

# Letter of Intent: Development of Pileup Mitigation Tools within the Context of a Dual Readout Calorimeter for CMS

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## 1. Introduction

The general motivation for the proposed work is given in a longer document[1].

In the current proposal for 2014 we will realize a direction for CMS Phase II forward Calorimetry that has been developing over the past year in discussions involving F. Bedeschi, R. Wigmans, P. Lecoq and S. White. There has also been a presentation to RD52 this Spring.

We propose a direction that could benefit both CMS and the RD52 Collaboration. The RD52 project has developed an impressive knowledge base in building calorimeters suitable for high performance jet measurements, based on the Dual Readout Calorimetry (DRC) technique. Up to now, the collaboration has not given attention to an HL-LHC application and the lack of reference to an active experiment has perhaps been detrimental toward assuring continued support.

At the same time, based on more than a year of activity in the CMS Forward Calorimetry Task Force, we feel that it is just a matter of time before all Phase II options, other than DRC, are eliminated- so long as technical and physics considerations drive the decision making.

The issues that make the (CALICE-motivated) "PFCAL" alternative unsuitable are too numerous and obvious to list here.

We plan 2 main activities that should significantly accelerate CMS's ability to reach a technology decision:

- There are some urgent questions that need to be addressed regarding suitability of DRC to HL-LHC, such as radiation hardness of components and the placement of photosensors in a CMS FCAL design. We expect to work closely with our collaborators on one[2] or both concurrent DRC related proposals, dividing responsibility according to our primary goals.
- Our primary focus, however, will be to address over the year the issues relating to the severe pileup conditions expected for HL-LHC.

There is a growing divide in the CMS management discussion about addressing pileup, as was clear at the ECFA workshop. Every presentation says CMS is interested in pileup mitigation tools, possibly using 10-20 picosecond timing, but the upgrade managers are unable or unwilling to show anything like a technical implementation.

As can be seen from ref. 1, we have been seriously addressing this issue in a resultful program.

Aside from generally working closely with colleagues on the related proposal, we will take the lead in addressing pileup (even the ERC research proposal of Lecoq et al. considers this aspect to be to be a later stage of their work).

Specifically, we will:

- develop concepts for pileup mitigation (including from timing) in the evolving CMS DRC design.
- ensure that proper attention, which is now lacking, will be given to making the best use of available tools for timing in the upcoming FNAL beam tests( for Shashlik also).
- Continue the work described in ref. 1 developing 10-20 picosecond technology and- perhaps most importantly- continue to involve a network of experts (beyond CMS) who have been so helpful up to now.

At this early stage an initial budgetary estimate would be:

- \$50k for specific design and testing within the FCAL upgrade effort.
- \$50k for continuing toward the goal of a generic 10-20 picosecond timing solution- according to ref. 1.

About 70% would be for material and fabrication. The remainder is for travel.

[1] S. White, "Experimental Challenges of the European Strategy for Particle Physics",

<http://arxiv.org/abs/1309.7985>

[2] C. Tully, "4D Dual-Readout Crystal Fiber Calorimeter (CFcal) Letter of Intent for Phase 2 Upgrade R&D"

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