ZEEMAN EFFECT - STRENGTH OF MAGNETIC FIELD

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Post date: 25 September 2021.

The Zeeman effect is a splitting of spectral lines when an atom is placed in an external magnetic field. The effect can be weak (if the external field is much weaker than the field produced by the electron's orbital motion relative to the nucleus within the atom), strong (if the external field is much stronger than the internal field) or intermediate (if the two fields are roughly the same magnitude). To get an idea of the fields involved, the internal field in hydrogen is

$$\mathbf{B} = \frac{\mu_0 e}{4\pi m r^3}\mathbf{L} \tag{1}$$

Since $\mathbf{L}$ is always in multiples of $\hbar$ we can take $L = \hbar$ as a typical value of orbital angular momentum. Taking $r = a$, the Bohr radius, we have in SI units

$$\begin{aligned}
\mu_0 &= 1.257 \times 10^{-6} \text{ m kg s}^{-2} \text{ A}^{-2} &(2)\\
e &= 1.602 \times 10^{-19} \text{ coulombs} &(3)\\
m &= 9.109 \times 10^{-31} \text{ kg} &(4)\\
a &= 5.29 \times 10^{-11} \text{ m} &(5)\\
\hbar &= 1.055 \times 10^{-34} \text{ m}^2 \text{ kg s}^{-1} &(6)
\end{aligned}$$

Plugging in these values, we get

$$B = 12.516 \text{ Tesla} \tag{7}$$

This is roughly the dividing point for weak versus strong external fields.

This field strength, by the way, is a powerful magnetic field. A typical refrigerator magnet's field is only about 5 millitesla and the Earth's magnetic field is only about 5×10^{-5} Tesla. A field of 12 Tesla is about what you'd find in a magnetic crane (for lifting cars). At the other end of the scale, the field at the surface of a neutron star is about 10^8 Tesla.

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