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Scintillating sampling technologies with precision timing capabilities for the Upgrade II electromagnetic calorimeter of LHCb

The aim of the LHCb Upgrade II is to operate at a luminosity in the range of 1 to 2 x 10^{34} cm^{-2} s^{-1} to collect a data set of 300 fb^{-1}. This will require a substantial modification of the current LHCb ECAL due to high radiation doses in the central region and increased particle densities. Timing capabilities with O(10) ps precision for neutral electromagnetic particles and increased granularity with denser absorber in the central region are crucial for pile-up mitigation.

Several scintillating sampling ECAL technologies are currently being investigated for this purpose: Spaghetti Calorimeter (SpaCal) with garnet scintillating crystals and tungsten absorber, SpaCal with scintillating plastic fibres and tungsten or lead absorber, and Shashlik with polystyrene tiles, lead absorber and fast WLS fibres. The aim is to optimise each technology for timing performance, radiation hardness as well as spatial and energy resolution.

The presentation focusses on results for the time resolution from test beam measurements at DESY and the CERN SPS in 2021 using prototypes for all technologies mentioned above. It also includes an overview of the overall R&D programme towards the Upgrade II of the LHCb ECAL.

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