

Plenary Talk PV X Wed 9:45 AudiMax
Precision at the Energy Frontier: What the LHC is revealing about Fundamental Particle Physics — ●LUDOVICA APERIO BELLA — DESY, Hamburg, Germany

The Large Hadron Collider (LHC), the most powerful particle accelerator ever built, has opened an unprecedented window onto the fundamental laws of nature. Across the vast set of results published by its major experiments (ATLAS, CMS, LHCb and ALICE), the Standard Model (SM) remains the most successful framework for describing the elementary constituents of matter and their interactions. Historically, precise relations among SM parameters enabled the prediction of the top-quark mass and placed stringent constraints on the Higgs boson

long before their discoveries.

Today, thanks to the extraordinary volume and quality of LHC data, precision measurements of key SM parameters have become central to the LHC physics program. These measurements provide some of the most sensitive tests of the internal consistency of the SM and offer unique opportunities to uncover deviations that could signal new physics.

This talk will present recent high-impact results from the LHC collaborations, highlighting landmark measurements that have achieved unprecedented precision and discussing their implications for the structure of the SM and the broader physics landscape. Prospects for the High-Luminosity LHC era will also be outlined, where an order-of-magnitude increase in data will enable even more stringent tests.