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Search for displaced dimuons using Run 3 Data Scouting at CMS

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A search is performed for long-lived particles decaying to pairs of muons by the CMS experiment recording proton-proton collisions at a centre-of-mass energy of 13.6 TeV at the LHC. The data is collected using a special stream which stores collision event information from 2022 and 2023 produced only by the High Level Trigger (HLT) system of CMS, thereby reducing the size of an event. This data collection programme, known as "Data Scouting", enables the relaxation of event selection requirements in the trigger system by lowering the thresholds for objects such as the transverse momentum for muons.

The analysis focuses on the properties of dimuon vertices, which are pairs of muons originating from a common point displaced with respect to the collision. These properties, such as the transverse displacement, the precision of the displacement measurement of the vertex and the opening angle between the muons are optimised using displaced J/Ψ's as a proxy for displaced dimuons. Events are categorised in terms of the displacement, proximity of other particles, magnitude, and relative orientation of the momentum of the vertex with respect to the collision point, leading to 40 dimuon categories. These selections are designed to be model independent and the event yields are interpreted under a range of models such as the Hidden Abelian Higgs Model and Dark Shower Models which provide candidates for Dark Matter production.

This analysis is an improvement on the Data Scouting search performed for long-lived particles with data collected in Run 2 of the LHC's operation. A rigorous treatment of the systematic uncertainties associated with the mismodelling of the simulation is performed, and is tailored for the trigger and reconstruction systems at the HLT. Preliminary estimates of the upper limit at 95% confidence level on branching fractions of long-lived particle decays to dimuons are competitive for low lifetimes and surpass the Run 2 analysis for high lifetimes despite the lower integrated luminosity collected.

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