Chlorine is a deadly poison gas employed on European battlefields in World War I. Sodium is a corrosive metal which burns upon contact with water. Together they make a placid and unpoisonous material, table salt. Why each of these substances has the properties it does is a subject called chemistry.

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Energy in Everyday Life

Atomic Structure

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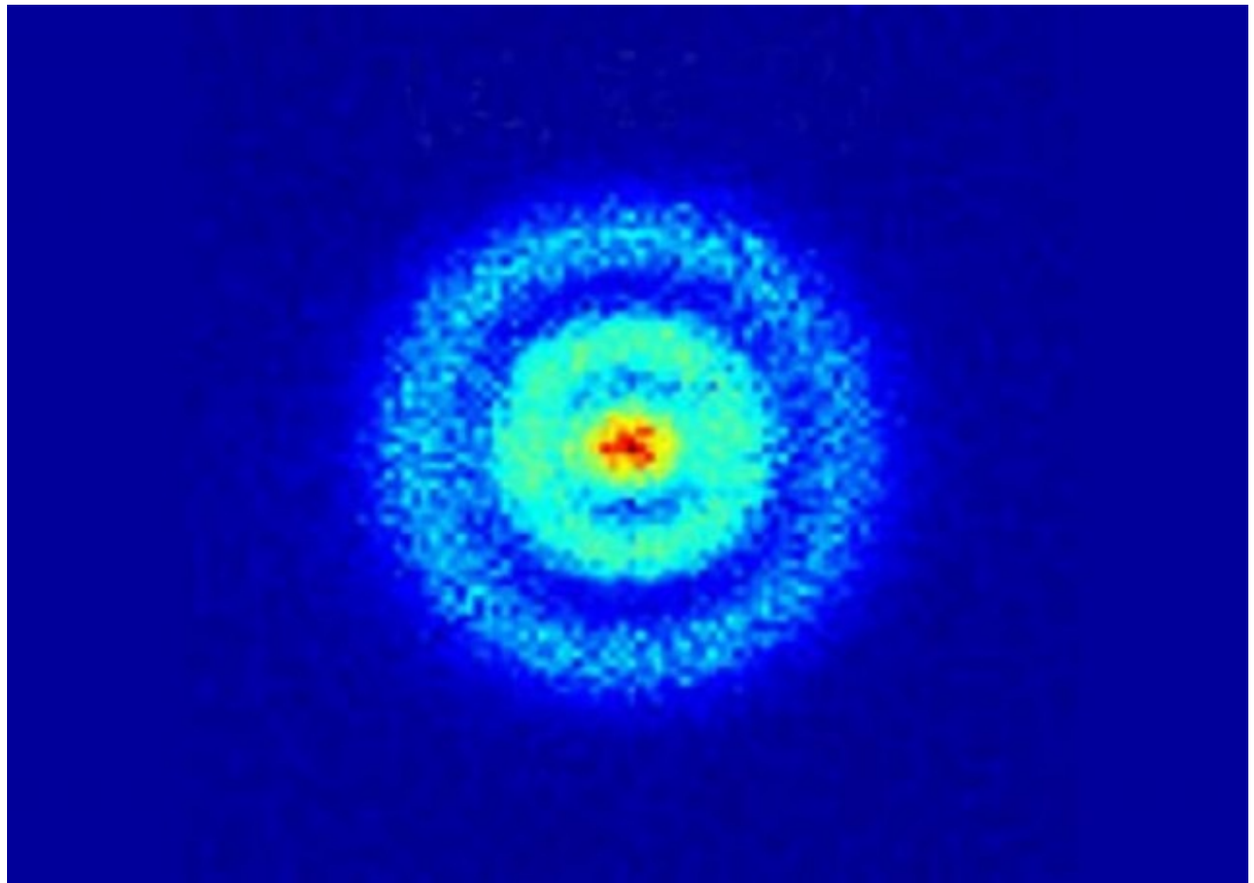
In any chemical reaction there is a change in the condition of the constituents of the atoms involved.

To find out what happens we have to look at an atom.

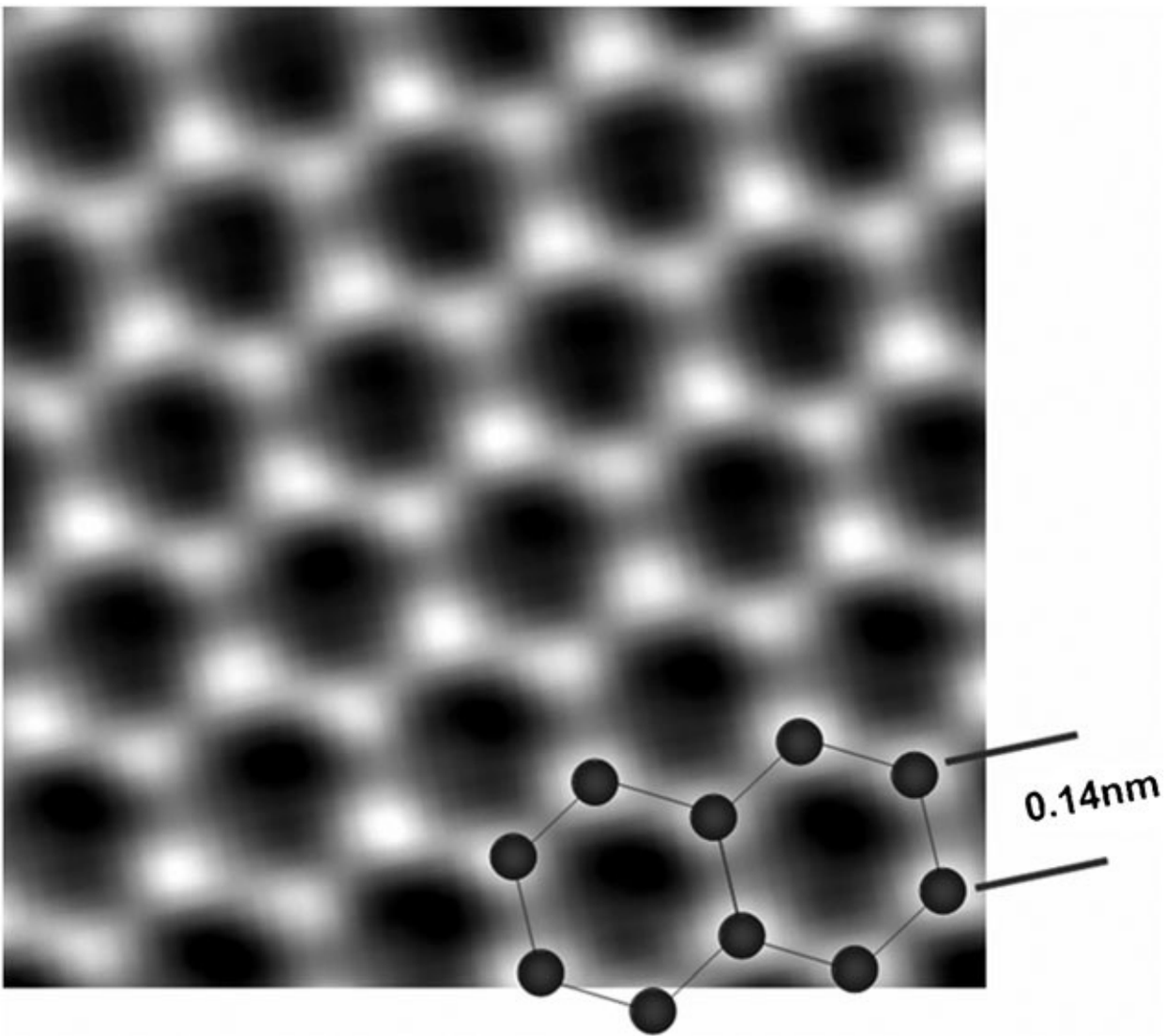
If we take a material and shrink our field of view, we would eventually identify what seems like an impenetrable shell. We would be looking at the outer surface of an atom.



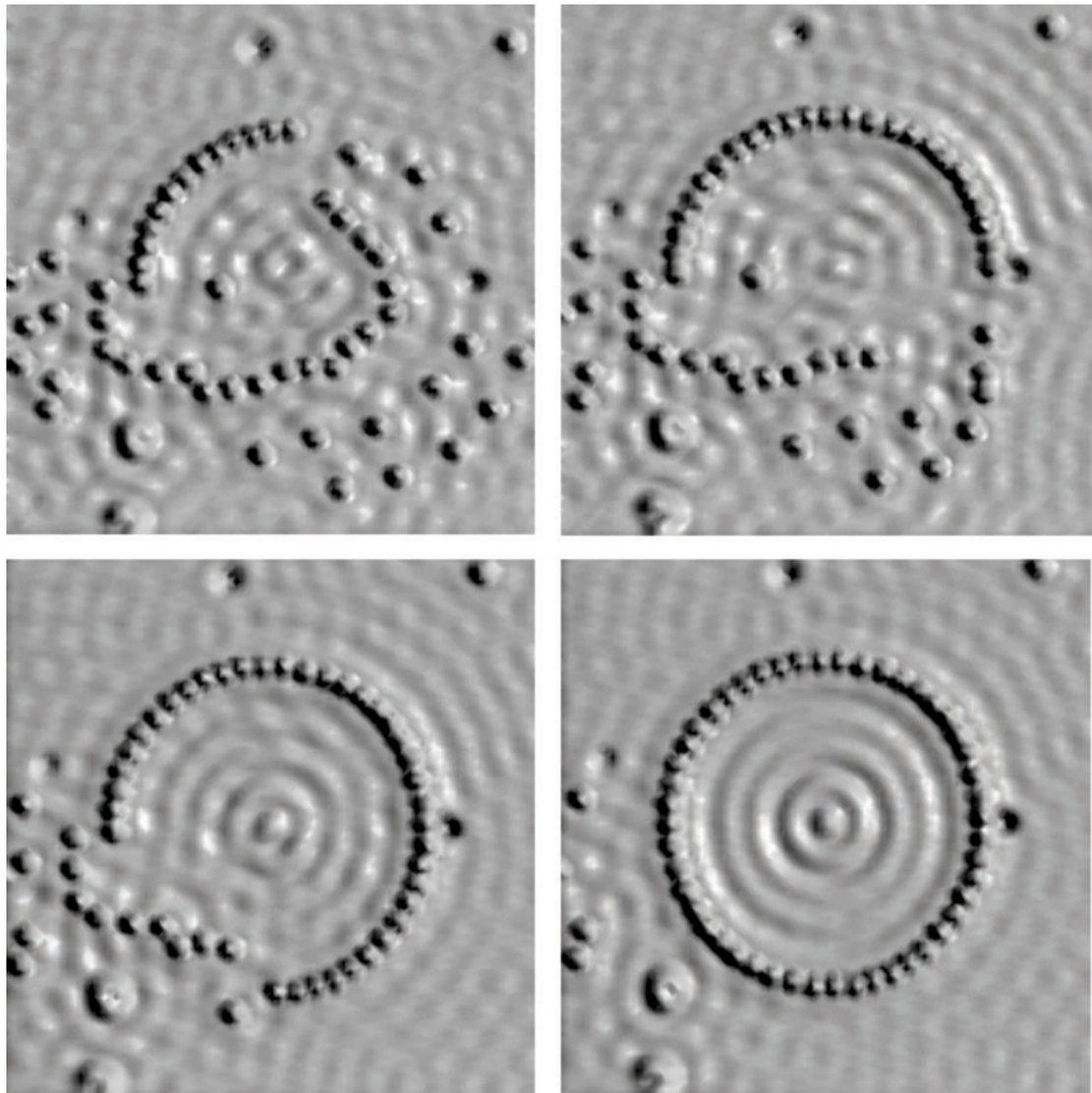
First image of a hydrogen atom's structure, 2013.

This surface is provided by the atom's electrons.
A typical atomic diameter is 10^{-10} m.

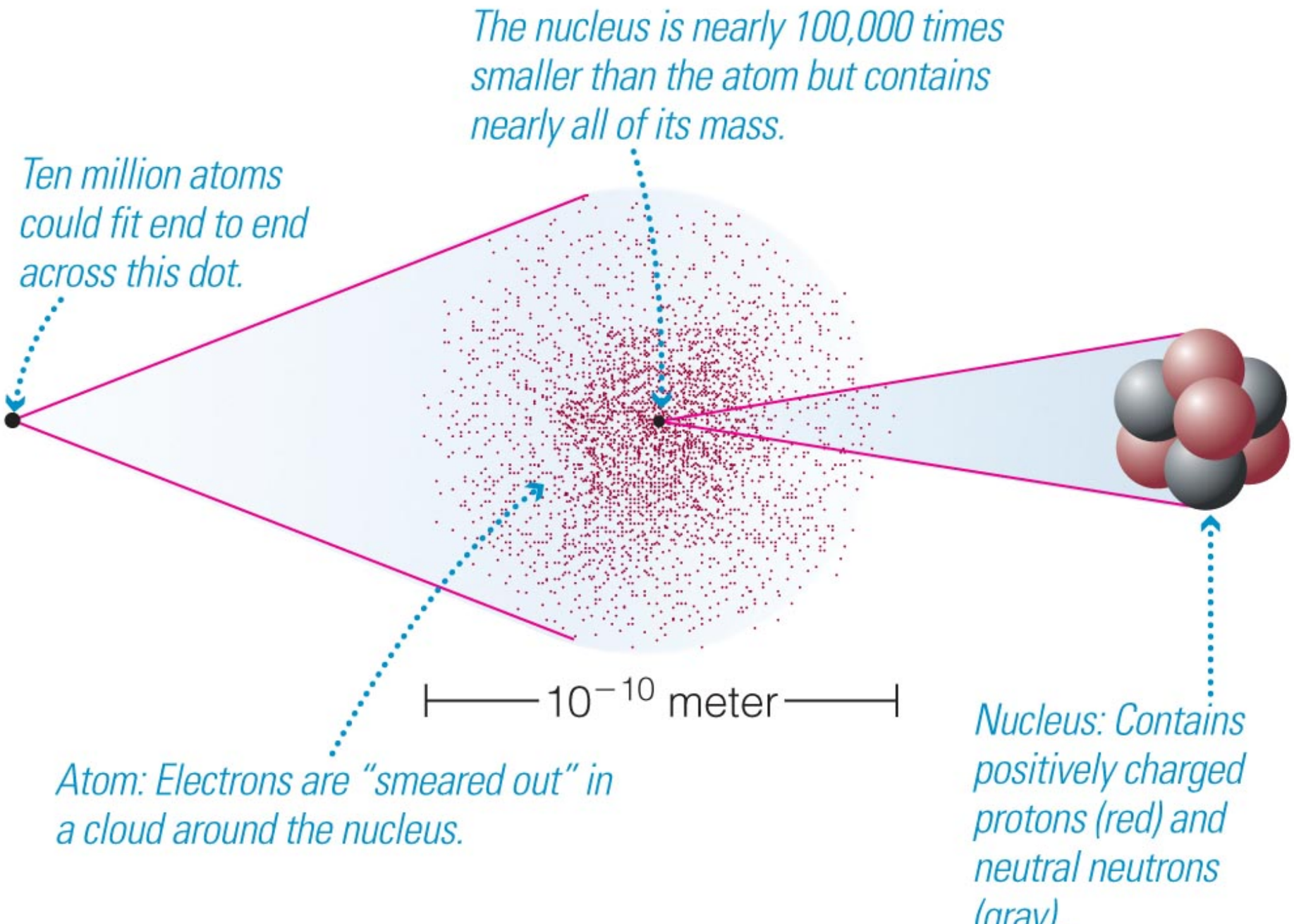
Carbon atoms of graphene.



Iron atoms on a copper surface.



Everyday matter is made of atoms, which are made from protons, neutrons, and electrons.

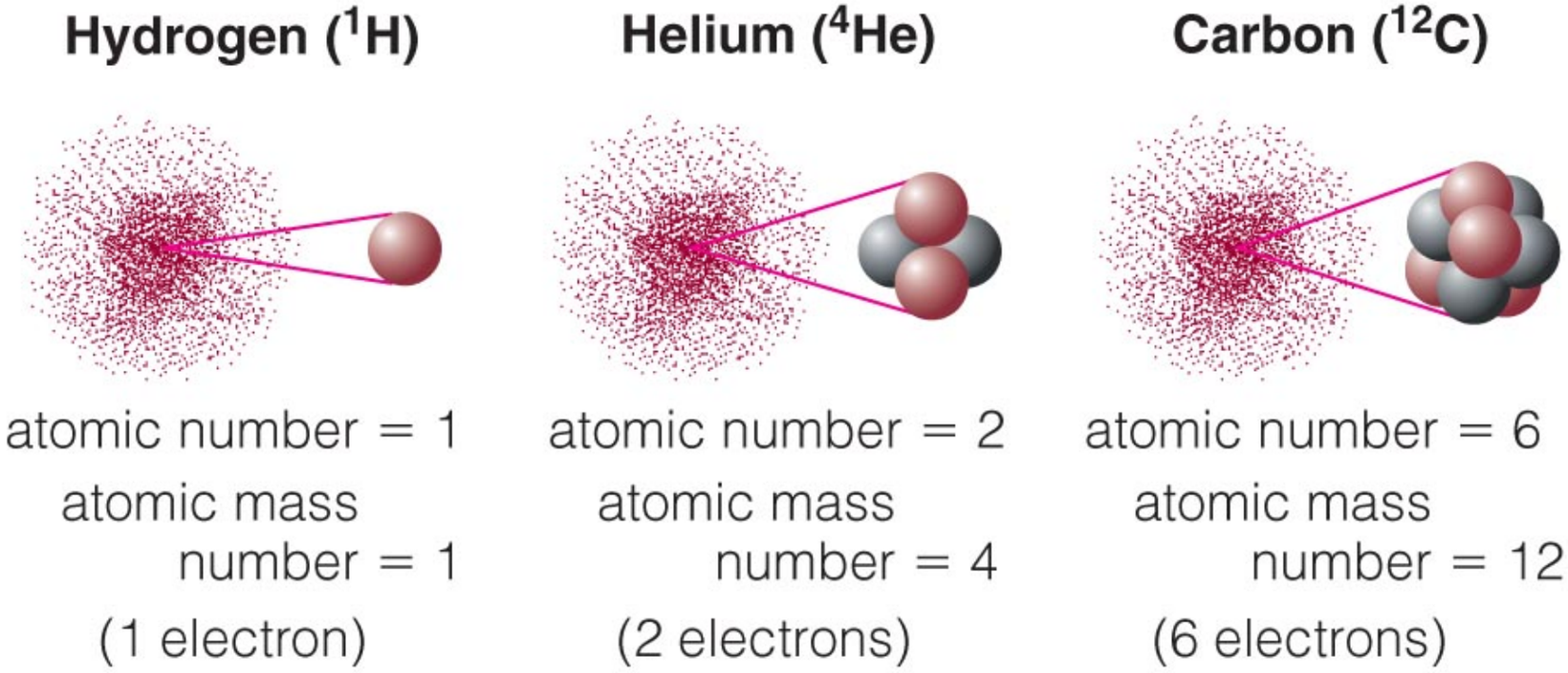


Atoms of different chemical elements have different number of protons.

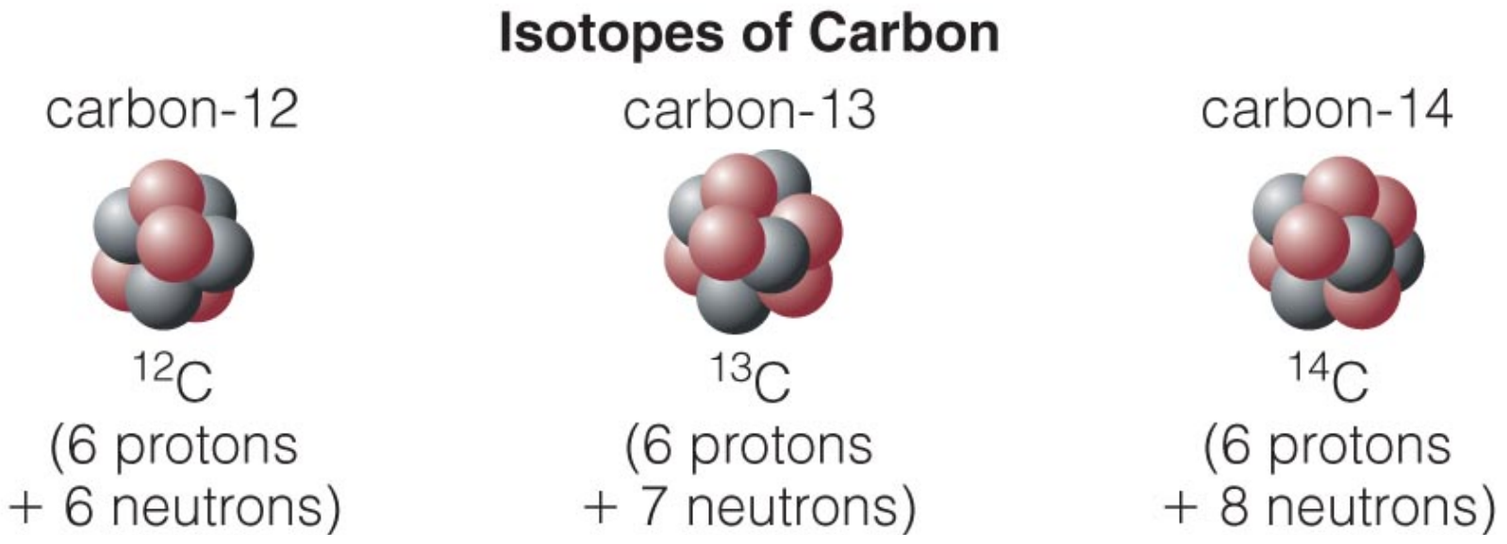
Isotopes of an element have the same number of protons but different number of neutrons.

Molecules are made of two or more atoms.

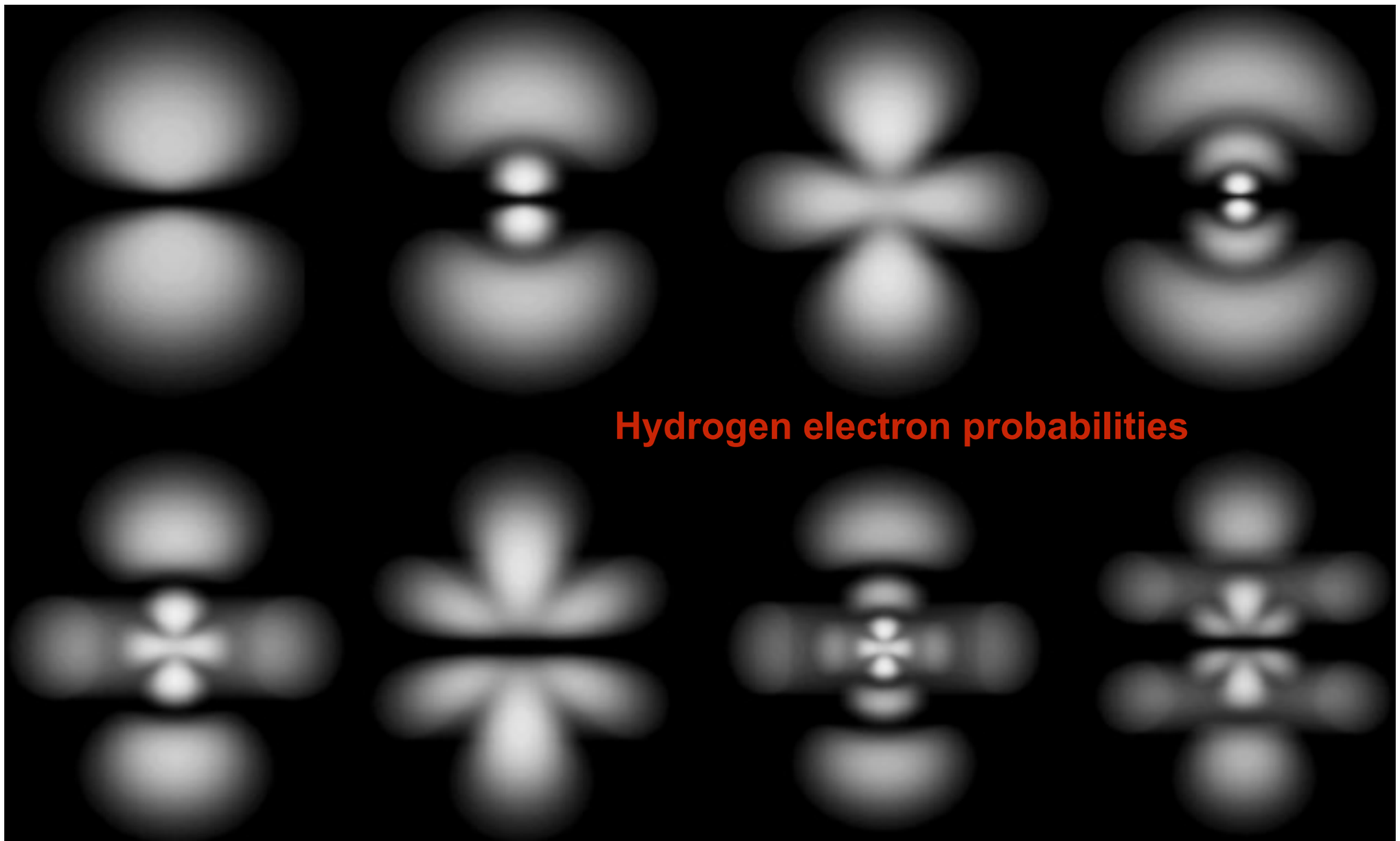
atomic number = number of protons
atomic mass number = number of protons + neutrons
(A neutral atom has the same number of electrons as protons.)



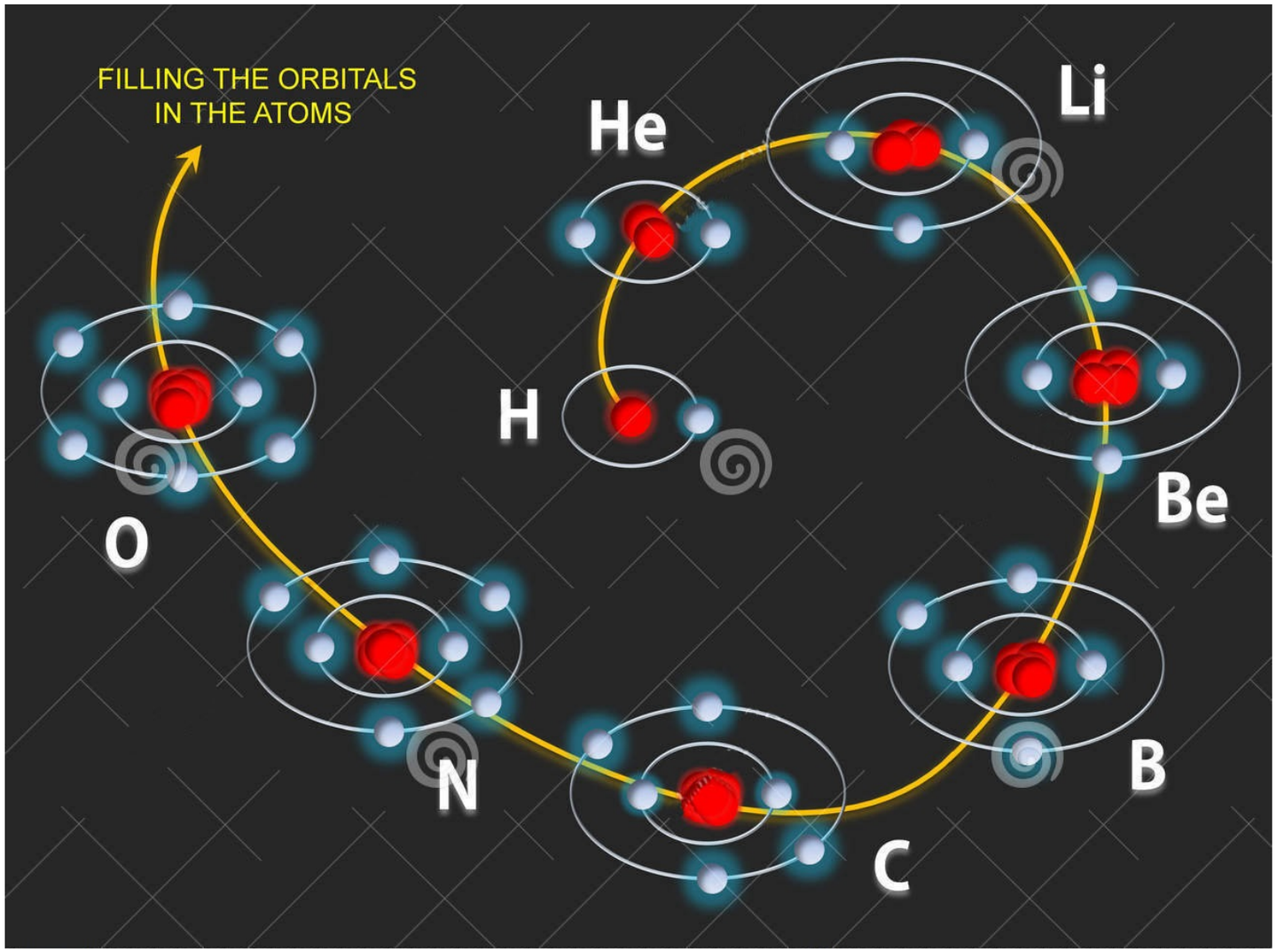
*Different **isotopes** of a given element contain the same number of protons, but different numbers of neutrons.*



Although the electrons are wavelike and not localized in space, they do have a high probability of being near positions they would occupy if they were particles.



Negatively electrons repel each other electrically, just as they are attracted to the positive charge of the nucleus, but they cannot all get close to the nucleus.



We find experimentally that no two electrons may exist in the same state (distance, energy, etc) in an atom.

The outermost electrons, the valance electrons, provide what we consider to be the outer surface of the atom, the “size”.