



The Carpet-3 EAS array: a current status

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for the Carpet-3 Collaboration



Abstract

The Carpet-3 extensive air shower array (EAS) is now under construction at the Baksan Neutrino Observatory (43°16'37.2"N 42°41'24.0"E and 1700 meter above sea level). The array is located at an altitude 1700 meters above sea level, and it consists of surface detection stations, situated close to each other for best sensitivity to extensive air showers with lower energy, and of an underground muon detector with a continuous area of 410 m². The energy threshold for vertical muons is 1 GeV. The main aim of the array is to study the primary gamma radiation with energy above 100 TeV. The design of the Carpet-3 EAS array gives a possibility to carry out research on the composition of primary cosmic rays around the knee. It is planned that the Carpet-3 EAS array will be in full operation by the end of 2021.



DAQ System of Surface array

- (A) Crate controller
- (B-E) Caen CFD V816 (x4).
- (F) Caen TDC V1190 (x1)
- (G-I) Caen ADC V1742 (x3)
- and will be updated in the future

The surface array will consist of 39 new detectors, 5 old detectors, and 25 Carpet's modules. As shown in figure 1. The block diagram of the Carpet-3 EAS array data acquisition system is shown in figure 3, left. The analog signal from all detectors comes to the analog-to-digital converter (ADC) for the calculation of energy release in the detector also to the constant fraction discriminator (CFD) to fix the time of arrival of the signal. Signals from the CFD are sent to the time-to-digital converter (TDC) to measure the arrival time of the event. The trigger is generated using an FPGA based on signals from the CFD.

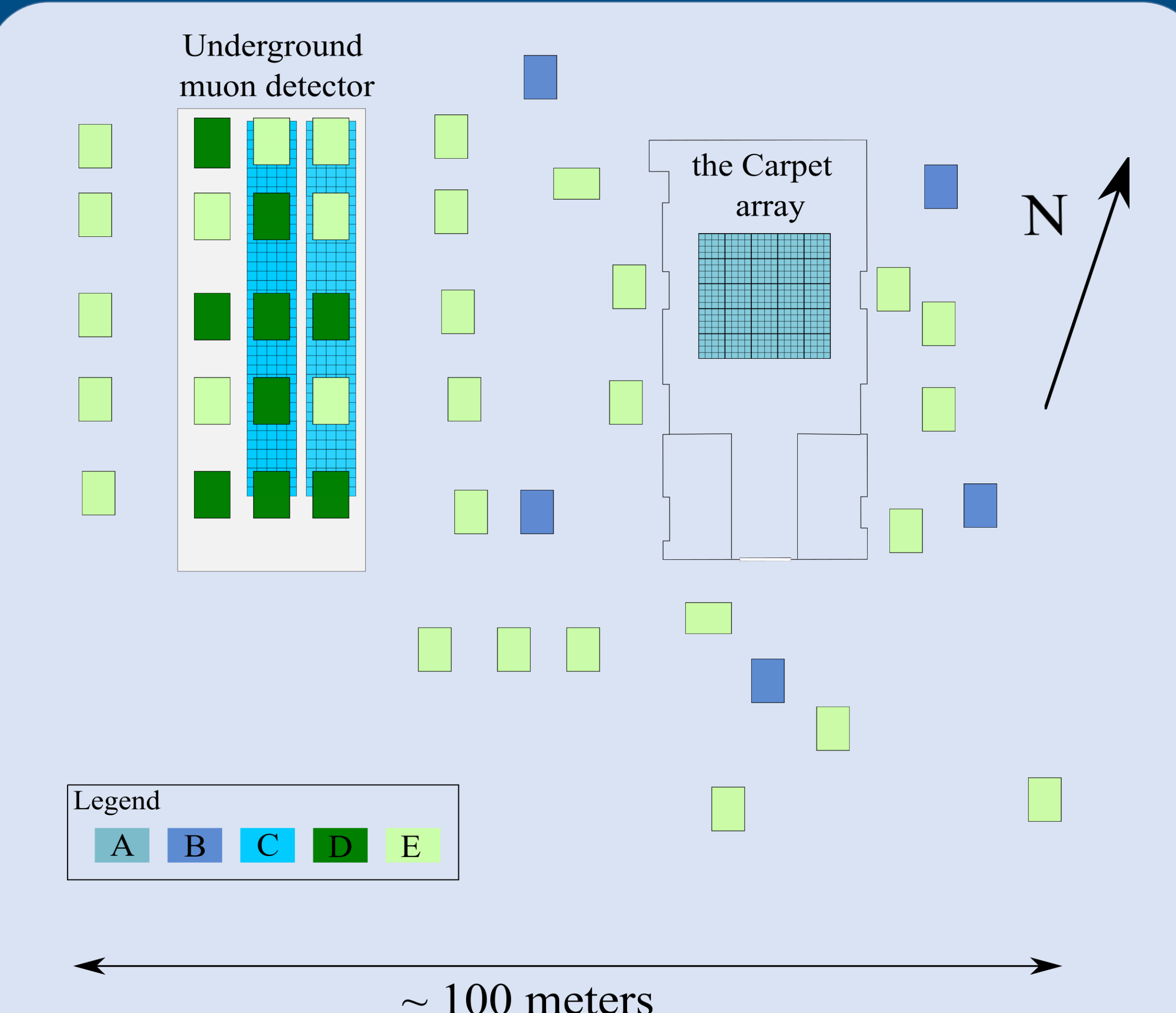
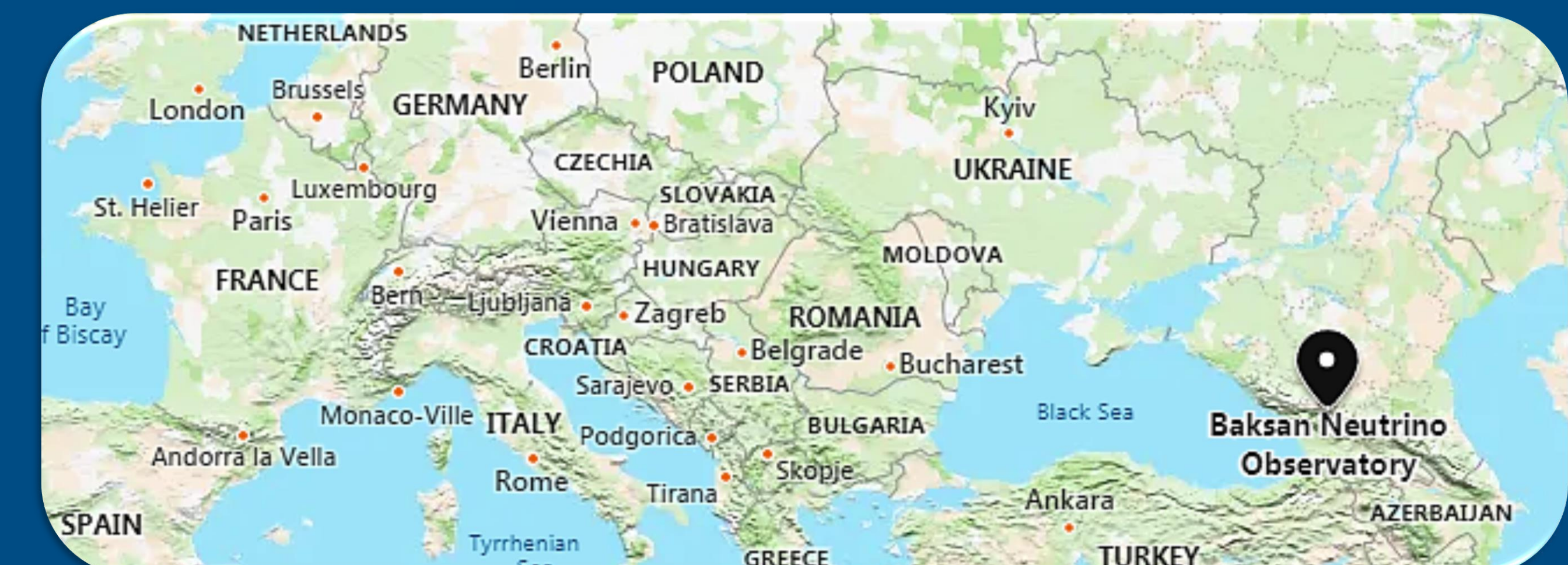
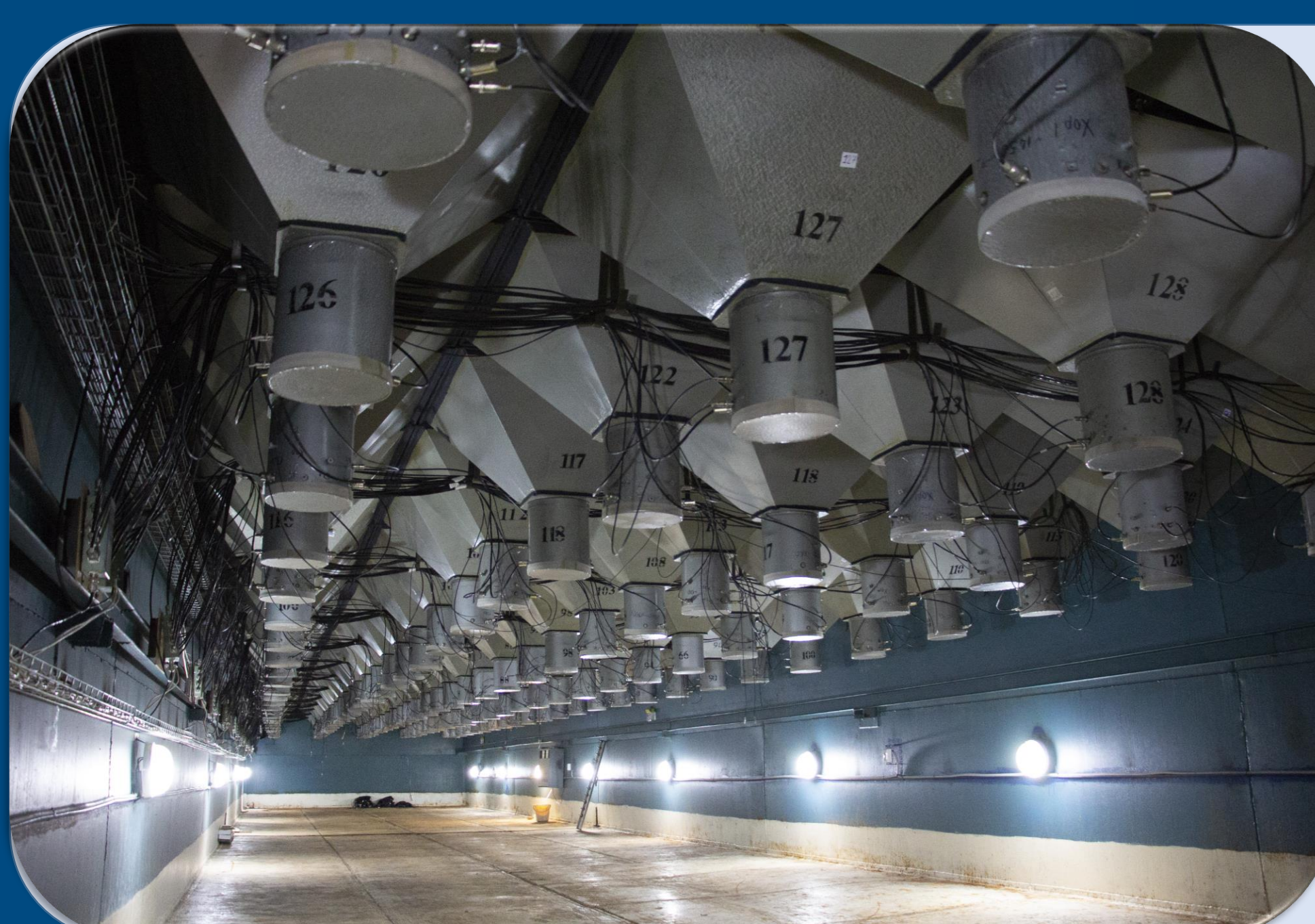
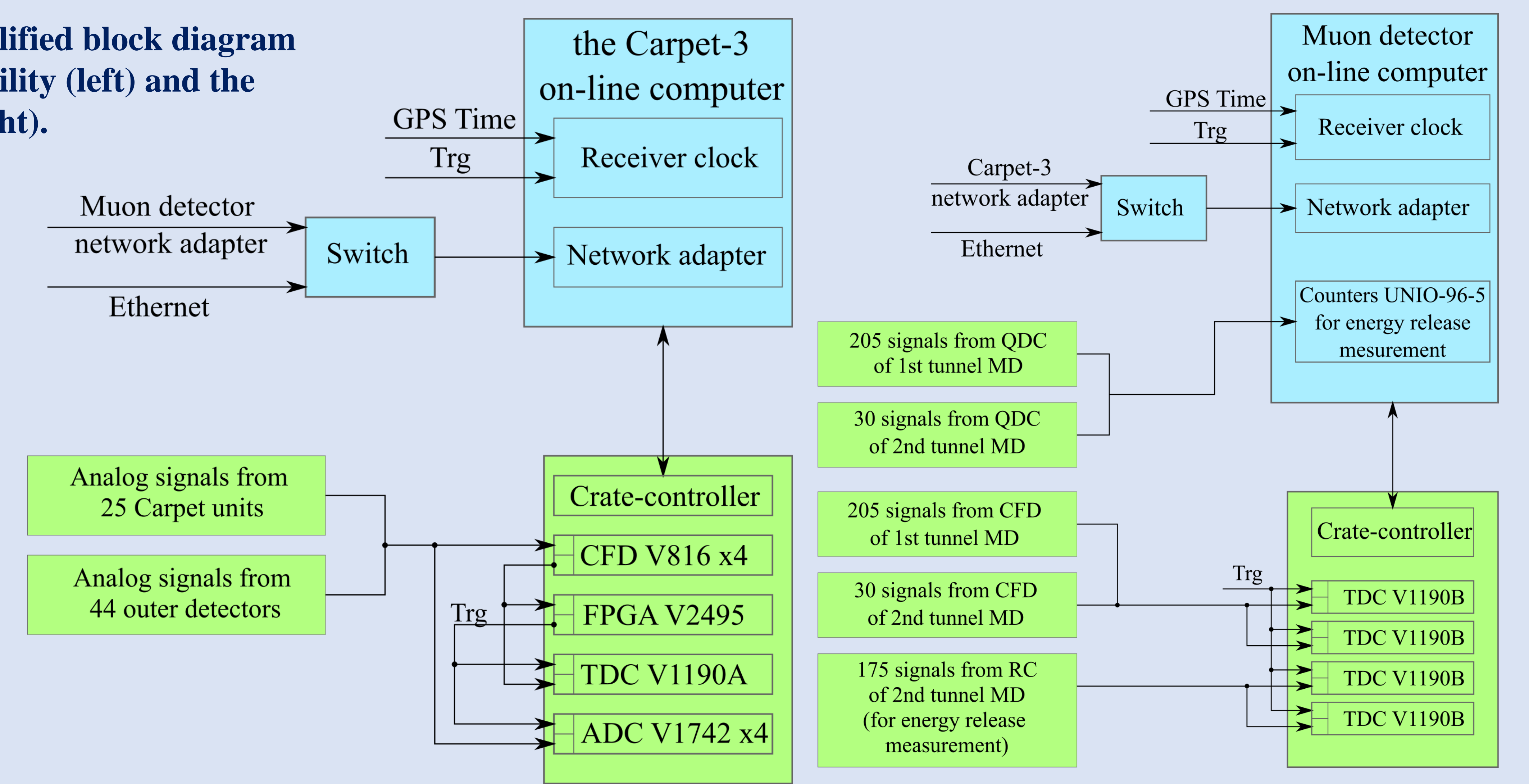


Figure 1. General scheme of the Carpet-3 facility.
(A) The Carpet array: 400 liquid scintillator (196 m²)
(B) 5 ground detector with 18 liquid scintillator (~9 m²) in each
(C) Underground muon detector: 410 plastic scintillators (410 m²)
New ground-based detectors, 9 plastic scintillators (9 m²) in each
(D) Ready to operate
(E) Detectors without plastic scintillators. Will be installed during 2021

Figure 3. The simplified block diagram of the Carpet-3 facility (left) and the muon detector (right).



The underground Muon Detector (MD), 410 m², 1 GeV threshold

Consists of two tunnels with dimensions 41x5 meters. It fills with standard plastic scintillation counters (Figure 2, right). 235 counters are equipped with the new electronics other 175 counters are equipped with old electronics (MD of the Carpet-2 EAS array) which will be upgraded in the future. New counters are using the constant fraction discriminator (CFD) to fix the time of arrival of the event and after to fed to the TDC for the measurements. The logarithmic converter of charge to the sequence of logic pulses (QDC) for measuring energy deposition in each counter. 175 counters are using the logarithmic resistor-capacitor (RC) module that converts the charge of the analog pulse to a logic signal of variable duration, where the charge is proportional to its duration and after to fed to the TDC for the measurements. The block diagram is shown in Figure 3 on the right.

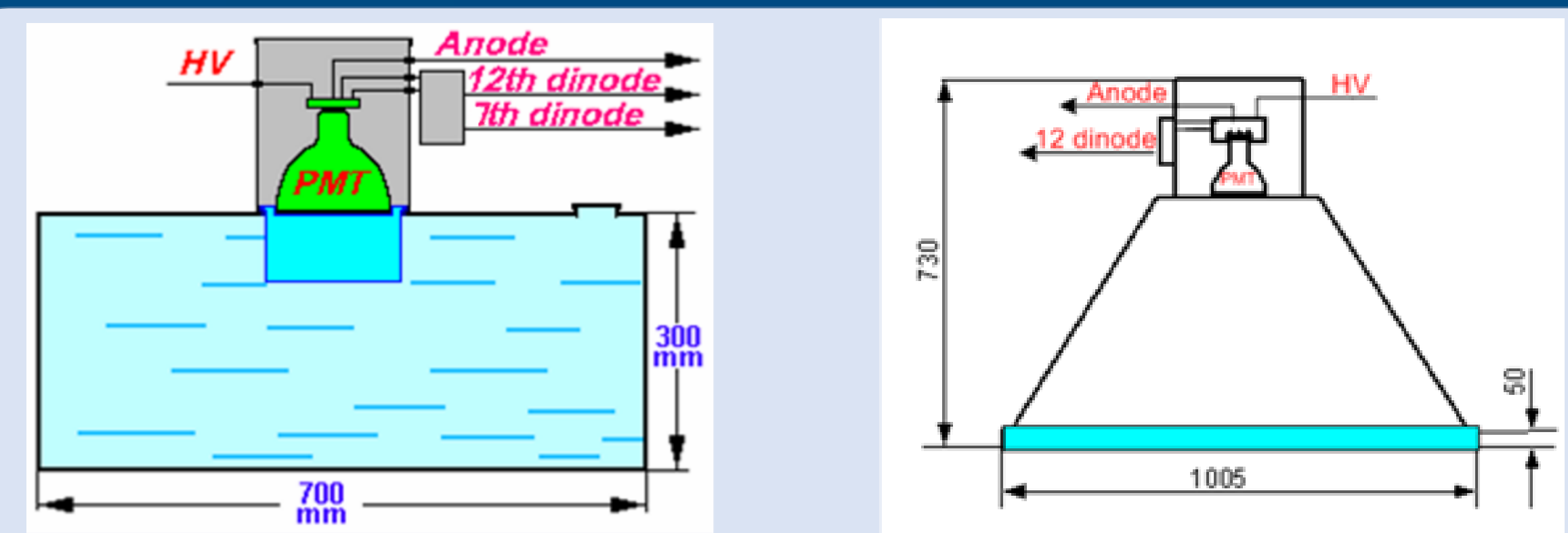


Figure 2. Scheme of a liquid scintillator (left) and a plastic scintillator counter (right).

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