



CMS Tracker Upgrade modules and mechanics design/prototyping

Project code	61
Supervisor	Antti Onnela
Department	EP (funding only for 2 EP projects)

Title

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Description

CMS is one of the two experiments at CERN's Large Hadron Collider (LHC) that, in 2012, announced the discovery of the Higgs boson. It is one of the largest, most complex and highly performant experiments in history and has so far taken <5% of the total expected data. It will continue operation until around 2040. In order to operate efficiently for this length of time, in the harsh radiation environment of CMS, several subsystems must be upgraded in the coming years. One of the biggest upgrade projects is that of the CMS Tracker detector, based on around 200 square metres of high-resolution silicon strip and pixel detectors. The entire CMS Silicon tracking system will be replaced in 2024-2025 with a new system, which will feature increased radiation hardness, higher granularity and compatibility with higher data rates. The heart of the outer tracking system will consist of about 14,000 silicon detector "modules", each consisting of silicon sensors with front-end electronics on a light-weight mechanical support structure. The detector modules for the CMS Tracker Upgrade consist of silicon sensors, microelectronics, optoelectronics and mechanical stiffeners. The modules are positioned and cooled by high-performance carbon-fibre composite support structures that include cutting-edge, environmentally-friendly two-phase CO2 cooling. The CERN groups are responsible for much of the mechanical engineering and design of the complete Tracker upgrade project. You will be embedded in the EP-DT group and will participate to this engineering, design and prototyping work.

Functions and Training Value

You will play an important role in the development of these modules, support structures and their production tooling. The tasks include 3D modelling studies (using the CATIA V5 CAD-tool), thermo-mechanical calculations (using the ANSYS FEA tool), qualification of novel materials for thermal management, realization and test of prototypes, as well as definition and validation of assembly procedures. An essential part of the work is to contribute to the transition of the project from prototyping to final production phase, including contacts with collaborating institutes and companies world-wide. You will profit from the guidance of a senior mechanical engineer and a senior physicist, and work within a multi-discipline team composed of engineers, physicists, designers and technicians. You will obtain real-world experience in multiple activities, including:
Design, manufacture and testing of composite structures, light metals and adhesives, including practical laboratory work.
Manufacturing of high-precision components and assemblies.
Introduction to particle physics experiments and their instrumentation.
Writing of technical documentation, either in English or in French.
Preparing and making presentations, in English, in meetings within a multi-cultural collaboration.



These acquired skills are applicable in other R&D environments or in industry

Qualifications/Skills

Mechanical engineer or equivalent

Knowledge and experience in 3D CAD-modelling. Knowledge of CATIA V5 would be an advantage.

Basic knowledge of Finite Element Analysis. Knowledge of ANSYS would be an advantage.

Basic knowledge of fibre-reinforced composite materials would be an advantage.

A working knowledge of either English or French is necessary.