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Search for Neutral Long-lived Particles Decaying in the CMS Endcap Muon Detectors

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Many extensions of the standard model (SM) predict the existence of neutral, weakly-coupled particles that have a long lifetime. These long-lived particles (LLPs) often provide striking displaced signatures in detectors, thus escaping the conventional searches for prompt particles and remaining largely unexplored at the LHC.

I will present a first search at the LHC that uses a muon detector as a sampling calorimeter to identify displaced showers produced by decays of LLPs. The search is sensitive to LLPs decaying to final states including hadrons, taus, electrons, or photon, LLP masses as low as a few GeV, and is largely model-independent. The search is enabled by the unique design of CMS endcap muon detectors (EMD), composed of detector planes interleaved with the steel layers of the magnet flux-return yoke. Decays of LLPs in the EMD induce hadronic and electromagnetic showers, giving rise to a high hit multiplicity in localized detector regions that can be efficiently identified with a novel reconstruction technique. The steel flux-return yoke in the CMS detector also provides exceptional shielding from the SM background that dominates existing LLP searches. The search yields competitive sensitivity for proper lifetime from 0.1m to 1000m with the full Run2 dataset recorded at the LHC.

I will present the result of the search, as well as the supplementary materials that allow for reinterpretation of the analysis to any models containing LLPs. I will show the recast and projected sensitivity of this search in a few benchmark models. We show that this new search approach is sensitive to LLPs as light as a few GeV, and can be complementary to proposed and existing dedicated LLP experiments.

In-person or Virtual?

In-person

Primary author: WANG, Christina (California Institute of Technology)

Presenter: WANG, Christina (California Institute of Technology)

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