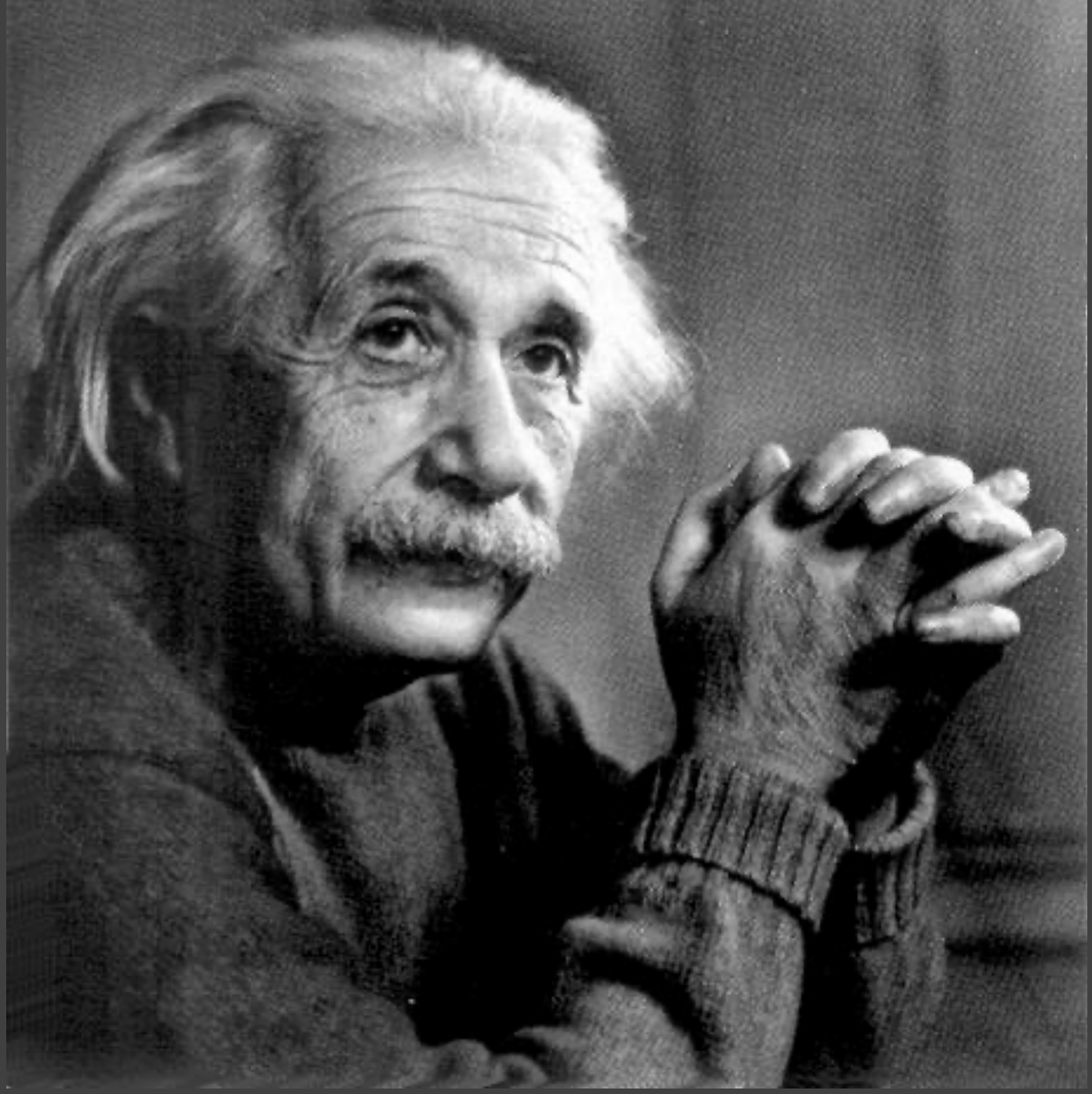
Noddy's Guide to Fission and Fusion

by

Tony Heyes



The Energy Equivalence of Mass

$$E = m_0 c^2$$

Velocity of Light

- 299,792 km/s

- 1Kg equivalent to
  - 25,000 Kwh

Einstein's Postulate

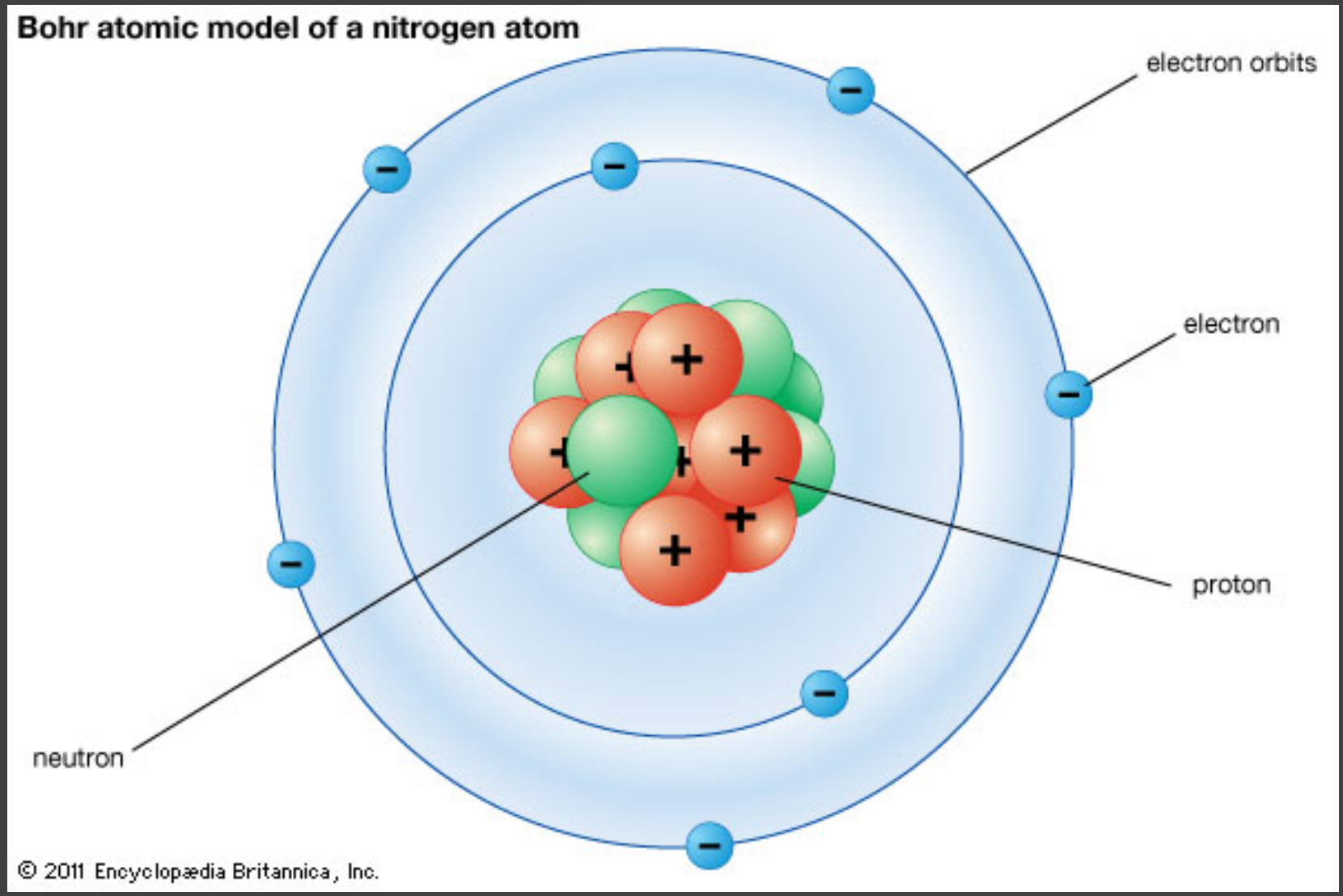
That physics should be the same in any none accelerating frame of reference.

Einstein's Postulate

The speed of light in a vacuum is independent of the motion of both the observer and the source.

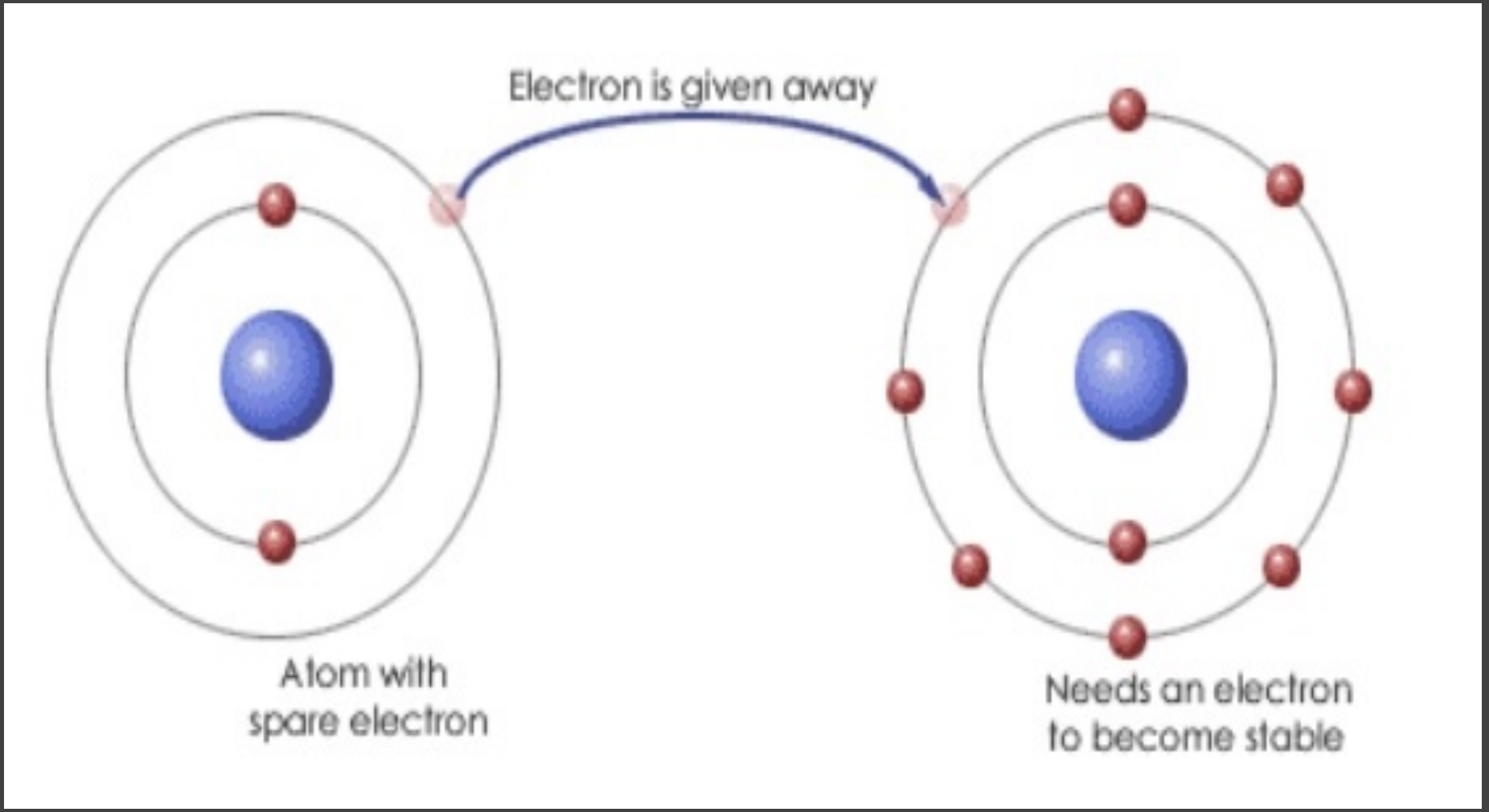
Niels Bohr
(1885 – 1962)
Nobel Prize 1922

The Bohr Atom

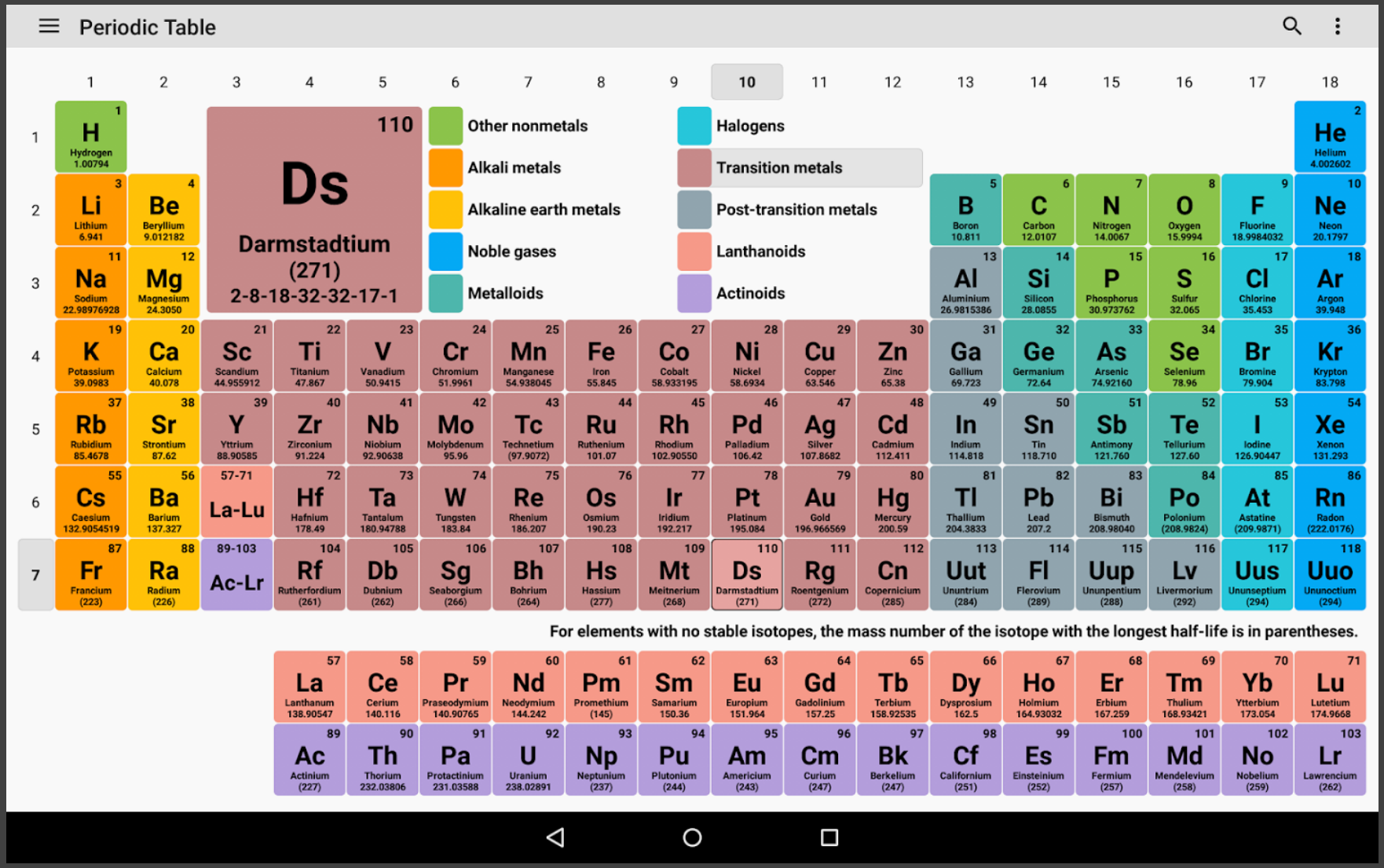


Chemistry

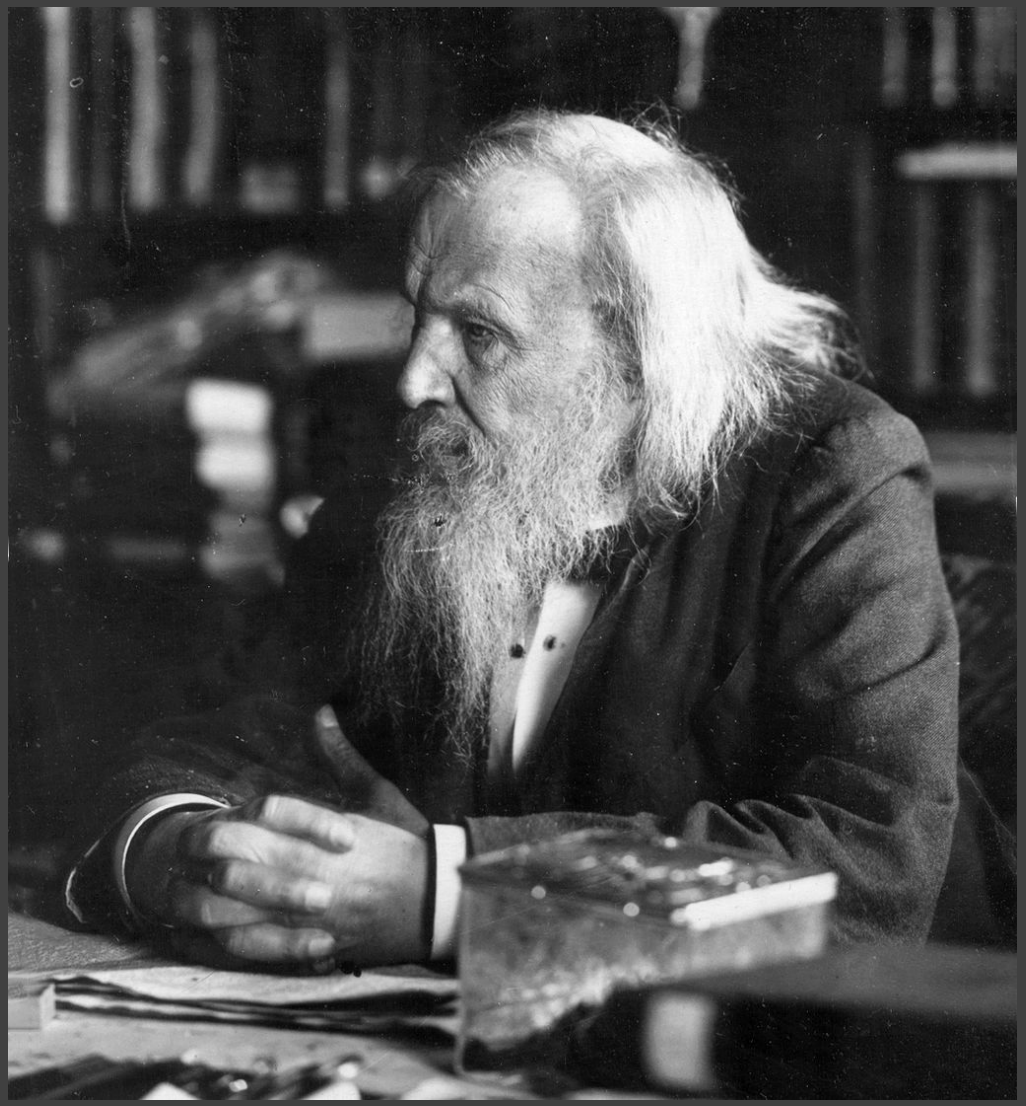
Lithium Flourine



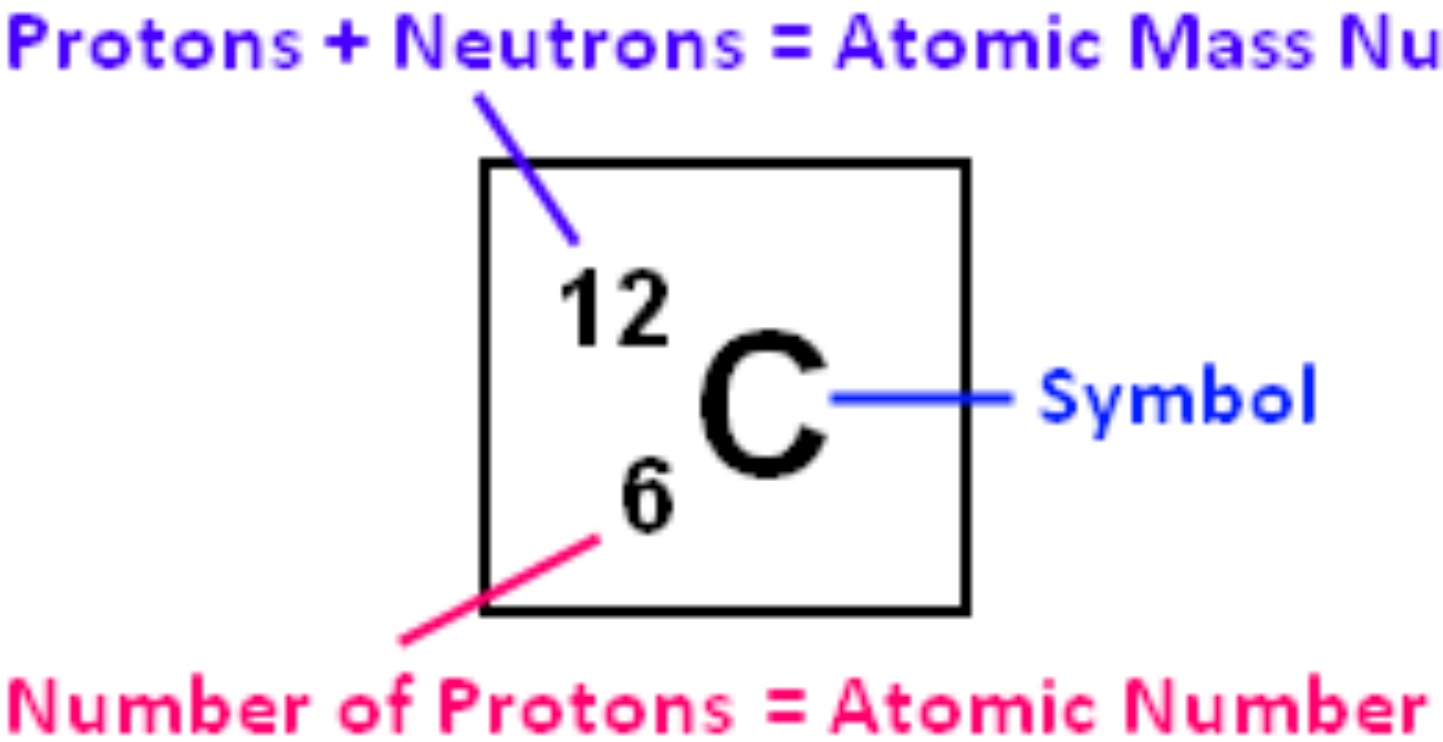
Mendeleevian Table



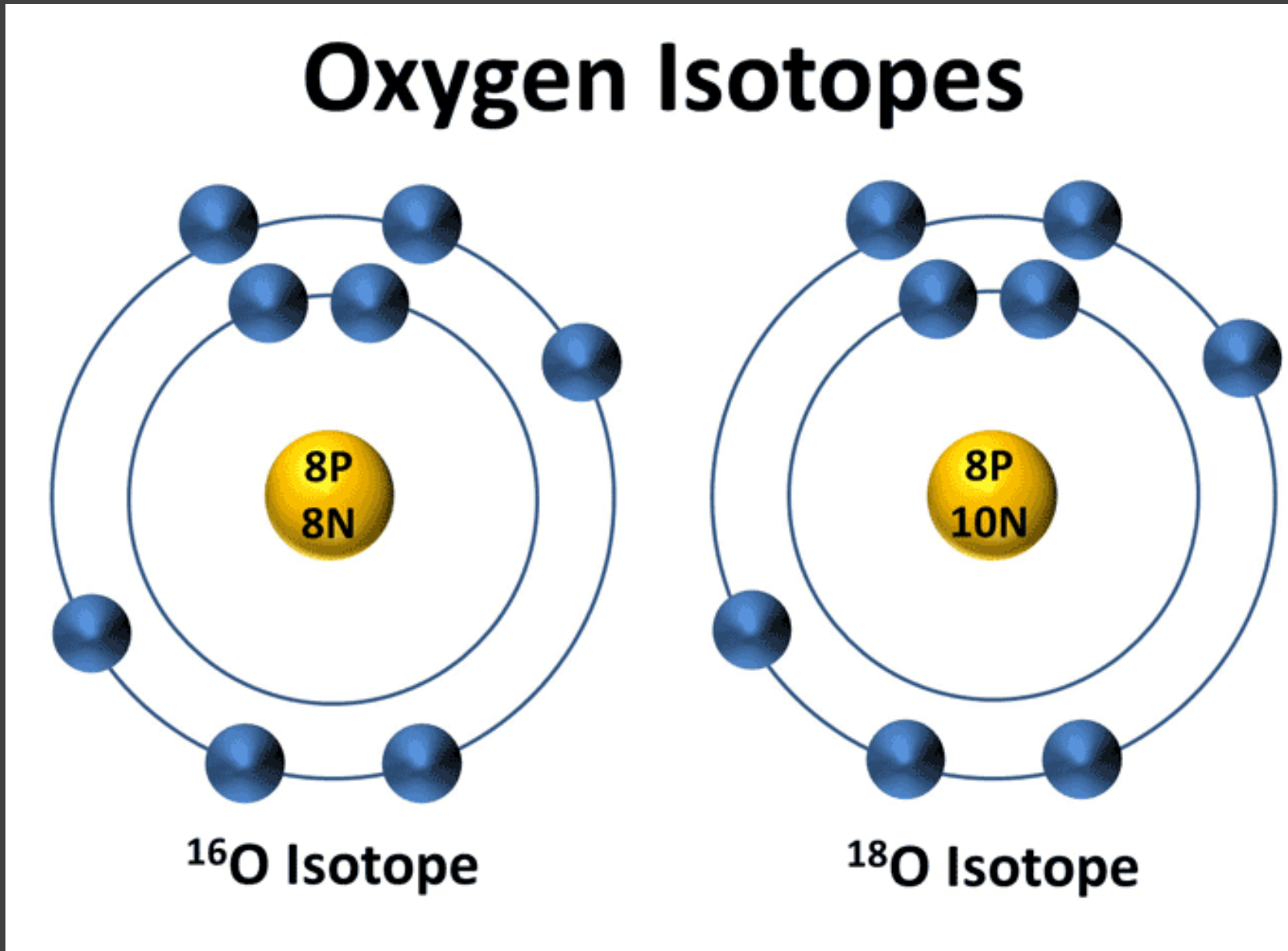
Dmitri Mendeleev (1834 – 1907)



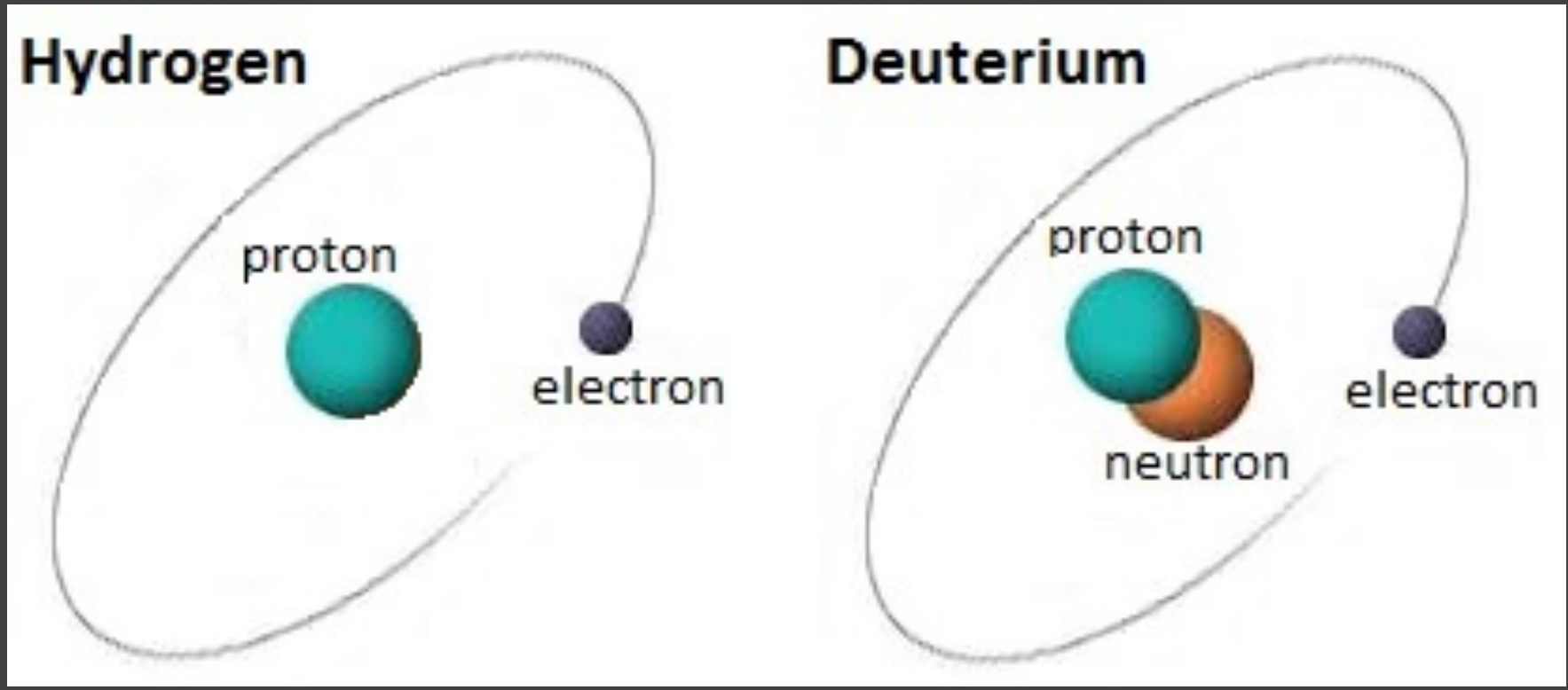
Notation


Protons + Neutrons = Atomic Mass Number
12
C
6
Symbol
Number of Protons = Atomic Number

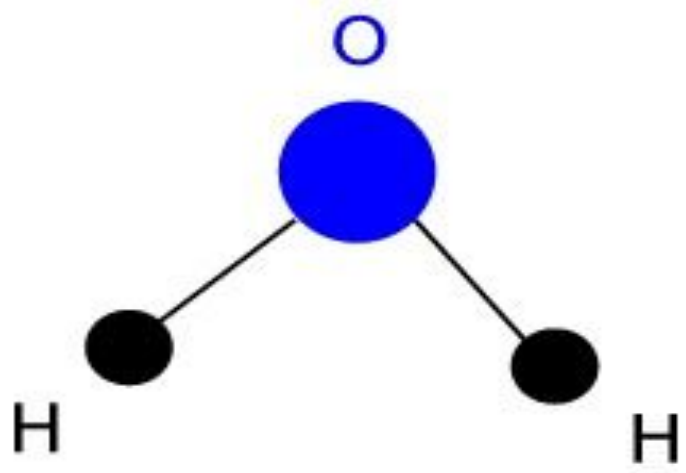
Isotopes



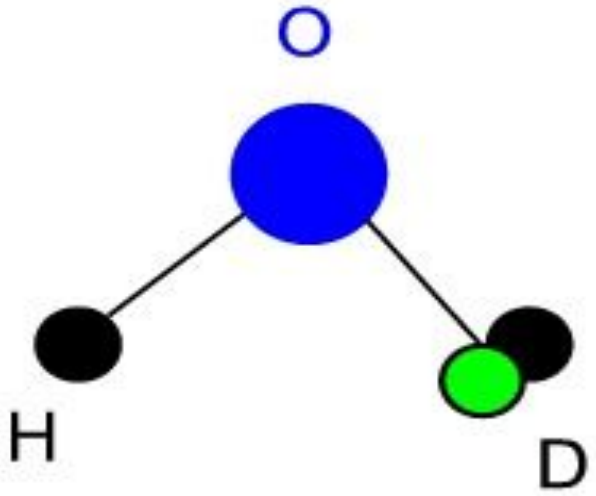
Deuterium


Hydrogen
proton
electron
Deuterium
proton
electron
neutron

Semi-heavy Water

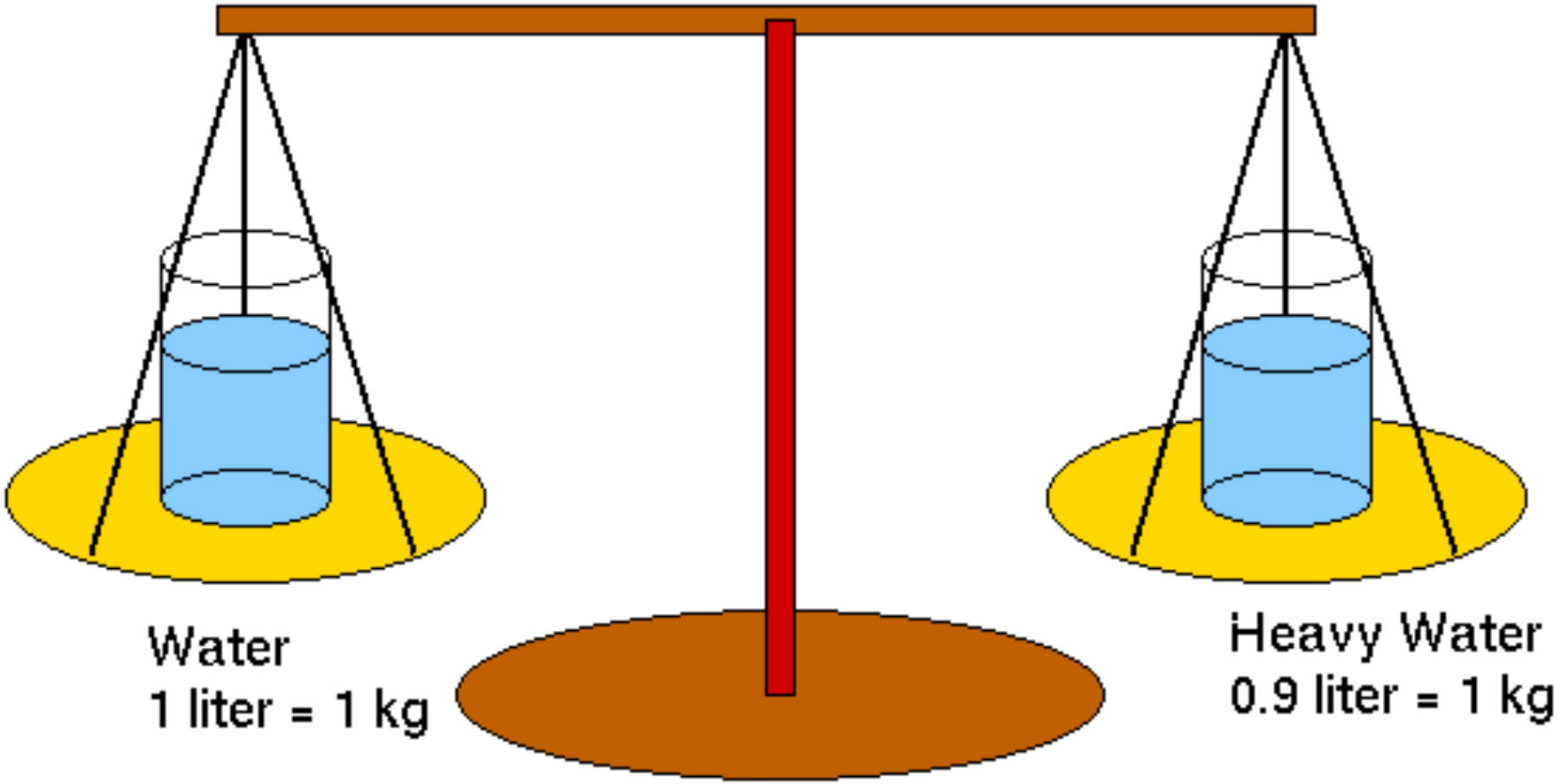


ordinary water



"heavy" water

Heavy Water



Lise Meitner
(1878 - 1968)

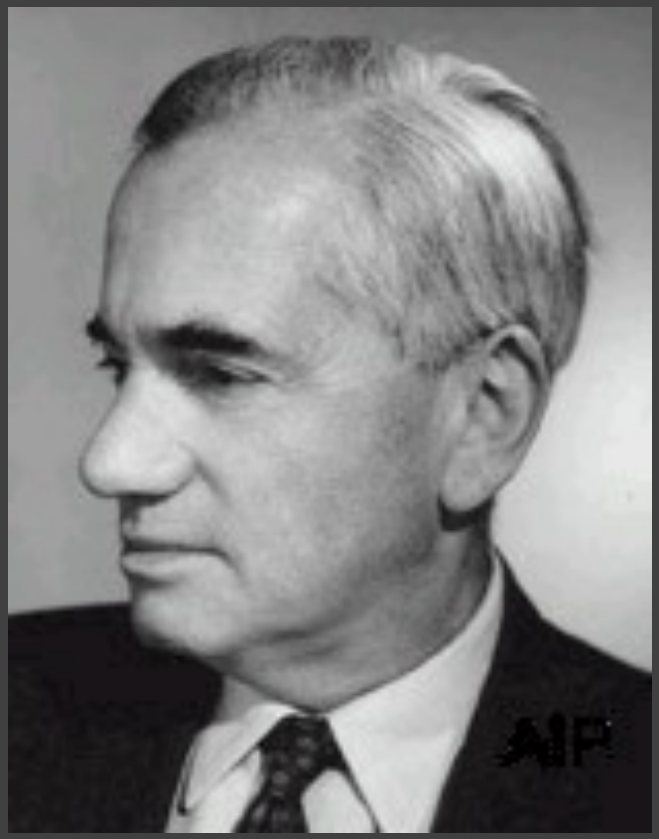
Lise Meitner

- An Austrian, later Swedish, physicist.
- She was praised by Albert Einstein as the "German Marie Curie".
- July, 1938 escaped to Sweden via the Holland.

Lise Meitner

- Worked closely with her nephew Otto Frisch.
- Kept in touch with her old boss in German, Otto Hahn.

Otto Frisch
(1904 – 1979)



Otto Hahn
(1879 – 1968)

Their problem

- Atoms heavier than Iron weigh more than the sum of their parts.
- Atoms lighter than Iron weigh less than the sum of their parts.

- The discrepancy is known as the mass defect.
- Now known as Binding Energy
- Binding energy is released when heavy nuclei split (fission) or when light atoms fuse.
- The Energy is huge!

E = Mc^2

And c is VERY large

Lise Meitner and Otto Frisch

- Explained why Uranium was the heaviest stable atom.
- Explained nuclear fission.
- Uranium -> Barium, Krypton + neutrons + Energy
- Were the first to realise that the Energy came from the missing Mass.

Lise Meitner and Otto Frisch

- Frisch experimentally confirmed the predictions by bombarding Uranium with Neutrons (1939).
- Together they realised the possibility of a chain reaction.
- Kept Otto Hahn informed of their progress.

Otto Hahn
(1879 – 1968)

- Nobel Prize in Chemistry (1944).
- For the discovery of the fission of heavy nuclei.
- A solo winner!!!!

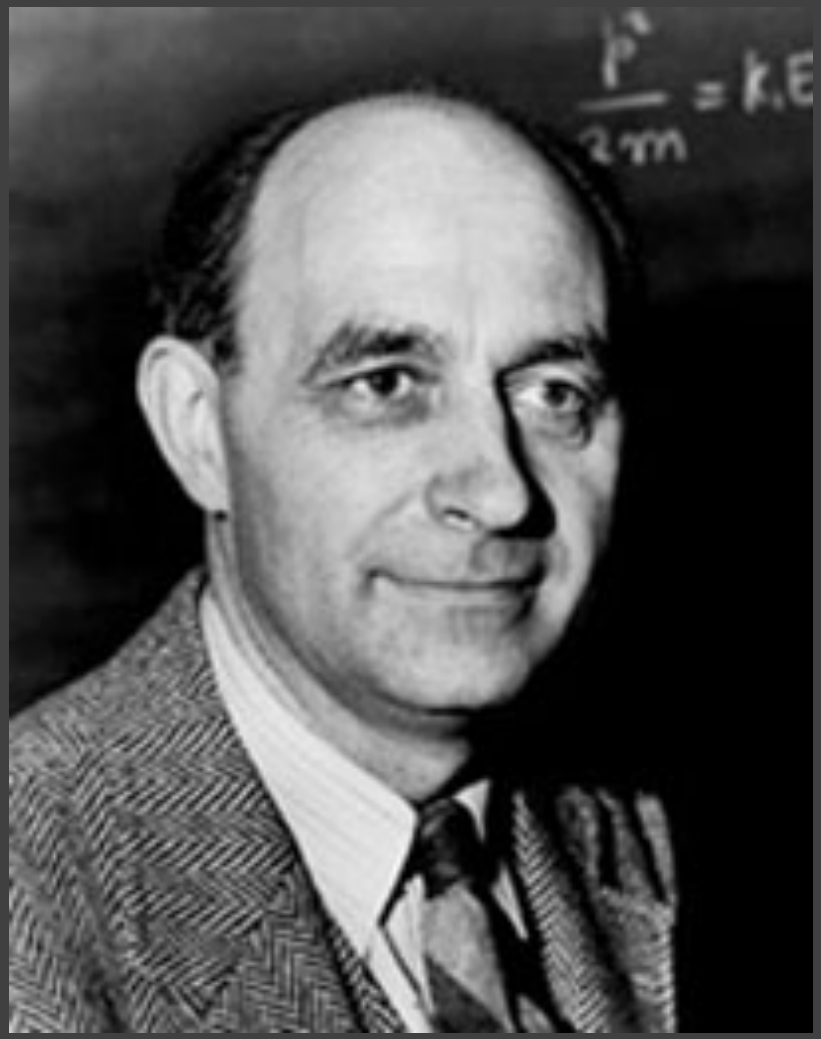
Lise Meitner
(1878 - 1968)

- Had an element named after her
- Element 109
- Meitnerium (Mt)
- Mt 278 half life of 7.6 secs

Chain Reaction

- Hit a Uranium nucleus with a neutron and it will fission to produce:
- Fission products eg Barium, Kripton
- But also Gamma rays, Neutrons and Energy.
- Critical Mass
- Frisch and Meitner were correct: the Energy came from the missing Mass.

Enrico Fermi
(1901 – 1954)



What about Fusion? ….

Fusion reactors

- Abundant fuel
- No radioactive waste
- Its how the sun works
- International Thermonuclear Experimental Reactor (ITER) – 90 MW in, 500 MW out - France (2019)

The End