

The Research Group  
**Elementary Particle Physics**

has the honor to invite you to the public defence of the PhD thesis of

## **Abanti Ranadhir Sahasransu**

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

**Triggering and scouting for long-lived dark matter in proton collisions at the CMS experiment**

### **Curriculum vitae**

Promotors:

**Prof. Dr. Steven Lowette**

**Prof. Dr. Freya Blekman (DESY, University of Hamburg)**

The defence will take place on

**Monday 27 November 2023 at 16:00h in auditorium D.2.01**

The defence can also be followed through a live stream:

<https://cern.zoom.us/j/63523717935?pwd=VmY0ZzUwSTYvbTJDNUJaa3dzQ1grZz09>

### **Members of the jury**

Prof. Dr. Alberto Mariotti (VUB, chair)

Prof. Dr. Steven Goderis (VUB, secretary)

Prof. Dr. Sara Strandberg (Stockholm University)

Prof. Dr. Laurent Thomas (ULB)

Abanti Ranadhir Sahasransu (1994) obtained his BS-MS in Physics from the IISER Kolkata in 2017. He joined the VUB as a doctoral candidate in 2018 in the “be.h” Excellence of Science project, with a focus on beyond-the-Standard-Model physics. As a member of the Compact Muon Solenoid collaboration, he made leading contributions to identify new-physics signals and ensured the efficient data collection for it. He has supervised a bachelor thesis. He published as lead co-contributor in an internationally peer-reviewed journal and has been invited as speaker to two international conferences.

### **Abstract of the PhD research**

The Compact Muon Solenoid (CMS) experiment at the Large Hadron Collider (LHC) in CERN searches for Dark Matter (DM) in particle collisions. A significant challenge in the search for DM arises from the data storage and processing time. The LHC generates copious amounts of data which are subsequently trimmed by a mechanism called data triggering. The trigger selections can reduce sensitivity of the experiment to new and exotic DM models. With a new data-collection of the LHC, planned from 2022 to 2025, the aim was to improve the ability of the CMS experiment to search for compressed mass spectrum DM with long-lived electron and muon detector signature.

This work showed that the potential of the CMS experiment to detect a novel DM signature with electrons and muons is improved if the energy threshold of the particles is lowered during triggering. I created new triggers with low energy threshold for the upcoming LHC proton collisions. I was able to achieve 5 to 30 times more acceptance to the DM model with the new triggers. They have been collecting data since the beginning of the LHC proton collisions in July 2022. The data collected with the new set of triggers was analysed. Some operational improvements have been made since then.

An alternative approach favours data size reduction and decreases the reprocessing time for the data collected by the experiment. This is referred to as data scouting. I integrated the low-energy electrons and photons into the scouting mechanism. I demonstrated that low-energy DM searches can be performed with the scouting data by reconstructing the standard model low-mass  $J/\psi$  and  $Y$  mesons. This is the first ever result with electrons using the scouting data in the CMS experiment. It certifies the quality of data collected with the new mechanism and heralds the possibility of searches with feeble couplings with the electrons and photons in the CMS experiment.