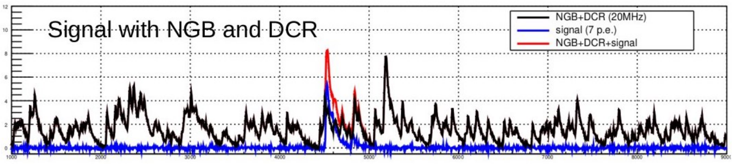

Figure 14: Signal with NGB and DCR

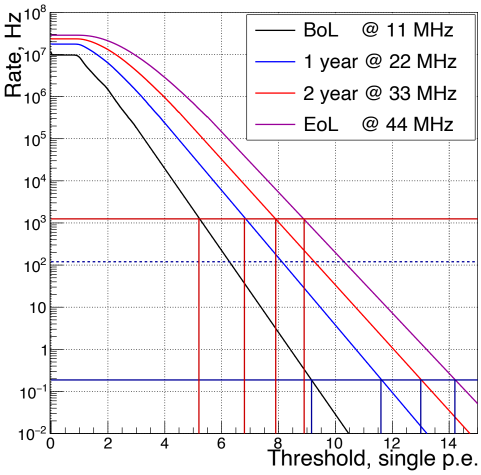

Figure 15: Single pixel trigger rate as a function of the threshold expressed in p.e. for DCR + NGB values estimated at different times during the mission life. The horizontal blue dashed line corresponds to the maximum trigger rate of (120 Hz). Horizontal blue line corresponds to the maximum single pixel trigger rate (120 Hz/640 ∼ 0.18 Hz per pixel). The horizontal red line corresponds to 1250 Hz (maximum single pixel rate for configuration with two pixels cluster). The vertical lines shows thresholds for single (blue) and double coincidence (red) trigger logic. Thresholds can be reconfigured during flight.

ble pixel, to the single point failure of a frozen combinatorial logic in the ASIC. This monitor has to operate constantly over mission duration. The monitor will deliver the rate at a given threshold for each pixel. The estimated monitoring data size, running at 1 Hz, is about 1-2% of the event data rate. Hopefully, this method will allow to discriminate the human-induced or meteorological spurious background also through correlations with meteo-maps.

5.3 Validation of the trigger through simulation

The parametric waveform simulation was used also to understand the requirements of the sensor and also where to set the trigger thresholds of the two configurations in order to satisfy the total data throughput limit of 45 Gbit/d. We simulate waveforms for a time frame of 10^7 ns for different NGB+DCR conditions. Counting the numbers of peaks below a given threshold divided by the simulated time frame, we can estimate the trigger rates (see Fig. 15). For the results shown here, we assume the variable NGB during mission lifetime described in Sec. 5 and a cross-talk of sensors of 6.6% and DCR of 77 kHz/mm^2, as expected for NUV-HD-MT.

For the single pixel trigger, which requires crossing the threshold in a single pixel, the threshold will have to be increased during the lifetime of the mission due to the increasing radiation damage as discussed in Sec. 2. To satisfy the data throughput requirement, the threshold has to be set at the levels of: 9.2 p.e., 11.7 p.e, 13.1 p.e., 14.3 p.e (blue horizontal line), correspondingly at BoL, after the first year, after the second year, at EoL, respectively.

The number of possible pixel configurations which form a two-pixel cluster (see Fig. 16) in a single ASIC of 64 channels is equal to 210 or 2100 in the full camera. The number of all possible two-pixel configurations in a single ASIC is given by the $n-k$ combination equation:

$$\left.\frac{n!}{k!(n-k)!}\right|_{k=2}^{n=64}, \tag{3}$$

which yields a total of 2016 combinations per ASIC or 20160 in the full camera. Considering the single pixel rate R_1 and the already defined concidence window τ, the coincidence rate for clusters in the full camera is computed as follows:

$$2 \times R_1^2 \times \tau \times 2100. \tag{4}$$

On the other hand, the coincidence rate for every possible combination of two pixels firing per ASIC in the full camera is:

$$2 \times R_1^2 \times \tau \times 20160. \tag{5}$$

The maximum single pixel rate for the coincidence configuration that can be afforded, given the data transmission rate, is therefore 1250 Hz (with fixed size of the readout pad - 9 pixels). Hence, from Fig. 15 (red horizontal line) we define the low threshold (in p.e.) for the considered different epochs of the mission as 5.2, 6.8, 7.8, 8.8 p.e. for BoL, after the first year, after the second year, and at EoL, respectively.

Processing two random pixel coincidences will amount to a total of 250 μs per second, while processing the 240 Hz expected trigger rate from single and two pixels configurations will reach ~7.4 ms which corresponds to a dead time below 1%.

6 Conclusions

Terzina is a pathfinder mission to demonstrate Cherenkov detection from a space platform of middle size enabling the possibility to perform neutrino astronomy from space