Shining Lasers on Particle Beams: Production, Interaction, and Control of Extreme Matter at CERN

From generating particles to probing antimatter, lasers play an increasingly central role in accelerator science.
At CERN, laser-based techniques are used to generate, interact with, and control ultra-relativistic particle beams, enabling non-invasive diagnostics and exploring novel methods for antimatter cooling and beam manipulation.
In this talk, I will provide an overview of the underlying physics of laser-charged particle interactions and illustrate how these processes are implemented in practice at CERN.
Particular emphasis will be placed on applications in particle beam production, diagnostics, and spectroscopy, highlighting the interplay between lasers and particle beams in large-scale accelerators.