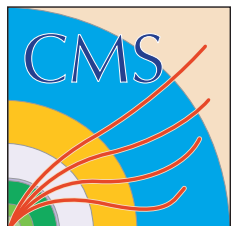


Supporting Materials Work Package for APD and MPDG Fast Timing Devices

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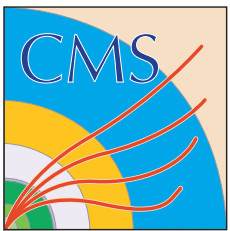
(recap)

Deliverables on ~year time scale



Addressing in the near term

- **Tests and comparisons of detector designs at testbeam scale that could be used to build a layer**
 - Need to expand the list of “apples to apples” comparisons of fast-timing sensors
- **Radiation hardness studies and results in low radiation fields (1e14 or so)**
 - For devices situated beyond the outer tracker barrel
 - Testing to 1.5x expected dose in the HL-LHC @ 200PU
- **Radiation hardness studies and results in high radiation fields (1e15 or so)**
 - For devices situated within the tracker volume or in the endcaps
 - Testing to 1.5x expected dose in the HL-LHC @ 200PU
- **Scalability tests (longer term, could be more than a year)**
 - creating small-scale arrays of devices
 - understand noise and clocking issues when reading out multiple, densely packed, channels
 - develop an understanding of creating modules of various device types
- **All of these deliverables would yield novel results in fast timing research, and significantly bolster the timing-layer and global-timing efforts on CMS**



(recap)

Rough Estimate of Materials Cost 2



● Hybrid APD/MPGD:

- Supporting materials (amplifiers/digitizers):
 - 2x [Cividec 40dB 2 GHz amplifiers](#) = \$3650
 - U.Penn High-BW transimpedance amps = \$10,000
 - 1x [SAMPIC Digitizer](#) = \$5700
 - 1x [DRS4-v5 evaluation boards](#) = \$1,000

- Total cost = \$20350
- Coordinate with Sebastian / Lindsey



To keep making progress we should support the work done here already while also building up our ability to self-support.



Concerning U. Penn Developments

- ◎ This started out as a CMS effort which inspired further R&D at U. Penn resulting in prototypes
- ◎ To implement a timing layer it is necessary to develop low noise radiation hard front-end amplifiers
 - Low noise electronics generally useful in HEP in a variety of situations
 - Beneficial for CMS to continue support of these electronics
 - Allows multiple options for electronics to be pursued and tested
 - Resulting in well considered choice for detector design
- ◎ Could form the basis of an effective collaboration between CMS and ATLAS concerning timing



Detail of Work Package

- As given in [MPGD](#) and [APD](#) Workpackages
 - at CERN H2, FNAL
- APD or MPDG setup (latter in prep.)
- Assembly required in some places, rest ordered
 - SAMPIC assembled at Princeton PRISM Facility
 - U. Penn amplifiers assembled by ????
- Data analysis results as given in MPGD and APD work packages, this request allows those results to take place
 - Continuing support of electronics work for fast-timing research in CMS
 - Gather baseline set of amplifiers for sensor evaluation and debugging
- Results given through APD and MPGD results (results start from fall?)
 - analysis by FNAL/Princeton/CERN
- Total M&S: **\$20350**, Total Labor: **\$????** (overhead?)