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KITP 12.5.04

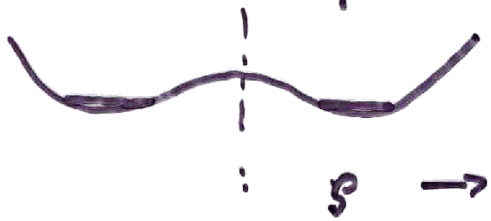
①

Rotation in Mean-Field Regime

1. Thomas-Fermi profile if # of vortices $N_v \gg 1$.

2. Non uniformity of vortex lattice.
   (Effect of order $1/N_v$)

3. Anharmonic traps.



$V(\rho) = \frac{1}{2} m \Omega^2 \rho^2$

$\rho \longrightarrow$

Optimal frequency in lowest Landau level is rotation frequency.

4. Dynamics. Use frequency in LLL wave fn. as dynamical variable.

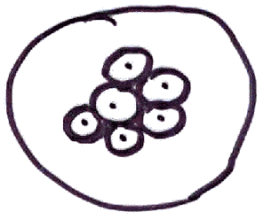
5. LLL wave function as a tool for understanding hydrodynamics.

②

1. LLL wave fn. localized on length scale $\sim \left(\frac{\hbar}{m\Omega}\right)^{\frac{1}{2}}$.
   ∴ "Bending" density distribution costs little energy.

TF profile
"Two length scales"
Fischer & Baym
Baym + CJP
Watanabe

LLL wave fns.
Sinova, Hanna, MacDonald, P.R.L. (2003)
Cooper, Read, Kominis



$\psi = \prod (z - z_i) e^{-|z|^2/2\ell^2}$

$z = x + iy$

(3)

2. Lattice distortion

LLL

$$\underbrace{\nabla^2 \ln|\Psi|^2}_{\sim \frac{1}{N_v}} = \frac{4}{\ell^2} - 4\pi n_v$$

n_v: vortex density / area

(e.g. Sheehy & Radzihovsky)

3.-4. How to treat breathing mode?

Angular momentum & size coupled in LLL if ℓ fixed.

Treat ℓ as dynamical variable.

(4)

5. Kelvin's theorem.

"Vortices move with local fluid velocity."

When does it work?

a. What is "local fluid velocity".

Velocity inhomogeneous.

b. Free particle in oscillator (Halvor Nilsen)

$$\psi = (z - z_0)\, e^{-|z|^2/2a_{ho}^2}$$

Precesses at trap frequency

Velocity field is $\frac{\hbar}{m|z - z_0|}$.