

Title: PACIFIC readout ASIC for the LHCb Scintillating Fibre (SciFi) tracker

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Abstract (500 words max.):

The LHCb detector will be upgraded during the Long Shutdown 2 (LS2) of the LHC in order to cope with higher instantaneous luminosities and to read out the data at 40MHz using a trigger-less read-out system. The current LHCb main tracking system will be replaced by a single homogenous detector based on 2.5m scintillating fibres with a diameter of 250um coupled to silicon photomultipliers (SiPMs) arrays. The arrays are formed by two 64 channels dies packaged together in a 128 channels sensor.

The signal generated at the SiPM signals is collected and processed by the low Power ASIC for the sCIntillating FIBres traCker (PACIFIC). The 64 channel ASIC comprises for every channel analog processing, digitization, slow control and digital output at a rate of 40MHz. The analog processing includes preamplifier, shaper and integrator. The integrator is formed by an interleaved double gated integrator and a track and hold to avoid dead time (one integrator is in reset while the other collects the signal and the track and hold merges the two integrators output to give a continuous measurement). The output of the track and hold is digitized using 3 comparators (non-linear flash ADC). The three bits output is then encoded into two bits and serialized. It is then transmitted to the readout FPGA used for clustering and data-compression. Some auxiliary blocks are also needed to produce a fully functional device and include voltage references, current references, control DACs, power on reset (POR) circuitry and serializers. The slow control digital block consists in a 10 bit addressing I2C slave and a register bank for holding the configuration values.

PACIFIC has been designed using TSMC 130nm technology and several prototypes have been validated. PACIFICr5 is expected to be the final prototype version with minor changes in the analog channel, some features added and a differential data link serializing the channels output at 320MHz.

The talk will present the ASIC features and evolution, focusing on latest improvements and design concept. Results from laboratory tests and test-beam campaigns will also be included. The characterization of the prototypes is performed using electrical signal and light injection and measurement with a radioactive source (Sr90) using full fibre modules. The test-beam results are in particular important to understand the expected physics performance of the full chain from the fibre to the digital PACIFIC output.