Quartic Discussions

July, 2016

25th July, 2016

Hamiltonians up to quartic order — Anisotropic / Isotropic

I. $\mathcal{H} = \mathcal{H}_{quad} + \mathcal{H}_{quartic}$

Case I:- $\mathcal{H}_{quad} = p_x^2 + p_y^2$. (2 eigenvalues)

II $= p_x^2$ (1 ")

III. $= 0$ (0 ")

ie Arbitrary quadratic $\mathcal{H}$ can be reduced to one of these forms using a linear transformation.

Case I:- As $B \to 0$, ie $l/a \to \infty$ $\left(B \propto \frac{1}{l^2}\right)$.

p_x^2, p_y^2 dominate.

(Assume rescaled coeffs for p^{2n}).

in the Landau gauge.

Suppose $\mathcal{H} = p_x^2 + p_y^2 + \lambda(p_x^4 + p_y^4)$.

$$\mathcal{H} \sim p_x^2 + c B^2 x^2 + \lambda c^2 B^4 x^4$$
$$+ \lambda p_x^4$$

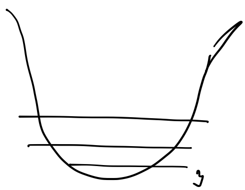
In the LLL / lowest eigenstate of H, ψ is negligible beyond

$$x \sim \ell$$

<u>Condn:-</u>

$$\langle c B^2 x^2 \rangle \sim \langle \lambda c^2 B^4 x^4 \rangle$$

$\frac{\ell}{a} \to \infty$.



$E(p)$.

X ———————— X.

for $H_{quad} = 0$

$H_{quartic} = H_0^2$

physics — band geometric
- stability of FQHE (gap)

— Hall viscosity
— Conductivity at finite q } depend on H.

26th July, 2016

The first thing to prove is :-

Given an effective Hamiltonian :-

$$\mathcal{H} = (P_x^2 + P_y^2) + \sum_{i=x,y} \lambda_{i,n} (P_i)^{2n}$$

working in say, the Landau gauge,

$\vec{A} = (0, Bx)$ with the substitution

$\vec{p} \to \vec{p} - \frac{e}{c}\vec{A}$ and say $k_y = 0$,

the relative

perturbative corrections to the

energy & the eigenvalues always $\to 0$

as $B \to \infty$, i.e if we we write.

$|\psi(B, \lambda)\rangle$, $E(B, \lambda)$.

$$|\psi(B, \lambda)\rangle = c_0 |\psi_0(B, \lambda = 0)\rangle + \sum_n c_n \lambda^n |\psi'(B, \lambda)\rangle$$

where $c_0^2 + \lambda^2 = 1$, $|\psi_0(B, \lambda)\rangle$, $|\psi'(B, \lambda)\rangle$

are normalized w.f's, then.

$C_n(B, \lambda) \to 0$ as $B \to \infty$.

and similarly for the energy.

2. Find the effective Hamiltonian when the low-energy space consists of the lowest few LL's. (See Wiki page on pert. theory (q. mech) for defn of effective H).