigate flux quantization and superfluid weight in doped antiferromagnets, G. C. Psaltakis (Crete) has used a t-t'-J model to calculate the magnetic-field dependence of the energy of the metallic phase-modulated antiferromagnetic ground state close to half-filling. The author describes the charge carriers in terms of hard-core bosons and argues that the superconducting transition temperature T_c in the cuprates is of the Kosterlitz-Thouless type, signaling phase coherence of the condensate. The theoretical doping dependence of T_c agrees qualitatively with experiment.

Using the model of a singlet-correlated band, M. V. Eremin et al. (Kazan State) have calculated the temperature dependence of d-wave superconducting (SC) and charge-density-wave (CDW) gaps. The temperature interval for which there is SC-CDW coexistence is found to depend strongly on superexchange and Coulomb parameters.

At low temperatures superconductivity is found to suppress the CDW state.

Tunneling in ferromagnet/unconventional superconductor (F/S) junctions has been studied by I. Zutic and O. T. Valls (Minnesota). The authors have included the effects of spin polarization, interfacial resistance, and Fermi wavevector mismatch between the F and S regions. Andreev reflection at the F/S interface, which governs tunneling at low bias voltage, is found to be strongly modified by these parameters, and the conductance exhibits a wide variety of features as a function of applied voltage. The authors find that the conductance displays novel behavior, different from that found in unpolarized tunneling into an unconventional superconductor or in a ferromagnet/conventional superconductor junction.

The ground-state properties of the crossover between BCS superconductivity and Bose-Einstein condensation have been calculated by B. C. den Hertog (Waterloo and Canberra) using a model that exhibits $d_{x^2-y^2}$ pairing symmetry. The author compares results for zero temperature with known features of s-wave systems and shows that bosonic degrees of freedom are likely to emerge only in the dilute limit.

A calculation by Y. Tanaka (ETL) et al. predicts a resonance between a phonon of energy ω_0 and a superconducting gap of maximum value $2\Delta_{max}$ when $\omega_0 \sim 2\Delta_{max}$. Striking differences in the Raman spectrum are found depending upon whether the superconductor has s-wave or d-wave symmetry. The authors thus propose that the resonance structure opens up a new kind of spectroscopy for probing superconducting pairing symmetry.

To compute an electron-phonon correlation function characterizing the size and shape of the polaron lattice distortion in one, two, and three dimensions, A. H. Romero et al. (UC-San Diego) have applied weak-coupling perturbation theory to the Holstein molecular crystal model. The exactly calculated width of the polaron disagrees in all dimensions with some well-known characterizations of polarons, signaling the breakdown of the adiabatic approximation and self-trapping descriptions.

A preprint by E. L. Haase (Karlsruhe) describes many results following from an extended Ginzburg-Landau theory with two coupled order parameters, one for superconductivity and the other for a structural phase transition. The theory predicts enhancements of the superconducting transition temperature T_c when the structural phase transition is nearby in temperature.

$RBa_2Cu_3O_{7-\delta}$

A Raman study of the variation of the B_{1g} *O(2)-O(3)* out-of-phase plane-oxygen vibrations in $SmBa_2Cu_3O_y$ with temperature has been carried out by A. A. Martin (MPI-Stuttgart) et al. This mode shows an anomalously strong hardening of about 10-13 cm^{-1} between 300 K and 10 K for both the nonsuperconducting ($y \approx 6.0$) and superconducting ($y \approx 6.9$) samples. The authors suggest that the anomalous hardening is due mostly to its coupling to a Sm^{3+} crystal-field transition at 193 cm^{-1} found earlier in inelastic neutron-scattering experiments.

The effects of excess Y_2O_3 addition on the levitation force of melt-textured $YBa_2Cu_3O_{7-\delta}$ *(YBCO)* have been studied by W. M. Yang (Xi'an, Jena, and Shenyang) et al. The authors found that the melt-reaction temperature decreased and the solid-state-reaction temperature increased with increasing Y_2O_3 addition. To maximize the levitation force, the optimum Y_2O_3 addition was found to be about 10 wt%.

Bi Cuprates

As reported by W. G. Wang (Nordic Superconductor Technologies) et al., *Ag*-sheathed *Bi-2223* multifilament tapes with 19, 37, 55, and 85 filaments have been produced by the powder-in-tube method. The authors have achieved enhanced tape performance by optimizing processing conditions. Key factors include eliminating the *2212* phase, improving grain connectivity by reducing *2201* phase and alkaline-earth-cuprate phases, increasing the superconductor core density, and enhancing the current contribution from edge filaments. For example, the authors report a self-field, 77 K J_c of 5×10^4 A/cm^2 with I_c = 42 A in a 19-filament tape of dimensions 0.16×2.8 mm^2 and silver/superconductor ratio of 4.4 to 1. A pure *Ag*-sheathed tape of length 1,250 m and a *Ag*-alloy-sheathed tape of length 1,100 m were produced showing $J_c > 2.5 \times 10^4$ A/cm^2.

A preprint by L. Wu et al. (Brookhaven) reports the crystallographic analysis of three major intermediate phases that occur during the conversion of $(Bi,Pb)_2Sr_2CaCu_2O_{8+\delta}$ *(Bi-2212)* to $(Bi,Pb)_2Sr_2Ca_2Cu_3O_{10+\delta}$ *(Bi-2223)* phase in *Ag*-sheathed composite tapes. The authors describe the structure and morphology of these phases: $(Ca,Sr)_{5+x}(Pb,Bi)_{3+y}CuO$, $(Ca,Sr)CuO_2$, and $(Ca,Sr)_{14}Cu_{24}O_{41+\delta}$.

Hg Cuprates

Superconducting crystals (T_c = 88 K) of the *1201* mercury cuprate, $Hg_{0.75}V_{0.25}Ba_2CuO_{4+\delta}$, have been grown and studied by G. Villard et al. (Caen). Vanadium serves to stabilize the *1201* structure.

The out-of-plane (c-axis) resistivity ρ_c of $HgBa_2CuO_{4+\delta}$ *(Hg-1201)* crystals has been measured by G. Villard (Caen) et al. The results support the idea that there is a strong

correlation between ρ_c and the location of the irreversibility line in the B-T plane.

As reported by A. A. Gapud (Kansas) et al., the superconducting *$HgBa_2Ca_2Cu_3O_{8+\delta}$ (Hg-1223)* phase can be formed at temperatures as low as 720°C by the addition of *Li* at a level of 0.1 to 0.4 per unit cell, thus effectively lowering the processing temperature by more than 100°C. The data indicate that *Li* most likely forms a flux that catalyzes the reaction of constituents and the formation of superconducting domains at low temperatures.

The irreversibility lines of epitaxial thin films of *$HgBa_2Ca$-$Cu_2O_{6+\delta}$* (*Hg-1212,* T_c = 120-123 K) and *$TlBa_2Ca_1Cu_2O_7$* (*Tl-1212,* T_c = 90-93 K), whether deduced from field-induced magnetoresistive broadening or the onset of nonhysteretic magnetization, have been found by A. A. Gapud (Kansas) et al. to coincide when plotted against reduced temperature. According to the authors, these results indicate that replacing *Tl* with *Hg* has no noticeable effect on the anisotropy and suggests that T_c is not determined by anisotropy.

Other Cuprates

Two papers by H. Ito (Tokyo Tech and Tokai) et al. report the effects of oxygen content on high-pressure-synthesized *$CuBa_2Ca_2Cu_3O_{8+\delta}$ (Cu-1223:P)* and *$CuBa_2Ca_3Cu_4O_{10+\delta}$ (Cu-1234:P).* Since as-synthesized *Cu-1223:P* (T_c = 67 K) was found to be strongly over-doped, post-annealings in flowing *Ar* gas were used to remove oxygen and achieve optimal doping. The highest T_c obtained was 118 K for a sample annealed at 400°C. On the other hand, the amount of excess oxygen in as-synthesized *Cu-1234:P* was found to be low and quite insensitive to annealing in 1 atm *O_2* and *Ar* atmospheres. With extreme-condition treatments at high oxygen pressures, the oxygen content could be increased slightly, but the T_c remained nearly constant at 116-117 K over the entire range $0.09 \leq \delta \leq 0.35$.

Films

The microstructure of *$La_{1.9}Sr_{0.1}CuO_4$* thin films grown by molecular beam epitaxy (MBE) on *$SrLaAlO_4$ (SLAO)* and *$SrTiO_3$ (STO)* has been investigated by J. W. Seo (Neuchâtel and IBM-Zurich) et al. using transmission electron microscopy. The authors report that applying a compressive or tensile strain increases or decreases the distance between *CuO_2* planes. The authors present evidence that a decoupling of *CuO_2* planes is associated with an increase of T_c, which is in contradiction to recent theoretical predictions. A related paper by J. Perret (Neuchâtel and IBM-Zurich) et al. presents an analysis of the uniaxial strain or pressure derivatives of T_c in cuprate superconductors leading to a prediction that under a compressive epitaxial strain, a large increase in T_c should be possible. The authors indeed found that a large increase of T_c occurs for *$La_{2-x}Sr_xCuO_4$* under epitaxial strain on *SLAO* substrates.

As reported by F. Tafuri (Napoli) et al., the properties of *$YBa_2Cu_3O_{7-\delta}$* grain-boundary junctions can be reproducibly modified by focused electron-beam irradiation. Electron irradiation reduces the critical current I_c of the junctions and increases the normal-state specific resistivity R_n.

The morphology of the interface between a superconductor (S, *YBCO*) and a normal metal (N, *Co*-doped *YBCO*) has been found by E. Polturak et al. (Technion) to have a dramatic effect upon the proximity effect. The authors found that depending on the morphology of the S-N interface, the coupling between the S and N layers can be turned on to depress the T_c of S by tens of degrees, or turned off so that the layers appear to be almost totally decoupled. This effect is correlated with the presence of different crystalline orientations at the interface. The range of influence of N on S is about 240 Å, rather than 20 Å expected from the coherence length ξ_S.

The topography and crystallography of *YBa_2Cu_3-$O_{7-\delta}$ (YBCO)* bicrystal films grown epitaxially on oriented *$SrTiO_3$ (STO)* bicrystals have been characterized by J. Ayache (Orsay) et al. using scanning and transmission electron microscopies (SEM and TEM) and atomic force microscopy (AFM). In agreement with previous reports, the authors found via TEM analysis that the grain boundary in the film did not always follow the planar substrate grain boundary faithfully, but undulated about the average boundary plane.

As shown by J. H. Claassen (NRL), a two-coil mutual inductance apparatus is capable of yielding information about the E(J) relationship with considerably more sensitivity than is available via the usual transport measurement. The author also reports measurements of a contribution from the reactive nonlinearity of the superconductor, due to depairing effects.

A critical thickness for crack formation has been determined by J. Kawashima et al. (SRL-ISTEC) for *YBCO* films deposited on *$SrTiO_3$ (STO)* substrates by the liquid-phase-epitaxy (LPE) method. As-prepared films, even more than 4 μm in thickness, have no visible cracks, while oxygen-annealed films show apparent crack propagation depending on the film thickness, leading to an estimate of about 1.35 μm for the critical thickness. Films formed on *MgO*-buffered *STO* substrates were found to have almost the same critical thickness. By considering thermal expansion of the substrate and the *YBCO* film, which causes internal stress and crack formation in the film, the authors deduced the effective thermal expansion of *YBCO* crystalline films to be 13.4×10^{-6} K^{-1}.

As reported by D. Goo et al. (KAIST), two pieces of textured *Ni* tapes have been diffusively bonded under mechanical pressure, 0.3 MPa, at 1,400°C in a vacuum furnace. The cross-sectional view by SEM showed good bonding without voids in the bonding line, and x-ray-diffraction measurements showed that it was still well textured. A buffer layer of CeO_2 and a superconducting layer of *YBCO* were deposited on the bonded tapes and found to be well textured.

A paper by S. Tokunaga et al. (SRL-ISTEC) reports that an SiO_2 film on a *YBCO* junction is a good passivation film for humidity and annealing.

Applications

The use of small-volume, high-T_c superconducting *YBCO* thin films as low-power, wide-bandwidth mixers in the frequency range 75 GHz to 2.5 THz is discussed in a preprint by M. Lee (Virginia) et al. The *YBCO* films were patterned into lattice-cooled hot-electron bolometers (HEBs) coupled to an integrated *Au* thin-film antenna and transmission line. The bandwidths and small power requirements make these high-T_c superconducting mixers an attractive alternative to existing Schottky diode and conventional superconducting receiver technologies.

The modeling of the electrical properties of high-T_c superconducting bolometers is discussed in a preprint by M. Fardmanesh (Bilkent) and A. Rothwarf (Drexel). The calculated frequency response is in good agreement with experimental results on bolometers made of granular *YBCO* films on crystalline substrates.

A preprint by X. H. Zeng (Jülich) et al. reports on the performance of a first-order axial electronic gradiometer having a baseline of 10 cm, constructed by assembling two $YBa_2Cu_3O_{7-\delta}$ rf SQUID magnetometers with coplanar tank resonators, each having a white magnetic field resolution of about 20 fT/√Hz at 77 K. Using a magnetically shielded room of moderate shielding factor, a team of physicians, assisted by two of the authors, used the gradiometer over ten months to perform magnetocardiographic (MCG) measurements in a medical study of about 80 clinical patients, some with cardiac arrhythmia problems and others with healthy hearts. The system's performance was stable during the entire test period.

Two preprints by H.-J. Krause et al. (Jülich) report on the use of a portable high-temperature superconducting (HTS) SQUID system to test for aircraft wheel and fuselage cracks. The authors conclude that once this technology is improved and systems are developed for specific applications, SQUID systems will have a good chance of being established in aircraft testing.

The application of an HTS SQUID system for the detection of defects in *NbTi* wire manufacturing is reported in a preprint by H. Weinstock (TCSUH) et al. The authors believe the technique would be useful to superconducting wire manufacturers, as it is entirely feasible to use an ordinary HTS SQUID magnetometer to monitor at room temperature the on-line production of composite superconducting wire.

A magnetic levitation system with *YBCO* superconductors and *Nd-Fe-B* magnets has been constructed by P. Verges et al. (Dresden). Stable levitation of the superconductor above the magnets is possible without a regulation or feedback circuit. The demonstrator consists of an engine with two 25-mm diameter *YBCO* disks, cooled by liquid nitrogen, and a magnetic rail made of *Nd-Fe-B* magnets. The engine levitates about 5 mm above the magnetic rail and moves at a speed of about 1 m/s. A linear induction motor was successfully tested for driving the engine.

Overviews

The use of high-temperature superconducting devices as homodyne and heterodyne bolometric detectors of far infrared or submillimeter waves (0.3 THz or λ = 1 mm to 15 THz or λ = 20 μm) is discussed in a review by A. J. Kreisler and A. Gaugue (Paris). Topics discuss electromagnetic coupling aspects and treat submillimeter-wave antenna-coupled superconducting and hot-electron bolometers (56 refs.).

The fundamentals of flux pinning in high-temperature superconductors are reviewed, and a selection of recent experimental results on both high-temperature and conventional superconductors is presented and discussed in a preprint by P. H. Kes (Leiden). Topics include critical currents, flux creep, collective pinning, point disorder by oxygen vacancies, and line disorder by columnar defects (49 refs.).

An overview by V. Selvamanickam (IGC) et al. discusses the performance, cost, and geometry requirements of high-temperature superconductors for electric power and high-energy physics applications. The authors describe progress at Intermagnetics General Corporation in developing four types of high-temperature superconductors: powder-in-tube (PIT) *Bi-2223,* surface-coated *Bi-2212,* PIT *Bi-2212,* and surface-coated *YBCO*. The authors show the transverse cross-section of an 18-strand Rutherford cable fabricated with round, 300-filament, long-length PIT *Bi-2212* conductors (18 refs.).

Contributed by John R. Clem

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TECHNOLOGY NEWS

(Also see Applications section of Nota Bene.)

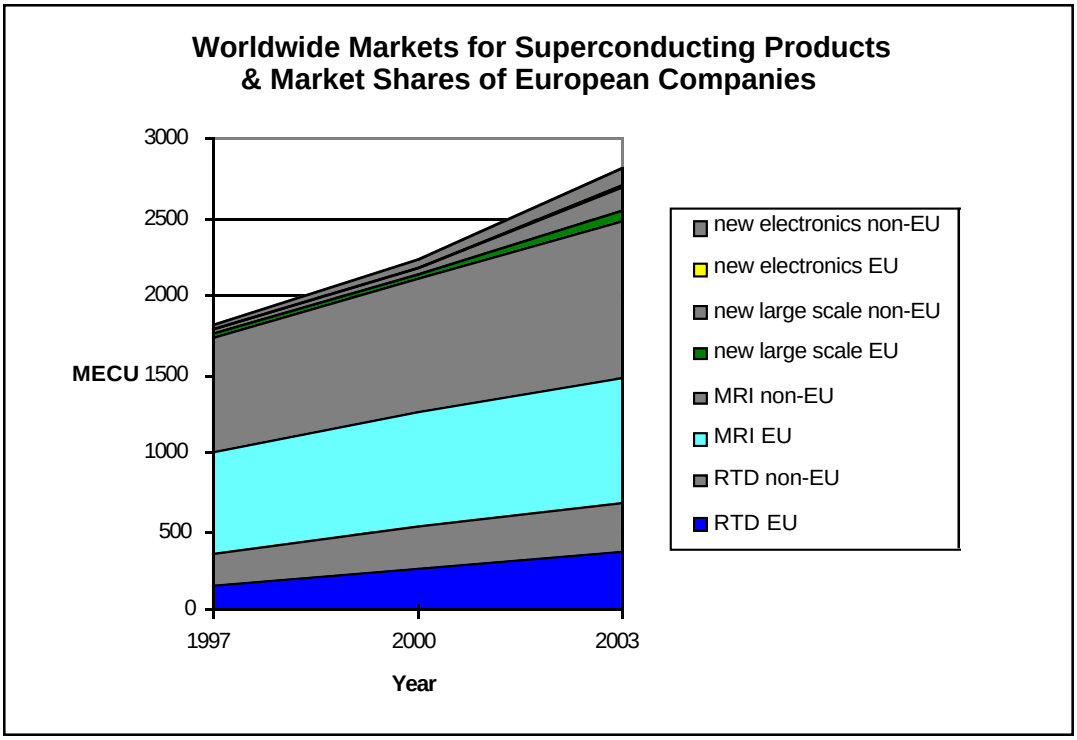
The following report on a recent market survey of European and global superconductivity markets has been contributed by Dr. Juan Farré, Chairman of Conectus & Managing Director of Nordic Superconductor Technologies A/S.

Conectus– the **CON**sortium of **E**uropean **C**ompanies determined **T**o **U**se **S**uperconductivity– announced its recent superconductivity market survey results and made some future projections for the superconductivity markets worldwide. The central objective of Conectus is to strengthen the general infrastructure for commercial applications of superconductivity in Europe. The common basis is to prepare increasingly accurate updates on the state of technology and market developments, thereby providing reliable guidelines for decision-makers in industry, academia, and governments.

Most of today's superconducting products still use LTS materials – these markets are mostly for magnets, ranging from small magnets for university research to enormous systems for large laboratory facilities, the biggest current market being for magnets used in medical diagnosis, such as Magnetic Resonance Imaging (MRI). As can be seen from the graph, both fields together account for most of today's market which was about 1.8 BECU ($2.1 Billion) worldwide in 1997.

In contrast to these traditional fields, there are some exciting new businesses which will be based mostly on HTS. The following areas are addressed: electric power, industrial processing, transportation, (new) medical applications, and information and communication. In the graph, these emerging new businesses are summarized under large scale and electronics applications; no distinction between LTS and HTS is made. Conectus members expect that their growing contributions to the world market will slightly exceed 300 MECU ($350 million) in the year 2003. At this time the EU market share in these new fields is expected to be considerably smaller and estimates suggest that it is about a quarter of the world market. The greatest growth rates among these emerging businesses are seen in the fields of power applications, industrial processing, and communications.

Success in the field of HTS depends on developing materials to techno-economic maturity and organizing efficient production, making model tests of key components, and proving reliability in endurance tests. The consortium



estimates the market in 2020 may reach 40 BECU, based on the expectation that market penetration will be about 15% in the key fields. The Consortium suggests a strong focus on two pre-competitive lines: a) the development of technologies which allow for the cost-effective and reliable manufacture of improved superconducting materials and components; b) the design and operation of systems based on technologies, which are already advanced enough to demonstrate the potential, but not yet competitive.

The membership of Conectus consists of the following corporations:

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Nordic Superconductor Technologies A/S
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A. S. Alexandrov, "d-Wave Bose-Einstein Condensate and Tunneling in Superconducting Cuprates." To be published in Physica C (in press). Department of Physics, Loughborough University, Loughborough, Leicestershire LE11 3TU, UNITED KINGDOM; telephone +44 1509 223303; telefax +44 1509 223986; e-mail asa21@cus.cam.ac.uk. Key words: d-wave, Bose-Einstein condensate and tunneling, superconducting cuprates. 74.20.-z.

A. R. Anderson, M. Murakami, K. Nagashima, and G. J. Russell, "Evidence for a Structural Change in TSMG *Y123* at 225 K." To be published in Physica C (in press). P.O. Box 88, Oatley, New South Wales 2233, AUSTRALIA; phone +61 2 9385 9999; fax +61 2 9385 9864; e-mail a.anderson@unsw.edu.au. Key words: activation energy, internal friction, structural phase transition, ultrasonic attenuation.

Igor S. Aranson, Stefan Scheidl, and Valerii M. Vinokur, "Nonequilibrium Dislocation Dynamics and Instability of Driven Vortex Lattices in Two Dimensions." Submitted to Phys. Rev. B. Contact Janice Coble, Materials Science Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439; phone (630) 252-5497; fax (630) 252-9595; e-mail coble@anl.gov. 74.60.Ge; 61.72.Bb.

J. Ayache, A. Thorel, J. Lesueur, and U. Dahmen, "Characterization of 3-D Grain Boundary Topography in a $YBa_2Cu_3O_{7-\delta}$ Thin Film Bicrystal Grown on a $SrTiO_3$ Substrate." To be published in J. Appl. Phys. CSNSM-CNRS, Université Paris XI-Orsay, Bâtiment 108, F-91405 Orsay Cedex, FRANCE; telephone +33 1 69 41-5219 or -6750; telefax +33 1 69 41-5268; e-mail ayache@csn-hp.in2p3.fr.

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COMING EVENTS

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

*May 18 - 21, 1999:

International Magnetics Conference (INTERMAG 99), Hotel Hyundai, Kyongju, Korea. Purpose is to provide a forum for presentation of new developments in applied magnetics, magnetic phenomena and materials, and information storage techniques. Will include sessions on superconductivity, magnetic levitation and propulsion, and microwave and millimeter-wave applications. Contributed papers are solicited in related topics in all areas. **Digests must be received by November 24, 1998.** For information, contact INTERMAG 99, The Korean Magnetics Society, Rm. 905, The Korea Science and Technology Center, Yeoksam-dong 635-4, Kangnam-ku, Seoul 135-703, Korea; telephone +82 2 967 0518; e-mail intermag@kistmail.kist.re.kr; Web site http://intermag99.kist.re.kr/.

July 11 - 12, 1999:

16th Space Cryogenics Workshop, Quebec City, Canada. Theme will be "Cryogenics for Space Exploration in the Next Millennium," with a focus on the particular technological challenges related to long-term space exploration missions. (This workshop precedes the CEC/ICMC'99 Conference in Montreal.) For information, contact Louis J. Salerno, Chair, 1999 Space Research Workshop, NASA Ames Research Center, Mail Stop 234-1, Moffett Field, CA 94035-1000; telephone (650) 604-3189; telefax (650) 604-0487; e-mail lsalerno@mail.arc.nasa.gov.

*July 12 - 16, 1999:

Cryogenic Engineering Conference & International Cryogenic Materials Conference (CEC/ICMC), Hotel Inter-Continental Montreal, Montreal, Quebec, Canada. The CEC focuses on the science and engineering required for cryogenic applications such as liquefied gases for fuels; space applications of cryogenic liquids; cooling and performance of superconducting magnet systems in medical, transportation, power, and basic research applications; as well as the systems, machinery, control technology, and thermodynamics required to produce low temperatures. The ICMC focuses on the development, characterization, fabrication, and optimization of the materials used in cryogenic applications, typically broken into two broad categories: structural materials and superconducting materials. ICMC contributions cover both high- and low-temperature superconducting materials from basic materials research through behavior of composite cables and wires in applications. Cryogenic structural materials cover a broad range, including non-metallic composites, polymeric resins and insulation materials, ferrous alloys, nickel-base alloys, aluminum

alloys, and specialized materials for advanced cryocooler applications. **Abstract deadline, November 1, 1998 (for mailed submissions) and December 11, 1998 (for Web submissions).** For information, contact Centennial Conferences, 4800 Baseline Road, Suite A-112, Boulder, CO 80303; telephone (303) 499-2299; telefax (303) 499-2599; e-mail centennial@orci.com; Web site http://www.cec-icmc.org.

July 17 - 25, 1999:

5th International Summer School and Scientific Workshop, Eger, Hungary. Organized by the SuperTech Consortium, Hungary. The objective of the Workshop is to provide an overview on the basic and up-to-date information on the theories and newest results both in fundamental research and applications of high temperature superconductors. The main framework of the School is a series of tutorial lectures, each of two-hour duration, presented by well-known scientists and experts. The lectures will be published in textbook form and, in addition, proceedings (containing the lectures and the papers of the conference, videos from the lectures, and the social programs) will be available on a CD-ROM. Round-table sessions to be organized after lectures for free discussion. Last two days of the School will be devoted to a scientific conference for participants willing to present results of their work. **Abstract deadline, March 1, 1999.** For more information, contact Istán Vajda, Department of Electrical Machines and Drives, Technical University of Budapest, H-1111 Budapest, Egry József u. 18., Hungary; phone +36 1 463 2961; fax +36 1 463 3600; e-mail vajda@ntb.bme.hu.

**July 29 - Aug. 2, 1999:*

International Workshop on Low Temperature Physics in Microgravity Environment (CWS-99), ISSP, Chernogolovka, Moscow Region. Satellite to the LT-22 Conference in Helsinki, Finland (Aug. 4-11, 1999). Topics are: studies in low-temperature and fundamental physics in microgravity environment, equilibrium and critical phenomena in quantum fluids and solids, suspended droplets, laser cooling, relativistic effects, and low-temperature techniques for fundamental studies in space. Number of participants limited to 50. **Abstract deadline, March 15, 1999.** For information, contact Leonid Mezhov-Deglin, Inst. of Solid State Physics, Russian Academy of Sciences, 142432 Chernogolovka, Moscow Region, Russia; e-mail mezhov@issp.ac.ru.

**Aug. 4 - 11, 1999:*

22nd International Conference on Low Temperature Physics (LT22), Espoo and Helsinki, Finland. Topics will include: quantum gases, fluids and solids; superconductivity; magnetism and lattice properties; quantum electron transport; applications; materials; and techniques. For information, contact Conference Service Bureau, TSG-Congress Ltd., Kaisaniemenkatu 3 B 31, FIN-00100 Helsinki, Finland; telephone +358 9 628044; telefax +358 9 667675; e-mail info@tsgcongress.fi. For technical information, contact the LT22 Office, Low Temperature Laboratory, Helsinki University of Technology, P.O. Box 2200, FIN-02015 HUT; telephone +358 9 451 2962; telefax +358 9 451 2969; e-mail info@LT22.hut.fi; Web site http://lt22.hut.fi/LT22/LT22.html.

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.

RESOURCES

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Instruments has launched the Cryojet nitrogen jet cryostat specifically designed for x-ray crystallography on macromolecule single crystals. Cryojet has no pumps, no moving parts, and therefore minimal servicing requirements. A key factor contributing to the reliability of operation is the absence of room-temperature pumps and fittings from the gas circuit, which ensures that moisture cannot enter the system causing a flow blockage. This is crucial for chemists and biochemists running long experiments to study the physical structure of small molecules and proteins.

Cryojet operates by delivering a constant flow of temperature stabilized nitrogen gas to a nozzle at the Cryojet head. This may be used for flash cooling samples and for maintaining them at a stable, controlled temperature for the duration of a measurement. The liquid nitrogen is supplied to the Cryojet head by controlled evaporation of liquid nitrogen from a dewar. Because it is held at atmospheric pressure, the dewar can be refilled during operation. A second flow of dry nitrogen acts as a shield around the cold jet to prevent ice accumulation on either the nozzle or the sample.

Combining continuous operation, small size, ease of use, and long-term reliability, Cryojet is ideal for crystallographic applications in the growing fields of research in biotechnology and materials science. For further information, contact Anita Cullen, Oxford Instruments Ltd., Old Station Way, Eynsham, Witney, Oxford OX8 1TL, United Kingdom; phone +44 1189 331331; e-mail enhancemc@compuserve.com.

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