Summary

In the proposed work, a careful approach to the front-end electronics design has shown to be critical in order to fully keep the exceptional performances of the SiPMs in terms of single photon detection, dynamic range and fast timing properties. At the moment 100 preproduction batch is ready and tested with an ultra-low background construction material in order to be used in rare event searches. A complete test report about the performance of the preproduction batch at room temperature and at -50° will be presented, showing the solution taken to ensure an high stability and reproducibility of the results.

Fig. 1 – Front and back side of the proposed Front End Board

The board dimensions, showed in Fig.1 is 5cm x 3cm, so it can be perfectly arranged behind a 5cm x 5cm SiPM tile. Different shapes were already tested showing the same performances.

The proposed Front End Board has two separate channels and it has been tested with many SiPM-based photodetector multi-pixel photon counter (MPPC) available on the market from different vendors, from temperatures down to -70° and up to +80°, showing excellent performances and a mean time between failure of 9*10^6 hours, due to reduced component numbers and the accurate selection of the passive part number.

Figure 2 shows the finger board obtained at -50° for different over voltage from a 5 cm x 5 cm SiPM tile from Hamamatsu.

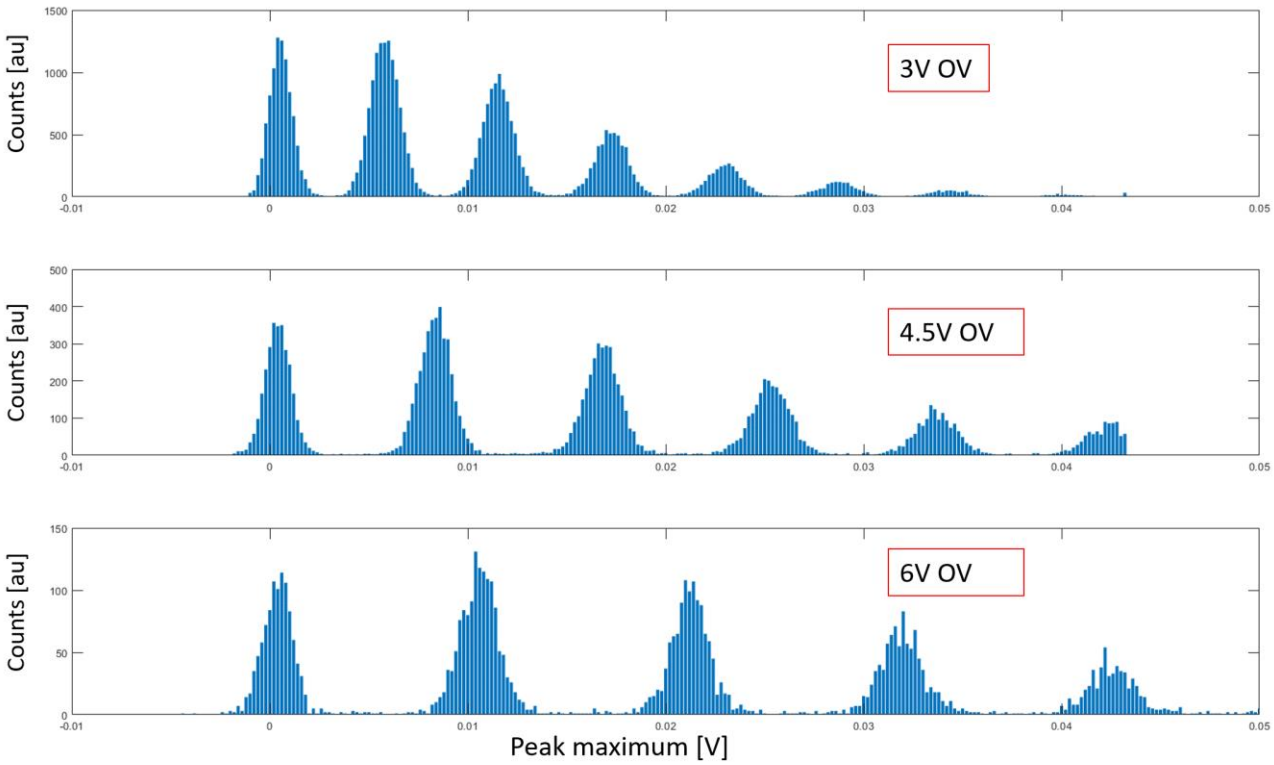

Fig. 2 – Finger plot from a 5 cm x 5 cm SiPM tile coupled to the proposed Front End Board.

The nanosecond timing properties make them suitable to work with the typical mixtures of liquid scintillators currently used in particle and astroparticle physics experiments. FEB can read from few squared millimeter SiPM, ensuring a very high timing resolution, up to several squared centimeter by the use of passive gangling. Moreover, by changing the shaping time and the gain factor by changing two resistor, the board can be coupled even with plastic scintillators.

The JUNO-TAO experiment will need more than 8000 channels (by the use of 4000 FEB) to ensure the proposed energy resolution (<1.5% @ 1 MeV), spatial resolution (around 1 cm) and timing performances (around 1 ns).