Summary - Nuclear properties, force and models

- Nuclear radius

↳ mean radius $R = R_0 A^{1/3}$

-▷ skin thickness

-▷ measurements of 2 types:

- charge distribution (Coulomb force)
  - low energy scattering
  - K- X-ray energies
  - muonic X-rays
  - Coulomb E differences of nuclei
- nuclear matter distribution (strong force)
  - high energy scattering
  - radioactive decay
  - π mesonic X-rays

- Nuclear mass

ways of measuring the mass:

- mass spectrometer
  - ↳ relative mass measurements
- nuclear reactions

-▷ nuclear abundances - isotopes, isotope separation

nuclear binding energy

- mass defect
- neutron separation
- semi empirical mass formula — components!

- Nuclear angular momentum and parity

- total angular mom: I combination of l and s
- parity: even or odd $1^{\pi} \Rightarrow 0^+, 2^+ \ldots$

- Nuclear electromagnetic moment

Q - electric moment
μ - magnetic moment

} discrepancy of predictions and observations ⇒ p, n are not point like particles, n ⇒ has internal charge structure

§2 nuclear pairing force favours coupling of nucleons so that the mag. mom and spin mag mom = 0

paired nucleons vs. non paired nucleons

- nucleons have excited states ⇒ various properties

Nuclear force

properties of the strong force:

- basic consideration of the deuteron
- basics of nucleon-nucleon scattering → crosssection, → scattering length ....

⇓

properties of the nuclear force

1. attractive potential $V_c(r)$
2. spin dependence
3. non central term (tensor potential) direction of spin
4. charge symmetry p-p same as n-n interaction
5. nearly charge independent p-p, p-n, n-n

   n-p, p↑p↑, n↑n↑ } scattering length is different

   ↳ mesons π^+ and π^0 not the same mass
6. repulsive at short distances

   ↳ high energy scattering
7. dependence on the relative velocity of nucleons (momentum)

   ↳ polarization in scattering experiments based on the angular momentum and spin

→ The exchange force model

↳ interaction trough meson exchange

Modells:

Shell model

- valance nucleon
- last unfilled shell

Liquid drop model

- rotation
- vibration

predictions vs experiments

+ problems we did in class