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## Performance of the CMS-HF Calorimeter After Phase I Upgrade

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CMS-HF Calorimeters have been upgraded within the Phase I upgrade program of the CMS. These upgrades that were finalized during EYETS16/17 involved the replacement of the single anode PMTs with the 4-anode PMTs and the associated front-end electronics to read out the signals coming from these PMTs. Four-anode PMTs were more effective in reducing the noise in the HF detectors due to the window events caused by the muons hitting the PMT windows directly. These PMTs have also thinner windows, further reducing this Cherenkov radiation produced in the windows. Front-end electronic cards were designed to readout the four-anode signals in two channels instead of four to reduce the costs; also, a feature to measure the arrival time of the signals was added. The TDC information is useful to identify the window events that come earlier than the regular signals. Reading the four-anode PMTs with these new cards helped reduce the noise due to the HF in the data collected during the collisions. In this poster, details and the final commissioning of the upgrade will be given. Timing and the comparison of the charge signals from the two channels actually seen in the collision data will be shown.

**Author:** GULMEZ, Erhan (Bogazici University (TR))

**Presenter:** GULMEZ, Erhan (Bogazici University (TR))

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