Search for long-lived Dark Photons through lepton-jets

INTERNATIONAL CONFERENCE OF HIGH ENERGY PHYSICS

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So far most analyses have considered new particles to decay **promptly**, impacting the design of the detector and reco. algorithms.

A particle with a displaced vertex of only a few **millimetres** would leave an unusual signature that heavily differ from the SM BSM models, as **hidden/dark sectors**, predicts exotic long-lived particles.
Dark Matter could be part of a hidden sector that interacts with SM particles through subtle mixing.

The Higgs boson could work as a portal to a hidden sector.

Lifetime of the dark photon (Z_d) varies with its mass, but mostly

\[ c \tau = \frac{1}{\Gamma_{Z_d}^{tot}} \propto \frac{1}{\epsilon^2 m_{Z_d}} \]
Dark Photons would typically be produced with large boost due to their small mass, forming collimated jet-like structures containing leptons and/or hadrons (lepton-jets).

Analysis divides signal lepton-jets (LJ) into categories.

Selection is based on dark photon jets identification, its displaced vertex signatures and a BDT discriminant.
QCD multi-jet
Rejected by requiring a single collimated jet with low EM fraction

Cosmic ray
Rejected by requiring $\geq 2$ MS tracks without ID track, no jets, and tracking variables

Beam-induced-background
Estimated using data-driven methods
Upper limit on the production as a function of the dark photon proper decay length for two dark photons

Upper limit on the production as a function of the dark photon proper decay length for four dark photons
No significant excess of events compares with the background expectation is observed at 95% CL.

An additional interpretation of the kinetic mixing parameter as a function of the dark photon mass is given at 90% CL for the two dark photon process.