SHORT OVERVIEW OF DIFFERNET TYPES OF HALL PHONEOMENA

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Different types of Hall Phoneomena are some of the most active researched results in Condensed Matter Physics!

1. The Classical Hall Effect

Recall from an E&M class that given a particle, the force acting on that particle from an E&M system is

$$\vec{F_b} = c(\vec{\mathbf{E}} + \vec{v} \times \vec{\mathbf{B}})$$

Where c is the charge of the particle, $\vec{v}$ is the velocity, and $\vec{\mathbf{E}}$&$\vec{\mathbf{B}}$ are the direction / magnitude of the fields at the location of the particle.

So now picture this setup: Given a piece of condutive material lets induce a current along the $\vec{x}$ axis. Let's then induce a magnetic field pointing upwards on the $\vec{z}$ axis. Now, lets measure the voltage across the $\vec{y}$ axis.

Inititally, you might think that there should be no voltage here, because there is no current in that direction. But actually, there is an induced current given by the Lorenz force!

So why is this interesting? Well it gives us a nonsymmetric quantity to look over. This lets us defintiively determine things like how doped a material is.

2. Expanding into other Phoneomena

The first thing you have to understand when starting to learn about other types of Hall Phoneomena is that while the end result might be similar enough to have related naming, the physics to get there is completelty disjoint.

I guess the main classification is that

Now when you look at these results, notice something interesting here. Looking at the names of all of these different states we see that they are basically modifiers to what is going on in the classical effect. Yet when we go into it, you will see there is actually little related structure in derevation between any of these results! This is one of the things that makes many body phoneomenon interesting, because many different results can lead us to the same idea.

Attatched below is a table that should give insight on all the differnt permutations

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