

## Charge for the CMS Pixel Detector Upgrade Workshop

### Background:

The performance of the Pixel Detector will begin to degrade after exposure to a fluence of  $\sim 6 \times 10^{14}$  particles/cm<sup>2</sup>. This fluence will be reached about 4-5 years into LHC operation. This is earlier than the end of the first phase of LHC operation which will achieve an integrated luminosity of more than 300 fb<sup>-1</sup>. After Phase 1, there will be a long shutdown to upgrade the machine for 10<sup>35</sup>/cm<sup>2</sup>-s peak luminosity, followed by a Phase 2 of several years of running at this higher luminosity. Upgrades to most electronics systems, the trigger, the data acquisition system and some detectors will be required due to higher occupancies and radiation levels, and possibly shorter bunch crossing intervals.

The US Research Program includes funding for R&D to design a replacement pixel detector that can survive and perform well through the end of Phase 1 and another replacement that can survive and perform in phase 2. It does not include funds to construct either detector. Funds for construction would have to be negotiated separately.

There have been meetings to begin to formulate the R&D for the upgrades of all aspects of the CMS detector to handle 10<sup>35</sup>/cm<sup>2</sup>-s peak luminosity. The FPIX community has participated in these meetings but has not yet developed an R&D plan for either upgrade.

### Goal of the workshop:

**The goal of this workshop is for members of the Forward Pixel Group, along with colleagues in the Barrel Pixel Group, to formulate the requirements of these two upgrades and to outline a program of R&D of a design to meet those requirements.**

An important aspect of the workshop is to **determine the level of interest in the FPIX groups and BPIX groups for carrying out this R&D and to determine whether other collaborators in CMS share this interest.** The Silicon Strip Tracker will also carry out an upgrade for Phase 2 (although no intermediate upgrade is currently planned) and may consider pixel detectors for the replacement of the inner layers of the Tracker Inner Barrel. It may make good sense for the “vertex detector” and “tracker” parts of the overall CMS tracking to work together to accomplish the upgrades. One goal of this workshop is to prepare us to participate effectively in the wider discussion within the Tracker Group.

CMS is considering the addition of a new requirement of the upgraded detectors: to provide track information, including impact parameters, to the Level 1 trigger. This is a daunting problem, given the event rates, the amount of data, the high radiation levels, the severe constraints imposed by the existing trigger architecture (short Level 1 latency), and the very limited cable plant. This is a new area of R&D that might have strong implications for the geometry of the pixel detectors and the electronics. **Moreover, the designs of the total upgraded pixel system, tracker and trigger are inextricably linked at such a deep level that upgrade designs of any of these elements must be**

**closely coupled to the others. It is a major goal of this workshop to begin to establish the requirements for the tracking trigger at L1 and to formulate a plan for meeting them for phase 2. The possible incorporation of triggering for the intermediate detector also needs to be considered.**

Many articles on SLHC upgrades and links to the four global SLHC workshops that have been held may be found at:

[http://cmsdoc.cern.ch/cms/electronics/html/elec\\_web/common/slhc.html](http://cmsdoc.cern.ch/cms/electronics/html/elec_web/common/slhc.html)