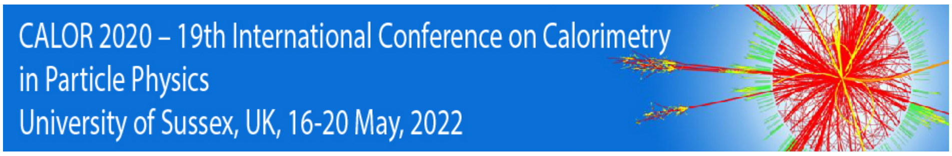

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Crilin: a semi-homogeneous calorimeter for a future Muon Collider

Crilin (CRystal calorImeter with Longitudinal InformatioN) is a semi-homogeneous calorimeter proposed for the future Muon Collider. It is based on Lead Fluoride (PbF_2) crystals readout by surface mounted UV extended Silicon Photomultipliers (SiPMs). Muon colliders have great potential for high energy physics especially in the TeV range. However, one of the main problem is given by the beam induced background which is mainly due to the $\mu \to e\,\nu_\mu\,\nu_e$ decay and following neutrinos interactions. From the detection point of view the discrimination of the signal from background in jet identifications requires high granularity and great energy resolution but also timing could help with the rejection: all this demands can be achieved with Crilin.
Crilin has a modular architecture made of stackable and interchangeable submodules composed of matrices of PbF_2 crystals, where each crystal is individually readout by 2 series of 2 UV-extended surface mount SiPMs each. It can provide: high response speed, good pileup capability, great light collection hence good energy resolution throughout the whole dynamic range, resistance to radiation and fine granularity which is also scalable with SiPMs pixel dimensions.
In 2021 a dedicated test beam was realized for the first prototype (Proto-0) made of two PbF_2 crystals coupled with 4 SiPMs. Samples were exposed to electron beams of energy 20-120 GeV, tagged photon beams derived from the 120 GeV electron beam, and 150 GeV muon beams. The analysis is still in progress but it already highlights a stochastic contribution to the time resolution that is less than $100\,ps$.
Is now under construction a bigger prototype (Proto-1) made of two layers of 3x3 PbF_2 crystals each: one layer will be realized with 15 μm pixels 3x3 mm^2 active area MPPC from Hamamatsu, while in the second layer, while in the second layer, SiPMs with 10μm pixel will be used in order to withstand fluences of neutrons $\sim 10^{14}\,n_{1MeV}/cm^2$ without reduce energy and timing resolution. Test were already run over these new SiPMs using an ultrafast blue laser and a new electronic front-end that showed a dynamic range from 0 to $2\,V$, a rise time of $\sim 2\,ns$ with a full signal in $\sim 70\,ns$ and a $\sigma_t < 50\,ps$ even at low charges ($50\,pC$). For this second prototype the operational temperature will be 0/-20\textdegree C and Proto-1 will be tested in a dedicated test beam at Cern before end 2022.

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