

CMS Upgrade MB Response to SLHC Document:

09.01: Proposal for Quartz Plate Calorimeter as Upgrade to CMS Hadronic Endcap Calorimeters

(Contact Person: Yaser Onel)

It is our intent to recommend this proposal for approval. Please see the comments from the referees.

Specific requests for the revised proposal are:

1. Provide a detailed breakdown of the estimated costs and resources needed, explaining how these are distributed amongst the various R&D components.
2. Explain the sharing of resources with proposal 09.02.
3. Explain the R&D plan with a time-line beyond FY09, deliverables, milestones and institutional responsibilities.
4. Explain how the relevant Photodetector/SiPM R&D will be performed and integrated in this program.
5. Engage in and report on efforts to involve additional institutions in this R&D program.

Referee #1:

This is a much better thought through proposal which in my view is worthwhile pursuing. If a working replacement plate with readout could be produced this would be a real break through for an HCAL at SLHC. A detailed budget should be produced, but looking at the large varieties of subjects which require R&D, I am rather pessimistic that the mentioned 150K/year will be sufficient. In addition the proponents should indicate the available manpower for this project. They should look if there are other institutes interested in contributing.

Referee #2:

The proposal appear to address the expected issues of the current HE when operated in the expected sLHC environment.

To my knowledge no duplication of effort.

The proposal could be endorsed subject to a more detailed plan with deliverables, time scales, and resource needs as suggested in the proposal.

In particular I think resources shared with the R/D described in the 09.02 proposal should be explained as it is essentially the same groups involved.

Referee #3

Background and Discussion

The high eta region of HE will need to be upgraded or replaced for Phase II. It is likely that the forward EM calorimetry will also need replacing by then. Also, for SLHC the geometry of the

forward region may change significantly. The plan for upgrading the whole forward region should be developed ~2012 or so. It is important that the R&D be carried out by then, to allow an informed technology choice.

One candidate technology is the subject of this proposal - radiation hard quartz plates coated with scintillator films to wave-shift the light and enhance the useable light yield. The proposal follows successful work that demonstrated a prototype calorimeter. The issues addressed in this next phase are (a) improved coating techniques, (b) collection of this enhanced light using radiation hard wavelength shifting fibers (developed with the same coating), and (c) SiPM arrays mounted directly on the tiles. Different readout schemes may be applicable in different eta regions.

I am not up to speed on other ideas for calorimetry upgrades in the forward region, but it does seem that this technique may provide a benchmark for performance, and could be a leading candidate. However, the extraction of the light to the front-end electronics is the outstanding issue - either via fibers with resulting light loss, or with direct placements of SiPMs on the tiles, placing the SiPMs in an extreme radiation environment. This is a challenging problem.

Recommendation

Forward calorimetry for SLHC is of course a challenge and at this point it is appropriate to pursue different technologies in parallel. This R&D should be supported to allow the demonstration of a fabrication process and readout scheme by ~2012.

It would however be appropriate to request information on R&D efforts for the photo-detectors - radiation hard SiPMs (for example) with parameters suitable for this application. These too are likely to be a significant R&D effort. Both aspects are needed to make an upgrade proposal for Phase II, and they should be developed in tandem.

Approval of funding should be contingent on a review of a cost breakdown and timeline for the work, which was not provided in this proposal. A cost scale of \$450K over three years is estimated for "a full scale replacement plate and readout", but it is not clear what is included and what is planned for each year, nor what the readout is. Are SiPM development costs included?

In summary, the work should be supported, but a more detailed plan is needed, coupled to a plan for the readout.