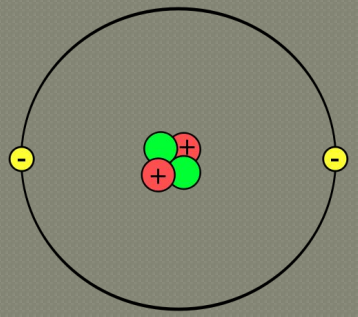
Unit 2 - Atomic Structure and Nuclear Chemistry

Section 3: "It's da bomb!" – Fission and Fusion Reactions

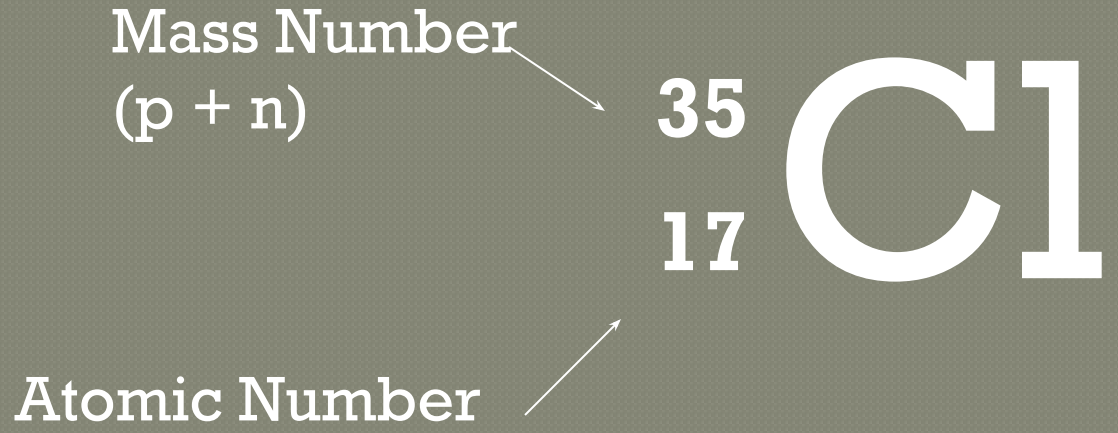
Quick Review



- Nucleus
  - Centermost part of an atom
  - Composed of protons and neutrons
    - Protons – Positive Charge
    - Neutrons – Neutral Charge
  - Surrounded by electrons
    - Electrons – Negative Charge

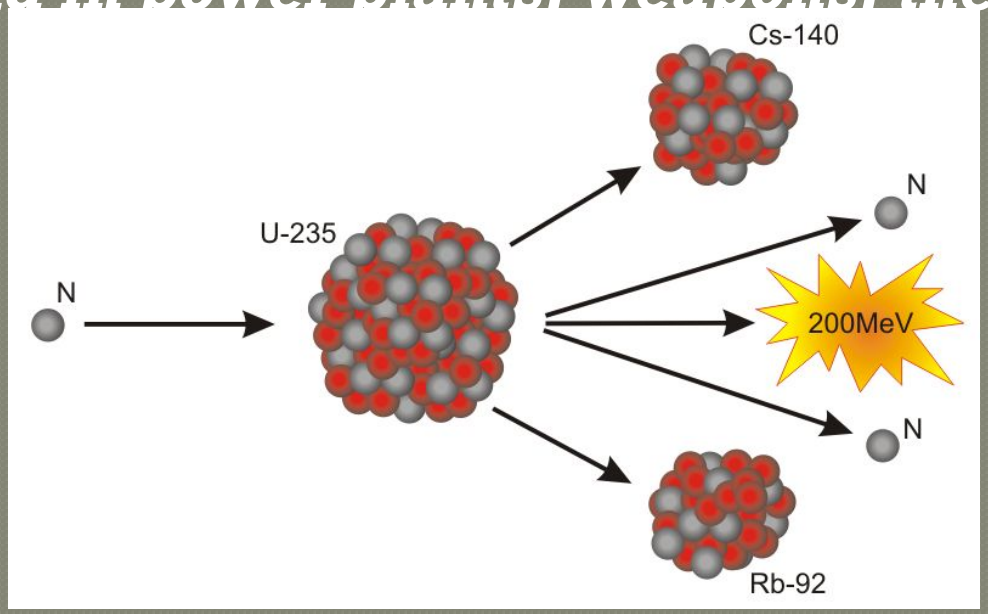
Atomic Structure (Review)

- In chemistry, a quick symbol may be used to describe an atom…



Fission Reactions

- **Nuclear Fission** – atomic nucleus is struck with a neutron, causing it to become unstable and split.
  - Splitting of the nucleus creates ***enormous amounts of energy - energy is converted from mass!*** **($E=mc^2$)**
    - ***Found in power plants, weapons, the sun, etc.***



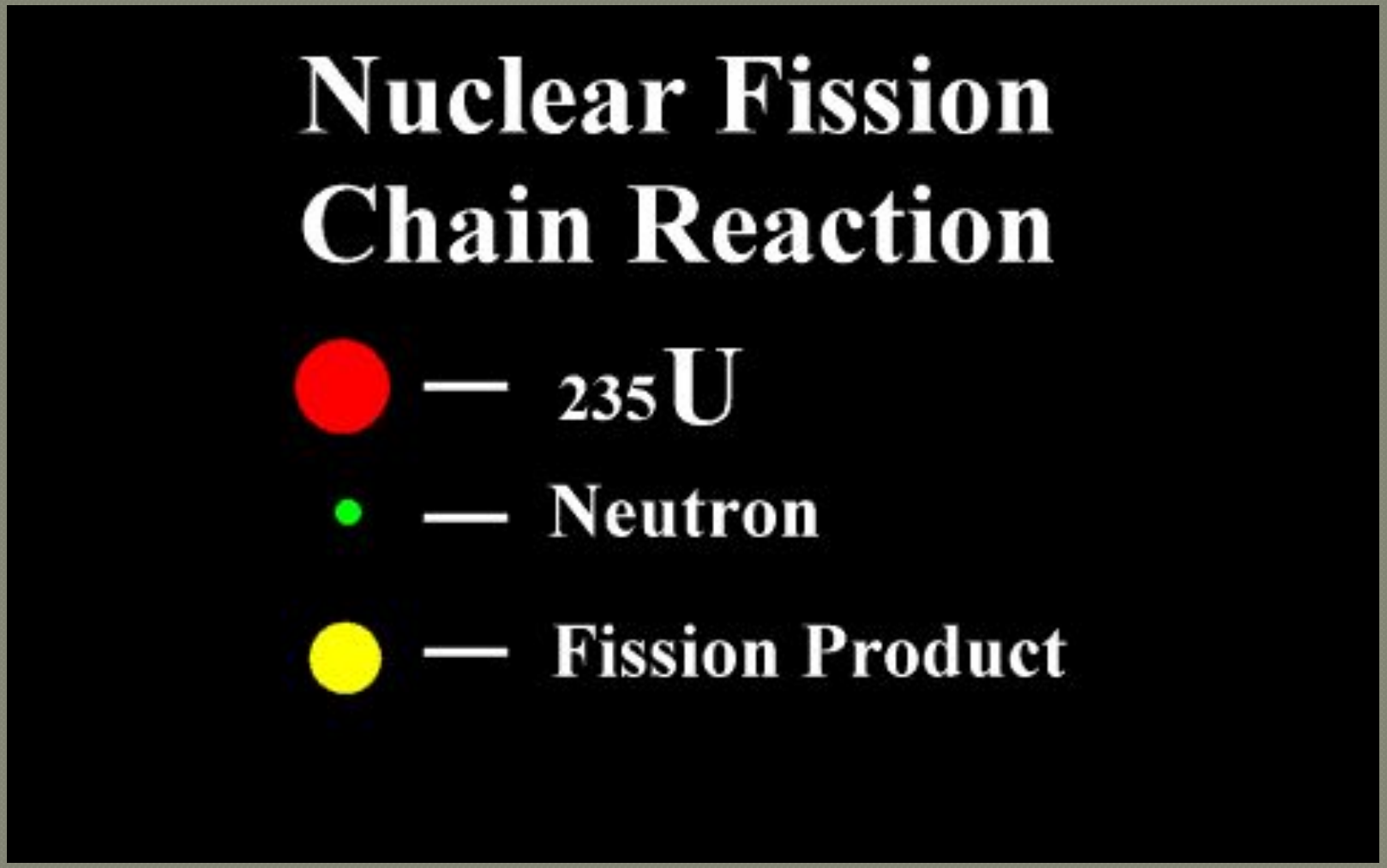
Fission Reactions

$$^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{93}_{36}\mathrm{Kr} + {}^{140}_{56}\mathrm{Ba} + 3\,{}^{1}_{0}\mathrm{n}$$

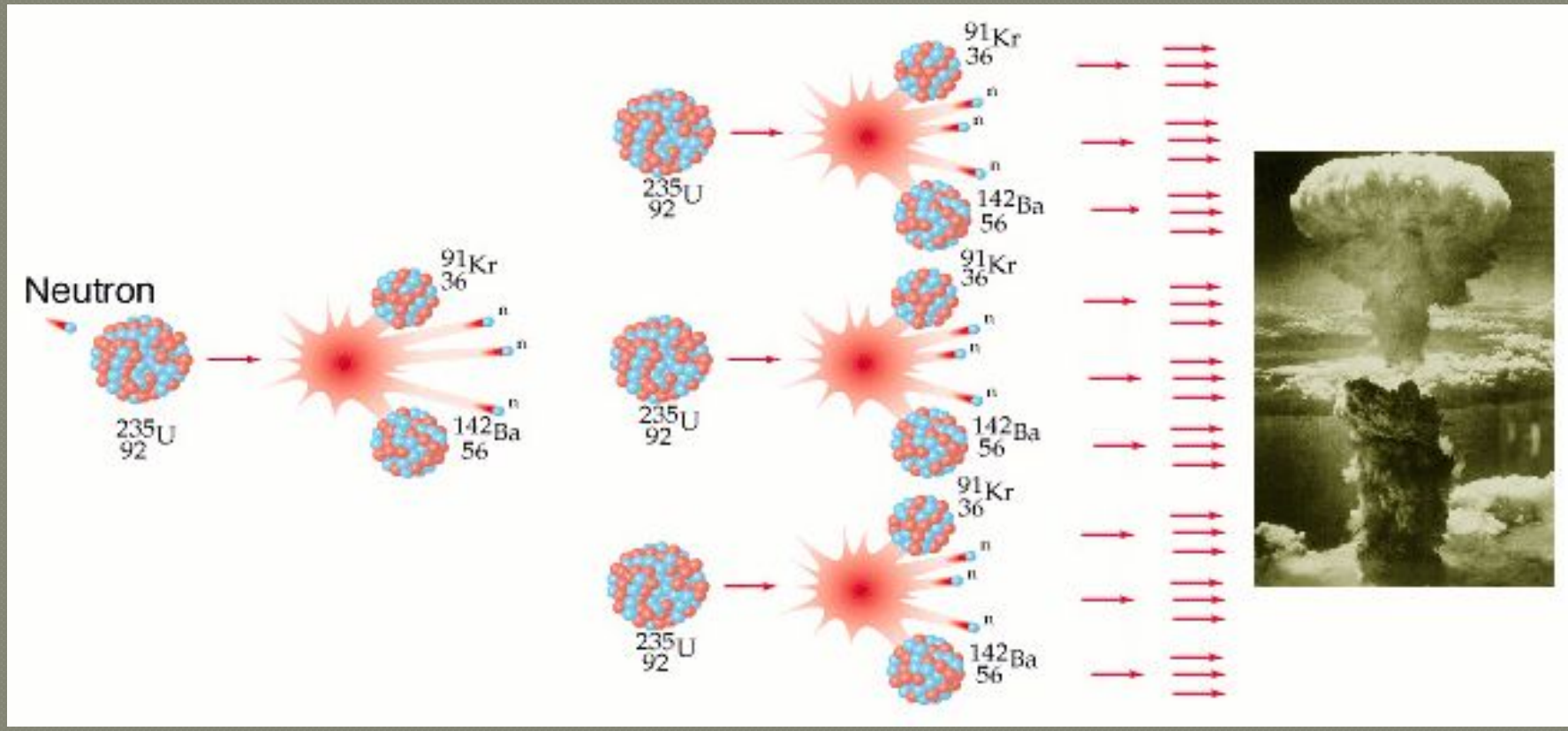
$${}^{1}_{0}n + {}^{235}_{92}U \rightarrow [{}^{236}_{92}U] \xrightarrow{85\%} fission\ (e.g.\ {}^{139}_{56}Ba + {}^{94}_{36}Kr + 3\ {}^{1}_{0}n)$$

$${}^{1}_{0}n + {}^{235}_{92}U \rightarrow [{}^{236}_{92}U] \xrightarrow{15\%} {}^{236}_{92}U + \gamma$$

Nuclear Fission – Chain Reaction



Fission Reaction – The Nuclear Bomb



Nuclear Explosions since 1945

Each explosion is represented by a circle.
Many of these circles overlap.

- atmospheric detonations
- underground or underwater tests

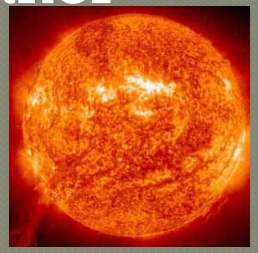
Country:	Year of first detonation:	Number of detonations: atmospheric	underground	underwater
United States	1945	206	912	5
USSR	1949	223	756	3
United Kingdom	1952	21	24	

- more than 20 megatons
- 2.5–5.1 megatons
- 160–320 kilotons
- less than 15 kilotons

The size of each circle represents the yield of the blast.
The scale is not linear:

Fusion Reactions

- Nuclear Fusion – the ***combination of two nuclei*** to create a nucleus with a greater mass.
  - Often occurs when Hydrogen nuclei fuse at high temperatures but can occur with fusion of other elements!
    - **Found in Hydrogen bombs and the sun**

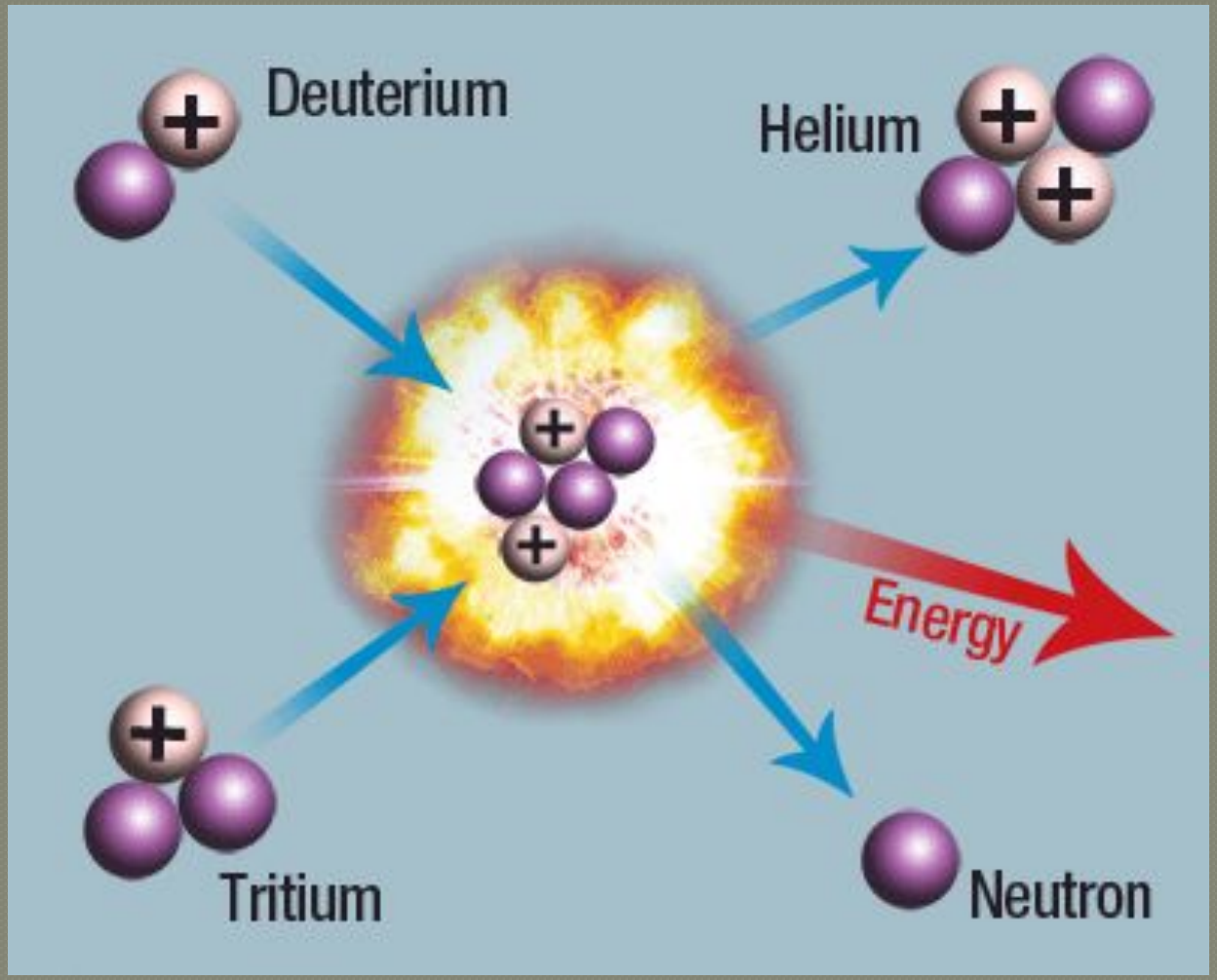


$$^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}He + \text{Neutron} + \text{ENERGY!!!}$$

Nuclear Fusion

$^{2}_{1}H$

$^{3}_{1}H$



$^{4}_{2}He$

Fission vs. Fusion Reactions