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FASER's Electromagnetic Calorimeter Test-Beam Studies

FASER, or the Forward Search Experiment, is a new experiment at CERN designed to complement the LHC's ongoing physics program, extending its discovery potential to light and weakly-interacting particles that may be produced copiously at the LHC in the far-forward region. New particles targeted by FASER, such as long-lived dark photons or dark scalars, are characterized by a signature with two oppositely charged tracks or two photons in the multi-TeV range that emanate from a common vertex inside the detector. The experiment is composed of a silicon-strip tracking-based spectrometer using three dipole magnets with a 20-cm aperture, supplemented by four scintillator stations and an electromagnetic calorimeter. The full detector was successfully installed in March 2021 in an LHC side-tunnel 480 meters downstream from the interaction point in the ATLAS detector. FASER is planned to be operational for the upcoming LHC Run 3.

The FASER electromagnetic calorimeter is constructed from four spare LHCb calorimeter modules. The modules are of the Shashlik type with interleaved scintillator and lead plates that result in 25 X0 and ˜1% energy resolution for TeV electromagnetic showers. In 2021 a test beam campaign was carried out using one of the CERN SPS beam lines to set up the calibration of the FASER calorimeter system in preparation for physics data taking. The relative calorimeter response to electrons with energies between 10 and 300 GeV, as well as high energy muons and pions, have been measured under various high voltage settings and beam positions. The measured calorimeter resolution, energy calibration, and particle identification capabilities are presented.

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