**Performance of the CMS-HF Calorimeter After Phase I Upgrade (#166)**

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**PROBLEM**

- HF Calorimeter
- Light from real events
- Window hit

**SOLUTION**

- Replace with 4-anode PMTs R7600U-200-M4 and upgrade the readout electronics

Comparison of old (black) and new 4-anode PMTs (red): New PMTs produce lower pulse heights for stray muons hitting the PMT windows (left) but a higher response to the photons from the real events (right)\(^1,2\).

**IMPLEMENTATION**

- Phase I Upgrade: new 4-anode PMTs and 2-channel electronic cards

**PERFORMANCE**

- TDC versus charge in one anode channel in collision data; window events are early (<5 ns), real events are around 8 ns. (left)
- Charge asymmetry versus total charge in the PMT; signals towards ±1 are due to window events, i.e., single channel hits. (right)

**REFERENCES**


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