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Highly compact sandwich structure for a granular electromagnetic calorimeter

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Highly compact and granular electromagnetic calorimeters are necessary for luminometers in experiments at electron-positron colliders or for the measurement of the positron multiplicity and energy distribution in the laser-electron scattering experiment LUXE investigating strong field QED. In the former, Bhabha scattering is used as a gauge process. Using a highly compact calorimeter, i.e. with a small Moli\'{e}re radius, the fiducial volume is well defined, and the space needed is relatively small. In addition, the measurement of the shower of a high energy electron on top of widely spread low energy background is improved. In the laser-electron scattering case, the number of secondary electrons and positrons per bunch crossing varies over a wide range, and both the determination of the number of electrons and positrons and their energy spectrum per bunch crossing favours a highly compact calorimeter.

The concept of a sandwich calorimeter made of tungsten absorber plates interspersed with thin sensor planes is developed. The sensor planes comprise a silicon pad sensor, flexible Kapton printed circuit planes for bias voltage supply and signal transport to the sensor edge, all embedded in a carbon fibre support. The thickness of a sensor plane is less than 1 mm. The design, construction of these components and their combination to a sensor plane is described.

To ensure a safe mounting of the sensor planes within the tungsten plates a precise aluminium frame is designed and build. Tight requirements have to be applied to the flatness and dimensions of the tungsten plates. The results obtained are reported.

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