Year	Second semester 2025
Course	Lecture on Basic Nuclear Physics
Day/Period	Fri.3Period
Credit(s)	2Credits
Instructor	YUDAI ICHIKAWA
Eligible Participants	Not specified (For all grades)
Course code/number	SPH-PHY505B
Main Subjects	
Course of Media Class	
Practical business	
Language Used in Course	English
Course Title	Basic Nuclear Physics
Purpose/Abstract	Protons and neutrons, which constitute atomic nuclei, are hadrons composed of quarks and gluons, bound together by the strong interaction. This course will focus on hadron physics, covering the properties of quarks and gluons, the structure and interactions of hadrons, and the process by which they form atomic nuclei. In this course, we will divide the study into three main domains: the world of hadrons, the world of quarks, and the world of nucleon many-body systems. First, we will explore the properties of hadrons and the forces acting between them. Next, we will examine the behavior of quarks and gluons. Finally, we will consider the structure and interactions of atomic nuclei, which emerge as many-body systems of hadrons. At the beginning of the universe, right after the Big Bang, quarks existed in a free state. As the universe cooled, they became confined within hadrons, which later formed atomic nuclei. To understand this process, we will introduce the fundamental concepts of Quantum Chromodynamics (QCD) and discuss recent research findings obtained from accelerator experiments and neutron star observations. Through this course, students will gain a fundamental understanding of hadron physics, explore the hierarchical structure of matter from quarks to atomic nuclei, and develop a perspective on the evolution of matter from the viewpoint of modern nuclear physics.
Goal	Get an overview of modern nuclear physics and learn how quarks create our physical world.
Contents and progress schedule of the class	(1) The World of Hadrons: Explain the properties and structure of hadrons using the quark model. (2) The World of Quarks: Describe the structure of nucleons through experiments such as electron-proton scattering. (3) The World of Nucleon Many-Body Systems: Explain the interactions between hadrons and the physics of nucleons as a many-body system.
Grading	Evaluate through reports and final exams
Books required/referenced	Quarks and Leptons: An Introductory Course in Modern Particle Physics (F. Halzen, A.D Martin, John Wiley & Sons Inc) HIGH ENERGY HADRON PHYSICS (Martin L. Perl, John Wiley & Sons Inc)
Contents of preparation and review	It is desirable to have a prior understanding of the fundamentals of electromagnetism, quantum mechanics, and the theory of special relativity.
Study time for preparation and review	Standard Hours for Preparation/Review per class: *Lectures 4 hour *Seminar 2-4 hour *Experiment, Laboratory Work, and Skill Test 2 hours
How to contact and Google Classroom Code	Class code：3reipiy Phone：022-795-6453 yudai.ichikawa.d3@tohoku.ac.jp
Remarks	
Last Update	

One-credit courses require 45 hours of study. In lecture and exercise-based classes, one credit consists of 15-30 hours of class time and 30-15 hours of preparation and review outside of class. In laboratory, practical skill classes, one credit consists of 30-45 hours of class time and 15-0 hours of preparation and review outside of class.