

# **Nuclear Physics and Elementary Particles**

**Winter semester 2009/2010**

**Tuesday 12 c.t. – 14, SR E2 (1.1.53)**

**Wednesday 12 c.t. – 13, SR E2 (1.1.53)**

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**Prof. Dr. Maarten Peter Heyn  
Prof. Dr. Heinz-Eberhard Mahnke**

## LITERATURE

- 1) Ch. Berger, "Teilchenphysik", Springer Lehrbuch
- 2) W. Demtröder, "Experimentalphysik 4", Springer Lehrbuch
- 3) Th. Mayer-Kuckuk, "Kernphysik", Teubner Studienbücher
- 4) P. Marmier, E. Sheldon, Physics of Nuclei and Particle, Academic Press, 1969
- 5) H. Frauenfelder, E.M. Henley, „Subatomic Physics“, 1974, Prentice Hall, Englewood Cliffs  
(deutsch Oldenburg 1996)
- 6) Chr. Lehmann, Interaction of Radiation with solids, series “Defects in Crystalline Solids”,  
vol. 10, N-H P C 1977, Amsterdam
- 7) G. Schatz, A. Weidinger, „Nuclear Condensed Matter Physics“, Wiley 1995 (deutsch Teubner)
- 8) B. R. Martin, G. Shaw, „Particle physics“, Wiley, 1997, 2nd edition
- 9) D. H. Perkins, “Introduction to high energy physics”, Cambridge, 2000, 4th edition
- 10) G. Kane, “Modern elementary particle physics”, Addison Wesley, 1993, 2nd edition
- 11) particle data book: <http://pdg.lb.gov>
- 12) <http://cdsmedia.cern.ch/img/CERN-Brochure-2008-001-Eng.pdf>

Scriptum and excercises see <http://users.physik.fu-berlin.de/%7Eag-heyn/>  
(FU, Fachbereich Physik, Forschung, exper. Gruppen, Heyn, homepage, teaching)

### Adresses:

Prof. Dr. M. P. Heyn

Tel. 838-56160

email: [maarten.heyn@physik.fu-berlin.de](mailto:maarten.heyn@physik.fu-berlin.de)

Prof. Dr. H.-E. Mahnke

Tel. 8062-2715 (HZB)

email: [mahnke@helmholtz-berlin.de](mailto:mahnke@helmholtz-berlin.de)

Practical course:

Wednesday 12 - 13

## **Plan**

- 08.12.** 1. **Introduction: Nuclear physics and applications**  
Terminology, energies, stable - unstable nuclei, transformations by decay, - by reactions, decay law
- 15.12.** 2. **Interaction of radiation with matter, detectors, accelerators, biological effects, radiation safety, applications of accelerators in science, cultural heritage studies, medicine**
- 05.01.** 3. **Nuclear Properties: Nuclear masses, radii, cross section, excited states**
- 12.01.** **Nuclear moments, gamma-decay, hyperfine interaction**
- 19.01.** **Nuclear forces, nuclear models**
- 26.01.** 4. **Nuclear transformation: alpha-decay (tunneling, repetition from quantum mechanics), beta-decay, other modes**
- 02.02.** **Nuclear reactions**
- 09.02.** **Nuclear fission and fusion**
- 10.02.** **Final Exam (Written)**
- 11.02.** **Visit to an accelerator (at the Helmholtz-Zentrum Berlin, either Campus Lise Meitner or Campus Conrad-Wilhelm Röntgen)**

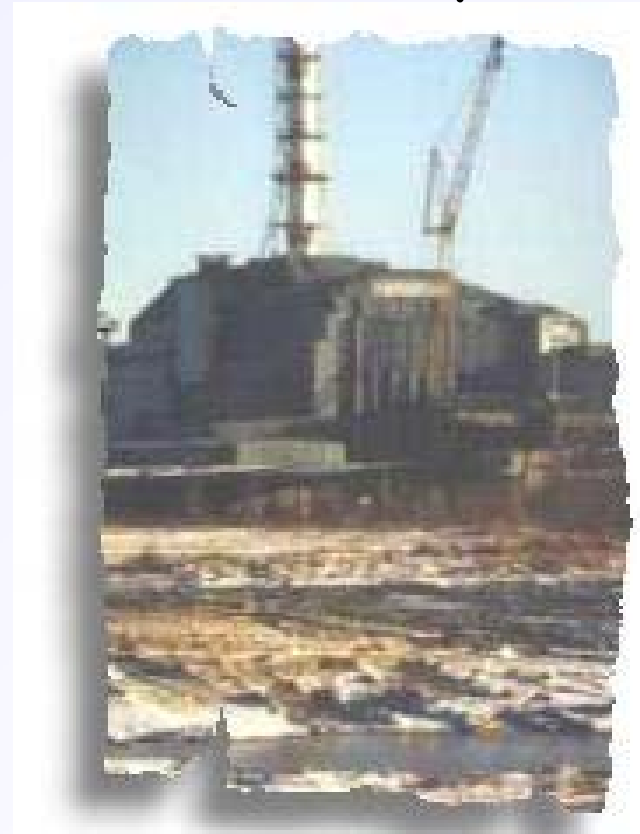
good examples - bad examples

## Technical applications Atom bomb - Reactor

Hiroshima 1945



Tschernobyl 1986



Energy from nuclear fission, is there an alternative?

# MRT and PET

(NMR nuclear magnetic resonance, PET Positron-Emission - Tomography)



Hyperfine interaction, physics of antimatter

# Tumor therapy with hadrons

## Proton PT at HZB

protons for eye tumors since 98:  
> 1000 patients



## C-12: GSI

heavy ion treatment

