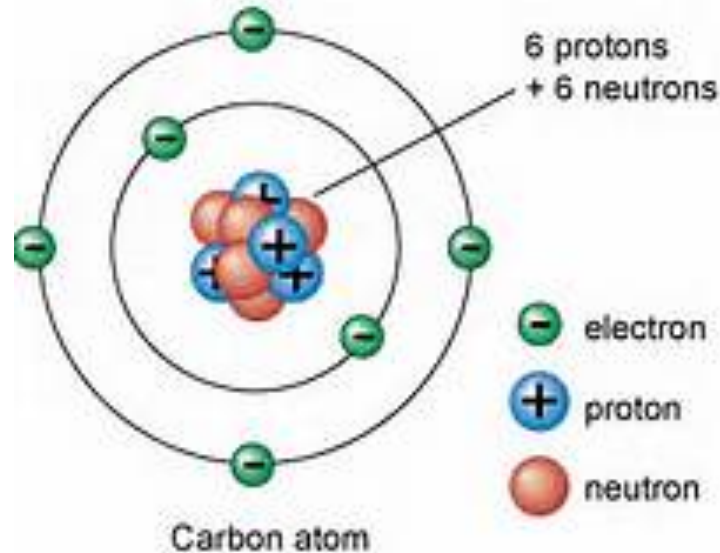


ATOMS

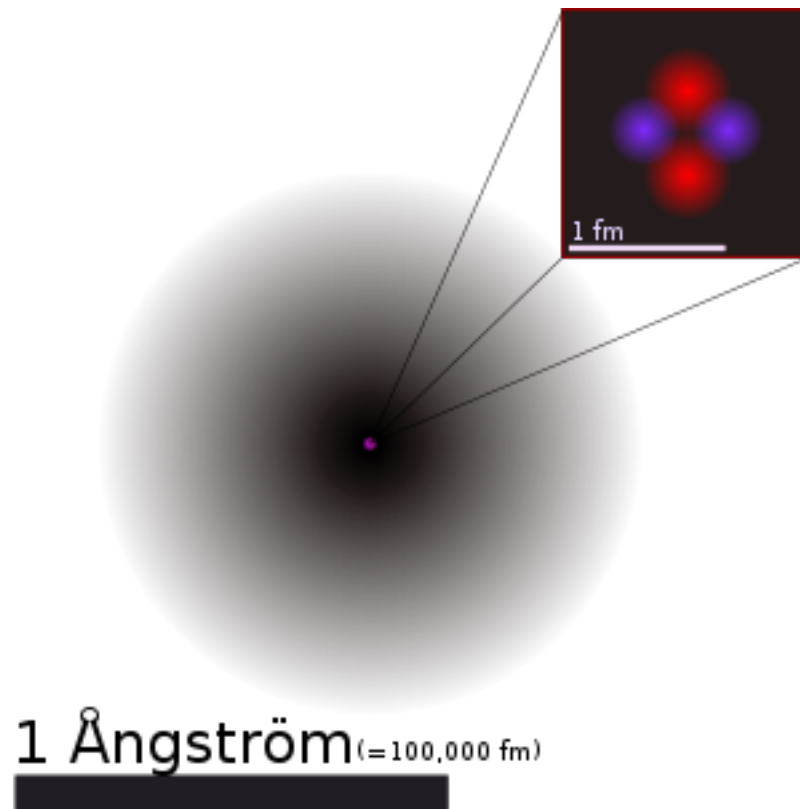
(*Atomos* = Greek → Unbreakable)



A carbon atom is 6th on the periodic chart. All carbon atoms have 6 protons...NEVER more NEVER less...Carbon can vary in its numbers of electrons and neutrons. If it has an imbalance of positive (protons) to negative (electrons) charged particles, it is called an ion. All atoms can have a variety of numbers of neutrons...atoms of the same element that differ in their numbers of neutrons are called isotopes. Atoms with odd numbers of electrons are very unhappy and are called free radicals.

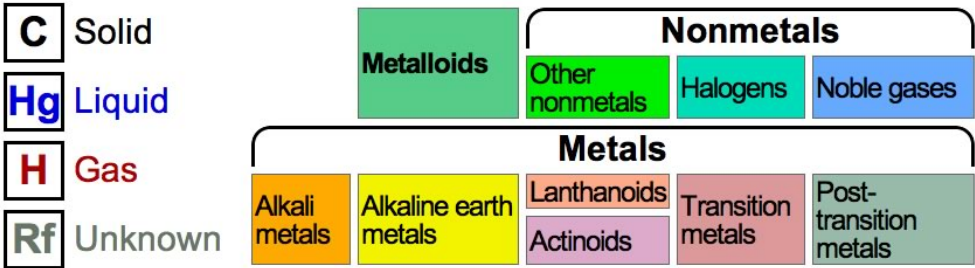


The helium atom including its electrons is about 1 angstrom in diameter. Its nucleus is about a femtometer (10^{-15} meters)



Periodic Table of Elements

1 IA												18 VIIIA					
1 H Hydrogen 1.00794	2 He Helium 4.002602											13 B Boron 10.811	14 C Carbon 12.0107	15 N Nitrogen 14.0067	16 O Oxygen 15.9994	17 F Fluorine 18.9984032	18 Ne Neon 20.1797
3 Li Lithium 6.941	4 Be Beryllium 9.012182											5 Al Aluminium 26.9815386	6 Si Silicon 28.0855	7 P Phosphorus 30.973762	8 S Sulfur 32.065	9 Cl Chlorine 35.453	10 Ar Argon 39.948
11 Na Sodium 22.98976928	12 Mg Magnesium 24.3050	3 IIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 Al Aluminium 26.9815386	14 Si Silicon 28.0855	15 P Phosphorus 30.973762	16 S Sulfur 32.065	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955912	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938045	26 Fe Iron 55.845	27 Co Cobalt 58.933195	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.96	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.293
55 Cs Caesium 132.9054519	56 Ba Barium 137.327	57 La Lanthanum 138.90547	72 Hf Hafnium 178.49	73 Ta Tantalum 180.94788	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.084	79 Au Gold 196.966569	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.98040	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (267)	105 Db Dubnium (268)	106 Sg Seaborgium (271)	107 Bh Bohrium (272)	108 Hs Hassium (270)	109 Mt Meitnerium (276)	110 Ds Darmstadtium (281)	111 Rg Roentgenium (280)	112 Cn Copernicium (285)	113 Uut Ununtrium (284)	114 Fl Flerovium (289)	115 Uup Ununpentium (288)	116 Lv Livermorium (293)	117 Uus Ununseptium (294)	118 Uuo Ununoctium (294)



For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

Periodic Table Design and Interface Copyright © 1997 Michael Dayah. <http://www.ptable.com> Last updated Dec. 10, 2011*

Key
Atomic #
Symbol
Name
Atomic Mass

58 Ce Cerium 140.116	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.242	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92535	66 Dy Dysprosium 162.500	67 Ho Holmium 164.93032	68 Er Erbium 167.259	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.054	71 Lu Lutetium 174.9668
90 Th Thorium 232.03806	91 Pa Protactinium 231.03588	92 U Uranium 238.02891	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (260)

*Edited by Dr. Casagrande



Some Isotopes of Carbon



Carbon

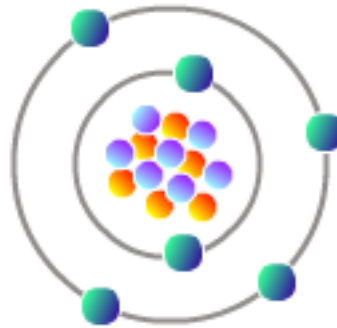
● 6 Protons

● 6 Neutrons

Nuclear number

$$= 6 + 6$$

$$= 12$$



Carbon-13

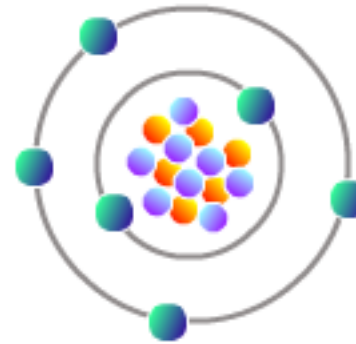
● 6 Protons

● 7 Neutrons

Nuclear number

$$= 6 + 7$$

$$= 13$$



Carbon-14

● 6 Protons

● 8 Neutrons

Nuclear number

$$= 6 + 8$$

$$= 14$$



The 3 most common isotopes of hydrogen

The Nuclei of the Three Isotopes of Hydrogen

Protium



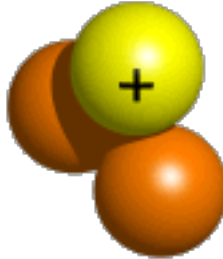
1 proton

Deuterium

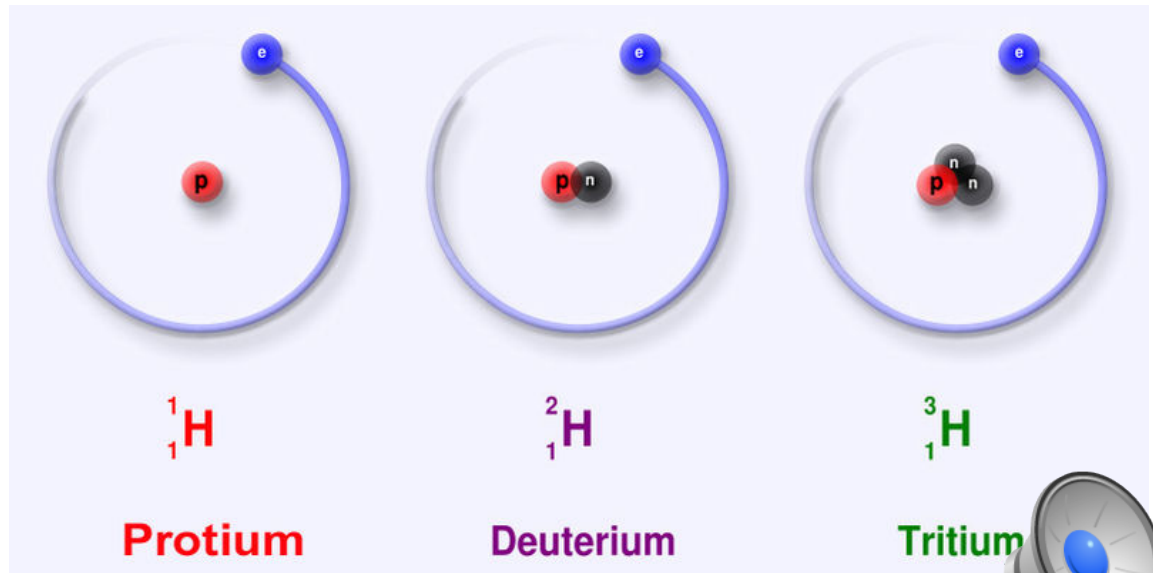


1 proton
1 neutron

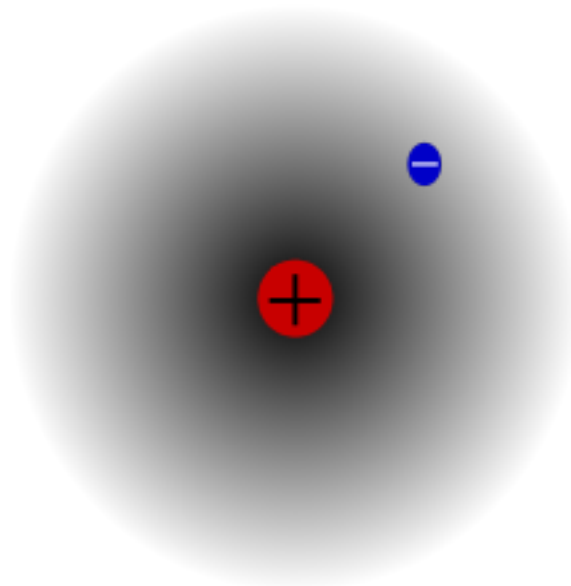
Tritium



1 proton
2 neutrons



Hydrogen...the most common element in the Universe

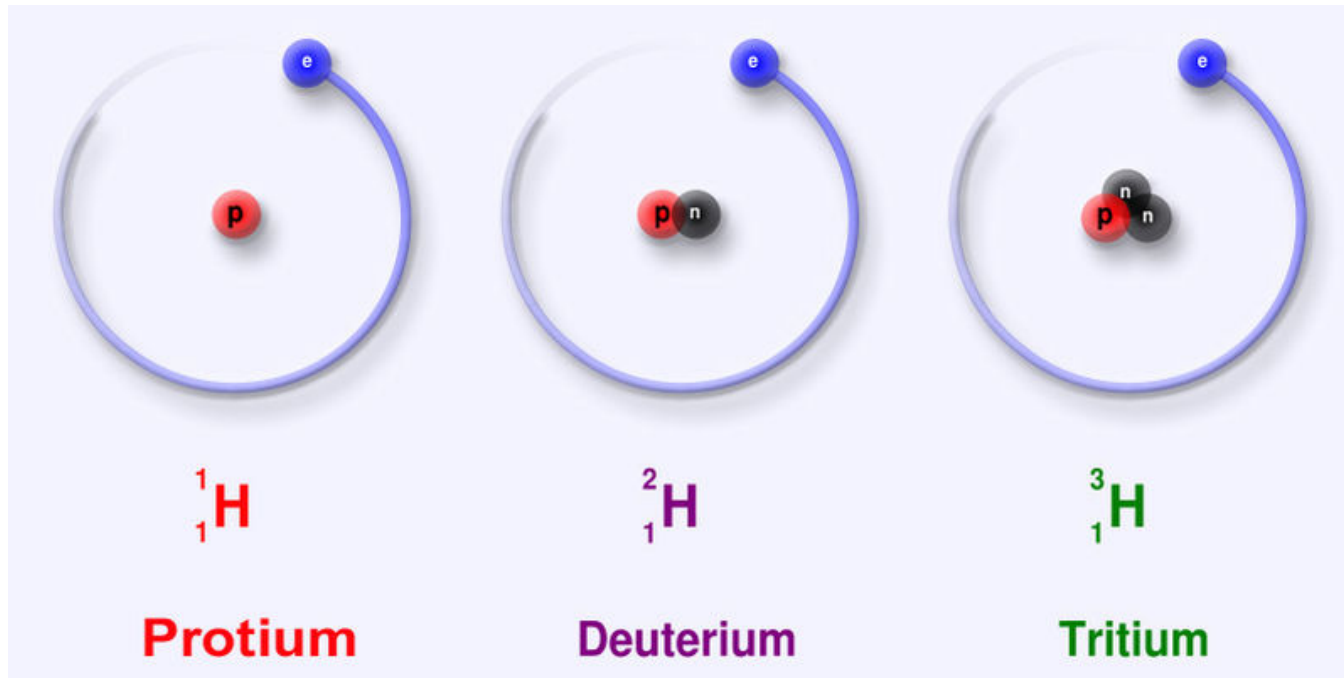


Protium, the most common isotope of hydrogen, consists of one proton and one electron. Unique among all stable isotopes, it has no neutrons. (see diproton for a discussion of why others do not exist). ^1H (atomic mass 1.00782504 amu) the most common hydrogen isotope with an abundance of more than 99.98%. Because the nucleus of this isotope consists of only a single proton, it is given the descriptive but rarely used formal name protium.



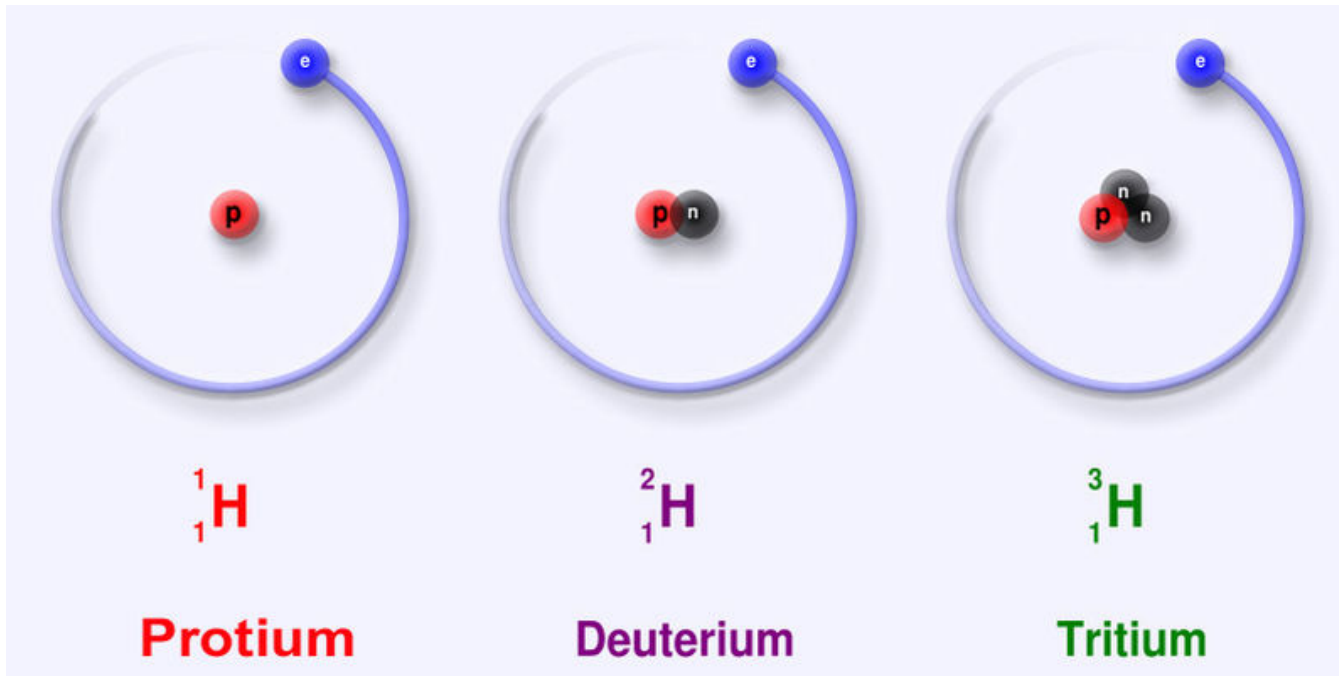
Deuterium

Deuterium comprises 0.0026 – 0.0184% (by population, not by mass) of hydrogen samples on Earth.

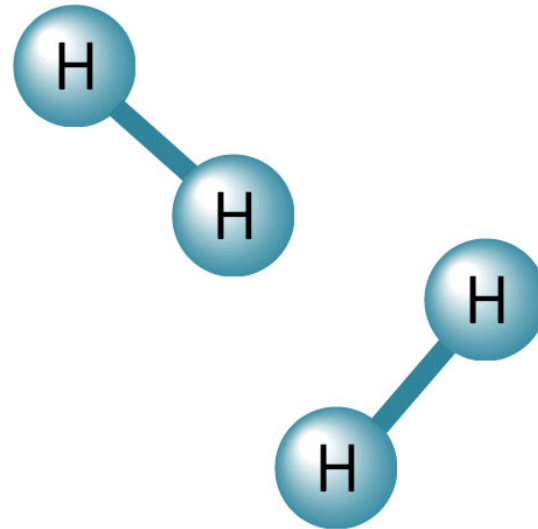
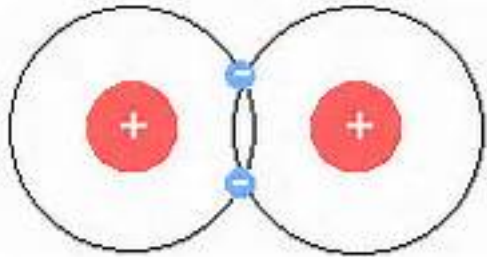


Tritium

^3H is known as tritium and contains one proton and two neutrons in its nucleus. It is radioactive, decaying into helium-3 through β^- decay with a half-life of 12.32 years.[3] Small amounts of tritium occur naturally because of the interaction of cosmic rays with atmospheric gases. Tritium has also been released during nuclear weapons tests. It is used in thermonuclear fusion weapons, as a tracer in isotope geochemistry, and specialized in self-powered lighting devices.



Hydrogen Molecule H₂

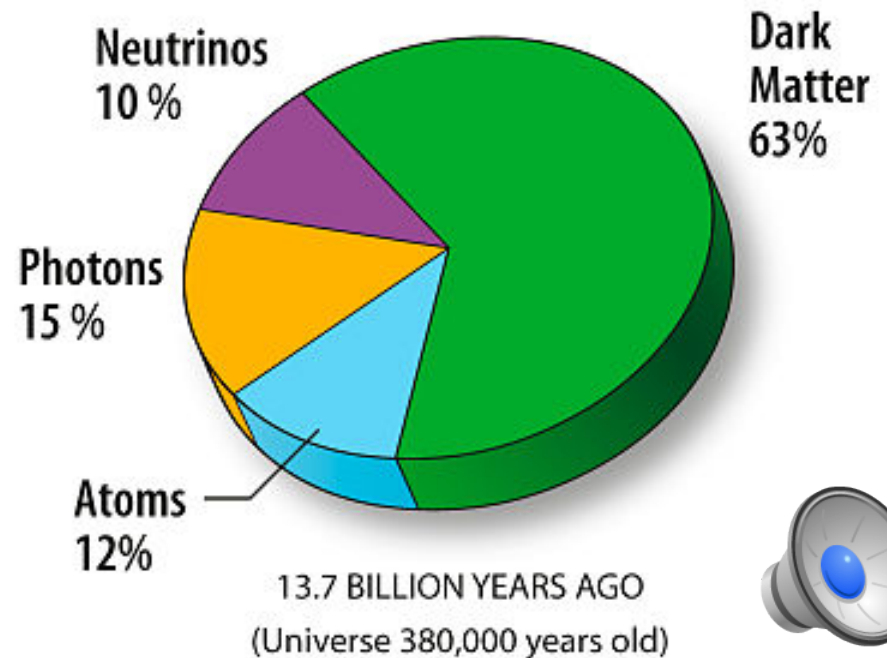
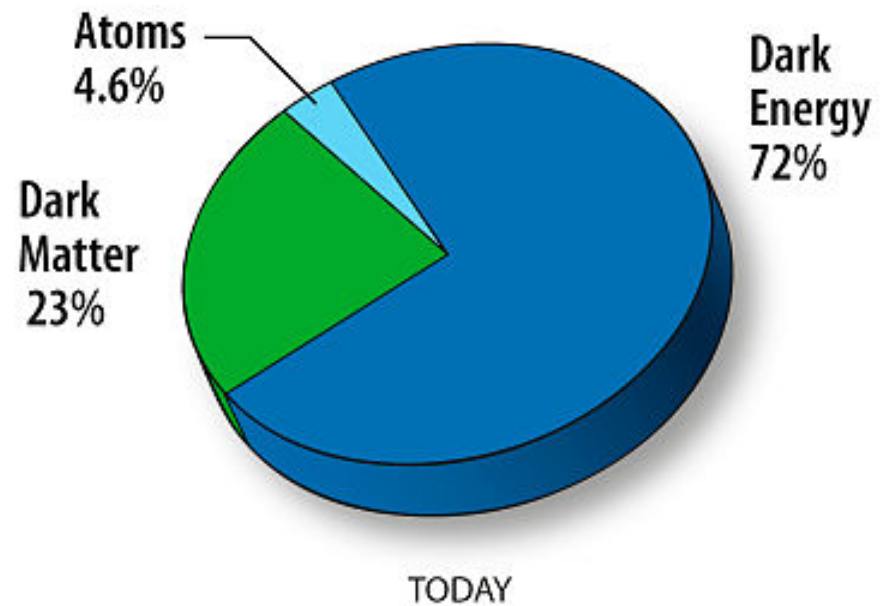


Hydrogen exists normally as a diatomic molecule...two hydrogen atoms sharing electrons are chemically bonded. A chemical bond is represented by a single solid line

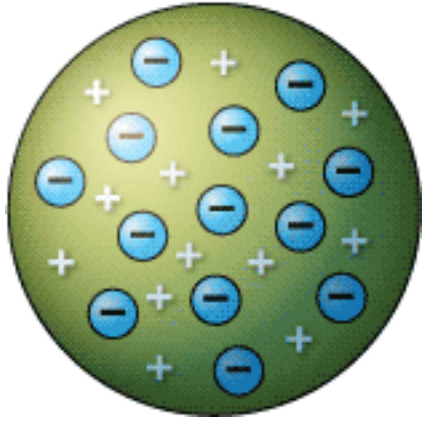


The matter we interact with on an everyday level only makes up about 4.6% of the universe. Most of the matter of the universe is called “dark matter”. Dark Matter’s existence was originally inferred from the motions of galaxies that shows that their orbital motions could only behave as they do if they had more mass. The rest of the Universe is made of a mysterious force called dark energy that is causing the universe to expand at ever increasing velocities.

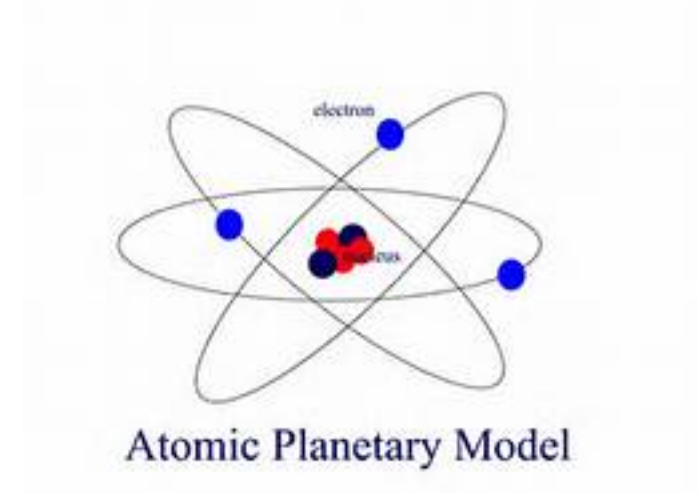
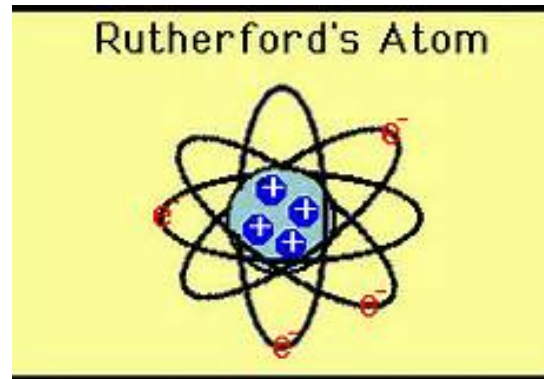
Dark matter's existence is also inferred from gravitational effects on the light from stars and galaxies... Gravity can bend light.



Atoms from an Historical Perspective



plum pudding model

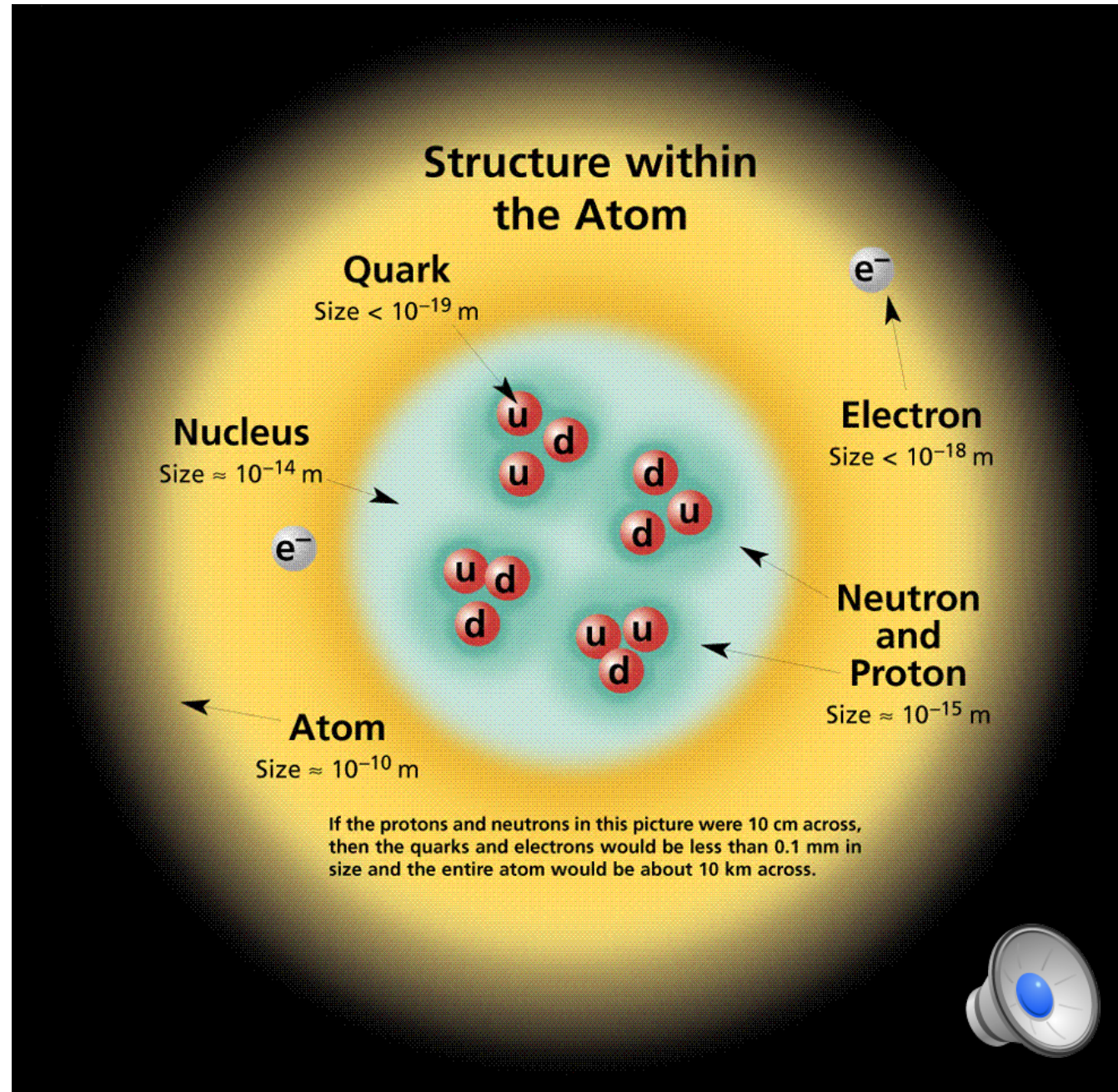


Evolution of the model of the atom from the electrons mixing in the same space as protons through the protons with no neutrons in the nucleus surrounded by electrons and then the “planetary model” which is rather functional but somewhat inaccurate



Current Model

We now believe that the nucleus is made of protons and neutrons that are in turn made of quarks.



The Bohr model of the atom, showing states of electron with energy quantized by the number n . Electrons have a probability of being found in different energy levels, shown as rings sometimes referred to as orbits in this model. The orbits farther away from the nucleus have higher energies. An electron dropping to a lower orbit emits a photon equal to the energy difference between the orbits. This emission of photon energy is a consequence of the conservation of energy.

