dot, the exact ground state energy has cusps at the same angular momentum values as the mean-field theory. For large N, Wen's algebraic decay of the probability for resonant tunneling through the dot is reproduced, albeit with a different exponent. The theory can be readily generalized to include spin-unpolarized states.

13:12
B29 12 **A new proposal for a quasielectron wavefunction for the FQHE on a disk***. MARCUS KASNER and WALTER APEL, *Physikalisch–Technische Bundesanstalt Braunschweig, Germany* — We propose a new quasielectron trial wavefunction for a two–dimensional disk containing N interacting electrons in a strong magnetic field. First, a wavefunction is presented which displays the correct filling factor corresponding to a quasielectron. The following application of the magnetic translation operator leads to N+1 orthogonal eigenfunctions. The energy expectation values of these wavefunctions are calculated for up to eight particles. These energies are then compared with the data from exact numerical diagonalizations and with expectation values for different trial quasielectron wavefunctions proposed by other authors.

Supplementary Paper

B29 13 Root configurations and many body interactions for fractionally quantized Hall states. M. Greiter, Institute for Advanced Study — Laughlin's theory of the fractional quantum Hall effect, viewed as a description of universality classes by model Hamiltonians with two-body interactions excluding small relative angular momenta and their exact ground states, is generalized to the case of many-body interaction potentials. In particular, a direct correspondence is established between the many-body potentials and the root configurations of the ground states, from which all the terms in the expansion of the wave function on the sphere are obtained via squeezing operations. The general principles are illustrated with examples at various rational filling fractions.

SESSION B30: DCMP: ^{4}He: LIQUID AND SOLID
Monday morning, 22 March 1993
Room 209 at 11:00
G. Ahlers, presiding

11:00
B30 1 Cooling of low-energy 4He beams.* N. Mulders and A.F.G. Wyatt, University of Exeter. _ Atomic scattering experiments indicate that 4He has an anomalously large low-energy scattering cross section.1) As a result, even at modest densities the interactions in a helium beam are sufficiently large to give rise to very high levels of beam cooling. Using a metal film heater covered with a superfluid film we have generated atom pulses with a mean energy in the range of 1 to 3 Kelvin. From a time of flight measurement we estimate a width in the momentum distribution. Under the right conditions of heater pulse shape and power, $\Delta p/p < 0.05$. There is also significant directional cooling, i.e., the beam is sharply peaked in the forward direction. These near mono-energetic atom beams are especially useful in quantum condensation experiments which involve energies close to the roton minimum in the dispersion curve.

1) J.C. Mester et al., JLTP **89**, 569 (1992).
* Supported by SERC grant GR-G37408

11:12
B30 2 SINGLE ELECTRON TUNNELING FROM BOUND STATES ON THE SURFACE OF LIQUID HELIUM. G. F. SAVILLE, J. M. GOODKIND, University of California, San Diego.--- Tunneling rates for the escape of electrons from the surface of liquid helium have been measured over a range of six orders of magnitude as a function of electric field and electron density. The rates are over an order of magnitude smaller than previously measured rates and are in good agreement with numerical solutions of the Schrödinger equation using a static single particle potential. In this potential, the term due to the interaction of the electron with the helium has been previously determined by spectroscopy of the electron bound states[1], and the many body effects due to the electron surface layer are incorporated into an effective single particle term. In addition, changes in the tunelling rate when ^{3}He is added to the system are used to measure changes in the electron groundstate energy of a few tens of millikelvin due to the formation of a ^{3}He surface layer at low temperatures.

[1]C.C. Grimes, T.R. Brown, M.L. Burns, and C.L. Zipfel, Phys. Rev. B13, 140 (1976)

11:24
B30 3 **WAVE FUNCTION FOR BULK ^{4}He WITH AN ATTRACTIVE SHADOW PSEUDOPOTENTIAL. T.MACFARLAND**, *Cornell University* **L. Reatto** and **S. A. VITIELLO**, *Universitá degli Studi Milano* — We report a new form of shadow wavefunction that provides an improved description of the ground state of bulk ^{4}He. It has a pseudopotential with an attractive part for the shadow variables. This new form has greatly improved variational energies compared with those of the original shadow wavefunction. The new energies are close to the best of which we are aware. It also has enhanced the description of other properties. The two-body correlations are now in excellent agreement with those of Greens Function Monte Carlo. The computed condensate fraction agrees much better with the accepted value. We have used a basis set approach to optimize the two body pseudopotential of the particles, yielding further improvement. This new trial function maintains the basic properties of this class of wavefunction: It is Bose symmetric and translationally invariant in both the liquid and solid phases of ^{4}He. It does not need an explicitly prescribed lattice to describe the solid phase.

11:36
B30 4 **Momentum Distribution and Final State Effects in Quantum Fluids and Solids.** H. R. GLYDE, *Department of Physics and Astronomy, University of Delaware,* K. H. ANDERSEN, R. AZUAH, AND W. G. STIRLING, *University of Keele (U.K.).*— We present a new method of extracting the momentum distribution, $n(p)$, and Final State Effects from measurements of the dynamic structure factor, $S(Q,\omega)$, at intermediate and high momentum transfer. Results for $n(p)$, the one body density matrix and the Final State Resolution function $R(Q,\omega)$ in normal and superfluid ^{4}He are presented to illustrate the technique. The method is based on expanding the intermediate scattering function $S(Q,t)$ in powers of t. High Q is a short scattering time limit. The expanded form of $S(Q,t)$ is fitted to experiment to determine the coefficients of the expansion. The terms in the expansion belonging to $n(p)$ and $R(Q,\omega)$ are then used to reconstruct $n(p)$ and $R(Q,\omega)$. The method is very general and applications to other fluids and solids are discussed.

BULL. AM. PHYS. SOC. 38, 137 (1993)

ROOT CONFIGURATIONS & MANY-BODY INTERACTIONS FOR QUANTIZED HALL STATES

Laughlin's $\frac{1}{m}$ state:

$$\Psi[u_i, v_i] = \prod_{i<j} (u_i v_j - u_j v_i)^m$$

is the unique ground state of a model Hamiltonian demanding

$\Psi \propto d^m$

as 2 particles approach each other

Q : Can we generalize to other filling fractions using many-body interactions ?

($\nu = \frac{2}{5}$ via 3 body - int. ?)

Root configurations :

Lauglin $\frac{1}{3}$:

$$\overset{0}{1}00\overset{3}{1}00\overset{6}{1}00\overset{9}{1}\ \ldots \qquad \text{means} \qquad u_1^{0}\, u_2^{3}\, u_3^{6}\ \ldots$$

specifies Ψ uniquely ; all terms in the expansion of Ψ can be obtained via squeezing operations :

$$\begin{array}{c} ..010010... \\ \searrow\ \swarrow \\ ..001100... \end{array} \qquad \text{but} \qquad \cancel{\begin{array}{c} ..010010... \\ \swarrow\ \ \ \ \searrow \\ ..100001... \end{array}}$$

Their coefficients are then fixed by demanding rotational in-variance on the sphere:

$$\vec{L}\,\psi = 0$$

Their is a direct correspondence between these root configurations and the model Hamiltonians which single out ψ as unique ground state:

$\begin{array}{cccccccccc} 0 & & & 3 & & & 6 & & & 9 \\ 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1\ldots \end{array}$ implies

$\psi \propto d^{3}$ as 2 particles approach

$\psi \propto d^{3+6}$ " 3 " "

etc.

This idea can be generalized and used to construct states at various filling fractions :

e.g.

$$\overset{0\,1}{1\,1}\,0\,0\,0\,\overset{5\,6}{1\,1}\,0\,0\,0\,1\,1\,\ldots$$

is the unique ground state of a model Hamiltonian demanding

$\psi \propto d^{0+1+3}$ as 3 particles approach each other

The filling fraction is $\nu = \frac{2}{5}$:

simple period $\underbrace{\overbrace{11}^{2\text{ electrons}}000}_{5\text{ states}}$

Similarly, we can construct states at $3/7$, $4/9$ etc.

$\frac{3}{7}$ $\quad \overset{0}{1}\overset{1}{1}00\overset{4}{1}00\,\overset{7}{1}100100 \ldots$

$\psi \propto d^{12}$ as 4 part. approach

$\frac{4}{9}$ $\quad \overset{0}{1}\overset{1}{1}00\overset{4}{1}\overset{5}{1}000\,\overset{9}{1}10011000 \ldots$

$\psi \propto d^{13}$ as 5 part. approach