T 43: Invited Topical Talks I

Time: Wednesday 13:45–15:45 Location: AudiMax

Invited Topical Talk T 43.1 Wed 13:45 AudiMax

Upgrade of the ATLAS tracker for HL-LHC: production status and challenges — •Roland Koppenhoefer — Albert-Ludwigs-Universität, Freiburg, Germany

In 2030, the High-Luminosity Large Hadron Collider (HL-LHC) at CERN is planned to start its operation. An integrated luminosity of up to 4000 fb^{-1} is expected over a runtime of up to twelve years. This results in significantly increased particle densities and radiation levels in all HL-LHC experiments compared to the LHC phase. The ATLAS experiment replaces its inner detector by a completely new all-silicon tracking detector within the Phase-II Upgrade.

The new ATLAS Inner Tracker (ITk) consists of pixel modules in the innermost layers and strip modules in the outer layers. To assemble the required number of detector modules with highest quality and install them in larger detector structures ready for installation in the ATLAS detector in time, a production scheme has been developed with shared responsibilities between ITk institutes all over the world. After an overview of the scope of the ATLAS ITk Upgrade, this contribution will mainly focus on the production plan of the ITk strip detector. Besides discussing the current production status, a selection of technical challenges that needed to be overcome on the way is presented.

Invited Topical Talk T 43.2 Wed 14:15 AudiMax

Entering the high-granularity calorimetry era: the CMS HGCAL upgrade — •Antoine Laudrain — Deutches Elektronen-Synchrotron, Hamburg, Germany

The LHC has seen a successful data taking over the last 15 years. However, 90% of the planned dataset will be recorded in the upcoming High-Luminosity phase of the LHC (HL-LHC). While this enormous dataset will enable the high-precision measurements on a range of topics, the LHC experiments will come under a high stress: radiation damage, detector occupancy, data rate, etc. To cope with these challenging conditions, the CMS experiment is upgrading most of its subsystems, including its end-cap calorimeters: they will be completely removed and replaced by the High-Granularity Calorimeter. The HGCAL uses a mixture of silicon sensors in the high-radiation areas, and plastic scintillator tiles readout by SiPMs in the lower radiation areas. It totals more than 6 million channels, 2 orders of magnitude more than the current calorimeter system. The scintillator section alone is composed of 4000 modules hosting more than 270'000 individual channels which poses challenges for the production scalability, especially automating the assembly and quality control. This contribution will present the HGCAL upgrade and the German contributions to its construction: DESY, one of the two assembly centres worldwide for the scintillator section, will build and test half of these modules, while KIT is involved in the readout electronics in.

Invited Topical Talk T 43.3 Wed 14:45 AudiMax

Searching for New Physics in Otherwise Lost LHC Data — •Falk Bartels — CERN

The search for physics beyond the Standard Model at the LHC is often limited by trigger requirements that prioritise high-energy signatures. As a consequence, potential signals at lower energies may evade conventional analyses altogether. Extending the experimental sensitivity into this previously inaccessible phase space is therefore a key challenge for current and future searches at both ATLAS and CMS.

This talk will discuss several innovative ideas that aim to overcome these limitations and open up new regions of parameter space for LHC searches. A central example is trigger-level analysis, which makes use of event information reconstructed online during data taking. By recording reduced event content at high rates, this strategy relaxes bandwidth constraints and allows searches to probe significantly lower mass scales. Beyond this, further developments are addressing the hardware-based Level-1 trigger, including the use of anomaly detection techniques to increase sensitivity to unconventional or unexpected signatures. Together, these approaches demonstrate how novel trigger concepts can substantially expand the discovery potential of the LHC.

Invited Topical Talk T 43.4 Wed 15:15 AudiMax

Federated Computing Infrastructures — •Inga Lakomiec — II. Institute of Physics, Georg-August-University, Göttingen, Germany

Federated computing infrastructures are established to address the rapidly growing data volumes and computational demands of high energy physics (HEP) research. The transition from self-sufficient data and computing centres towards federated resources requires a dedicated approach to ensure interoperability across heterogeneous architectures, research organisations, and geographically distributed sites. Such changes cannot be introduced without significant financial support. The ErUM-Data, ErUM-Pro and NFDI projects are an essential part of this transformation in Germany.

An important step in this process is a transition of storage and computing contributions of the German university-based WLCG Tier-2 centres to the Helmholtz Centres and National High Performance Computing (NHR) sites, respectively. The technologies developed within the dedicated projects are crucial to meeting the computing and storage needs of the WLCG and HEP research in general. The solutions offered by the involved communities are designed in a sustainable way, taking into account scalability as well as efficient resource provisioning and utilisation.

This talk presents recent strategies for federated computing infrastructures and technologies being developed within the R&D projects in Germany. It focuses on the WLCG and the challenges posed by the High-Luminosity LHC.