



Next-Generation Particle Detectors at Future Colliders 2 CFU

Teaching staff

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Reception hours: upon student request.

Program of the course:

The objective of this course is to outline the state of the art and technological developments in high-energy physics experiments at particle colliders. The course will illustrate technological advances aimed at building next-generation detectors—with a specific focus on trackers, calorimeters, timing detectors, and muon systems—designed to ensure optimal performance even under the most extreme operating conditions.

1. Advanced Particle Tracking & Vertexing

- Material budget minimization, cluster counting, and monolithic integration.
- Monolithic Active Pixel Sensors (MAPS) and ultra-light helium-based drift chambers.

2. High-Performance Dual-Readout Calorimetry

- Fluctuations in hadronic showers, compensation mechanisms, and signal decoupling.
- Scintillating and Cherenkov fibers embedded in dense absorbers (e.g., copper or lead).
- Simultaneous measurement of electromagnetic and hadronic components for superior jet energy resolution.

3. Ultra-Fast Muon Spectrometers & Timing Chambers

- High-rate background suppression, aging effects, and picosecond-level time stamping.
- Low-Gain Avalanche Diodes (LGADs), Micro-Pattern Gaseous Detectors (MPGDs), and resistive plate chambers.

Bibliography:

“The IDEA detector concept for FCC-ee” and references therein, [arXiv:2502.21223](https://arxiv.org/abs/2502.21223)

<https://doi.org/10.48550/arXiv.2502.21223>