E-892 (Green) The US CMS Collaboration at Fermilab

Fermilab
(and 39 other US institutions)

Status: *No Data Yet*

The Compact Muon Solenoid (CMS) is one of two high p_t experiments to be built at the CERN Large Hadron Collider (LHC). The primary physics goal of CMS is to explore electroweak symmetry breaking - the origin of mass. To that end, the basic philosophy of CMS is to enclose the tracking and calorimetry inside a strong **S**olenoidal magnet. This design allows for a **C**ompact design allowing optimal **M**uon detection without compromise to the electromagnetic calorimetry because of inert material. In general CMS is optimized for electrons, photons, muons, neutrinos and jets. The Higgs decay modes imply an emphasis on lepton detection. At the high luminosities to be used at the LHC, the charged lepton of choice is the muon due to its relatively clean signature. Neutrinos and jets may also be used in higher-rate but also higher-background signatures, $H \rightarrow ZZ \rightarrow llv\nu$, $H \rightarrow WW \rightarrow jjlv$.

There are about 1500 physicists in the CMS Collaboration who plan to build the detector for a cost of around 475 M Swiss Francs. The detector is to be built from 1997 until data-taking in 2005. The composition of CMS is roughly 50% physicists from member states, 30% from Russia and other non-member states, and 20% US groups. The US CMS Collaboration consists of about 311 physicists and engineers from 40 institutions (4 national labs). The collective goal of this group is to pursue high energy physics at the energy frontier which will be available at CMS. We find the physics opportunities compelling.

Test beam data was taken in 1995/96 by subgroups of US CMS involved in Hadron Calorimetry (HCAL), Endcap Muon Chambers (EMU), Electromagnetic Calorimetry (ECAL) and Tracking. The Fermilab group is particularly active in HCAL and EMU. The CMS Project Managers for both HCAL and EMU are members of the Fermilab group. During 1995 engineering studies were carried out with the aim of beginning the conceptual designs which will culminate in a full Technical Design Report in 1997, followed by the fabrication of preproduction prototypes in 1997. The CMS Fermilab group is heavily involved both in test beam R&D and in engineering design.

Fermilab has also accepted to act as the "host laboratory" for the US CMS collaboration. Therefore, Fermilab will provide a focal point for US CMS. The Project Management of US CMS will be centralized and located at Fermilab. The intent is to utilize existing infrastructure at Fermilab for muon chamber construction, the production of calorimeter optical readout, the mechanical layout of tracking detectors, and the pipelined electronic readout of all the HCAL devices. In addition, the fact that Fermilab is the location of the

US HEP hadronic collider program, means that the synergy between CDF and D0 upgrades and CMS design and construction is available. For example, high-rate triggering and data acquisition is an area where Fermilab will contribute expertise to CMS.

In turn, working on CMS will enhance the art of detector building in the US, especially in the demanding environment found in high-luminosity hadron colliders. The operational experience obtained at CDF and D0 is crucial in ensuring a realistic detector design for CMS. Fermilab physicists are taking a leading role in the management of the hadronic calorimetry and the forward muon system. The collaboration plans to construct major elements of these two systems at existing facilities at Fermilab. In addition, the use of Fermilab facilities by university groups, such as the facilities for silicon detectors being developed for the Run II collider program, represents a low cost way for Fermilab to support university groups within the US CMS Collaboration.

At present, KEK operates a remote control room to enable Japanese physicists to stand shift on CDF. Based on this positive experience, we imagine that a similiar remote control room could be set up at Fermilab in order to enable US physicists to stand shift on CMS. In general, the aim of Fermilab is to enable US CMS physicists to do physics at their home institution or within the U.S. if at all possible.

Fermilab has considerable experience operating computing farms of workstations as a cost effective method of providing analysis power to CDF and D0. It is thought that this expertise will translate well to support of US CMS. Fermilab plans to explore the operational meaning of "host laboratory to US CMS." Clearly, the decade-long experience of Fermilab in the running of the US hadron collider experimental program makes it a natural nucleation point.

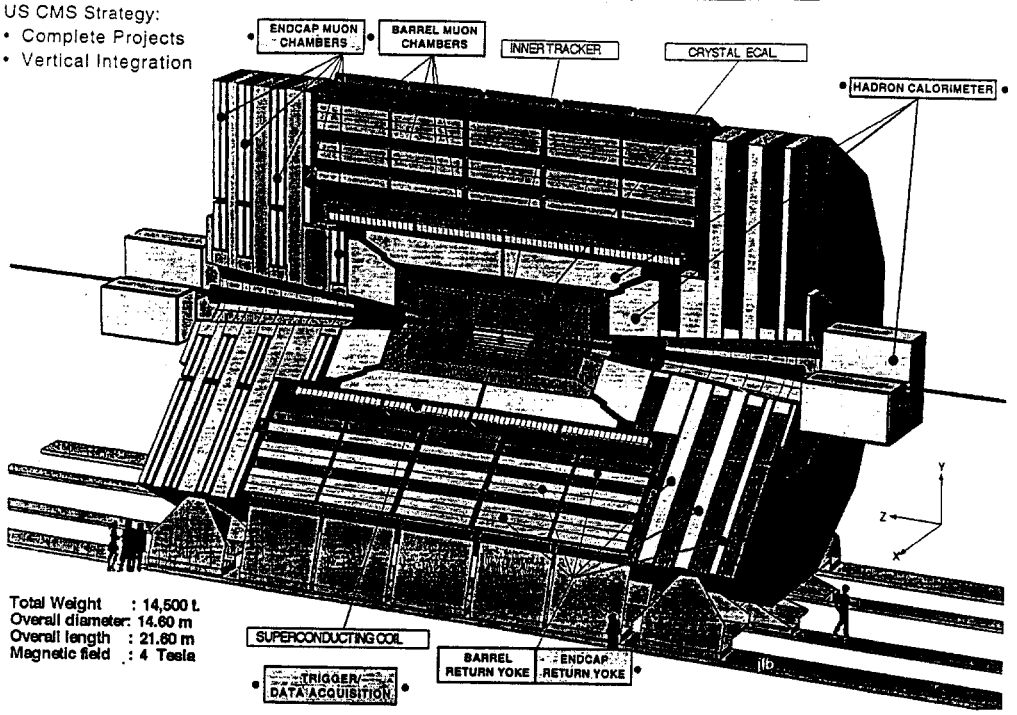
Experience on existing hadron collider experiments at Fermilab and CERN and on the R&D associated with the SSC makes it possible for US physicists to have a major impact on the design of CMS. US physicists have been assigned distinct and coherent managerial and construction responsibilities as seen in the accompanying figures. We are the managers for HCAL, EMU, and the trigger system. We also have construction responsibilities in electron calorimetry (ECAL), tracking and data acquisition (DAQ). We are now fully integrated into the decision-making bodies of CMS and are represented in all the CMS governing bodies.

The US groups will also, as noted in the Letter of Intent (LoI) to DOE and NSF, take proportional responsibilities for the costs of common projects, such as the solenoid. Specifically, US physicists have positions of responsibility for the solenoid vacuum vessel and the endcap steel return yoke. Fermilab is very involved in the engineering analysis of the vacuum vessel, as that device supports the HCAL for which we are responsible. The aim is ultimately to provide in-kind contributions to CMS bid and bought in the US.

The CMS experiment has been under intense review in 1995 by the program advisory committee of CERN, the LHCC. It has been scientifically approved early in 1996. The plan is to achieve financial approval sometime in 1997 and to then begin construction. The experiment is presently scheduled to commence in 2005. It will subsequently have at least a decade lifetime, LHC being at present the sole facility in the world capable of addressing the physics of the TeV mass scale. Currently an interim MOU for CMS has been signed by US and CERN representatives.

US CMS Management Responsibilities

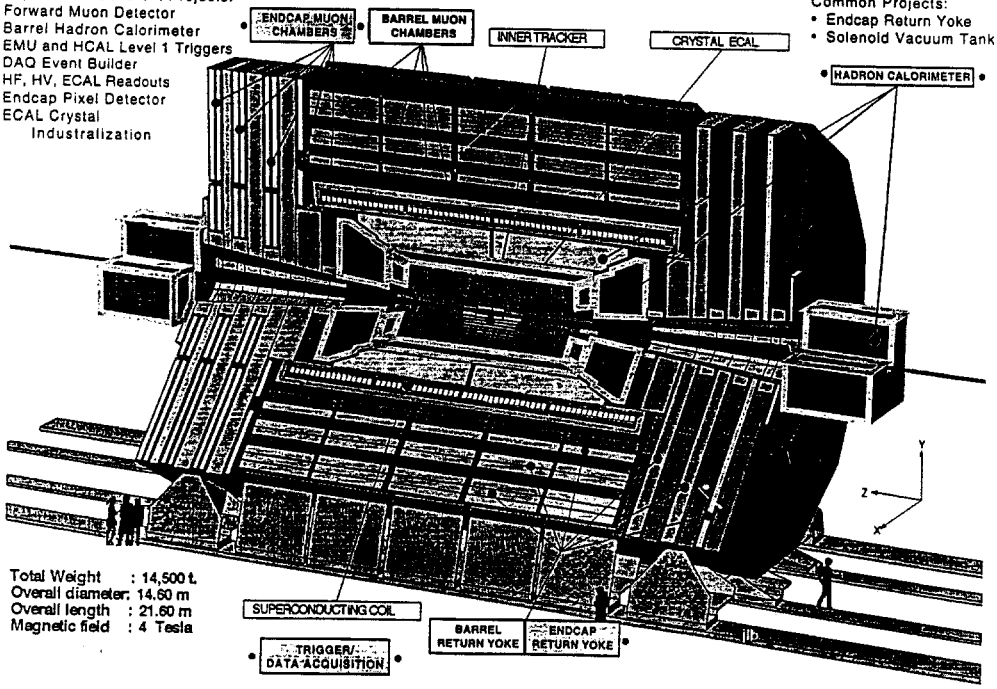
US CMS Strategy:
- Complete Projects
- Vertical Integration



US CMS Construction Responsibilities

Complete and Coherent Projects:
- Forward Muon Detector
- Barrel Hadron Calorimeter
- EMU and HCAL Level 1 Triggers
- DAQ Event Builder
- HF, HV, ECAL Readouts
- Endcap Pixel Detector
- ECAL Crystal Industrialization

Common Projects:
- Endcap Return Yoke
- Solenoid Vacuum Tank



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