Rebeca Gonzalez Suarez – Colloquium 10/29/2020
CERN

Title: Staying alive - New physics at the LHC and beyond

The LHC is the largest and most energetic particle physics experiment ever made. By colliding protons accelerated close to the speed of light to very high energies, the LHC experiments probe the smallest components of matter and study how they interact with each-other in controlled conditions that emulate the Universe a fraction of a second after the Big-Bang. The LHC is has been in operation for a decade. The two largest experiments, ATLAS and CMS, have plowed the data producing about 1000 publications each; achieving a milestone discovery, the one of the Higgs boson, in 2012.

The Universe however, remains puzzling at its most fundamental level. The Standard Model of particle physics is clearly incomplete but nature does not seem to like to strand away much from it at the energies we are able to reach at the LHC so far. Although many theoretical models are being tested, most of the questions present before the discovery of the Higgs boson still remain, so we must keep searching. At the LHC and its upgrade, the HL-LHC, two lines of research stand out from the rest: Searches for Dark Matter, where the LHC provides a complementary sensitivity that cannot be tested with non-collider experiments; and the exploration of the Higgs sector: where the HL/LHC have exclusive options.

This talk will highlight specific experimental signatures that can appear in both dark sectors and Higgs physics: new long-lived particles (LLPs) with discernible decay lengths giving rise to decays significantly displaced from the primary interaction point. LLPs have characteristic experimental signatures that, while making them distinct from other processes, also can make them invisible to current data-acquisition methods. The potential of LLP is therefore still untapped and what is more important, extends beyond the LHC, providing exciting alternatives at future colliders.