# Diamagnetism

In many substances the atom have no permanent magnetic moments, in these circumstances, when you turn on a magnetic field, little extra currents are generated inside the atom by induction. According to Lenz's law, these currents are in such a direction as to oppose the increasing field. So the induced magnetic moments of the atoms are directed opposite to the magnetic field.

This is the mechanism of diamagnetism.

# Paramagnetism

Then there are some substances for which the atom do have a permanent magnetic moment, so besides the diamagnetic effect, there is also the possibility of lining up the individual atomic magnetic moments. In this case, the moments try to line up with the magnetic field, and the induced magnetism tends to enhance the magnetic field.

These are the paramagnetic substances.

paramagnetism is generally fairly weak because the lining-up forces are relatively small compared with the forces from the thermal motions which try to derange the order.

paramagnetism is usually sensitive to the temperature.

for ordinary paramagnetism, the lower the temperature, the stronger the effect.

Diamagnectism, on the other hand, is more or less independent of the temperature.

In any substance with built-in magnetic moments there is a diamagnetic as well as a paramagnetic effect, but the paramagnetic effect usually dominates.

a ferroeletric material, in which all the electric dipoles get lined up by their own mutual electic field.

But the magnetic analog of ferroeletricity is impossible because the magnetic forces are so much smaller than the electric forces, thermal motions should knock out this alignment even at temperatures as low as a few tenths of a degree Kelvin.

On the other hand, this is exactly what does happen in iron — it does get lined up.

There is an effective force between the magnetic moments of the different atoms of iron which is much, much greater than the direct magnetic interaction.

It is an indirect effect which can be explained only by quantum mechanics.