Detector Lab's

Technical Seminars

PRISMA DETECTOR LAB

GEM Detectors for the Muon System Upgrade of the CMS Experiment at the LHC

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Building 2412 Room 05.431 (5th floor – West)

The upgrade of the Large Hadron Collider to increase the machine's luminosity will enable the LHC-based experiments to accumulate an order of magnitude more data that will allow for precision measurements of the properties of the recently discovered Higgs boson and may lead to new discoveries shedding light on the nature of the dark matter, matter-antimatter asymmetry and the unification of fundamental forces. However, the much increased luminosity of the High Luminosity LHC (HL-LHC) puts LHC experiments into a completely new operational environment with up to 200 simultaneous proton-proton interactions every 20 nanoseconds leading to significantly increased occupancies and rates of particles traversing the detectors beyond of what these systems have been designed for. As part of its preparations for the HL-LHC era, the CMS

experiment has embarked on a major upgrade of its detector to maintain and expand its physics capabilities in the new regime. The CMS HL-LHC upgrade is a large scale project involving hundreds of scientists and requiring significant research and development, as well as funding resources (the estimated cost of the new components is approximately $240M). Among the muon detectors, the most significant upgrade in terms of the scale and impact on physics is the addition of the new muon detectors based on the Gaseous Electron Multiplication (GEM) principle. While relatively new, the GEM technology has a number of advantages that make it uniquely suitable for the high luminosity upgrade of the CMS experiment, including its ability to operate in the high rate environment, its compact size and modest cost.

This talk will discuss the motivation for the CMS high luminosity upgrades, including the upgrades of the muon system and key considerations in designing the upgraded system. The talk will continue focusing on the experience of the CMS team in the design of large size triple GEM detectors, technology optimization for performance and manufacturability, design of the electronics for the data acquisition systems, studies and measurements aimed at assessing and optimizing the capabilities of these detectors for long term sustained operations in the high radiation environment of the CMS experiment. One example is the so-called GEM Slice Test, in which several GEM chambers have been placed inside the CMS to gain valuable operational experience and work out various challenges integrating a new system in the global CMS framework. The Slice Test is part of preparations for the installation of GE1/1, the first GEM detector in CMS, scheduled for 2019-2020. The talk will conclude with the overview of the developments for the second wave of upgrades that includes two additional detectors, the GE2/1 and ME0 that are scheduled for installation between 2021 and 2025.

Alexei Safonov has obtained his initial training (B.S. and M.S. in Physics) in Moscow Institute of Physics and Technology, followed by a Ph.D. that he obtained in 2001 from the University of Florida working on the CDF experiment at Fermilab. Following a postdoctoral term at the University of California at Davis, where he worked on Higgs and new physics searches at CDF, he has joined the Texas A&M University as initially an Assistant Professor in 2006. In 2007, Prof. Safonov has been named the Outstanding Junior Investigator by the US Department of Energy and received a funding award for research at the CMS experiment at the LHC. He became a full Professor in 2014. Currently, Prof. Safonov serves as the Deputy Project Manager and Upgrade Coordinator of the CMS Muon GEM Project, a collaboration of almost 40 university teams from across the globe. He oversees and coordinates the efforts to design and build GE2/1 and ME0 detectors for the upgraded CMS Muon System. In addition to that, he serves as the Project Manager for the NSF funded US CMS Forward Muon System Phase-2 Upgrade Project, where he oversees and coordinates efforts of the US institutions that are involved in all muon upgrades of the CMS experiment.