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Heavy stable particles, dark corner of modern physics and hands-on session

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Abstract

The LHC collider is an incredibly powerful testing machine for all sorts of theories beyond the Standard Model aiming to understand the unanswered mysteries of the Universe: nature of the dark matter, matter-anti-matter asymmetry, great unification of forces, etc. Currently, no clear hints of BSM physics have been uncovered, and many popular hypotheses were discarded or strongly weakened: The Natural SUSY, the compositeness models below the TeV scale, large Extra Dimensions, etc.

Still, a fundamental class of predictions remains in the blind spot of the LHC reach: long-living particles. Many BSM theories predict these hypothetical creatures but require a special detection apparatus. Indeed, if they are neutral, they can escape the detector unseen and decay outside or in the outer layers of its volume. They may look like a simple muon making its slow journey through the detector if charged.

The second phase of the LHC program (called HL-LHC) will start in a few years. For this phase a major upgrade of large LHC collaboration is ongoing (ATLAS, CMS< LHCb and ALICE). It includes exceptional capabilities of the new detectors (including muon system) to measure the time with a sub-ns precision. At the same time far standing detectors are added to catch whatever escapes the bulk of the detector volume.

In this talk, we will explore the dark side of the LLP, explain how the HL-LHC phase can find or discard them. We would concentrate on CMS, and a particular attention would be paid to explain how the Albanian scientific community could contribute to this new and exciting scientific program during the next 15 years.

A small hand on session for young students

Calculate the basic kinematic properties of Long Lived particles produced by the LHC: their momentum, speed, Lorentz boost and estimate the time resolution required by the Muon system to detect them and separate from Muons. Discuss the peculiarities of the trigger system required to catch them.

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