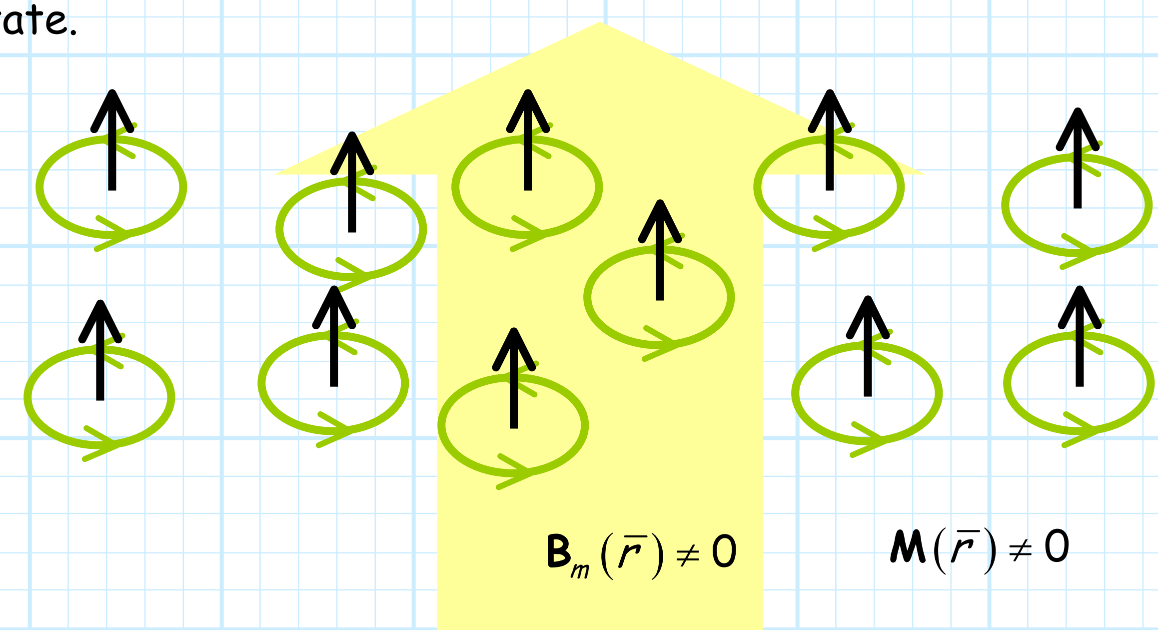
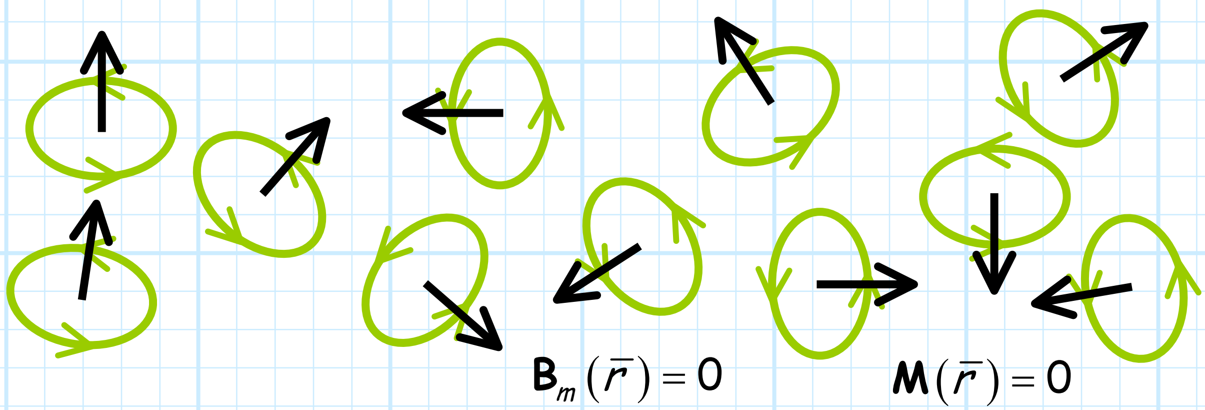
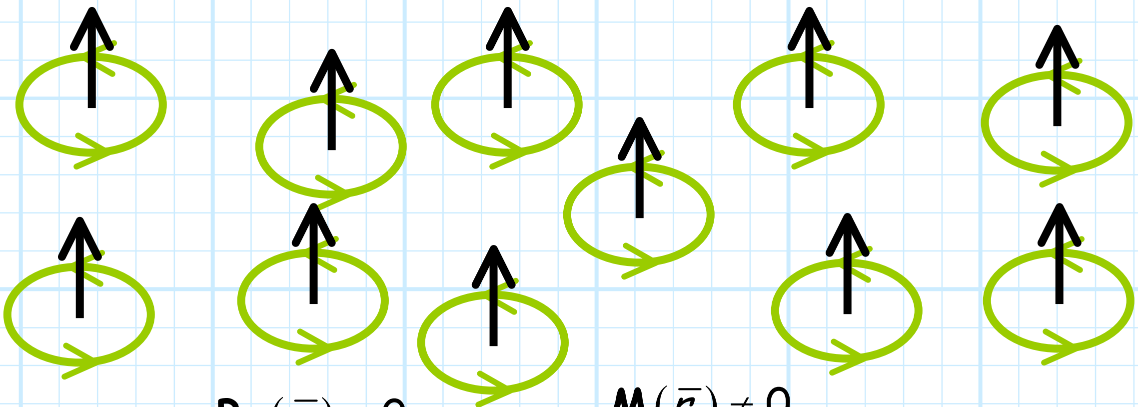
Permanent Magnets

For **most** magnetic material (i.e., where $\mu \neq \mu_0$), we find that the magnetization vector $\mathbf{M}(\bar{r})$ will return to **zero** when a magnetization field $\mathbf{B}_m(\bar{r})$ is removed. In other words, the **magnetic dipoles** will vanish, or at least return to their **random** state.

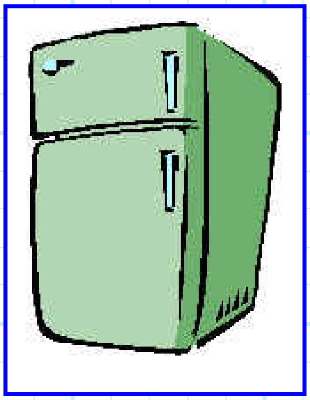




However, some magnetic material, called **ferromagnetic** material, will **retain** its dipole orientation, even when the magnetizing field is removed !



$\mathbf{B}_m(\bar{r}) = 0$ $\mathbf{M}(\bar{r}) \neq 0$



In this case, a **permanent magnet** is formed (just like the ones you stick on your fridge)!

Ferromagnetic materials have **numerous applications**. For example, they will **attract** magnetic material.

Q: *How?*

A: A permanent magnet will of course produce **everywhere** a magnetic flux density $\mathbf{B}(\bar{r})$, which we can **either** attribute to the magnetic **dipoles** with in the material, **or** to the equivalent magnetic **current** $\mathbf{J}_m(\bar{r})$.

The magnetic flux density produced by the magnet will act as a **magnetizing** field for some **other** magnetic material nearby, thus creating a **second** magnetization current $\mathbf{J}_m(\bar{r})$ within the nearby material. The magnetization currents of the material and the magnet will **attract**!