## Design and Performance of the mDOM Mainboard for the IceCube Upgrade

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About 400 mDOMs (multi-PMT Digital Optical Modules) will be deployed as part of the IceCube Upgrade Project. The mDOM's high pressure-resistant glass sphere houses 24 PMTs, 3 cameras, 10 flasher LEDs and various sensors. The mDOM mainboard design was challenging due to the limited available volume and demanding engineering requirements, like the maximum overall power consumption, a minimum trigger threshold of 0.2 photoelectrons (PE), the dynamic range and the linearity requirements.

Another challenge was the FPGA firmware design, dealing with about 35 Gbit/s of continuous ADC data from the digitization of the 24 PMT channels, the control of a high speed dynamic buffer and the discriminator output sampling rate of about 1GSPS. High-speed sampling of each of the discriminator outputs at ~1 GSPS improves the leading-edge time resolution for the PMT waveforms. An MCU (microcontroller unit) coordinates the data taking, the data exchange with the surface and the sensor readout. Both the FPGA firmware and MCU software can be updated remotely.

After discussing the main hardware blocks and the analog frontend (AFE) design, test results will be shown, covering especially the AFE performance. Additionally, the functionality of various sensors and modules will be evaluated.