Abstract

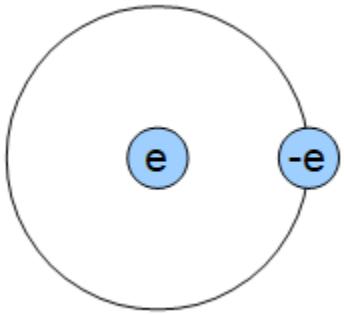
We can understand an atom as electromagnetism with equivalent circuit.

Atomic structure

Atom has atomic nucleus and electron(s). We can see balls as the shape with electronic microscope. Atomic nucleus in center and electron(s) in surface. Atomic nucleus has positive electric charge and electron(s) has negative electric charge. Total charge are zero. Coulomb's law shows the force between them. We can regard electron as average charge in a ball surface. And also we can regard a electron charge as a whole ball. Quantum mechanics makes sense. In this case, to simplify,we assume one electron.

Capacitance

We can regard a ball charge as capacitance.



$$F=\frac{Q_1 Q_2}{4\pi\varepsilon r^2}$$ Coulomb's law

$$E=\frac{Q}{4\pi\varepsilon r^2}$$ Gauss' law

These are same law.Then

$$V=-\int_{\infty}^{r} E(r)\,dr=\frac{Q}{4\pi\varepsilon r}$$ Voltage

Q=CV then

$$C=\frac{Q}{V}=4\pi\varepsilon r$$ Atomic capacitance

An atom has a capacitance(C).

Inductance

Ampere's law: Current,moving a electron in a ball surface,make magnetic field. It means that an atom has a inductance(L). No matter what shape.

Equivalent circuit

An atom has capacitance and inductance as shown. They have energy.

$\frac{1}{2}CV^2$ Capacitive energy

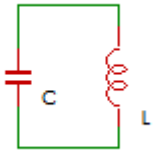
$\frac{1}{2}LI^2$ Inductive energy

Energy moves between capacitance and inductance repeatedly. It keeps energy.

That means resonance state.We can regard an atom as resonant circuit.

Atomic equivalent formula

As ω is angular velocity



$\omega^2=\frac{1}{LC}$ Resonant condition

Where c is speed of light, r is radius of atom.

$\omega=\frac{c}{r}$ Angular velocity

Note that large letter C is capacitance and small letter c is speed of light.

Then

$\frac{c^2}{r^2}=\frac{1}{LC}$

Speed of light c as known where ε is permittivity and μ is permeability

$c^2=\frac{1}{\mu\varepsilon}$ Speed of light

Then

$LC=\mu\varepsilon r^2$ Atomic equivalent formula

Conclusion

$LC=\mu\varepsilon r^2$ Atomic equivalent formula

$C=4\pi\varepsilon r$ Atomic capacitance

$L=\frac{\mu r}{4\pi}$ Atomic inductance

where r is radius of atom.

Applications

Questions: Evaluate C and L of hydrogen.r=0.53 angstrom.1 angstrom=0.1 nano meter.

Note that the radius is average.Not pricise regarding of uncertainty principle.

Atomic equivalent formula meaning

Atom is resonant circuit with L and C. There is not R.

$Z = R + jX$

where Impedance Z, Resistance R, Reactance X, imaginary unit j

If atom has R, atom will collapse.

Quantum

Quantum is energy chunk.We can regard Quantum as resonant circuit as also.

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