

# Particle Physics Experiments Spring 2025

**Topics for oral exam to be held 29.4.2025 at 10.15-14.00 in C310,  
5.5.2025 at 10.15-14.00 in D115 and 16.5.2025 at 13.15-17.00 in C310**

Those classified as difficult marked by a (\*)

Topics related to the Accelerators (chapters 2 to 5 in lecture notes):

1. Transverse beam motion: bending, focusing, accelerator lattice, FODO cell & equation of motion, (chapter 2, pages 2-12)
2. Transverse beam motion: twiss & transport matrices, stability, Liouville's theorem, beam distributions & measurements (chapter 2, pages 13-24)
3. Longitudinal beam motion (chapter 3, pages 2-11)
4. Electron dynamics (chapter 3, pages 12-19)
5. Radio frequency cavities (\*) (chapter 4, pages 2-13)
6. Closed orbit distortions, gradient errors, resonant conditions & Chromaticity (\*) (chapter 4, pages 14-24)
7. Collider types, LHC, luminosity & antiproton cooling (chapter 5, pages 3-24)
8. Future colliders & accelerator applications (\*) (chapter 5, pages 25-50)

Topics related to Detectors & Experiments (chapter 6 to 8 in lecture notes):

9. Tracking: momentum measurement, multiple scattering, interactions of charged particles, ionization in gas, gas amplification (chapter 6, pages 6-19)
10. Gas based detectors: gas choice, signal formation, operation modes, wire chambers, micro pattern gas detectors, electron & ion drift, drift chambers, time projection chambers (\*) (chapter 6, pages 20-38)
11. Silicon detectors: basic principles, characteristics, different types of sensors, silicon detector characteristics & trends (chapter 6, pages 43-53)
12. Silicon detectors: silicon trackers and their purpose, distinguish short-lived particles, radiation damage & ways to overcome it, time-of-flight detectors (\*) (chapter 6, pages 54-63)
13. Energy measurement, bremsstrahlung, electron/photon interactions, electromagnetic showers, energy resolution of calorimeters, neutrino interactions (chapter 7, pages 16-26)
14. Nuclear interactions, hadronic showers, calorimeter types, jet measurement & corrections, particle flow (\*) (chapter 7, pages 27-42)
15. Trigger, electronics, data acquisition system (\*) (chapter 8, pages 1-11)
16. Detectors systems (chapter 8, pages 12-22)