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Engineering Challenges of the CMS High Granularity Calorimeter

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At the High Luminosity LHC, the CMS detector will be exposed to large pile-up conditions and large radiation dose. To cope with the challenges, the whole endcap calorimeter system will be replaced with the High Granularity Calorimeter containing 52 longitudinal sampling layers made of silicon sensors in the high radiation area and scintillators read out by SiPMs in the low radiation area. A fine lateral segmentation of 0.5-1cm2 silicon pads and 4-10cm2 scintillator tiles amounts to a total of 6M channels in a very compact and necessarily dense structure, a major engineering challenge. The on-detector electronics is expected to dissipate ˜200kW and to reduce radiation damage the whole detector will operate at a temperature of -30C, achieved with a two-phase CO2 cooling system. Additional engineering challenges arise from the large difference in the coefficient of thermal expansion of Si and the mechanical structure. In order to study the thermal and mechanical properties of the detector the first mockup cassette with silicon modules has been built and CO2 cooling tests have been performed. We present an overview of the engineering design of the detector with an emphasis on the thermal tests of the mockup cassette and compare results to FEA calculations.

Secondary topics

Applications

Design concepts for future calorimeter at the energy frontier

Primary topic

Silicon

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