Quarks, gluons, hadrons, nuclei, and beyond nuclear structure

Chapter I Advanced course in hadron and quark-gluon plasma physics:
(15h, 2nd semester)

In this lecture, strong interaction physics will be discussed following two lines of research:

- Hadron physics:
  concepts and experimental methods to study the mass spectrum of hadrons and the internal structure of hadrons in terms of their constituents and aiming to explain their quantum numbers.

- Quark-Gluon plasma physics:
  concepts and experimental methods to study strongly interacting matter in the laboratory with the help of thermodynamics, hydrodynamics, electromagnetic radiation and the production of heavy quarks and jets.

The present lecture shall give the necessary basis for research on these advanced topics, illustrated by current research examples and pointing out connections to nuclear physics, astroparticle physics, cosmology, standard model particle physics, and beyond standard model physics.

Chapter II: Advanced nuclear physics: beyond nuclear structure
(15h, 2^{d} semester)

In this lecture, three main transverse topics shall be discussed, to help studying a large variety of phenomena in advanced nuclear physics:

- Nuclear reactions: from the measurement to probing nuclear structure
- Nuclear equation of state and applications to exotic nuclear excitations, neutron stars, and gravitational waves
- Nuclear decays: exotic decays, testing the standard model

The present lecture shall provide clear and basic knowledge on these advanced topics, illustrated by current research examples.

Exam: Oral questions for 15 minutes, with 5 min of preparation. Total length: 20 min.