

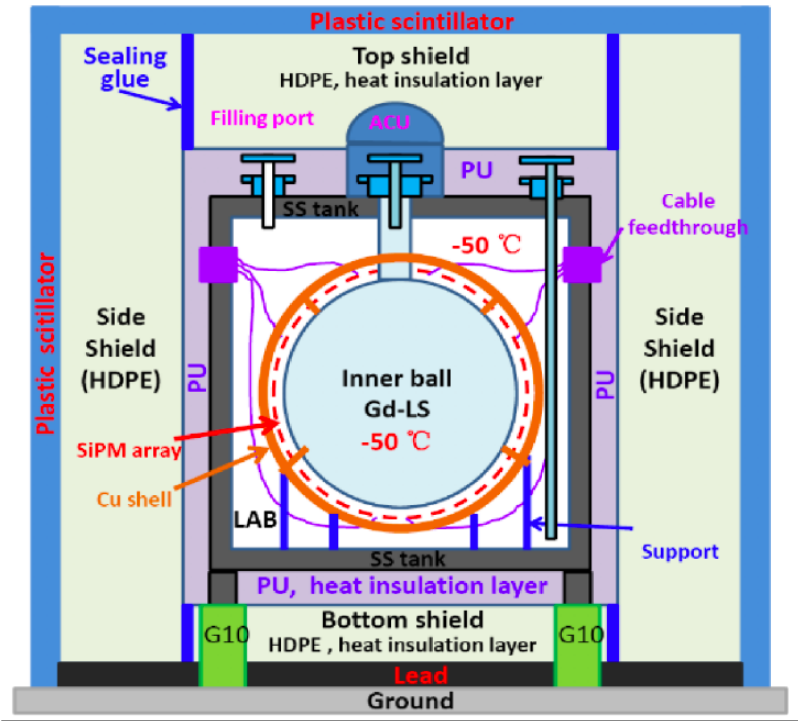


JUNO-TAO FEB board pre-production test

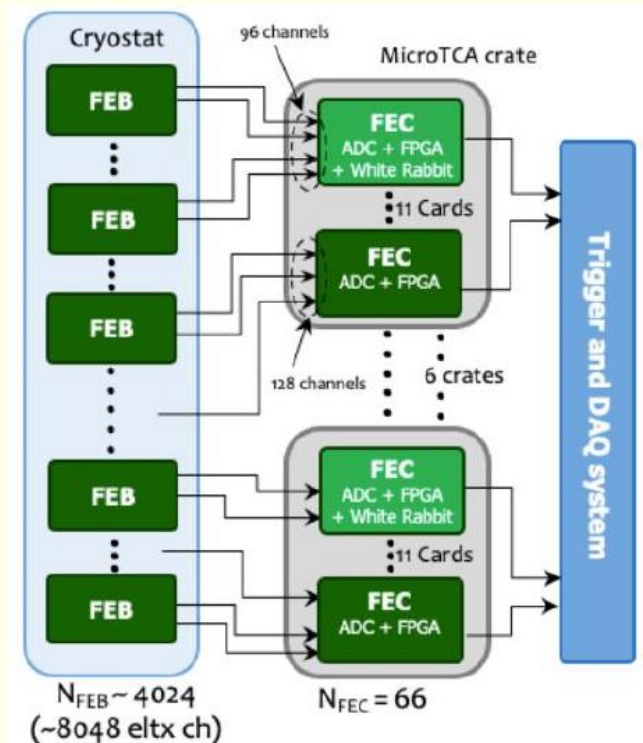
**Andrea Fabbri, Salvatore Loffredo*, Stefano Maria Mari,
Fabrizio Petrucci, Domenico Riondino,
Elia Stanescu, Carlo Venettacci**

JUNO ITALIA Meeting

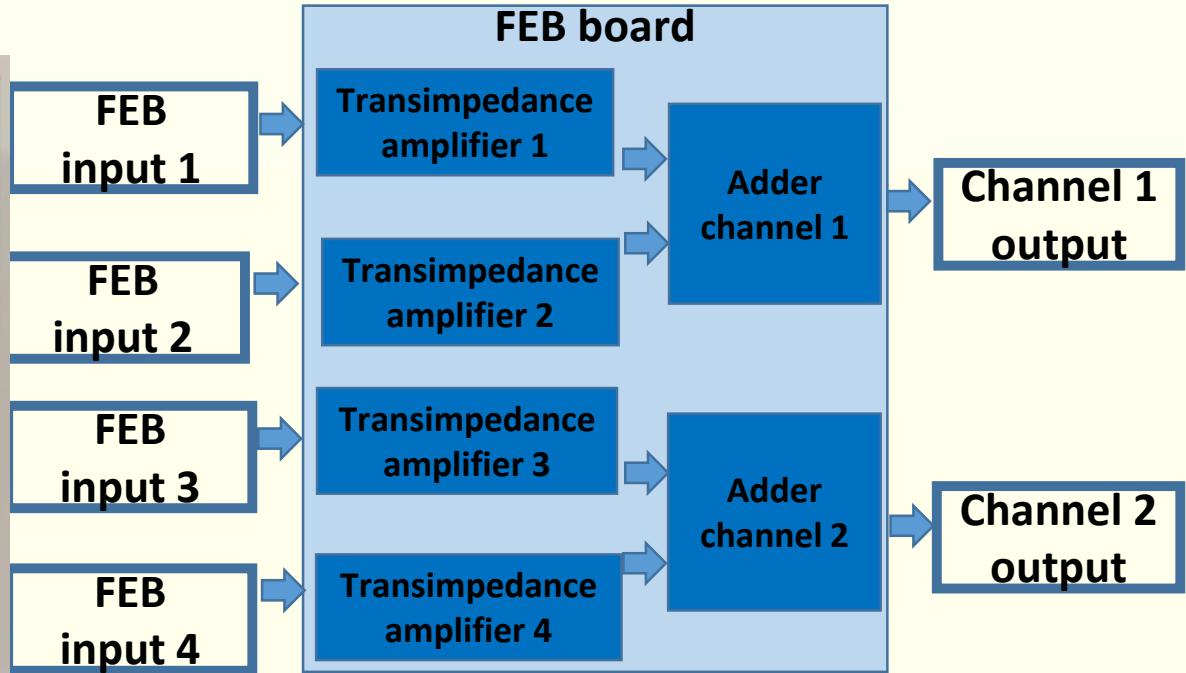
28/3/2023



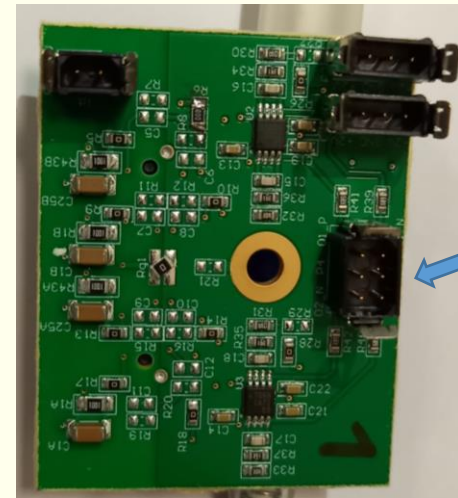
The FEB (Front End Board) boards will be paired to the SiPMs tiles and hosted on the copper shell inside the JUNO-TAO cryostat. They will amplify the charge signal from the SiPMs, convert it in a voltage signal and send it to the FEC (Front End Controller).



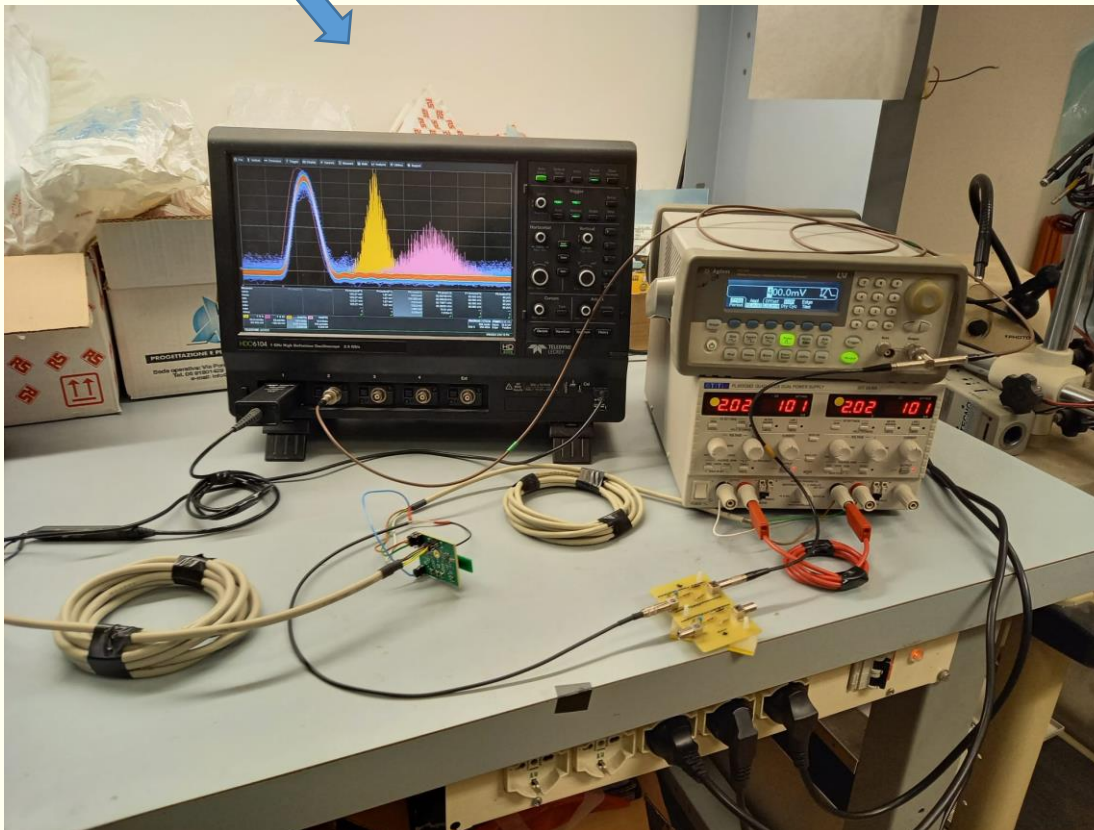
- 1 FEB for each tile.
- 2 channels for each FEB.
- 4024 tiles/8048 channels.
- Analog signals from FEB will be transferred to FEC via differential pairs, 3-4 m inside the SS tank, and then about 10 m outside the tank.



- SiPM elements (4x4 array) of each tile are splitted in 4 Transimpedance Amplifier (TIA).
- Each TIA reads out 4 SiPM elements.
- Two gain stages (TIA + Adder) reduces TIA instability.
- 2 Vpp output dynamic
- Dynamic range 1-250 photoelectrons
- Low background PCB
- It works at -50°C



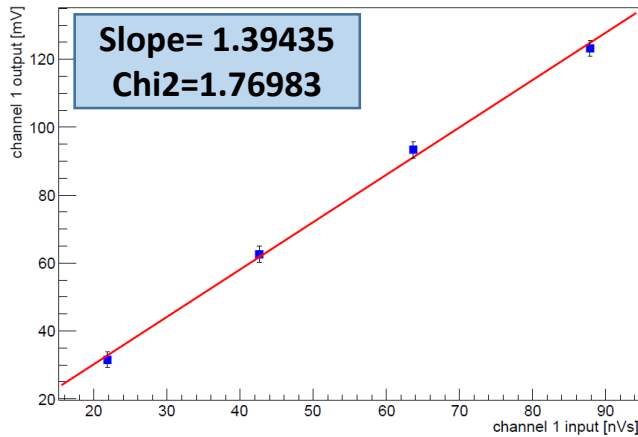
- ✓ Power/ground lines and FEB output lines decoupling is checked to prevent from short circuit.
- ✓ Power supply test is done, i.e. check that the current is about 100 mA for both voltages +2V and -2V.
- ✓ Pulser tests are done for all the 4 FEB inputs.



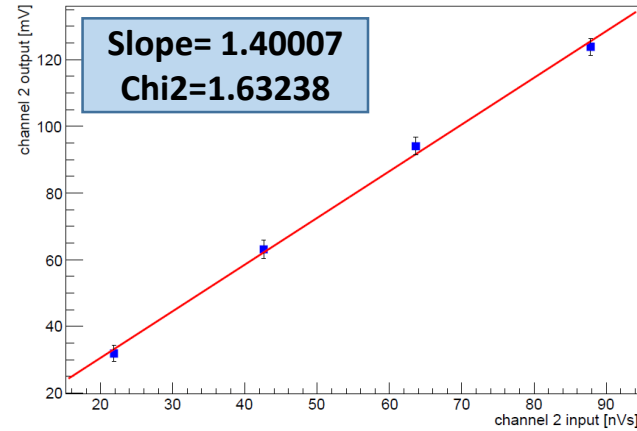
- ✓ The voltage signal sourced by the pulser is sent both to the oscilloscope and to an adapter board, that does the signal voltage-to-charge conversion.
- ✓ The charge signal provided by the adapter board is then amplified by the FEB board and the differential output signal is sent to the oscilloscope by means of an active probe.

- 93 FEB tested
- FEB max output voltage vs integral input voltage is plotted
- For each FEB linearity plots are produced for 4 channels

FEB ch.1

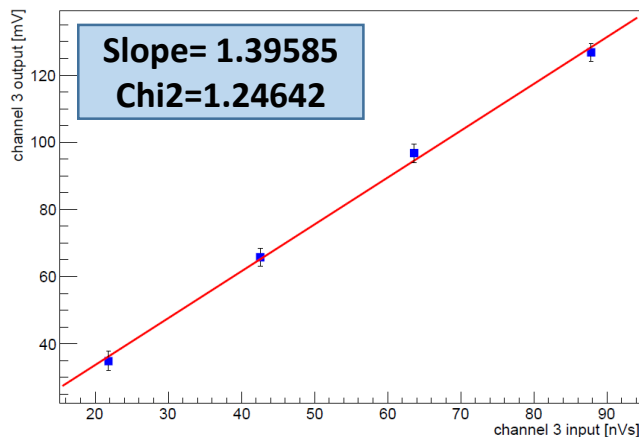


FEB ch.2

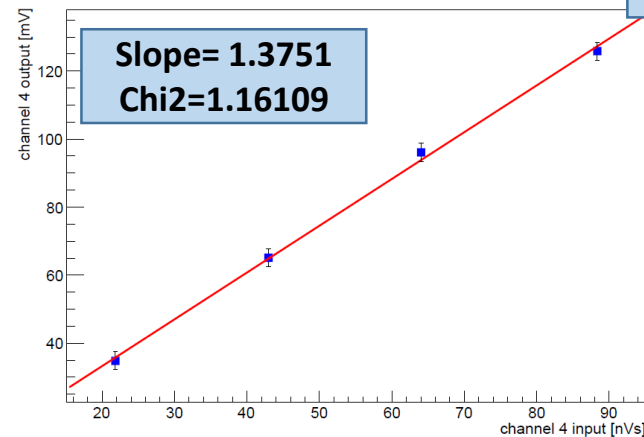


From each plot slope and chi2 are calculated

FEB ch.3



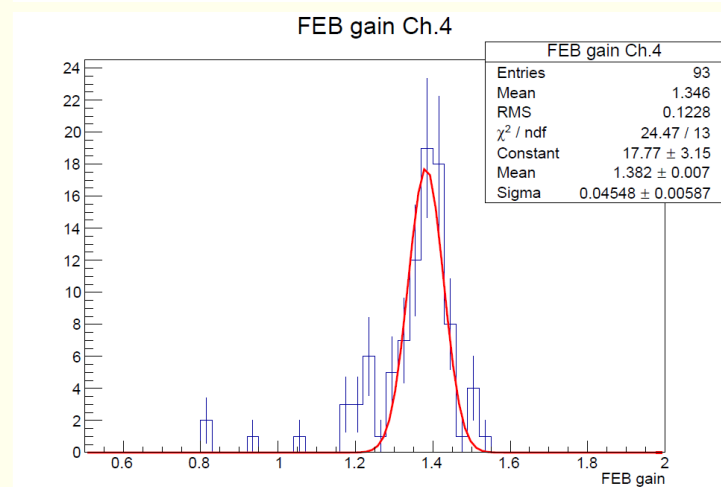
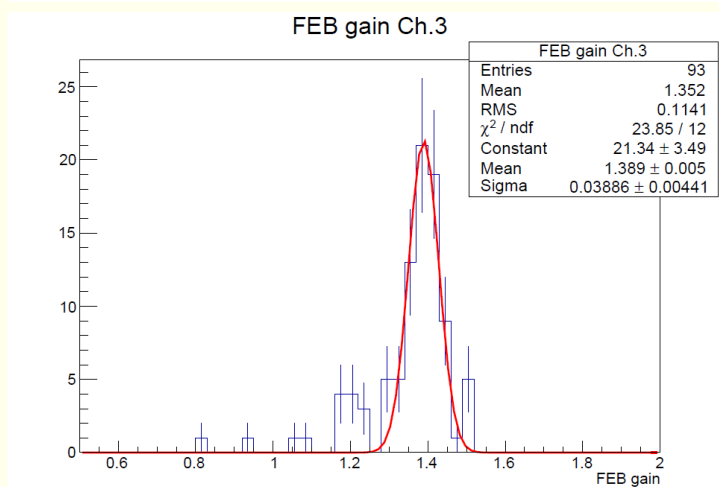
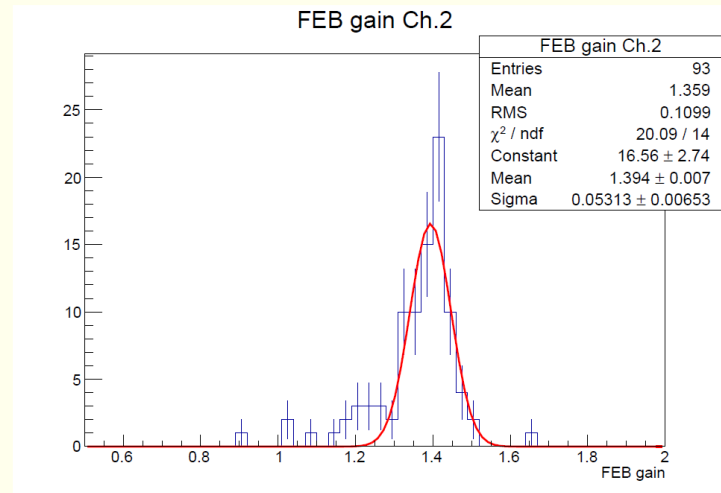
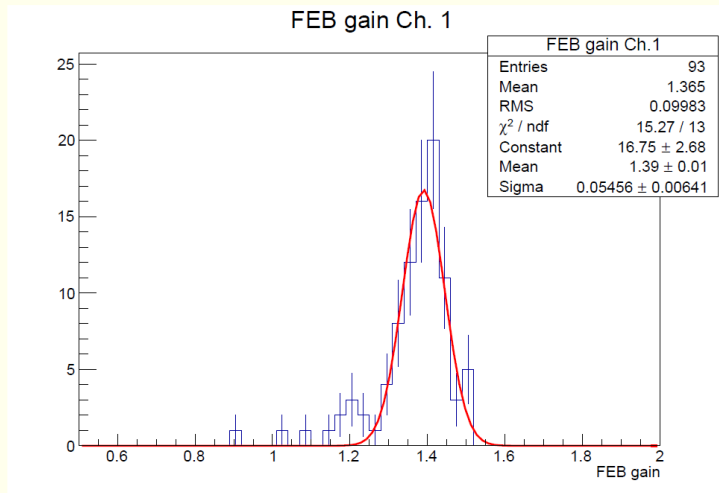
FEB ch.4



FEB Id 28

FEB range from ~5 to ~30 photoelectron is tested

- Gain distribution of 93 FEB boards is plotted for the 4 channels
- Width values are about 4%



- ✓ 50 FEB boards already sent in China to the experiment site.
- ✓ We are completing the test for the remaining 7 boards, in order to have all the 100 preproduction boards fully tested.
- ✓ We are developing an automatic test procedure in order to test all the production FEB boards (about 4050 boards). A very simple and fast system can be implemented to test and characterize FEBs with a simple microcontroller.
- ✓ A FEB Tester board was already designed by our group, in order to perform this kind of automatic test. Gerber file was sent to the manufacturer.

