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Fast Beam Condition Monitor of the CMS experiment for precision luminosity measurement at HL-LHC

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To achieve the challenging target of 1% precision on luminosity determination at the high-luminosity LHC (HL-LHC) with instantaneous luminosity up to $7.5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$, the CMS experiment will employ multiple luminometers with orthogonal systematics. A key component of the proposed system is a stand-alone luminometer, the Fast Beam Condition Monitor (FBCM), which is fully independent from the central trigger and data acquisition services and able to operate during all times at 40 MHz providing bunch-by-bunch luminosity measurement with 1 s time granularity. FBCM is foreseen to be placed inside the cold volume of the Tracker as it utilizes silicon-pad sensors exploiting the zero-counting algorithm of hits for luminosity measurement. FBCM will also provide precise timing information with a few ns precision enabling the measurement of beam induced background. We report on the optimization of the design and the expected performance of FBCM.

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