Summary

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Nuclear Physics

- Introductory Nuclear Physics
- Fission
- Fusion
- Medical Applications
- Nuclear Physics research

Introductory Nuclear Physics

- Binding Energy. Liquid drop model
- Decay
- Cross section
- Scattering, multiply scattering, elastic scattering, absorption, excitation
- Bohr model of the atom and atomic line spectra
- Coulomb barrier and barrier penetration
- Radio-carbon dating
- Q-value. Mass defect and Einstein equation
- Charged particle passage in matter. The Bethe-Block formula, known also as the stopping power or dE/dx
- Charged particle identification using dE/dx
- The electromagnetic force
- The strong nuclear force
- The weak nuclear force (e.g., radioactive decays)
- Gravity

Fission

- Fission reactors for electrical energy production
  - Requirements and examples of fission reactors
  - Advantages and disadvantages

Fusion

- The case of the sun
- The production of heavier elements in stars
- The condition of sustained fusion
- Towards using fusion on Earth for power generation
- The oceans as source of fusion fuel on Earth
- The p-p cycle and the CNO cycle
- D-D, and D-T fusion reaction
- Breakeven and ignition
- Confinement options
- High temperature and Coulomb barrier
- ITER
- Fusion and fission reactors. Pros and cons

Medical

- Radio nuclide production for medical application
- Radio tracers
- Tomography, PET
- X-ray, gamma rays tomography, therapy
- Proton and ion therapy
- The Bragg peak
- Activation

Research

- Nuclear labs for pure and applied research
- Understand the nuclear structure of matter
- Input into high energy physics
  - Inside the proton and the neutrons. Quarks and gluons are the basic constituents of matter