Note on a Timing Invariant for CMS LLP Searches

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A potential linear invariant in long-lived particle (LLP) timing may be expressed as:

$$\mathrm{Var}\big(t - \alpha \cdot d_0\big) \text{ is minimized for a universal } \alpha,$$

where t is the arrival time and d_0 the impact parameter.

How it can be tested: CMS has collected Run-3 LLP candidates with advanced timing capabilities (ECAL, MIP timing). One can test whether a linear combination of t and d_0 shows a minimal variance across LLP classes.

Why it may be important: Such a pattern would suggest an unexpected coherence in LLP kinematics and could provide a new discriminant for signal versus background.