

miniBeBe project

Advances in time resolution

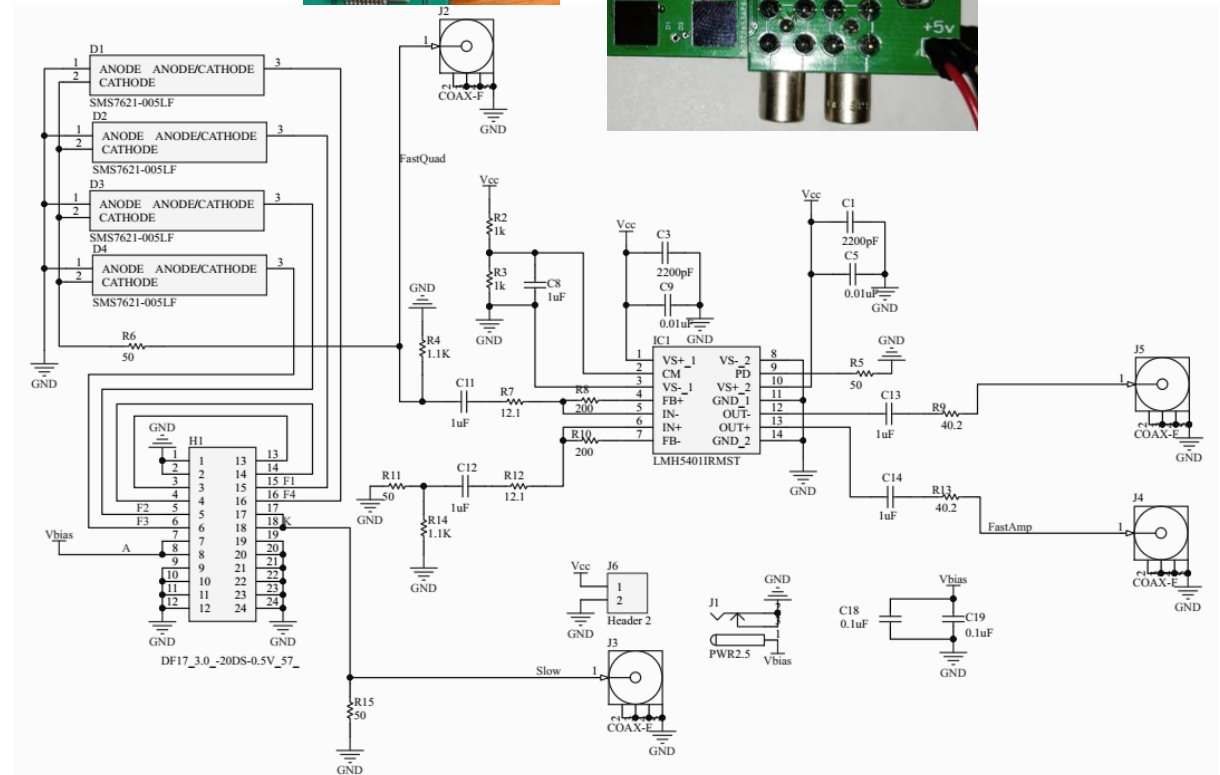
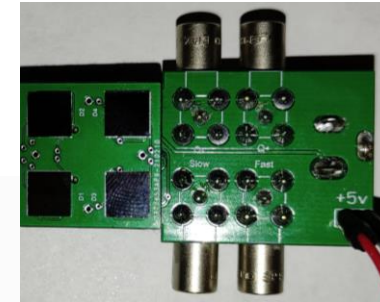
Dr. Lucio Rebolledo.

April 25th. 2022

Experimental setup in Dubna 2021

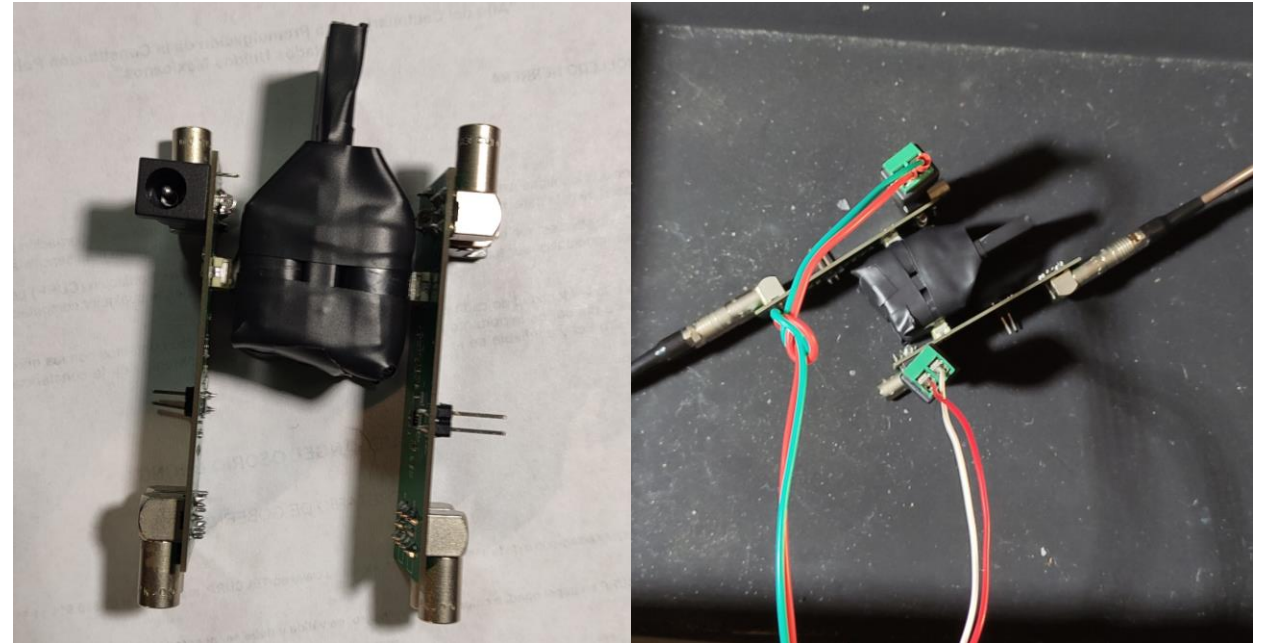
- Plastic scintillator:
 - BC404
 - $20 \times 20 \times 3 \text{ mm}^3$
- SiPM array:
 - MicroFJ-60035 (6 mm)
 - Array of 4 SiPMs
 - Series-Parallel interconnection
- Amplifier:
 - LMH5401-SP
 - $G = 17 \text{ dB}$
 - RF Fully differential (SE-DE)
- Cosmic rays muons

Result: Time resolution $\approx 200 \text{ ps}$

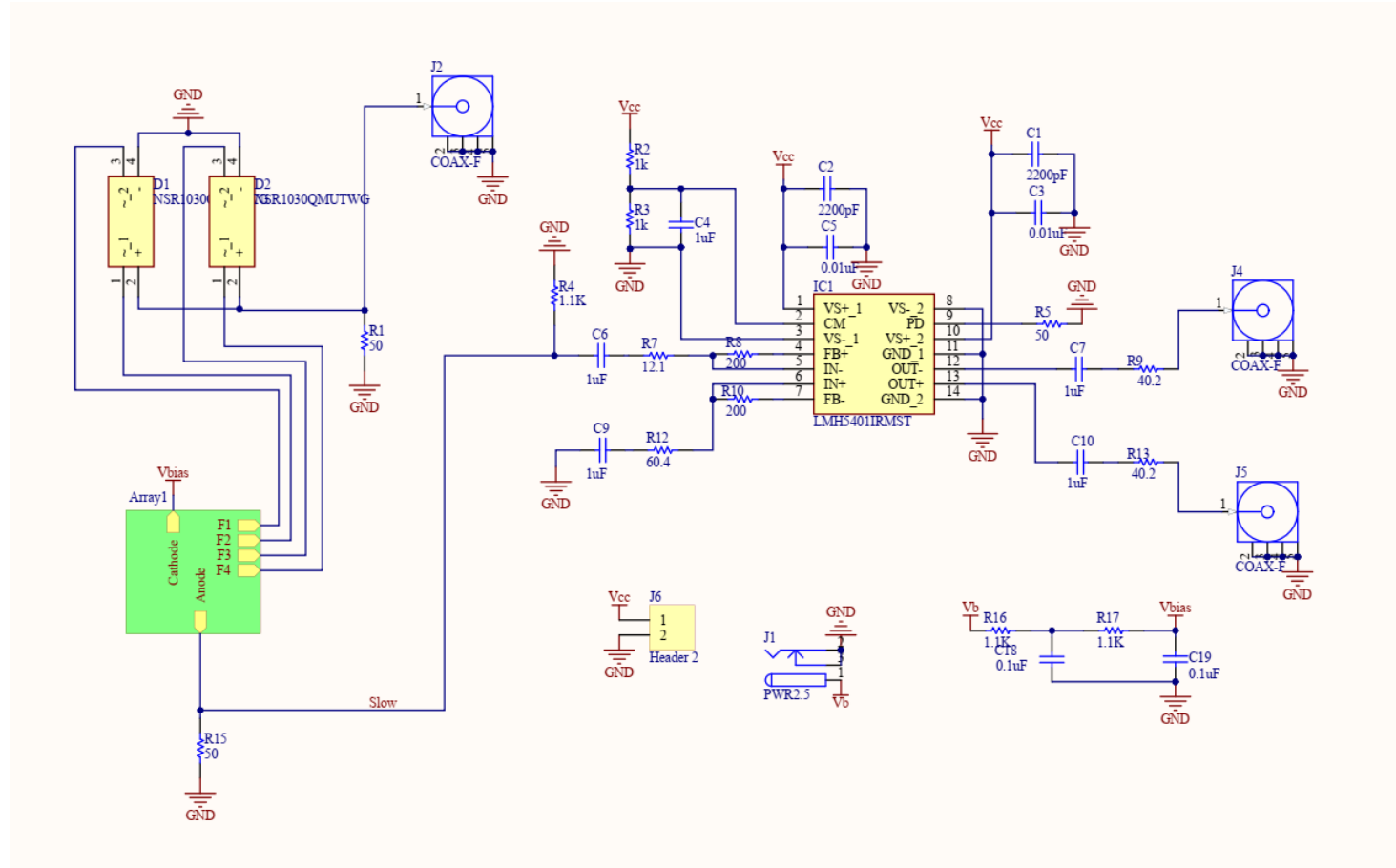


Current setup for coincidence

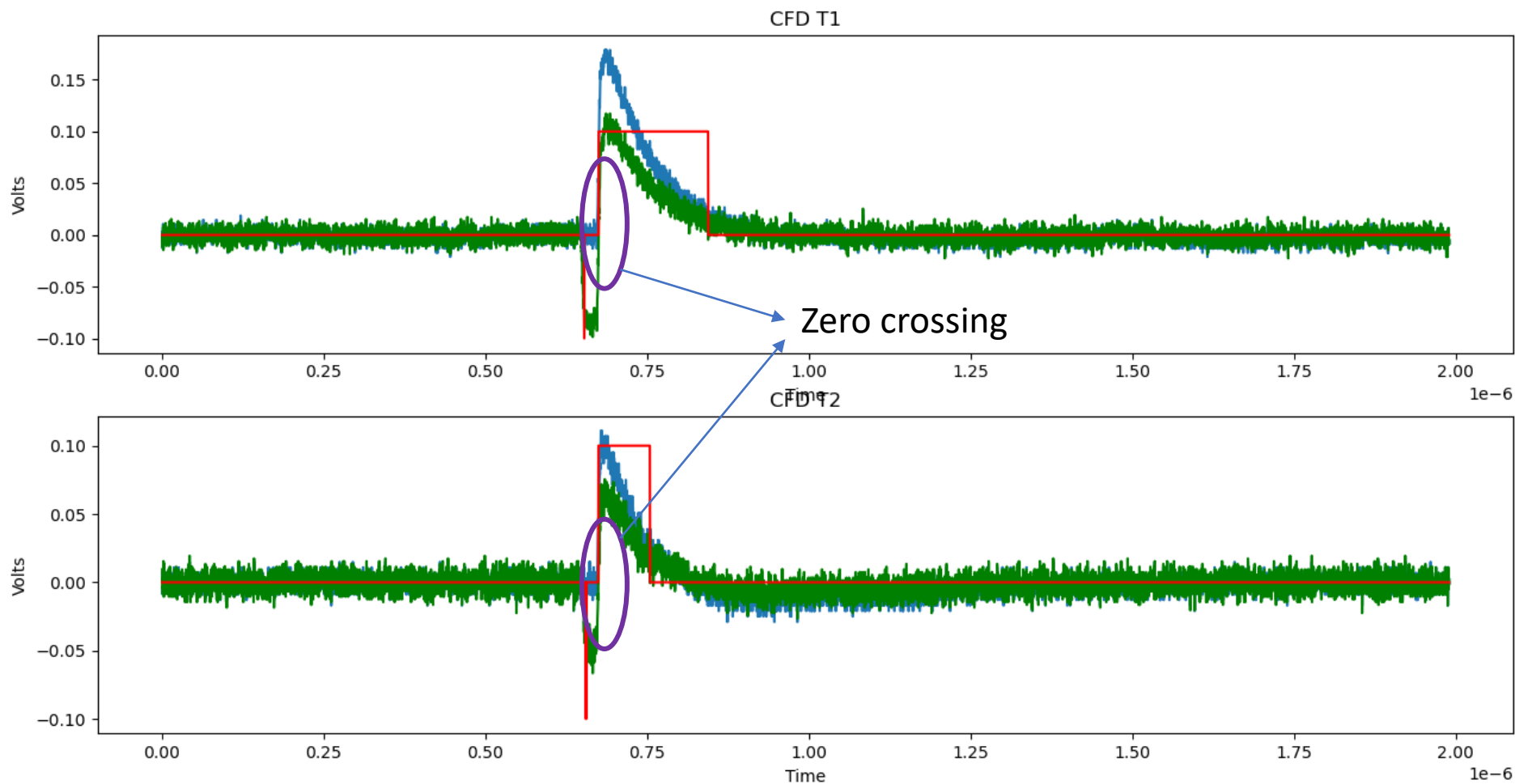
- Two BC422Q plastic scintillators.
 - $20 \times 20 \times 5 \text{ mm}^3$
- SE to differential amplifier (G = 17 dB).
- Parallel – Series SiPM interconnection.
- $V_{\text{bias}} = 60 \text{ V}$.
- $V_{\text{amp}} = 5 \text{ V}$.
- Separation = 5.4 mm



SE to differential amplifier



Digital CFD (dCFD)

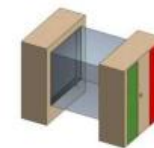
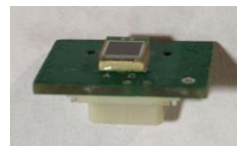
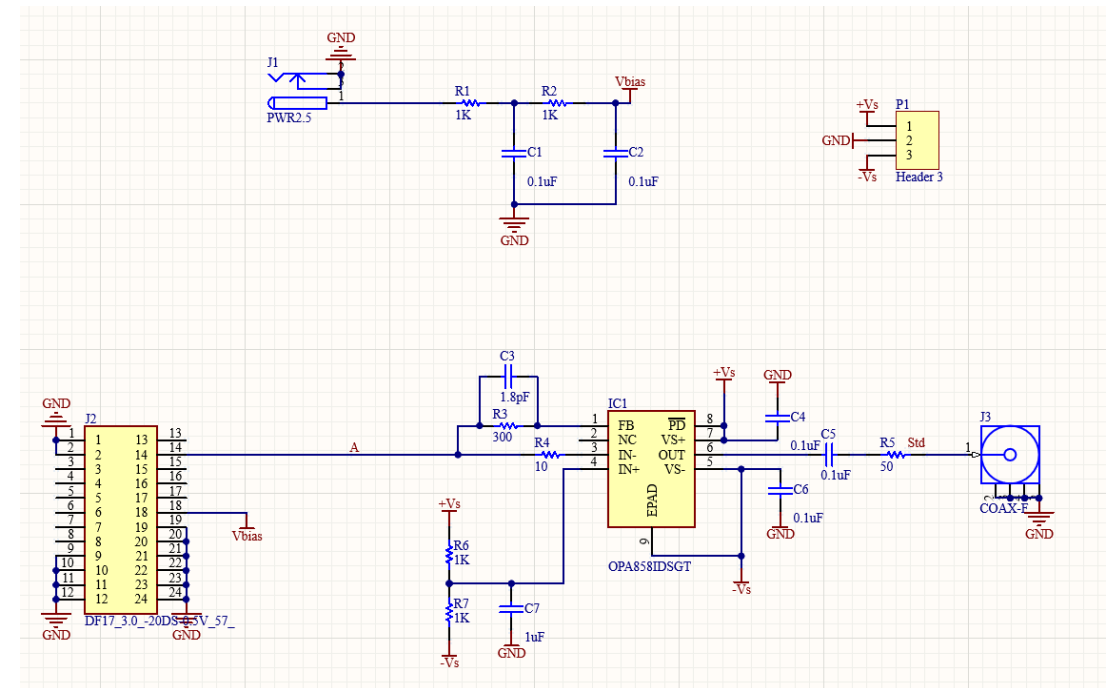


Current work on miniBeBe

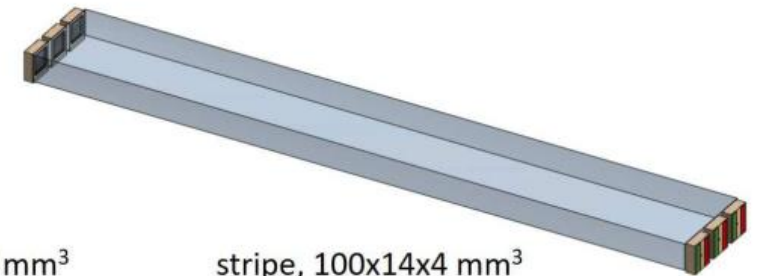
- BC422Q plastic scintillators.
- SensL J-Series 6 mm SiPMs.
- Digital CFD implemented in Python.
- Measurement of time resolution:
 - With MSO4104 **oscilloscope** at 5 GS/s → **200 ps**.
 - With **oscilloscope** at 2.5 GS/s → **400ps**.
- Third measure with **oscilloscope** of 40 GS/s (borrowed from external laboratory)
 - Results → **200 ps**.

Alternative setups

- Trans-impedance amplifier.
- Plastic scintillators.
 - $20 \times 20 \times 5 \text{ mm}^3$ - EJ232 (BC422)
 - $30 \times 70 \times 5 \text{ mm}^3$ - EJ232
- Location of SiPMs in lateral sides
 - SensL and Hamamatsu
 - 3mm and 6mm



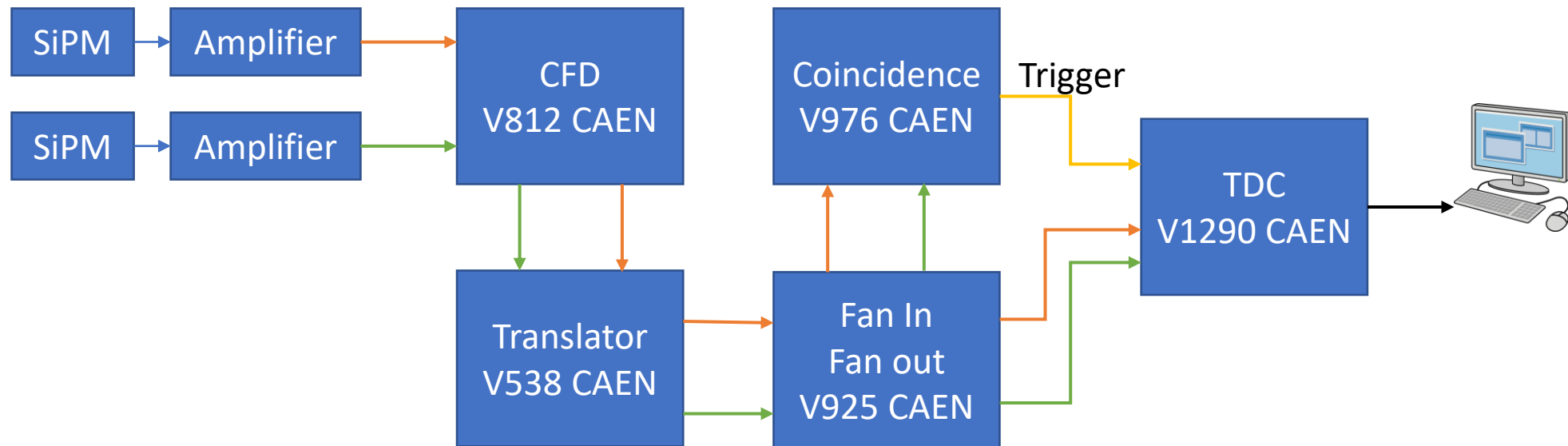
cube, $3 \times 3 \times 3 \text{ mm}^3$



stripe, $100 \times 14 \times 4 \text{ mm}^3$

Stoykov and T. Rostomyan, "Time Resolution of BC422 Plastic Scintillator Read Out by a SiPM," *IEEE Transactions on Nuclear Science*, vol. 68, no. 7, pp. 1487-1494, July 2021.

Instrumentation



Future work

- We will change the setup as described.
 - Lateral position of SiPMs
- Alternative instrumentation is under buying.
- Radiactive sources will be used, instead of cosmic ray muons.

Summary

- We still get a time resolution of 200 ps.
 - With cosmic ray muons.
 - BC422Q
- Equipment and materials have been an issue
 - EJ232 arrived two weeks ago.
 - We are buying some CAEN cards (TDC and ECL/NIM mainly).
- We got a scope, partially available (borrowed) of 40 GS/s (Sampling period of 25 ps).
- Geometry Will be changed.

**THANK'S FOR YOUR
ATTENTION**

