SciFi FE chip issues

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I. Introduction:

Foreseen electronic from the detector to the PC farm

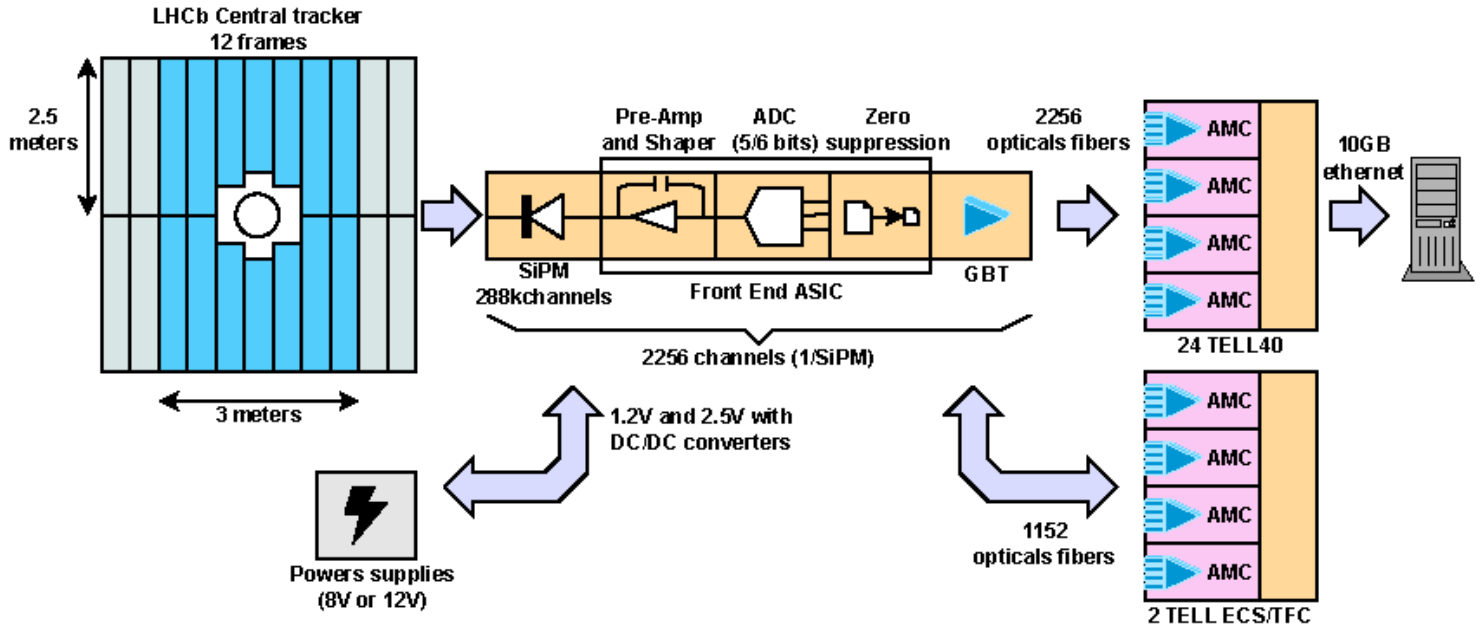


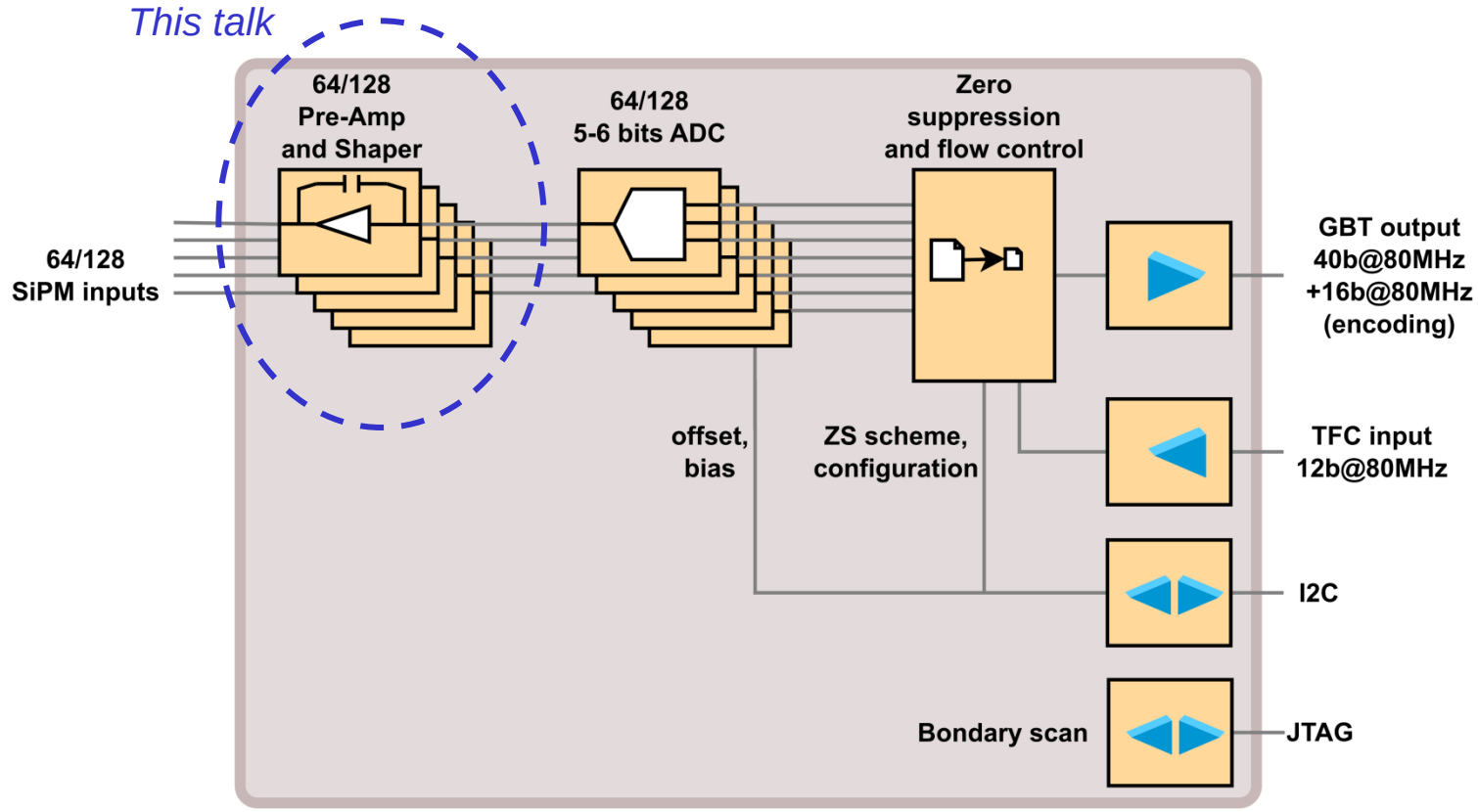
Figure: Foreseen readout scheme with 1 GBT/SiPM and 1 GBT ECS / 4 SiPM

The central tracker option

- 2.5 meters scintillating fibres;
- 250μm fibres;
- 4×3 layers.

See Herve's talk at last meeting (13th June):
https://indico.cern.ch/conferenceDisplay.py?confId=176155

I. Introduction:



The low-Power ASIC for the sCIntillating FIbres traCker (PACIFIC) is a collaboration between the Universitat de Barcelona and the Laboratoire de Physique Corpusculaire de Clermont-Ferrand. Synergies with the ASIC for the TT and VELO strip option are investigated.

- Low power (8mW/channel);
- With built-in test features.

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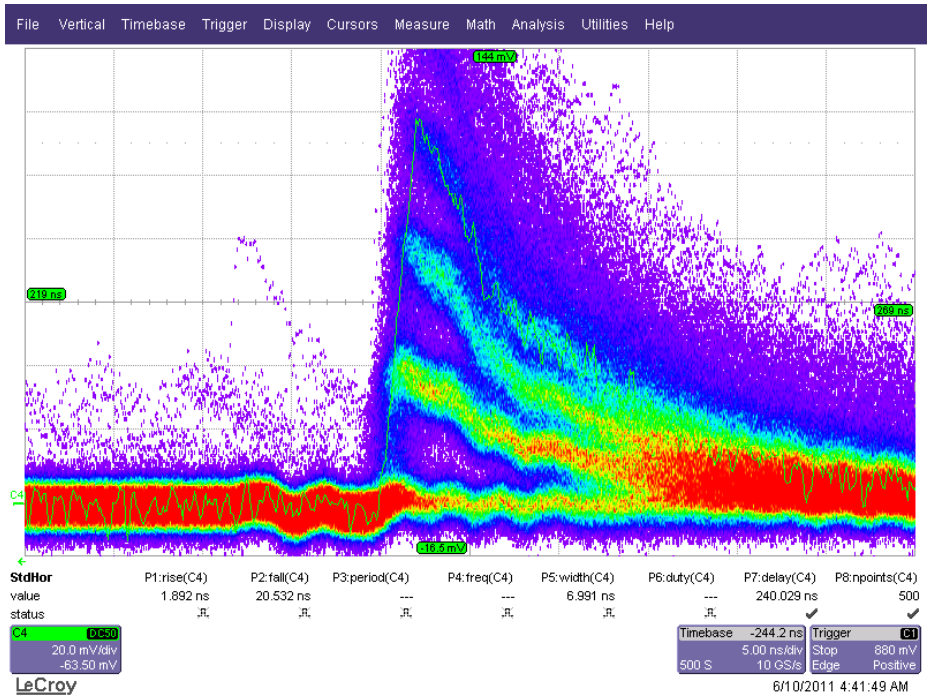
I. Introduction

- Assumptions:
  - Fiber decay time is about 3 ns (2.8 ns for SCSF-78MJ)
  - SiPM capacitance is low (< 20 pF)
  - Low input impedance electronics (< 20 Ohm)
- Factors spoiling signal shape and signal reproducibility:
  - Dependence of the pulse shape on track location
  - Light propagation (reflections)
  - Radiation damage
  - Low photostatistics
- Requirements (assuming ADC solution):
  - Double pulse resolution: ***25 ns (TBC)*** → fast peaking time
  - ADC synchronization
    - Time arrival dispersion according to the track location ***about 10 ns (TBC)***
    - Fast shaping
    - Difficult synchronization
      - Peak detector ?
      - Gated integrator ?
      - Other ideas ? ALTRO technique?

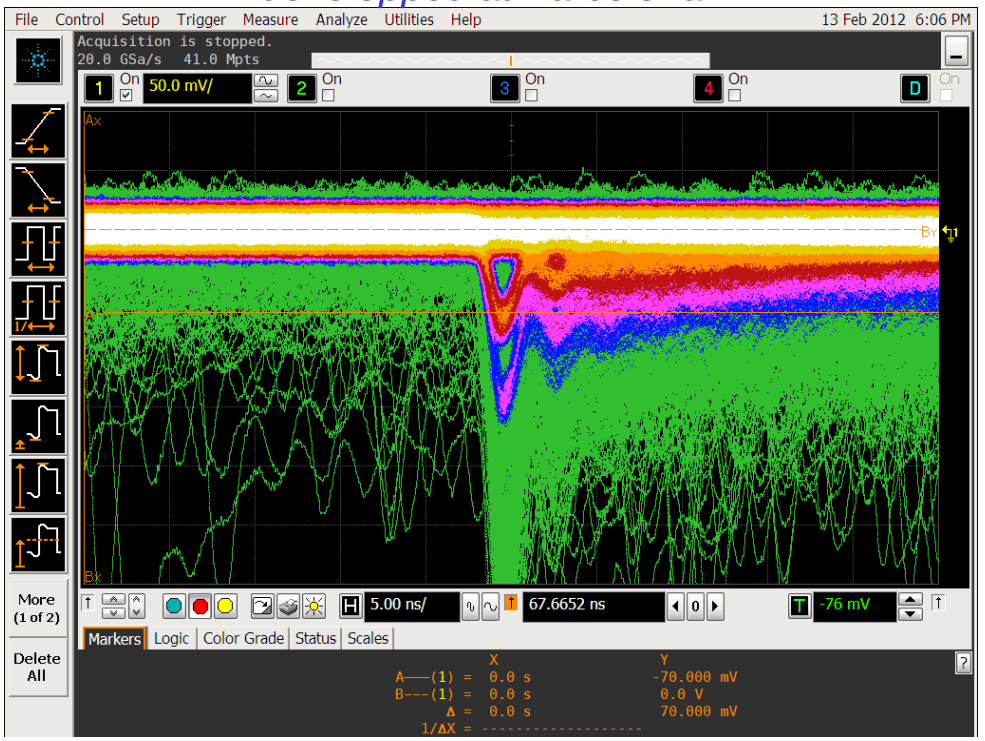
II. Measurements

- Signal shape for few fired cells (only SiPM response, no scintillator):
  - Relatively fast recovery: low SiPM capacitance and low amplifier's Zi
  - Still significant spill over after 25 ns !
  - On top of that: time arrival dispersion and signal shape fluctuation…

Guido's measurement with 50um but 1mm² SiPM
Signal terminated at the input of preamp with 50 Ohm



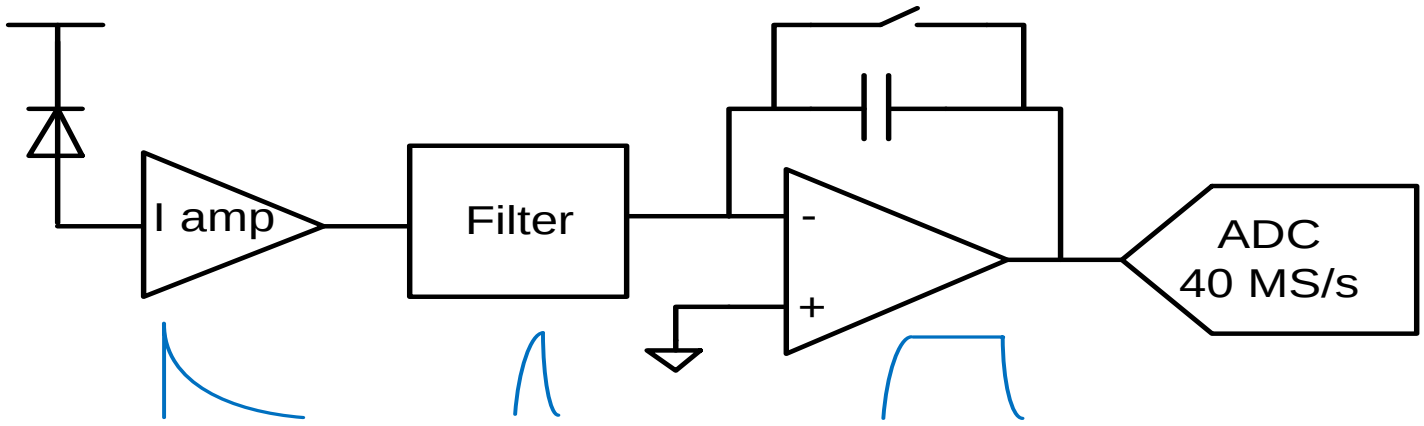
Albert's measurement with Hamamatsu SiPM for SciFi
Readout with current preamplifier (Zin=20 Ohm)
developped at Barcelona



Measurements for MIP signal at different fibre positions are needed

III. Proposed signal processing

- Clermont/Barcelona meeting on 28th June
- Flat top shaper (25 ns > Flat top > 10 ns) to:
  - Minimize the effect dispersion in time arrival
  - Minimize the effect of signal shape variations
  - Straightforward ADC synchronization
- Main possible drawbacks:
  - Short time left to reset:
    - Maybe dual channel would be needed: more complexity and power consumption
  - Usually differential processing is needed:
    - Complexity and power consumption



IV. Fallback options

- SemiGaussian shaper + peak detector
  - Well suited for silicon trackers, not really ideal choice here
  - Signal shape fluctuation might be an issue
  - Still possible if double pulse resolution can be relaxed
- Low pass filtering + digital signal processing (e.g. ALTRO chip)
  - Low pass filtering and 40 MS/s sampling
  - Enough samples to peform digital signal processing
    - Deconvolution
    - Tile supression
    - etc
  - Relatively simple analog electronics and very robust signal processing
  - Drawbacks:
    - Which would be the required resolution (dynamic range) for signal processing ?
    - Quite complex digital processing:
      - Area and power consumption
    - Effect of high occupancy ?