Ferromagnetism (rough sketch)

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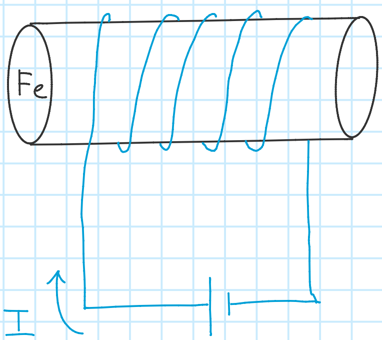
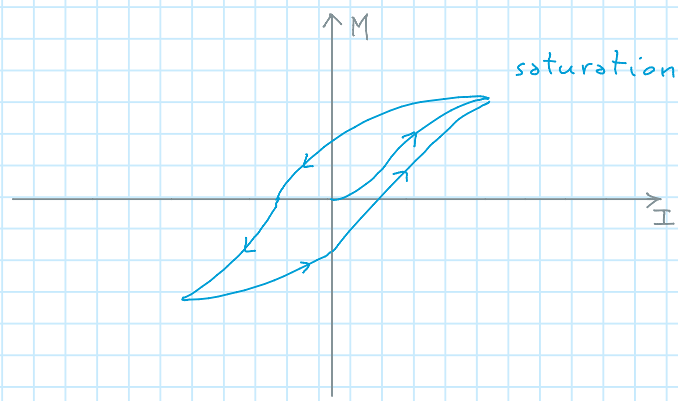
In a magnet each microscopic dipole "likes" to point in the same direction as its neighbors (for quantum mechanical reasons).
This alignment occurs in relatively small patches, called domain. The domains typically include more than ~ 10^19 magnetic dipoles.
The domain have in normal conditions a random orientation.
An external magnetic field will change and move the boundaries between domains, favoring domains which are aligned to the field, which will become larger at the expense of domains which are not aligned to the field.

If the field is strong enough, one domain takes over the entire object. In this case the material is said to be saturated.

The process of shifting domain boundaries is not entirely reversible: the material enters an Hysteresis Loop
Consider for example a cylinder made of iron inserted in a solenoid.





The hysteresis cycle is typically plotted in the H vs B plane , but

$$H \propto I \quad \text{and} \quad \bar{B} = \mu_0 \left(\bar{H} + \bar{M}\right)$$

However typically

$$|\bar{M}| \gg |\bar{H}|, \quad \text{therefore} \quad \bar{B} \propto \bar{M}$$

$$B \text{ vs } H \iff M \text{ vs } I$$

In a ferromagnetic material, the ferromagnetic properties disappear above the Curie temperature of the material (because thermal motion destroys the domains) The abrupt change in the material properties at the Curie temperature is a phase transition.