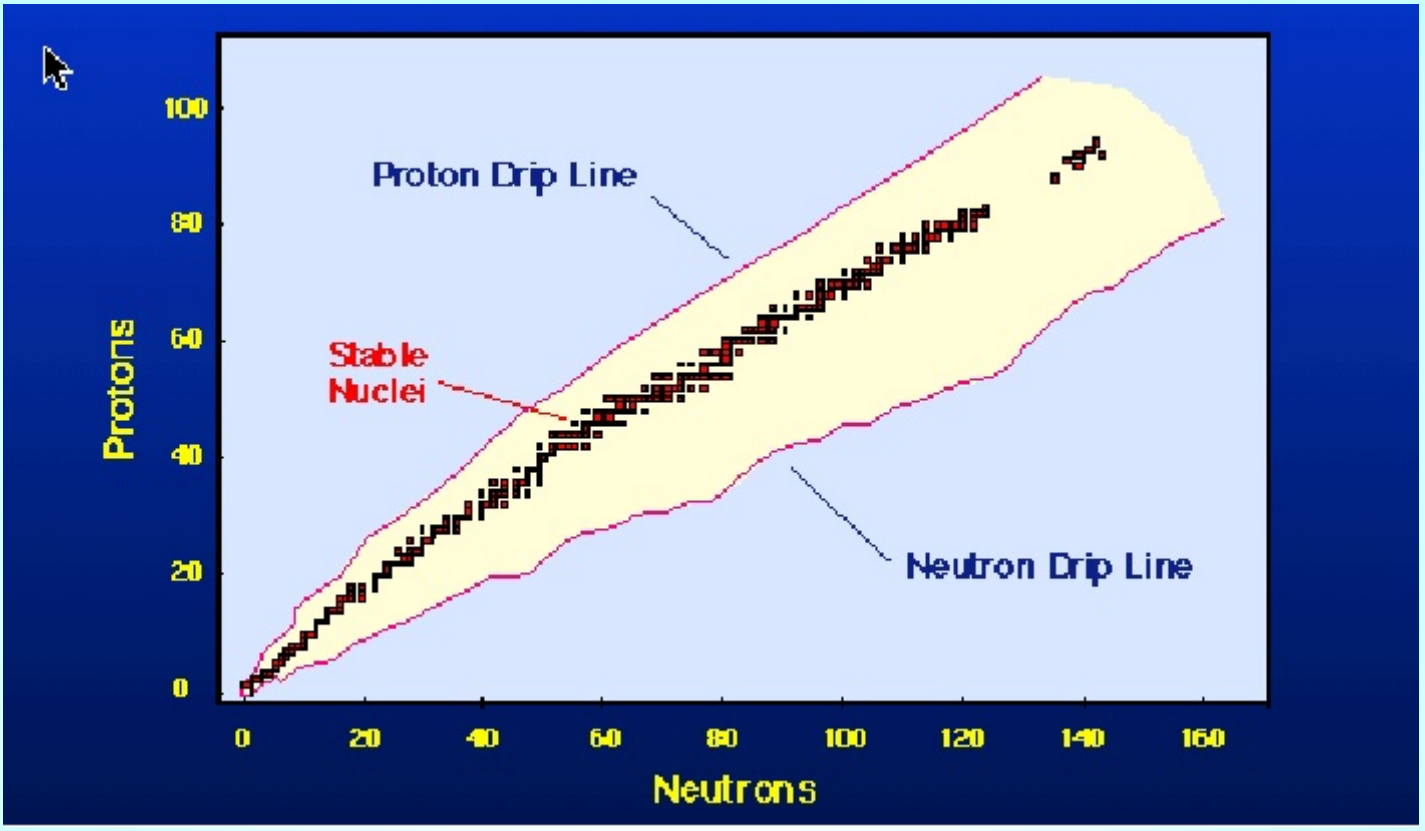
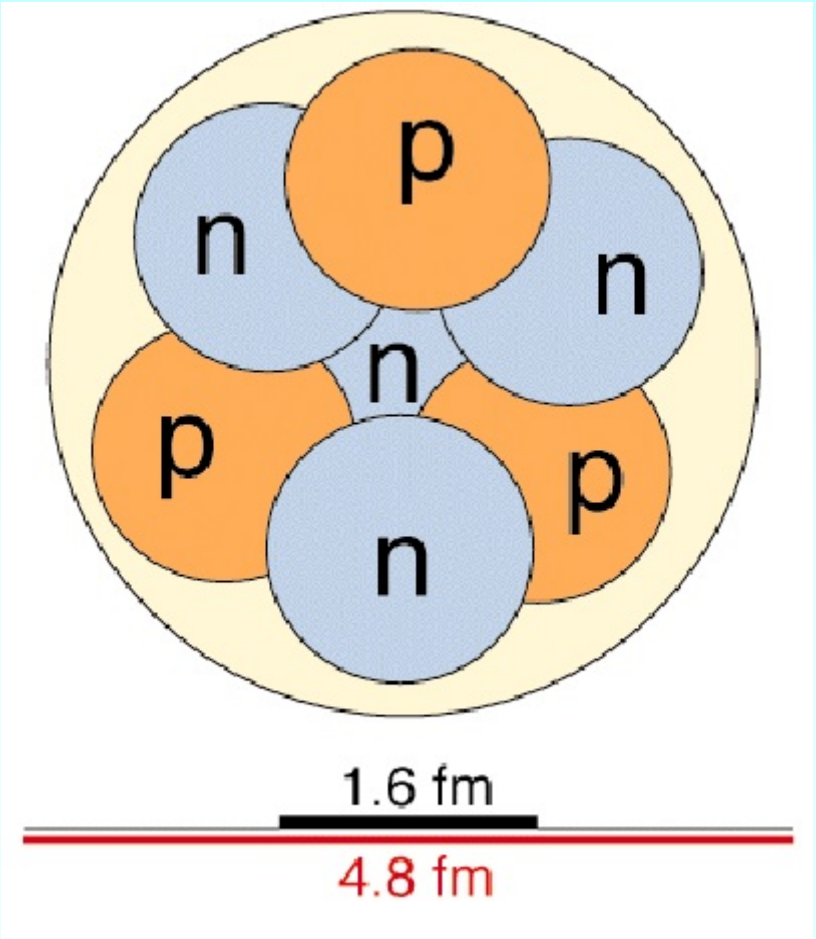
The valley of stability



The stable nuclides are found in the indicated region.
It is important to notice that the N/Z ration increases weakly towards higher mass numbers

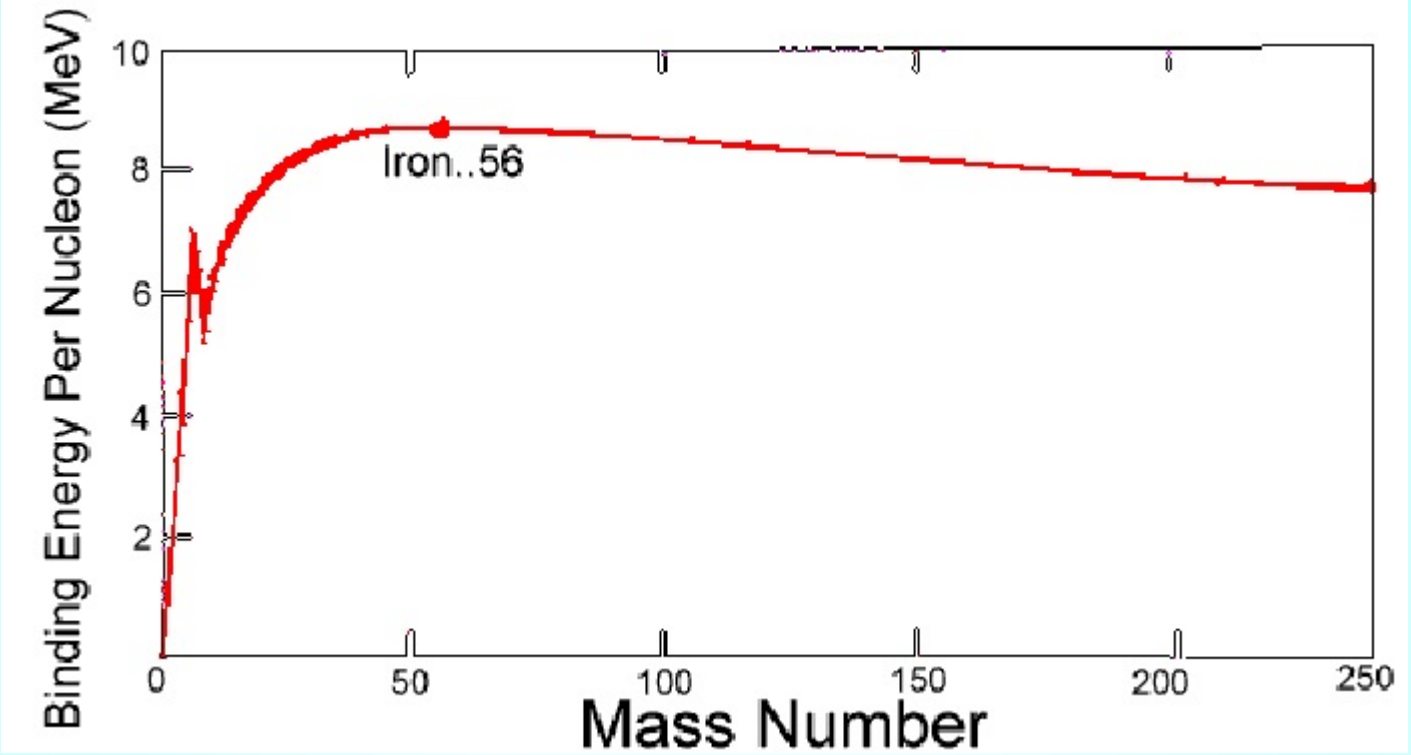
How is the nucleus composed ?



Size of a nucleon: approx. 1.6 fm
Size of the nucleus $\approx r_o A^{1/3}$

1 fm (femtometer, fermi) = 10^{-15} m

Binding energy



The binding energy pr. nucleon as a function of the mass number

Increases rapidly at low masses, with a maximum at ^{56}Fe
Sinks slowly towards high masses

From the chart of nuclides

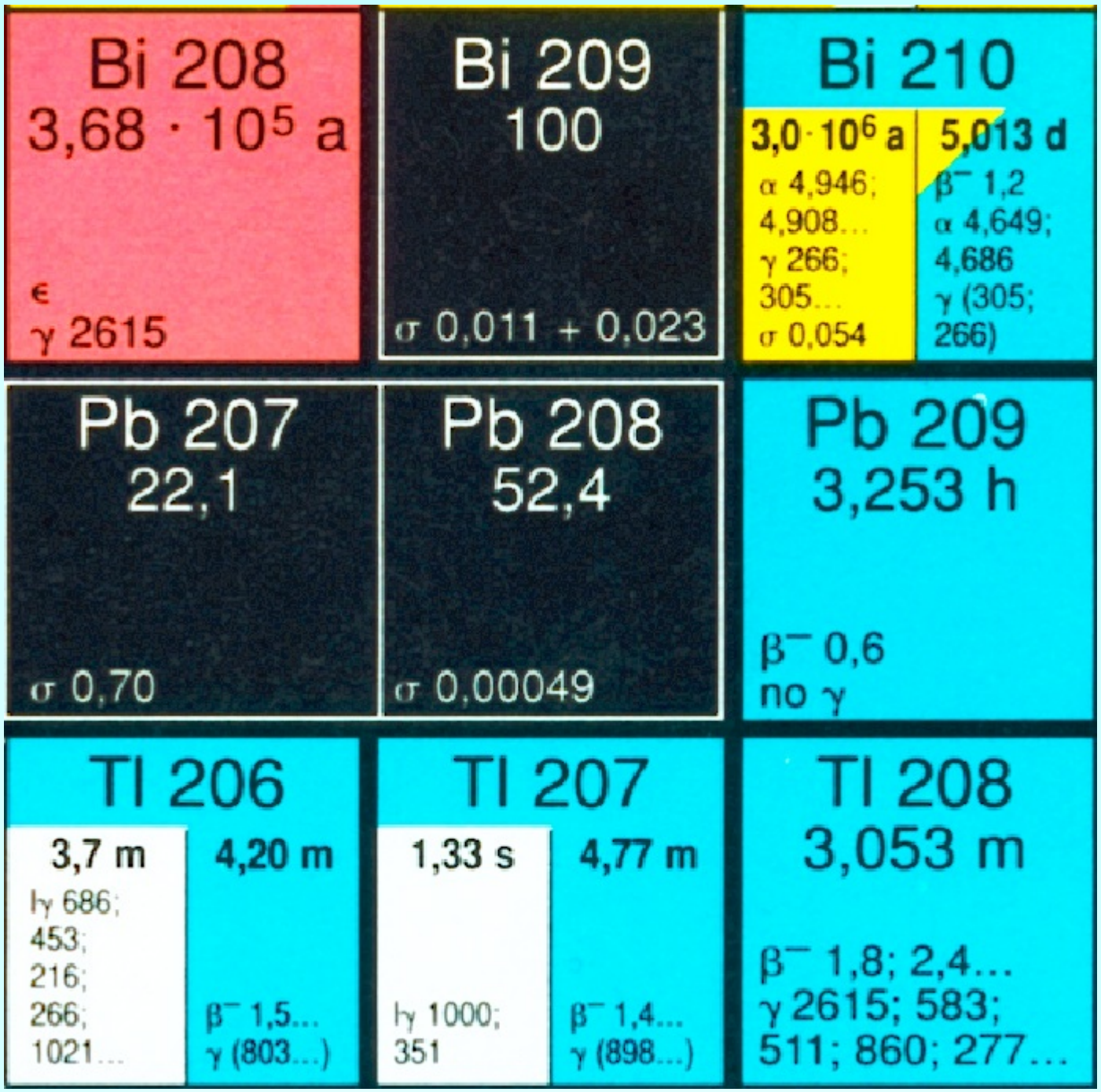
- We have roughly
  - Stable nuclides: approx.275 (black)
  - Nuclides occuring in nature: approx. 300
  - Total number of nuclides: approx. 2200
- The radioactive ones are:
  - β^- - neutronrich nuclei
  - β^+ - neutrondeficient nuclei
  - EC -neutrondeficient nuclei near stability
  - α - heavy nuclei
  - SF - very heavy nuclides
- Internal γ - everywhere
- Exotic forms:
  - Proton-emission
  - ^{14}C-emission

More observations from the chart of nuclides

- Stable nuclides
  - Even Z, even N 163 60,8 %
  - Even Z, odd N 55 20,3 %
  - Odd Z, even N 49 18,9 %
  - Odd Z, odde N 4* 1,5 %

  *) All with A≤ 14
- Stable nuclides
  - Only one on isobar chains with odd A
  - Up to three on isobar chains with even A
  - Max two stable isotopes wiith odd Z
  - No stable isotopes for Z=43 and Z=61
  - May be many stable isotopes for even Z (maxfor Sn, 10 stable)
- Other observations
  - Many isomers for cerntain elements (e.g. almost every In isotope)
  - Magic numbers
  - Strong occurrence of α-activity right above ^{208}Pb
  - No stable nuclides with A=5 or 8

Part of the chart of nuclides



^{208}Pb - double shell nuclide

Po 206
8,8 d
ε; α 5,2233
γ 1032; 511;
286; 807...
e⁻; g
Po 207
2,8 s
Iγ 815;
268;
301
5,84 h
ε; β⁺...
α 5,116
γ 992;
743;
912...; g
Po 208
2,898 a
α 5,1152...
ε
γ (292; 571...)
g
Bi 205
15,31 d
ε
β⁺...
γ 1764; 703;
988...
Bi 206
6,24 d
ε
β⁺...
γ 803; 881; 516;
1719; 537...
Bi 207
31,55 a
ε
β⁺...
γ 570; 1064;
1770...
Pb 204
67,2 m
Iγ 899;
912;
375...
1,4
σ 0,68
Pb 205
1,5 · 10⁷ a
ε
no γ
σ ~ 5
Pb 206
24,1
σ 0,030