Progress on the new beam telescope

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ECAL Upgrade II Workshop
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EPFL

Outline

- Current telescope setup

- Requirements

- The SciFi telescope

- Status and plans

Current telescope setup

- 2 x MCP PMT for time reference
  - ~ 14 ps average time resolution

- 2 x (Scintillator + PMT) used for trigger (discriminated and in coincidence)

- Light tight experimental box with the module inside.

- 3 x DWC for tracking and shower/multiple hits rejection
 - SciFi telescope will replace these!

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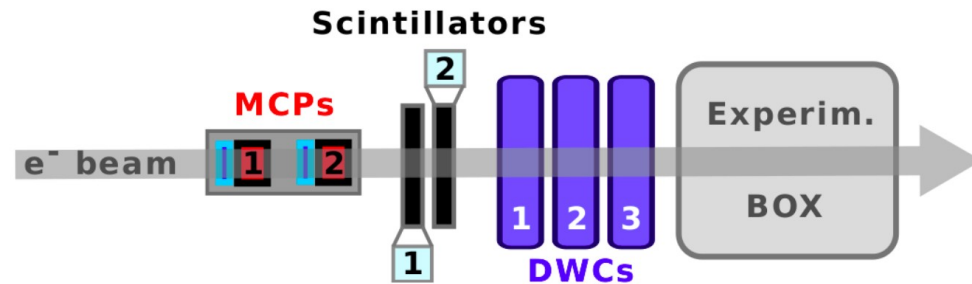
Requirements

- Spatial resolution < 500 μm on both axes

- Surface covered > 120 x 120 cm^2

- Compact

- Up to 1 kHz acquisition rate

- > 90% efficiency with all the planes combined

- Low material budget < 0.1 X$_0$

The telescope

- Build using small SciFi mats
    - 2 perpendicular mats, x-y coordinates
    - 13x13 cm^2
    - Completely light-tight
- Dedicated readout electronics
    - Developed for SND@LHC, different from LHCb
- < 100 µm resolution, ~250 ps time resolution
- ~ 0.007 X_0 thickness per module
- 2 modules will be enough for this setup

Electronics

60 cm

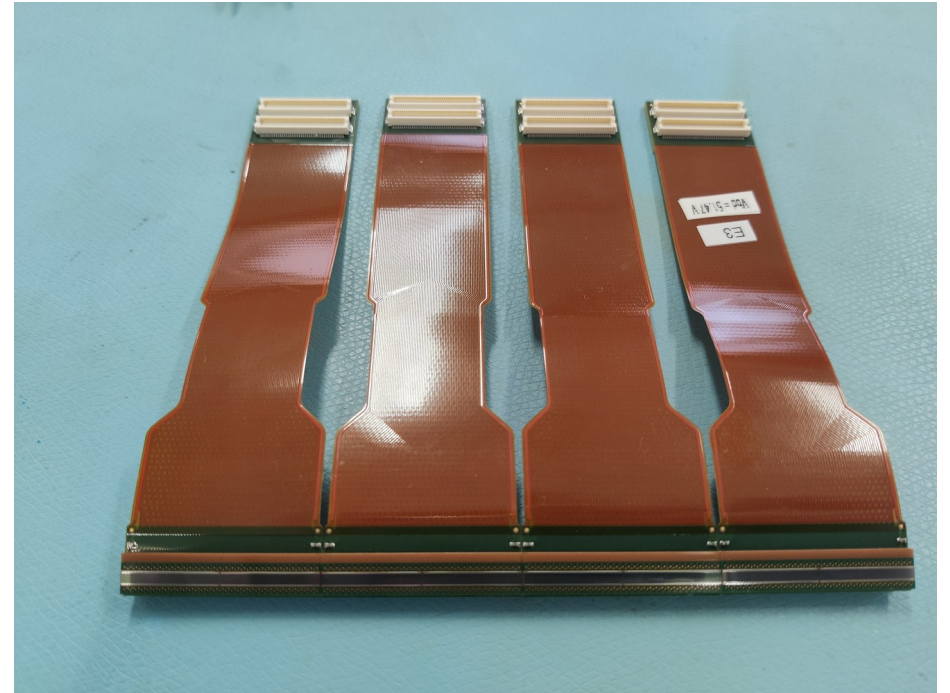Fibre mats

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5
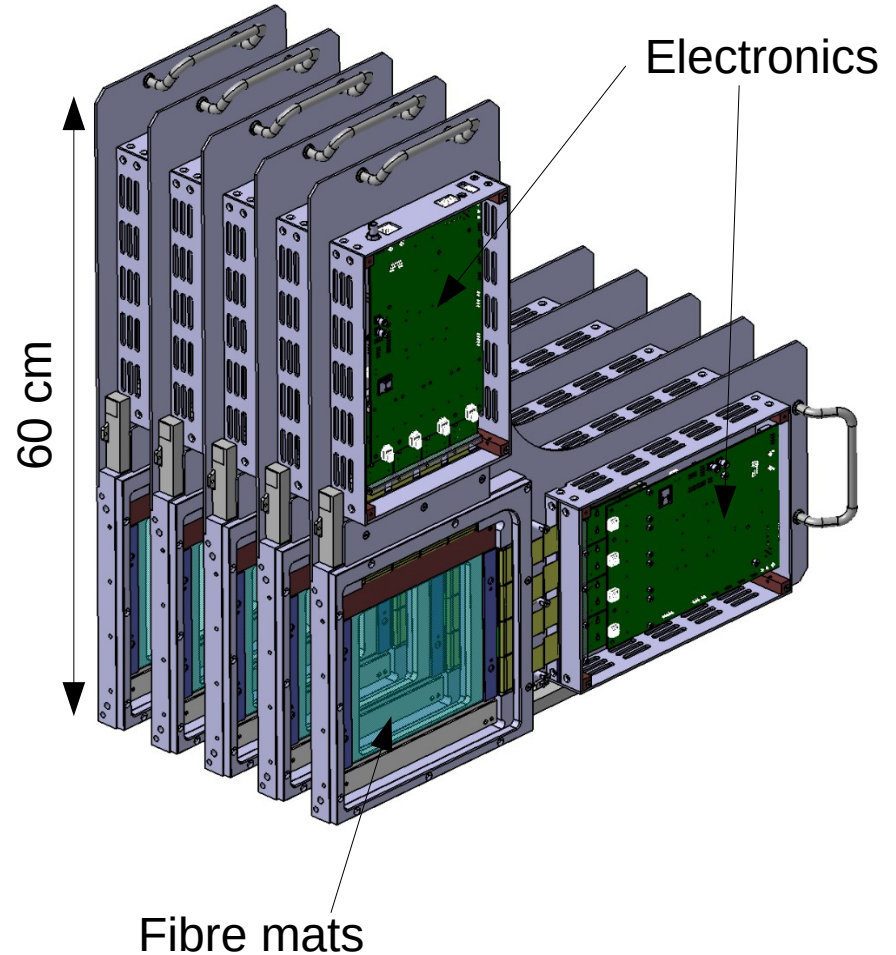
The SciFi mats

- Same concept as the ones in LHCb, just way shorter

- 2 mats assembled together at 90°

- Mirrors glued on one side, to increase light yield

13 cm

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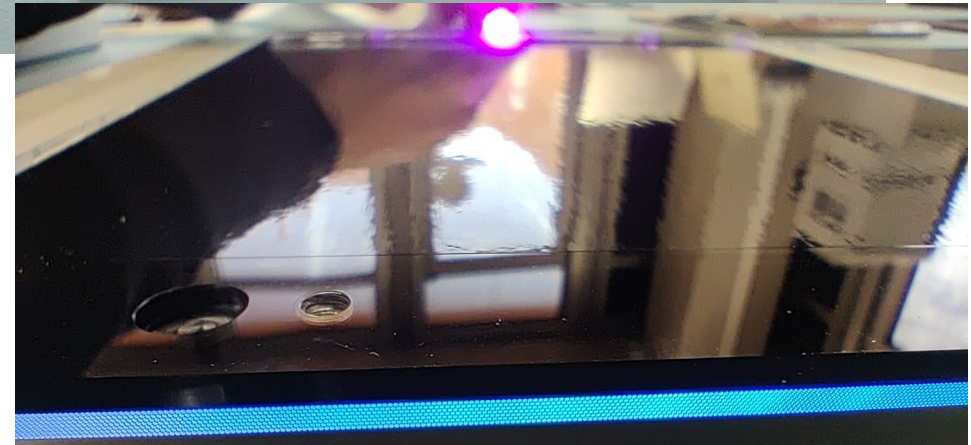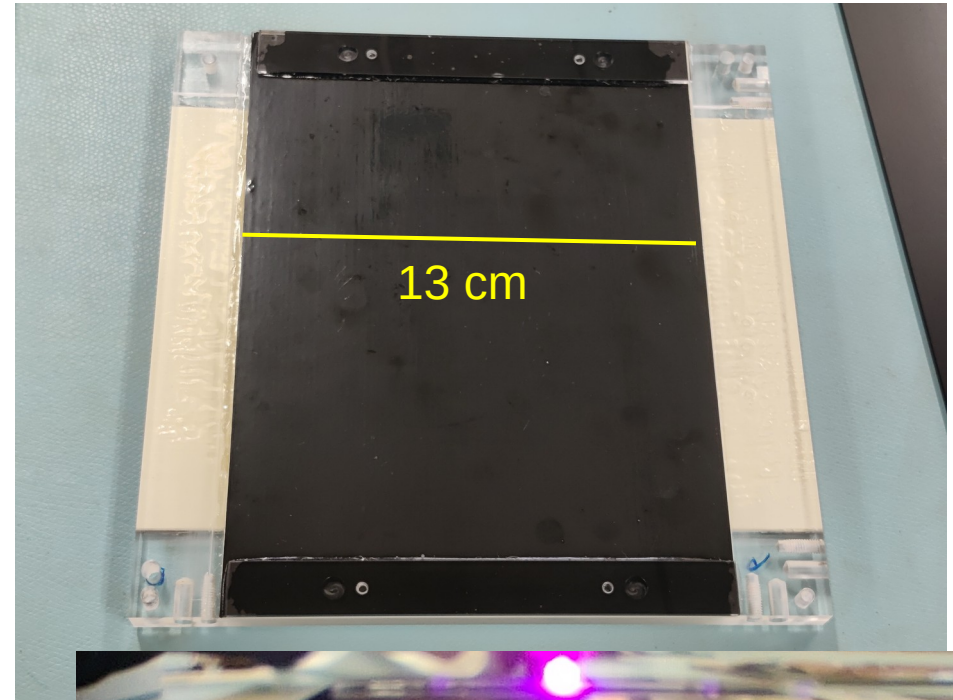
The SiPMs

- Same SiPMs used in LHCb SciFi

- H2017 multichannel arrays from Hamamatsu

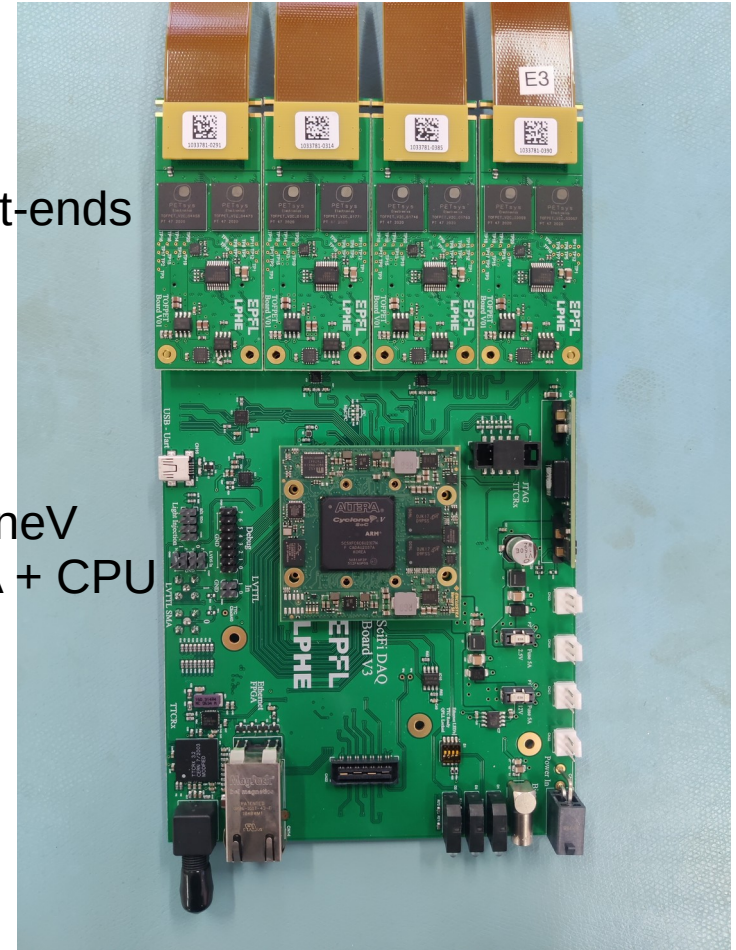   – 250 µm pitch, 512 channels per side

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The electronics

- One DAQ board and 8 front-end chips per side

- Data sent over Ethernet to a computer

- Boards run synchronously
  – Clock delivered via optical fibre

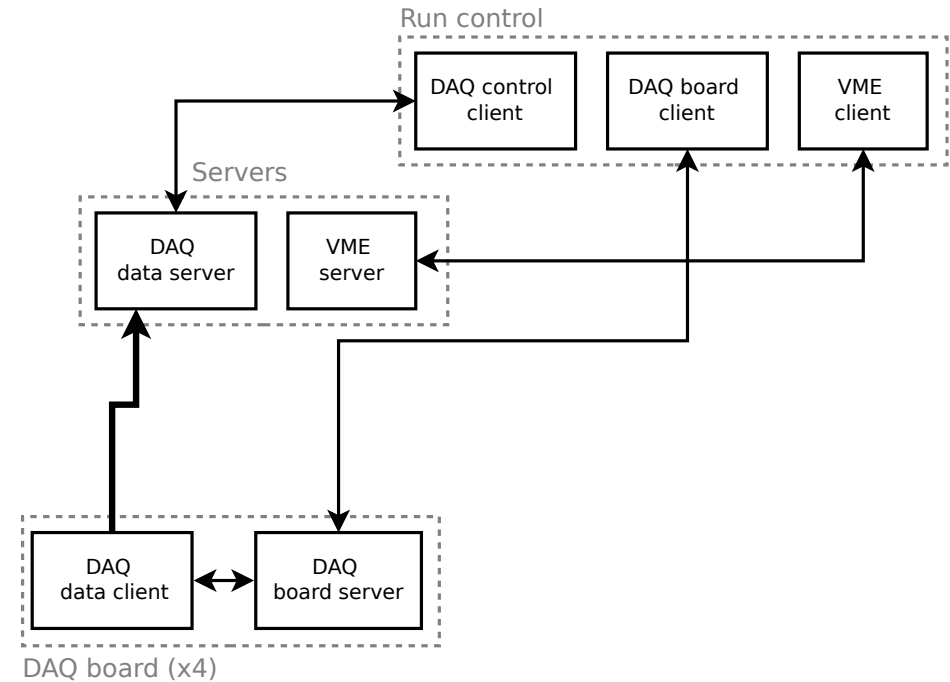- SiPMs biased via the board

To SiPMs

Front-ends

CycloneV
FPGA + CPU

The DAQ software

- Software used in SND@LHC
- DAQ data server
  - Online event builder and noise suppression
  - ~100 kHz max event rate
- VME server-client
  - Controls a VME crate for clock and synchronous reset
- System controlled with python scripts
  - Should be easy to integrate in existing DAQ

Run control

| DAQ control client | DAQ board client | VME client |

Servers

| DAQ data server | VME server |

DAQ board (x4)

| DAQ data client | DAQ board server |

Status

- Mechanical pieces ready

- Fibre mats are being finalized

- SiPMs glued on supports and tested

- Assembly will begin this week

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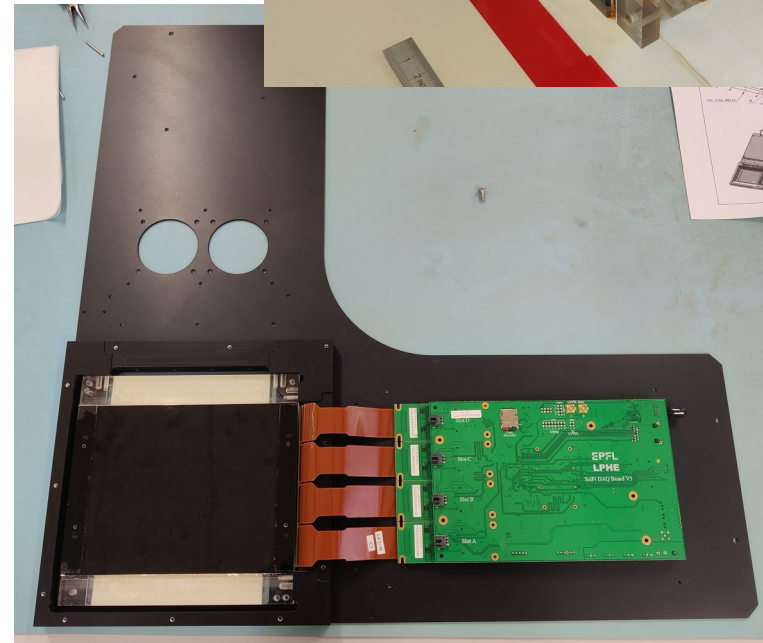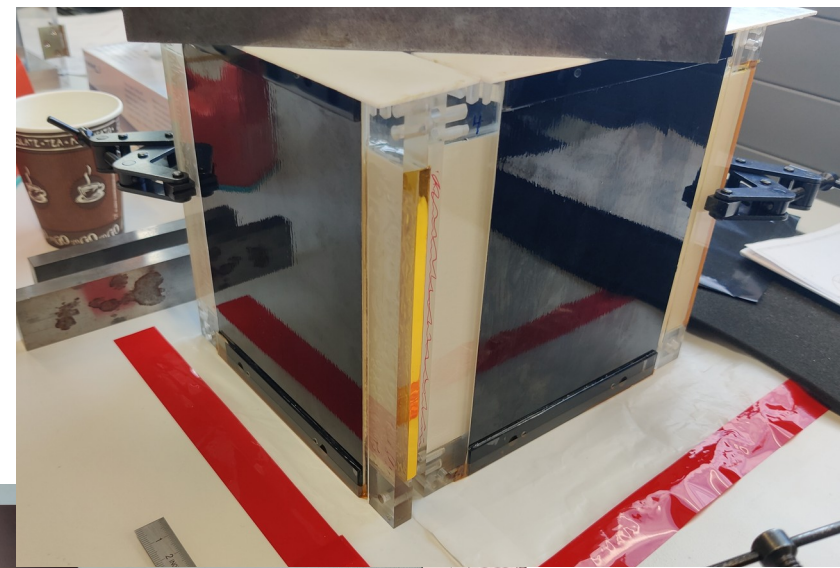
Plans

- Assemble 2 modules at EPFL
  - This week

- Take part of the setup to EPFL to test integration of the DAQ systems
  - 2nd half of December

- Debug the system and take cosmic runs
  - To have it ready for the next testbeam

- Develop tracking software

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Conclusions

- New telescope based on small SciFi modules is being built

- Software already available
  - Used in SND@LHC

- Setup assembled at EPFL between December and January

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