# Session 21AP

## Dynamics of Vortex Lattice Formation in a Rotating Bose-Einstein Condensate **21AP2**

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We study the dynamics of vortex lattice formation of a rotating trapped Bose-Einstein condensate by numerically solving the two-dimensional Gross-Pitaevskii equation with a dissipative term. The condensate trapped in a quadratic potential forms a triangle lattice of quantized vortices, following the damped elliptic oscillation of the condensate and the excitation of surface waves, which is consistent with the experimental results. A fast rotating condensate confined in a quadratic-plus-quartic potential generates a ”giant” vortex absorbing all phase defects into a single density hole, where a quasi-one-dimensional circular superflow is realized. Exciting animation movie of these dynamical processes is shown.

## Structure of vortex lattices in rotating two-component Bose-Einstein condensates **21AP3**

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We investigate theoretically the structure of vortex lattices in rotating two-component Bose-Einstein condensates. The stationary solutions of the coupled Gross-Pitaevskii equations with a rotating term show various nontrivial patterns of vortex lattices, depending on the intra and interspecies interaction strength $g_{11}$, $g_{22}$ and $g_{12}$. For $\sqrt{g_{11}g_{22}} > g_{12}$ the vortices in each condensate form a vortex lattice, and one lattice is displaced to the other to reduce the overlap of the condensates. While for $\sqrt{g_{11}g_{22}} < g_{12}$ when the phase separation of the condensate occurs, the vortex lattices are destroyed, the vortices of each condensate entering the other. The dynamics of formation of these structure is studied.

## 21AP4 Revealing Superfluid–Mott-Insulator Transition in an Optical Lattice

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We study (by an exact numerical scheme) the single-particle density matrix of $\sim 10^3$ ultracold atoms in an optical lattice with a parabolic confining potential. Our simulation is directly relevant to the interpretation and further development of the recent pioneering experiment by Greiner *et al*. [Nature **415**, 39 (2002)]. We show that restructuring of the spatial distribution of the superfluid component when a domain of Mott-insulator phase appears in the system, results in a fine structure of the particle momentum distribution. This feature may be used to locate the point of the superfluid–Mott-insulator transition.

## 21AP5 Bose-Fermi mixed condensates of atomic gas with Boson-Fermion quasi-bound state

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The Boson-Fermion (B-F) mixed condensates of atomic gas are very interesting topics in Bose-Einstein condensation (BEC) physics. In case that the Boson-Fermion interaction is attractive, Boson-Fermion pairs can make quasi-bound states (BF composite fermions), and it causes new phases in the condensate gas. In this paper, we study the possibility of B-F bound states with estimating their bound states using the finite temperature/density Schwinger-Dyson equation for Boson-Fermion pairs. We also make clear the phase structure of the low-temperature B-F mixed condensates with quasi-bound states BF under the equilibrium: $B + F \leftrightarrow BF$. Critical conditions are obtained especially for the BEC and the BF composite fermion degenerate phases.

## 21AP6 Peierls Instability of the Quasi-One-Dimensional Bose-Fermi Mixed Gas

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The mixture of quantum degenerate bose and fermi gases in a highly anisotropic potential at zero temperature is studied. It is found that a giant Kohn anomaly occurs on the Bogoliubov phonon spectrum around wavevector $k = 2k_F$ ($k_F$ is the Fermi wavevector) and the system undergoes the instability which is the analogue of Peierls instability in quasi-one-dimensional conductors. It is proven that the state of bose condensates at $k = 0, 2k_F$ with a fermion density wave is stable and has lower energy than the spatially homogeneous bose condensed state coexisting with a normal fermi gas.

## Two-boson pairing in 2D boson systems. **21AP8**

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We consider a possibility of two-boson pairing in a dilute 2D Bose-gas on a lattice with strong hard-core repulsion $U$ and a Van der Waals attraction tail $V$. We show that the phase diagram for the Bose-gas of one sort structureless bosons consists of two regions. For $V < 2t$, $t$ being a hopping amplitude, the phase diagram contains the region of the usual one-particle Bose-Einstein condensation. But for $V > 2t$ the total phase separation on Mott-Hubbard Bose-solid and dilute Bose gas takes place. However already for Bose-gas consisting of two sorts of structurless bosons described by the two band Hubbard model the $s$-wave pairing of the two bosons of different sorts $\langle b_1 b_2 \rangle \neq 0$ is possible. We discuss the obtained results with respect to recent experiments on 2D Bose condensation of hydrogen and excitons in semiconductors.

## Equation of state from hydrodynamic modes in dense trapped ultracold gases **21AP10**

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Hydrodynamic modes for ultracold gases of any density are considered. By writing the equations for the mode frequencies in a convenient way, we show that it is possible to determine the equation of state of the dense gas from the knowledge of the hydrodynamic frequencies. As an example, we investigate the case of two equal fermionic populations in different hyperfine states with attractive interactions. We also study the limit of the collapse where the interparticle distance is comparable to the scattering length.

## Production of Cold Metastable Helium Atoms in a Cryostat **21AP11**

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Metastable helium ($He^*$) is an attractive atomic species for studies of quantum effects such as Bose condensation. For laser trapping $He^*$, it is crucial to have an intense source of cold atoms. In most experiments, the $He^*$ atoms were produced by a DC discharge in a gas cooled with liquid nitrogen. This method subsequently requires a large-scale Zeeman slower for loading a magneto-optical trap (MOT).
Aiming at constructing a compact MOT without Zeeman slower, we have produced cold $He^*$ atoms in a simple He cryostat. The $He^*$ atoms are generated by a RF discharge in a vapor above a liquid He bath, which is cooled to 1.2K by pumping. The $He^*$ temperature and density are estimated to be 30 K and $10^{11}$ atoms/cc, respectively, from laser spectroscopy of $2^3S_1$-$2^3P_{2,1}$ transition. Improvements are underway to produce lower velocity atoms.

## 21AP12 Quantum Phase separation dynamics in BEC mixtures

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We dicsuss our recent work on phase separation dynamics in mixtures of Bose-Einstein condensates. We show that the coupled **two component** one dimensional Gross-Pitaevskii equations can be solved by the inverse scattering method. This opens the door for the investigation of different excitations for the **two component** system. We illustrate our results by constructing exact **extended** periodic solutions of this equation. We call these type solutions "striatons", in analogy to solitions which are **localized** solutions. Our solution suggests that the experimentally observed long-lived metastable intrinsic straition structure is a new kind of excitation of the two component Bose-Einstein condensates. We can find these solutions only in some region of parameter space. Numerical solution confirms our speculation that not all solutions are metastable.

## 21AP13 Statistical Mechanics of the Gas-liquid Condensation in the Atrractive Bose Gas

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The instability of the Bose gas with the attractive interaction has been known for a long time. However, its orthodox treatment on the basis of the statistical mechanics still remains in an undeveloped state. Recently, a compact form of its grand partition function including the coherence due to the Bose statistics correctly is obtained in the case of the contact attractive interaction, by summing terms of the perturbation expansion up to an infinite order. As a result, a singularity causing the gas-liquid condensation (Yang-Lee's zero) is extracted analytically [1]. This paper develops this analysis more closely, discussing its relationship with the BEC, the repulsive core of particles and implications on the atomic gas experiments.

[1]S.Koh, Phys.Rev.B**64**, 134529(2001), ibd **65**, 019901(E)(2002)

## 21AP14 BCS-BEC Crossover in a Trapped Gas of Fermi Atoms with a Feshbach Resonance

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We present a theoretical study of the BCS-BEC (Bose-Einstein condensation) crossover in a trapped gas of cold Fermi atoms with a Feshbach resonance. We show by including the effect of superfluid fluctuations that two kinds of stable Bosons appear in the strong coupling regime, i.e., (1) stable molecules caused by the Feshbach resonance and (2) preformed Cooper-pairs in which the pairing interaction is mediated by Feshbach quasi-molecules. The phase transition is shown to change continuously from the BCS-type to BEC of these two kinds of Bosons as the Feshbach resonance becomes stronger. In the BEC limit, we find $T_{\rm c} = 0.218 T_{\rm F}$ (uniform system) and $T_{\rm c} = 0.518 T_{\rm F}$ (trapped gas in an isotropic harmonic potential).

## Two-dimensional boson-fermion mixtures in harmonic traps **21AP15**

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Trapped boson-fermion (BF) mixtures are gaining attention because of the advances in symphatetic cooling techniques. Various combinations of interaction strengths among the species in BF mixtures offer the possibility of a rich phase diagram. The goal of this paper is to study the ground-state static properties of a 2D mixture of a Bose condensate and a spin-polarized Fermi gas at $T = 0$. One of the motivations for investigating a (BF) mixture in 2D is the recent successful creation of low dimensional condensates. Second, the fermion density dependence of the total energy functional is quite different in 2D than its counterpart in 3D. We employ the variational method to explore various phases in 2D (BF) mixtures and calculate respective density profiles of the components. We find a host of overlapping and segragated phases similar to the situation in 3D.

## Breathing mode collective excitation of a Bose-Einstein Condensate in a low-dimensional trap **21AP16**

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Using a sum-rule method and a time-dependent variational method, we study the breathing mode collective-excitation frequency of a trapped Bose-Einstein condensate. We show that the result for the three-dimensional trap applies also that to the ideal two- or one-dimensional trap, where the axial or radial degree of freedom is completely neglected. In the case of a realistic two- or one-dimensional trap, we obtain the lowest order correction for the collective-excitation frequency due to the finiteness of the trap frequency in the tightly trapped direction. We also show numerical results for the collective-excitation frequencies using parameters relevant to recent experiments.

## Numerical Analysis of Transition Temperature in Bose-Einstein Condensation **21AP17**

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We numerically investigate Bose-Einstein condensation (BEC) of finite number atoms in a mean field approximation. For the Bose gas interacting with a weak repulsive potential and trapped in an external parabolic potential, BEC occurs at finite temperature in one-, two-, and three-dimensional systems. The BEC state is identified by the non-vanishing thermal average of a boson field. Since the normal state can exist even at lower temperature, we compare free energies between the BEC state and the normal state and define the transition temperature as a crossing point of free energies. Relations among the transition temperature, the total number of atoms, and the repulsive coupling constant are provided and dimensional dependences of the relations are discussed.

## 21AP18 Simulations of Dynamics for Wavepackets made by Two-Component Bose-Einstein Condensates in Alkali-Atom Gases

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In relation with experimental report JILA, in which Bose condensates of $^{87}$Rb for different hyperfine states $\Psi_1$=|F=1,m=-1⟩ and $\Psi_2$=|F=2,m=1 ⟩ can be confined under various conditions in harmonic traps. We calculate [1] the behavior of $\Psi_1$ and $\Psi_2$ for the following two cases. (a)At the initial state, both states are fixed in the identical trap: With increasing time, we obtain the shell structure for $\Psi_1$ with strong repulsion, while $\Psi_2$ with weak repulsion occupies the center. (b) We give relative sags to both states in center of the trap: As a result, $\Psi_1$ and $\Psi_2$ show the phase-separation indicating the vibrational behavior. For (a) and (b), the agreements between the simulations and experiments are well. [1] K.Doi and Y.Natsume, J.Phys.Soc.Jpn **70** (2001),167

## 21AP19 Collective Spin Dynamics in a Dilute Bose Gas

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We present a finite temperature kinetic theory for a dilute, trapped Bose-condensed gas of two-level atoms. This spin-1/2 system exhibits interesting collective spin dynamics. Above $T_c$, the exchange mean field gives rise to spin-wave collective modes, which have been observed in recent JILA experiments. In the opposite limit of $T = 0$, interesting effects have also been observed in the spin-1/2 condensate at JILA, such as spin "untwisting" and vortex spin textures. We give a unified theoretical description which interporates thses two situations, and discuss possible new physics that occurs below $T_c$ where the spins of the condensate and thermal atoms interact through mean field and collisions.

## 21AP20 Collective Ferromagnetic States of Degenerate Atomic Fermi Gas with Two Components in Trapping Potential

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Particle distributions of the ground state are studied for a trapped degenerate Fermi gas of atoms with two-components (spin up and down) in terms of the Thomas-Fermi approximation. A spin asymmetric ground state is shown to appear for systems with a strong repulsive interaction or with large particle numbers. A condition for a realization of the spin asymmetric state is obtained.

## RPA Study of Collective Excitations in the Bose-Fermi Mixted Condensate of Alkali-Metal Gases

**21AP21**

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We perform RPA (Random Phase Approximation) study of collective excitations in the bose-fermi mixed degenerate gas of Alkali-metal atoms at $T = 0$. We investigate strength distributions for different combinations of bose and fermi multipole ($L$) operators with $L = 0, 1, 2, 3$. Transition densities and dynamical structure factors are calculated for collective excitations. Comparison with the sum rule prediction for the collective frequency is given. Time dependent behavior of the system after an external impulse is studied.

## Universality of the ground states of rotating bosonic atoms in magnetic traps

**21AP23**

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Trapped bosonic atoms with manipulated interaction strength near the sign flip of the scattering length are considered. Analytic solutions for the rotating ground states are obtained within algebraic approach [1]. It is shown that the form of the ground states at any angular momentum is universal, and it do not depend on the details of the interaction. The ground states are either "collective rotations" or "condensed vortex states", depending on the sign of the 'modified Born scattering length'. Application of the techniques to fermion system (quantum Hall effect) are discussed.

[1] To be subm. to PRL; Phys.Rev A65, 035603 (2002); Phys.Rev. A65 n5 (in press); Ann.Phys.(2002)in press.

## Oscillatory Transient Studies in the Convection of Supercritical $^3$He

**21AP24**

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We discuss the observed transient pattern of the temperature difference $\Delta T(t)$ observed across a very compressible $^3$He fluid layer in a Rayleigh-Bénard cell after starting the vertical heat flow $q$. The experiments are carried out along the critical isochore over a range $5 \times 10^{-4} < \epsilon < 0.2$ where $\epsilon = (T - T_c)/T_c$ with $T_c$= 3.318 K. For $q > q_{ons}$ ("convection onset"), the transient $\Delta T(t)$ shows an overshoot before decaying non-exponentially to the steady-state value $\Delta T$. It becomes larger with increasing $q$ until unusual damped oscillations in $\Delta T(t)$ appear, their rate increasing with $q$. At high values of $q$ and for $\epsilon$ <0.01, oscillations are no longer observed. The $\Delta T(t)$ pattern are compared with 2D simulations by Onuki et al. and by Amiroudine and Zappoli showing oscillations. There is fair agreement inside the ($\epsilon, q$) range where damped oscillations are observed, but the simulations do not reproduce the experiments outside.

## 21AP25 Finite-size effects on the thermal conductivity of $^4$He near $T_\lambda$

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We present the results of a renormalization-group calculation of the thermal conductivity of confined $^4$He in cylindrical geometry above and at $T_\lambda$ within model F with Dirichlet boundary conditions for the order parameter. We assume a heat flow parallel to the boundaries which implies Neumann boundary conditions for the entropy density. No adjustable parameters other than those known from bulk theory are used. Our theoretical results are compared with experimental data by Kahn and Ahlers.

## 21AP26 Nonuniversal critical Casimir force in confined $^4$He near the superfluid transition

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We present the result of a renormalization-group calculation of the effect of a van der Waals type interaction on the free energy of confined $^4$He near the superfluid transition. We consider a $^4$He film of thickness $L$ and assume Dirichlet boundary conditions for the order parameter. In the region $L \geq \xi$ (correlation length) we find that the van der Waals interaction causes a leading nonuniversal contribution $\sim \xi^2 L^{-6}$ to the critical temperature dependence of the Casimir force above $T_\lambda$ that dominates the universal scaling contribution $\sim e^{-L/\xi}$ predicted by earlier theories.

## 21AP27 Anomalous Temperature Dependence of the Casimir Attraction between Thin Metallic Films.

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A general expression for the Casimir force between a metallic film and an ideal bulk conductor is obtained for the conditions where the thickness $d$ of the film is much less than the characteristic skin depth $\delta$ and the spacing $a$ between the conductors. This expression consists of two terms. One of them, $F_q$, is related to the quantum fluctuations of the electromagnetic field and the second one, $F_{th}$, describes the attraction caused by the thermal fluctuations. The thermal force is shown to growth with the temperature $T$. The quantum force is defined by the conductivity of the film, and, therefore decreases with the increase of $T$. These sequences lead to the anomalous nonmonotonous temperature dependence of Casimir force for some range of the parameters of the problem.

## Vortex Loop Fluctuations in Casimir Thinning of Helium Films — 21AP28

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A vortex-loop renormalization theory is used to calculate the Casimir forces that lead to the thinning of $^4$He films near the superfluid transition point. For periodic boundary conditions the force is a maximum when the loop size becomes comparable to the film thickness. The results for T $<$ $T_c$ match well with a 2-loop $\epsilon$-expansion by Dietrich and Krech valid for T $>$ $T_c$. Although the periodic boundary conditions are not directly applicable to the experiments, the results suggest a revised interpretation of the existing data.
Work supported by the National Science Foundation, DMR-0131111

## Geometry of Fluctuating Vortex Loops at Superfluid Phase Transitions — 21AP29

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The geometrical properties of thermally-excited vortex loops near a superfluid phase transition are deduced from an analytic vortex-renormalization theory. The fractal Hausdorff dimensionality of the loops is $D_H$ = 2.5, and the corresponding 'anomalous' dimensionality exponent is $\eta$ = -0.5. This shows that their geometry falls midway between being strictly planar loops ($D_H$ = 2.0) and wound-up balls of string ($D_H$ = 3.0). As the temperature is increased towards $T_c$ the density distribution of loops of average diameter $a$ crosses over from exponential to algebraic decay in the loop diameter. Just at $T_c$ the distribution falls off algebraically as $a^{-\lambda}$, where $\lambda$ = D+1 = 4.0, which is in exact agreement with a cosmic-string prediction of Vilenkin and Vachaspati.
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## Test of Yang-Yang Anomaly in $^3$He near its Liquid-Vapor Critical Point — 21AP30

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The Yang-Yang thermodynamic relation established a direct connection between the singularity in the heat capacity at constant volume, $C_V$, and the temperature dependence of the second derivatives in the chemical potential $(d^2\mu/dT^2)_\sigma$ and the pressure $(d^2P/dT^2)_\sigma$ in the two-phase region of a liquid-vapor critical point. The lattice gas model and all currently-in-use equations-of-state assume that the entire singularity in $C_V$ is taken up in $(d^2P/dT^2)_\sigma$. A recent analysis by M. E. Fisher *et al.* suggests that $(d^2\mu/dT^2)_\sigma$ and $(d^2P/dT^2)_\sigma$ contribute almost equally to the $C_V$ singularity. Kostrowicka Wyczalkowska *et al.* demonstrated that impurities can complicate the analysis of these measurements. We have performed high precision $C_V$ measurements in the two-phase region with 1ppm pure $^3$He to determine the bounds on the size of these singularities. The results of these measurements will be presented.

## 21AP31 New propagating mode near the superfluid transition in $^4$He

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We have observed a genuinely new temperature-entropy wave that propagates opposite to the direction of a steady heat flux $\vec{Q}$ when the helium column is heated from above. Counter intuitively this new mode, which resembles second sound, propagates on the normal fluid side of the transition, but it exists only when the column of helium is heated from above. Such a new mode had been predicted to exist on the self-organized heat transport state for $Q$ less than about 100 nW/cm$^2$. We confirm that this mode exists in this regime, however we also observe that it propagates even when the helium is held off from the self-organized heat transport state. This work has been supported by the Fundamental Physics Discipline of the Microgravity Science Office of NASA.

## 21AP32 Thermal conductivity measurements on $^4$He in aerogels near the $\lambda$-line

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The static critical properties, such as the superfluid density and the heat capacity, of 4He near the ?-line are modified considerable when the fluid is adsorbed in an aerogel. Very little is known of the dynamic critical behavior as for example shown in the thermal conductivity. Attempts to measure the thermal conductivity have in the past been thwarted by the appearance of superfluid thermal shorts below the bulk transition temperature but above the $T_c$ in the aerogel. By growing the aerogel in a glass capillary array, this problem has been eliminated, and an apparent divergence of the thermal conductivity is observed which coincides with $T_c$

## 21AP33 Low Density Thin Films of $^4$He in Vycor

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$^4$He in vycor glass is a unique systems that allows us to observe the low density 3D behavior of a superfluid. As the density is lowered, behavior approaching that of an ideal bose condensate is seen. To measure properties at the lowest densities, it is necessary to cool the system to the lowest temperatures. A current experiment is running and has been designed to allow cooling of the vycor system down to one mill-kelvin, and thus allow a measurement of very low densities. We will present data from this experiment.

## Phase Separation Study Near the Tricritical Point in 3He-4He Mixtures **21AP34**

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Our understanding of critical phenomena can be uniquely tested at the tricritical point in the helium-3/helium-4 phase diagram. The associated critical exponents are (exact) integer fractions with logarithmic corrections to this critical behavior because D=3 is the marginal spatial dimension for tricriticality. All of the phase boundaries should appear linear in the temperature concentration plane, with extremely weak logarithmic corrections. We report on our study of the phase separation performed using inter-digital capacitor sensors on the top and bottom of our cell to measure the phase separation by probing the local concentration.

## Non-linear second sound in $^3$He –$^4$He mixtures near the tricritical point **21AP35**

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The tricritical point in the phase diagram of $^3$He –$^4$He mixtures offers unique opportunities to test our understanding of critical phenomena. Because D = 3 is the marginal spatial dimension for tricriticality, associated critical exponents are exact integer fractions. In addition, one expects to find logarithmic corrections. We present results for the superfluid density, obtained from time-of-flight non-linear second sound measurements near the tricritical point and along the phase separation curve.

## Heat Capacity of Mixtures of $^3$He-$^4$He Confined to Coupled 1$\mu$m boxes. **21AP36**

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We have measured the heat capacity of helium mixtures confined to lithographically created cylindrical boxes whose height, 1.08$\mu$m, equals their diameter. The specific heat at constant concentration $x$, $C_{px}$, is renormalized due to the $^3$He impurity. Thus, in order to observe critical behavior, a conversion must be made to a specific heat at constant $\phi=\mu_3-\mu_4$, $C_{p\phi}$. The confined system's specific heat, near it's maximum, has values which rise above the bulk system's specific heat at the same temperature. This is unexpected and is true for both $C_{px}$ and $C_{p\phi}$. This enhancement, not observed with pure $^4$He, becomes more dramatic as $x$ and the correlation length increase. The shift of the maximum with $x$ is much larger for the boxes than for 2D confined mixtures. These observations might be related to a "band structure" effect associated with the 18.5 nm channels which connect the cylinders.

## 21AP37 Theromodynamic and magnetic properties of the confined neutral Fermi systems

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In the present work we continue our study of the influence of the restricted geometry on properties of a neutral Fermi system (JETP Lett., 72, 616 (2000)). The examples of such systems are liquid or gaseous $^3$He in porous substances, in aerogels etc. It is shown that taking into account the existence of a pore size distribution leads to the smoothing of magnetic susceptibility oscillations. The heat capacity and magnetic suscpetibility of liquid $^3$He "puddles" in $^3$He-$^4$He thin films are considered.

## 21AP38 Torsion Oscillator Study of 3-Dimencial Superfluidity of $^4$He Thin Films in 10 $\mu$m Porous Glass

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The superfluid density of thin helium films (superfluid transition temperature 0.1 K $< T_C <$ 0.88 K) condensed on 10 $\mu$m porous glasses was studied. In spite of 2-dimential linear behavior of $T_C$-film thickness relation, the 3-dimensional coherence length is found to be beyond the pore size over the whole superfluid temperature range. We discuss the 3-dimensional nature of the superfluidity of the system.

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## 21AP39 Tosional Oscillator Experiment for superfluid $^4$He on porous glass under the rotation with the speed up to 2.0 rev./s

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3D features of the $^4$He film on a porous glass is studied with Torsional Oscillator technique under rotation up to 2.0 rev./s. We compare the results with the previously reported double peak energy dissipation.

## Superfluidity of Disordered Bose Systems: Numerical Analysis of the Gross-Pitaevskii Equation with a Random Potential

**21AP41**

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We study the two-dimensional superfluidity of disordered Bose systems by analyzing the Gross-Pitaevskii equation(GPE) with a random potential. First, we obtain the ground state of the GPE and calculate its superfluid density by the linear response theory. We show their remarkable dependence on the potential amplitude, the healing length and the density. Secondly, we apply the velocity field to these ground states, and observe the breaking of superfluidity due to vortex pairs excited above a critical velocity.

## Bose-Einstein Condensation and Superfluidity of Dirty Bose Gas

**21AP42**

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We develop the dilute Bose gas model with random potential in order to understand the Bose system in random media such as $^4$He in porous glass. Using the random potential taking account of the pore size dependence, we can compare quantitatively the calculated specific heat with the experimental results, without free parameters. The agreement is excellent at low temperatures, which justifies our model. The relation between Bose condensation and superfluidity is discussed. Our model can predict some unobserved phenomena in this system.

## Dynamics of the collapse of a Bose–Einstein condensate

**21AP43**

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We investigate the dynamical stability of a Bose–Einstein condensate in a non–isotropic harmonic magnetic trap and present the conditions for the collapse of the system. We show that the condensate may exhibit a variety of exciting phenomena. The system has two modes of viobration, transverse and longitudinal. If the mean–field interaction between the atoms is attractive and if the energy of the system is negative the condensate droplet collapses. When the collapse takes there is an interesting interplay between the modes of vibration.