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Mass Determination of Long-Lived and Invisible Particles with Precision Timing Detectors at the HL-LHC.

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The high luminosity run of the Large Hadron Collider (HL-LHC) promises a dataset far larger than previously collected in the preceding LHC runs. With this opportunity comes additional challenges. The increasing number of interactions present in each event adds difficulty to particle reconstruction and pileup disambiguation. To address this issue, ATLAS and CMS have been developing new precision timing detectors capable of measuring the time of arrival of charged particles and resolving spatially overlapping interactions in time. In addition to mitigating pileup-related effects, this new timing information can also be used in searches for new physics, allowing for previously inaccessible measurements.
This talk will describe how to measure the masses of Long-Lived Particles (LLPs) in collision events by using precision timing information, focusing on difficult cases with LLPs decaying to invisible, Dark Matter candidate particles. In addition to being able to reconstruct the mass of LLPs, we show that complete event reconstruction is possible with timing information, allowing for the direct measurement of the masses of Dark Matter candidates and spin-sensitive decay angles. These techniques will be described in the context of BSM searches at the HL-LHC.

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