Report from STT Working Group

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SAND meeting
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OUTLINE

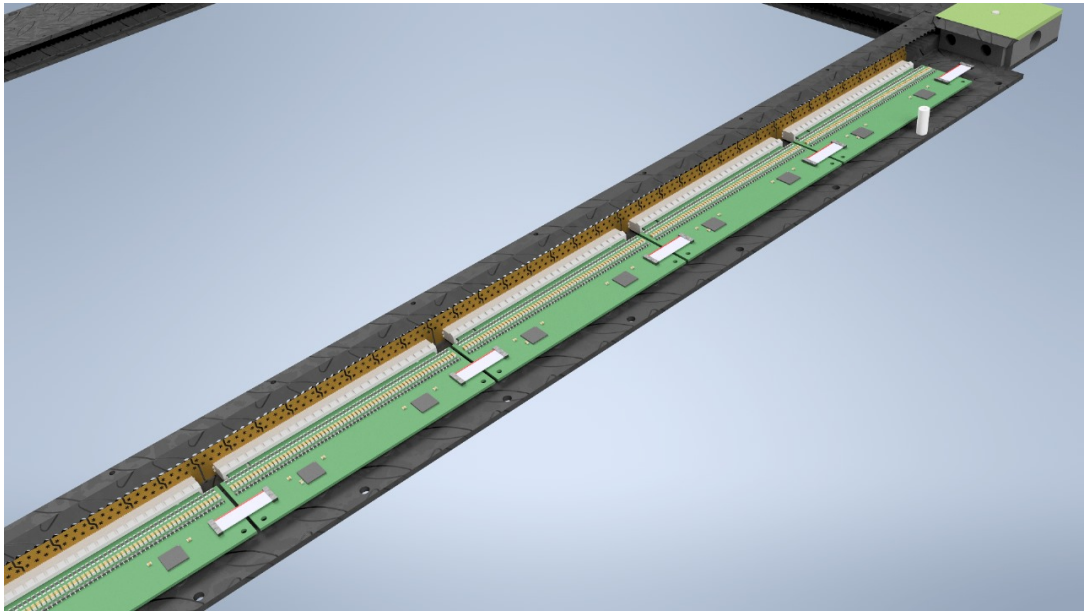
Focus on progress since May CM:

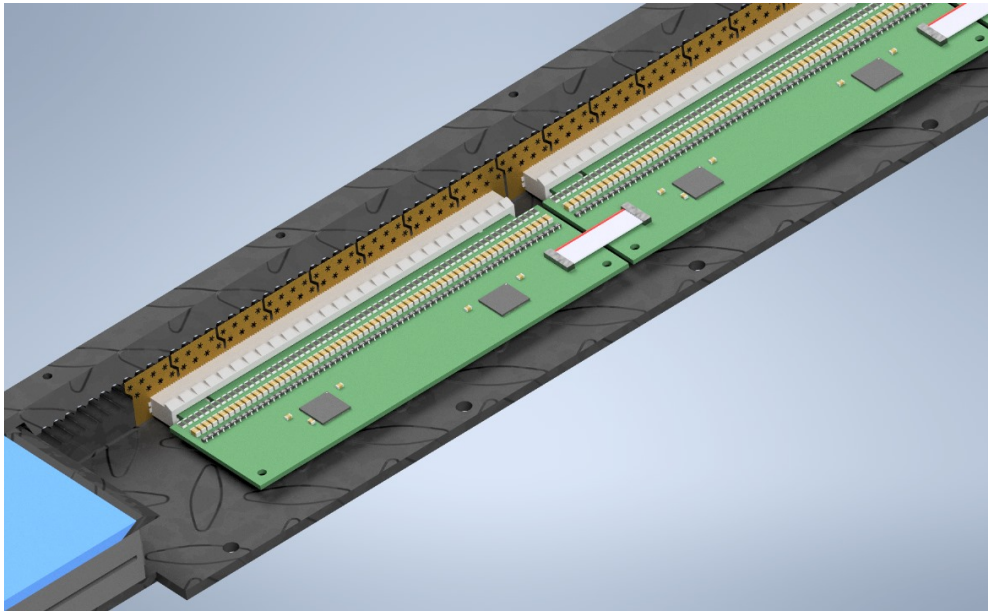
- *Update on integrated STT readout boards and kapton PCBs;*
- *Tests of prototype readout boards with VMM3a ASIC;*
- *Backup readout option for STT;*
- *Procurement of final spacers and end-plugs;*
- *Tests of crimping pins and wire crimping procedure;*
- *Preparation for the assembly of C-fiber prototype in Pisa.*

Material presented during WG meetings (Wednesdays, 8:00am Central Time / US) available on Indico:
`https://indico.fnal.gov/category/1402/`

INTEGRATED STT READOUT BOARDS

V. Bautin (JINR)



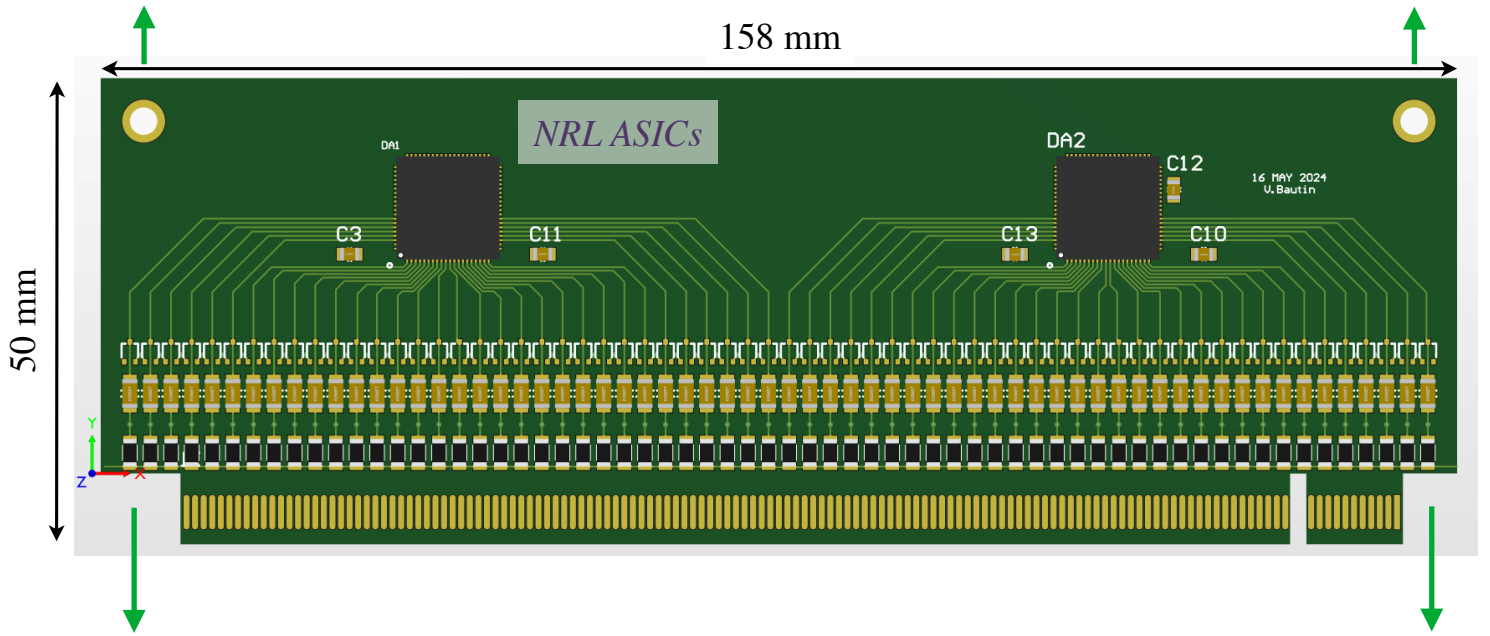


✦ *Integrated boards reading up to 64 straws each with ASIC + micro-controller (MCU):*

- *Connection with straw pins via flexible kapton PCBs with PCIe connector for easy upgradability/replacement;*
- *Design variants with different ASICs: NRL analog (G. De Geronimo), VMM3a, custom ASIC;*
- *Surge protections, LV fuses, and Solid State Relay (SSR) for HV connect/disconnect.*

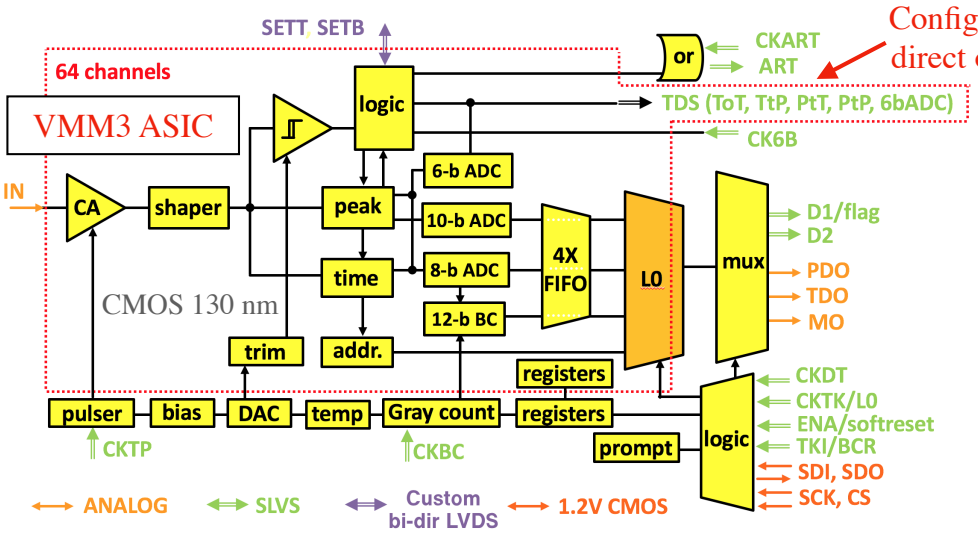
✦ *Low-power boards (~0.65 W for 64 channels with NRL ASIC) minimizing signal path*

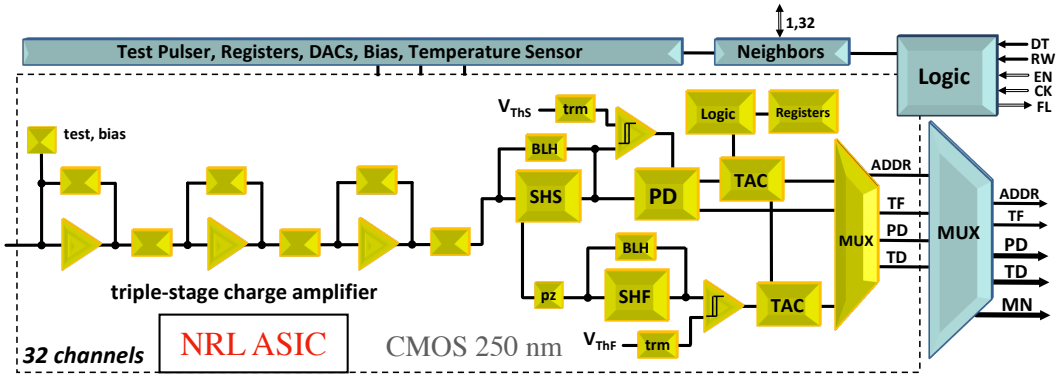
$\Longrightarrow$ *First version (v1) successfully tested, prototypes of revised version (v2) in preparation*



Revised design (v2) of the readout board and of the connecting flexible kapton board

VMM3A ASIC AND NRL ASIC

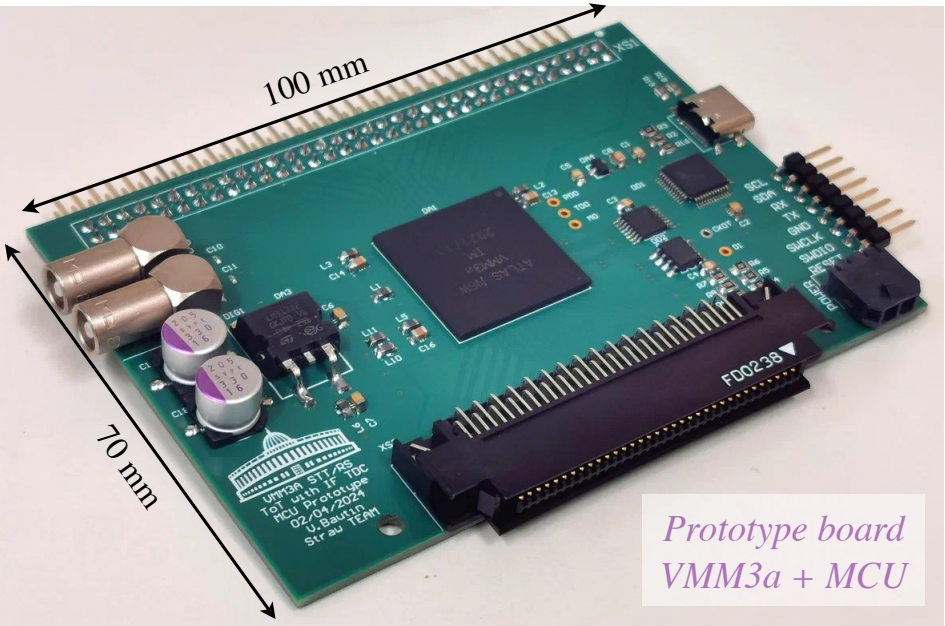


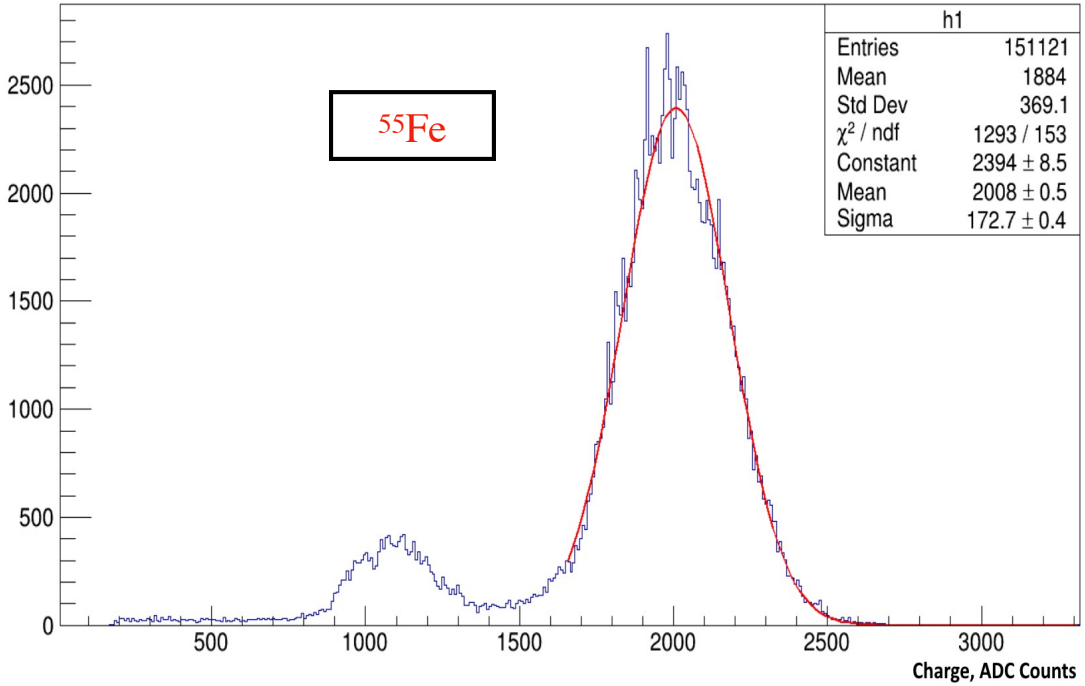


- *Design variant of STT readout board with existing VMM3a as backup solution:*
  - *Use VMM3a direct output in "external" ADC mode with the MCU (bypassing internal ADCs);*
  - *Readout variant readily available which could be used during construction and initial data taking;*
  - *Default STT readout minimizing project risks while developing custom ASIC.*

- *Design variant with existing NRL ASIC to test base architecture for custom ASIC*

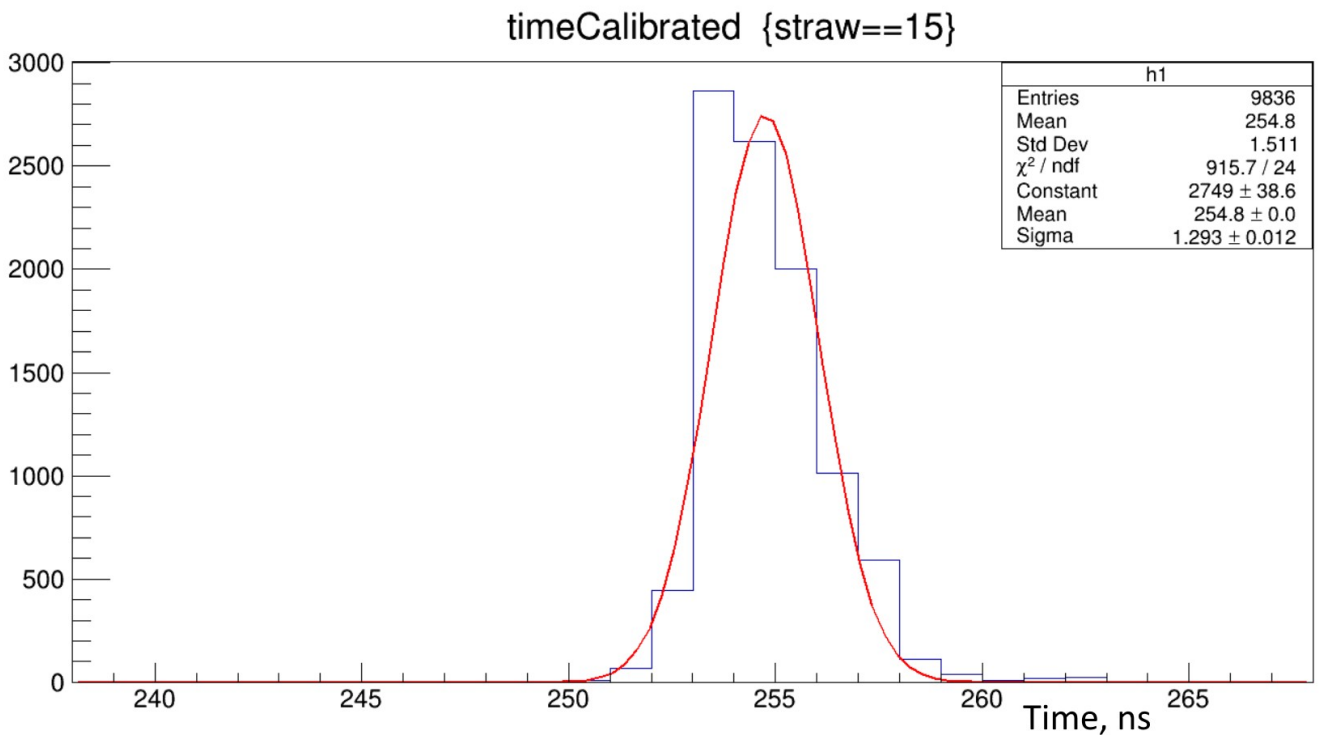
  $\Longrightarrow$ *Flexible design allows easy exchange/upgrade of individual STT readout boards*





- *Prototype board with VMM3a in "external" ADC mode and 12-bit 4MSPS ADC in MCU;*
- *Successful test of charge readout from a straw tracker prototype with ^{55}Fe source;*
- *External ADC mode fixes known bad ADC/TDC performance in VMM3a continuous mode.*

$\Longrightarrow$ *Prototype with the form factor and connections of STT readout boards in preparation*



- *Exploit short drift distances $\leq$ 2.5mm and small straw occupancy $<$ 2% in STT;*
- *Use VMM3a in "external" ADC mode with fixed peaking time of 50 ns;*
- *Preliminary measurements indicate that we can achieve a timing resolution close to 1 ns.*

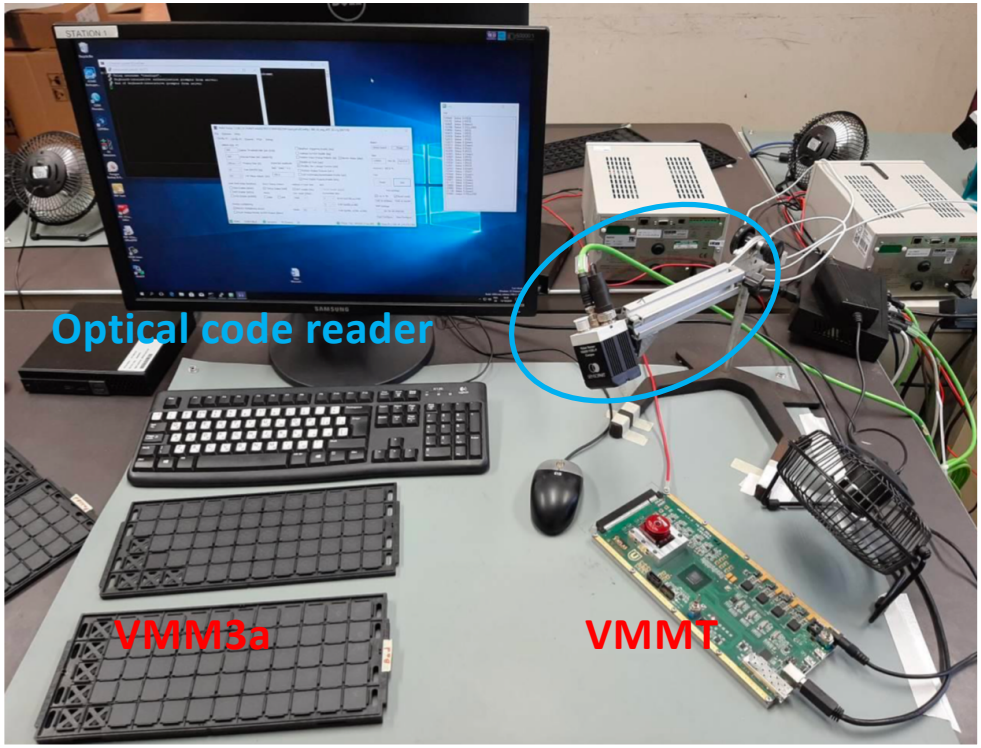
$\Longrightarrow$ *VMM3a could provide both time and charge measurements consistent with STT requirements*

VMM3A PROCUREMENT

- *225 VMM3a chips (2 wafers) procured by USC in 2020 were fully tested at CERN (average yield ~70%)*
- *226 VMM3a chips (2 wafers) procured by USC delivered to CERN in June 2024 to be tested*

  $\Longrightarrow$ *Enough VMM3a to read more than 20,000 channels at hands for STT prototyping and construction*
- *A new production of VMM3a chips dedicated to STT possible on relatively short timescale*

  $\Longrightarrow$ *Attractive backup option for STT readout minimizing project risks and costs*



2 VMM3a wafers procured by USC were tested and validated with the automatized VMMT setup developed for ATLAS NSW at CERN in October 2021

PROCUREMENT OF SPACERS & ENDPLUGS

RP (USC)

Roughness 0.25 μm

Completed mold for the mass production of end-plugs and spacers with injection molding: 8 cavities, lifetime 500k allowing production of 4M pieces each

First samples of spacers received are being tested at CERN for final validation before mass production

Expect to receive 15,000 spacers at CERN to be used for the 1.2 m Pisa prototype and the full-scale prototype (PC black color)

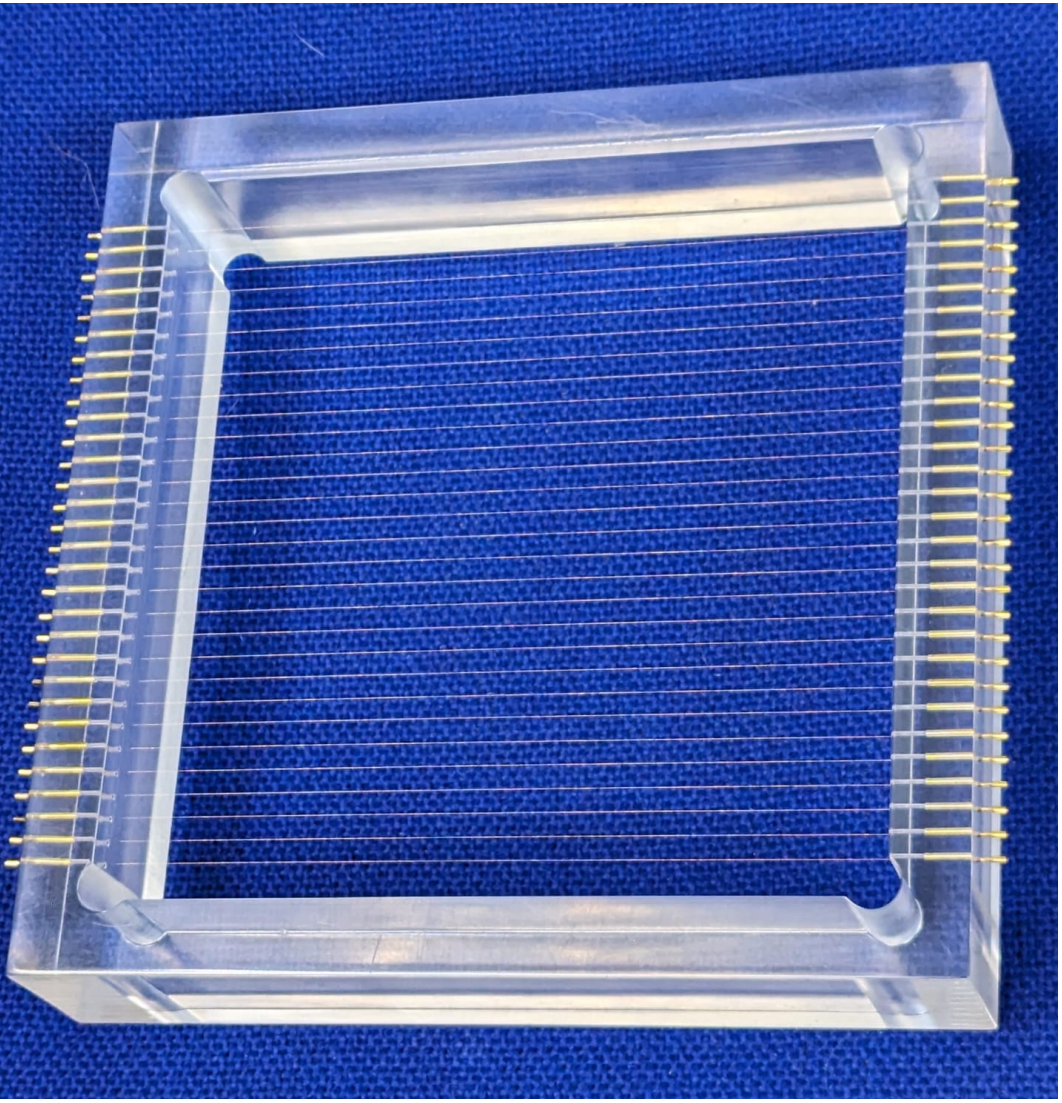
First samples of end-plugs received are being tested at CERN for final validation before mass production

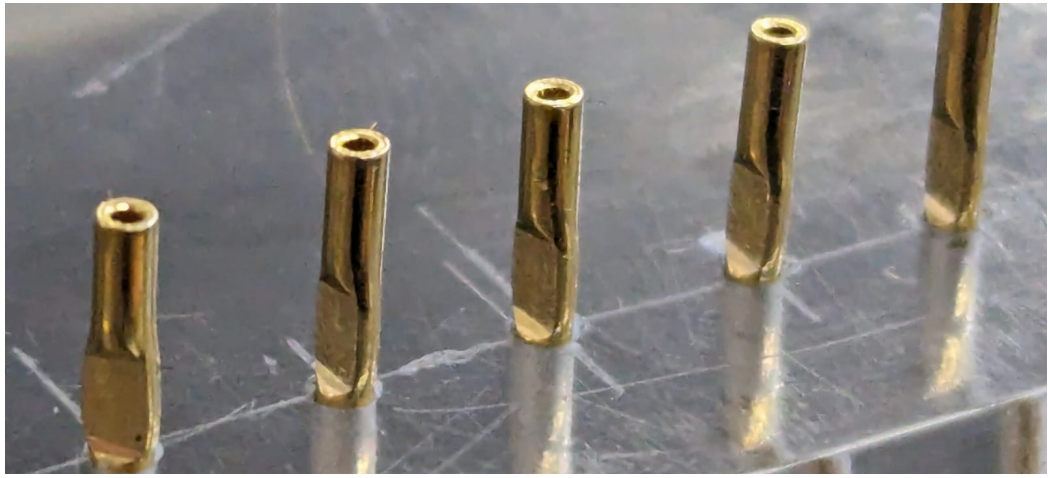
Expect to receive 10,000 end-plugs at CERN to be used for the 1.2 m Pisa prototype and the full-scale prototype (PC transparent color)

TESTS OF CRIMPING PINS

T. Enik (INP)

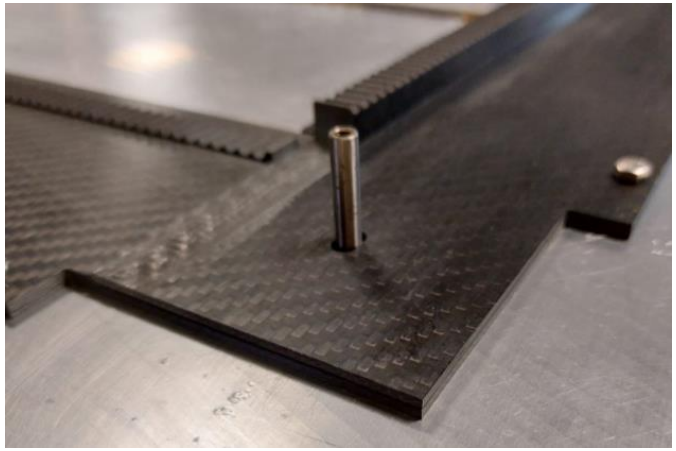
- *Improved setup for testing crimping pins based on machined plexiglass frame;*
- *Use 20 μm wire from LUMA and crimping tool developed by ATLAS TRT;*
- *Evaluate effect of different crimping points along the pin and long term stability of wire tension after crimping.*

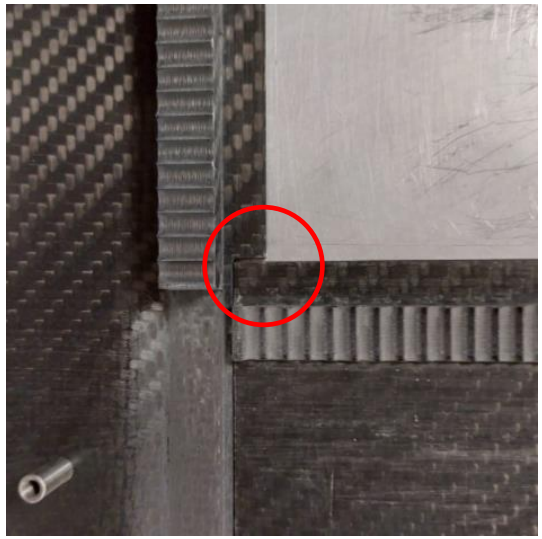




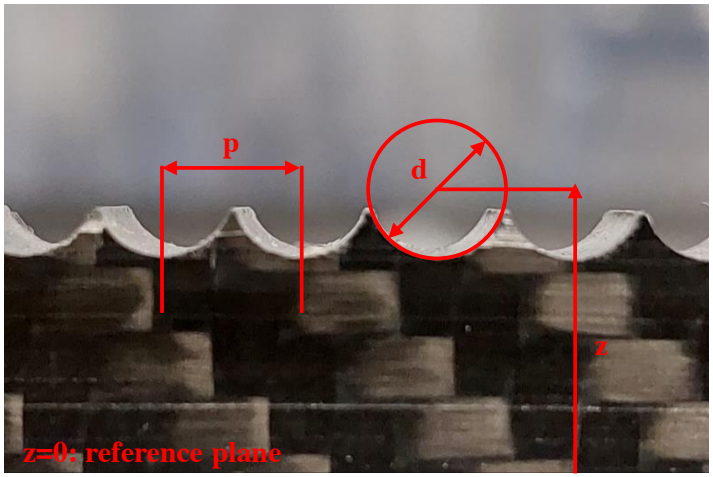
PREPARATION FOR PROTOTYPE IN PISA

- *C-fiber frame 1.2m × 0.8m checked on the assembly table in the clean room;*
- *Improved planarity, fitting/consistency of parts, and sealing with respect to the CERN prototype;*
- *No additional machining, nor heat treatment required.*

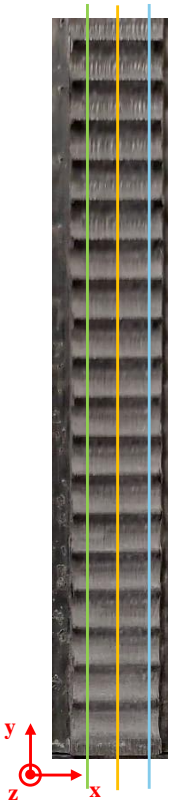


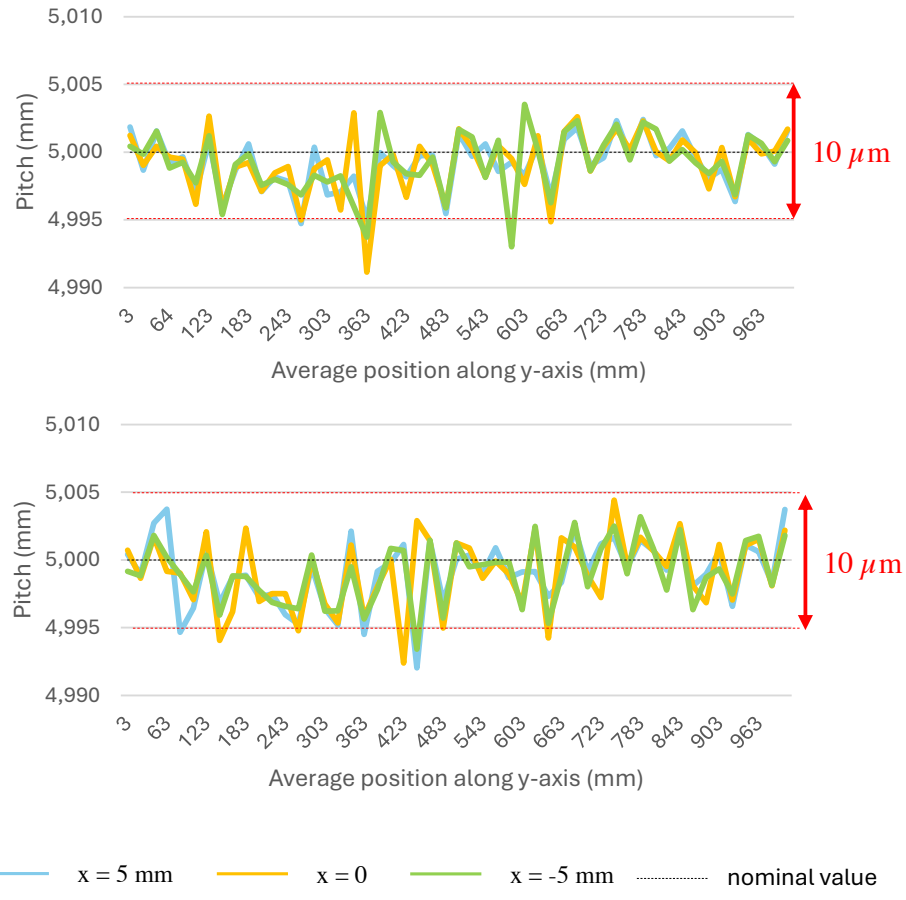


* old version of corner blocks

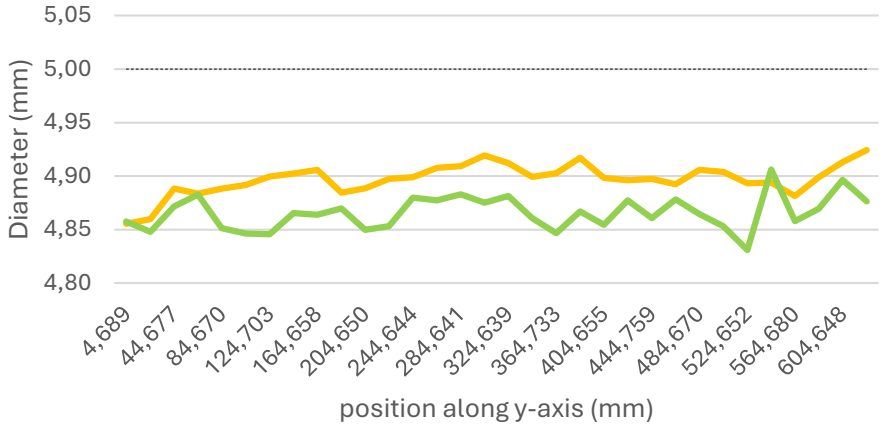


1. Place the component under a CMM
2. We measure pitch (p), diameter (d) and center height from reference plane (z) as function of the longitudinal coordinate (y)
3. Each measurement is repeated at three different x-coordinates: -5 mm, 0, 5 mm

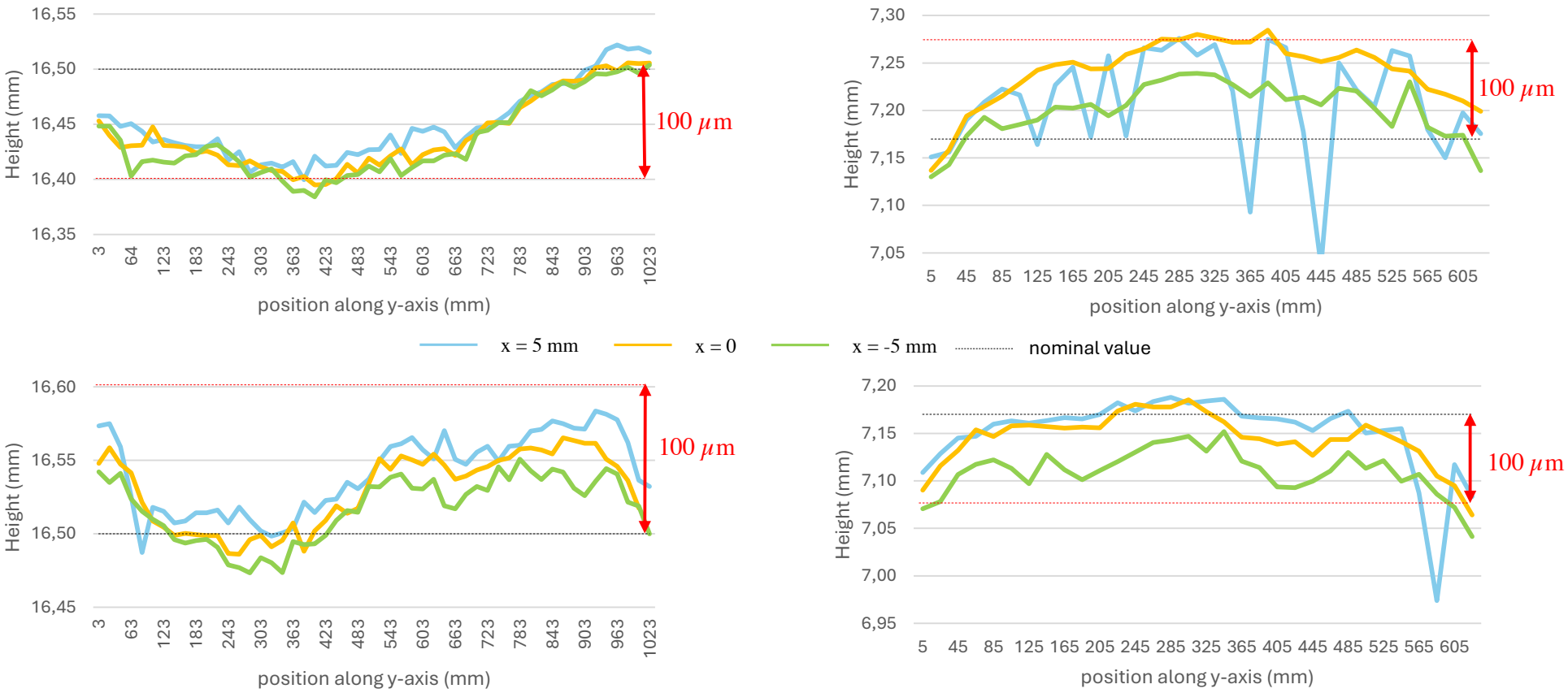




Measured pitch of the holes in the straw holder consisted with the nominal value within CMM accuracy



- *Hole diameter in the straw holder lower/higher than nominal but measurements affected by systematics;*
- *Further checks will be performed with calibrated pins and with the actual pressurized straws.*



- *Measured height of the straw holder within 100 μm from nominal;*
- *Calibrated spacers will be used to improve the planarity of the straw holder on the assembly table.*

Backup slides