ARRANGEMENT OF THE GELATICA NETWORK

The CELATICA network is arranged as a set of independent Cosmic Ray (CR) stations timed with the Global Positioning System (GPS). The scientific problems suggested to be solved by the network are described in the part «GELATICA PHYSICAL PROBLEM». Global disposition of CR stations operating now in Georgia is shown in the part «GELATICA DISPOSITION».

Every station detects the Extensive Air Shower (EAS) events and logs out both the universal coordinated time (UTC) of EAS front passage and the shower's arrival direction. The Global Positioning System allows EAS front passage timing with accuracy of 1μs UTC, while the EAS goniometer system measures the local arrival direction of the shower with average error of 3°. The method of the shower's arrival direction estimation used is briefly outlined in the part «GELATICA TECHNIQUE».

Each of network's station is provided with the same set of equipment: four counters, i.e. square blocks of scintillator with appropriate photo-multiplier tubes (PMT), two high voltage supplies and a data acquisition (DAQ) card with a GPS unit (**figure 1**) connected with local PC.

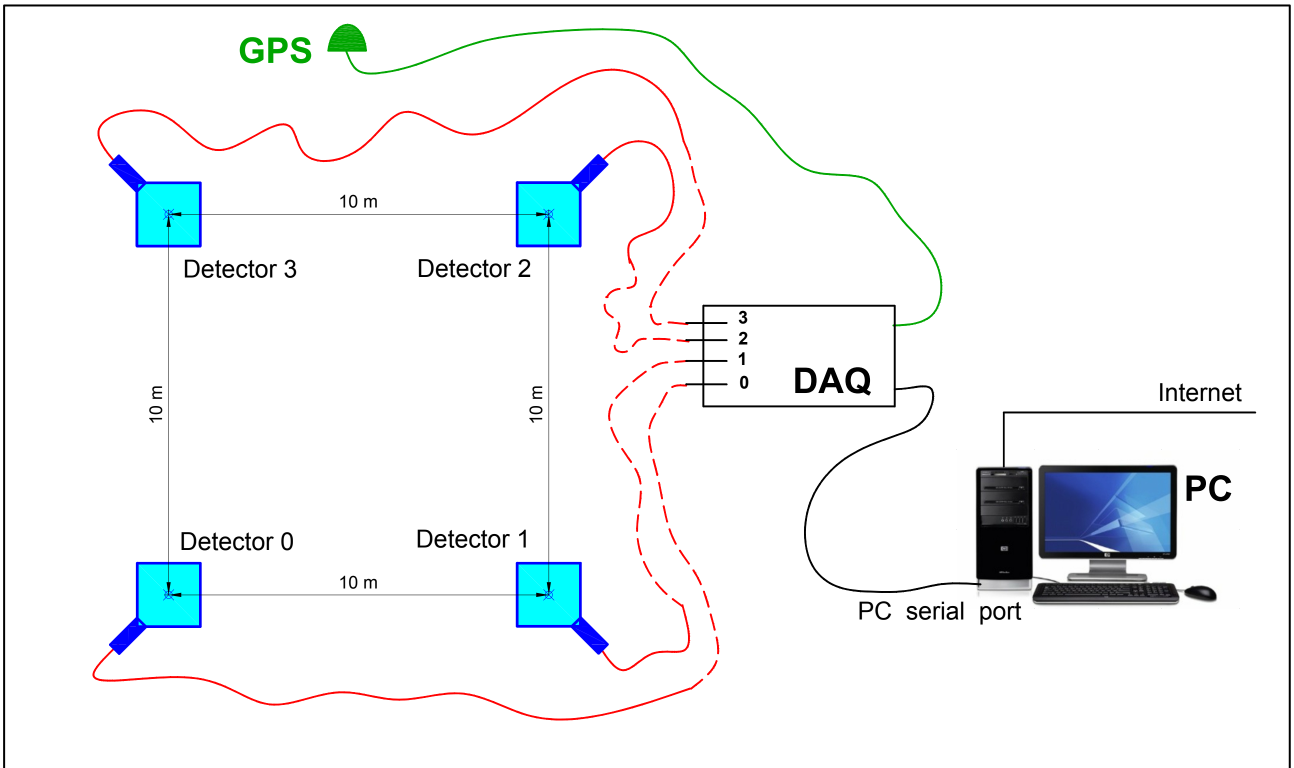

Figure 1. The hookup of a local station. All signal cables from all counters have equal lengths.

Each piece of scintillator block has an area of (50×50) cm^2. Two types of scintillator detector arrangement are used: a "flat" detector (**figure 2**) and "pyramidal" one (**figure 3**).

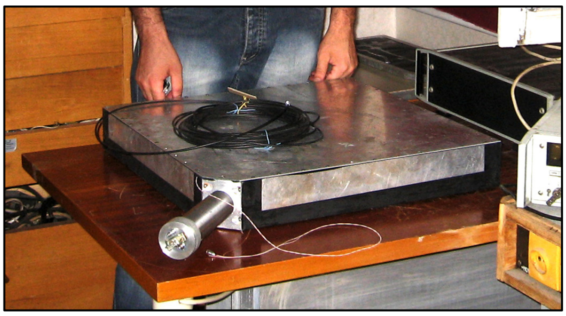

Figure 2. "Flat" detector example

Figure 3. "Pyramidal" detectors' set

Equipment

The PMT pulses are read out by DAQ card, shown in the **figure 4**. It is designed and developed in Fermilab and the University of Nebraska (USA) with support of QuarkNet.

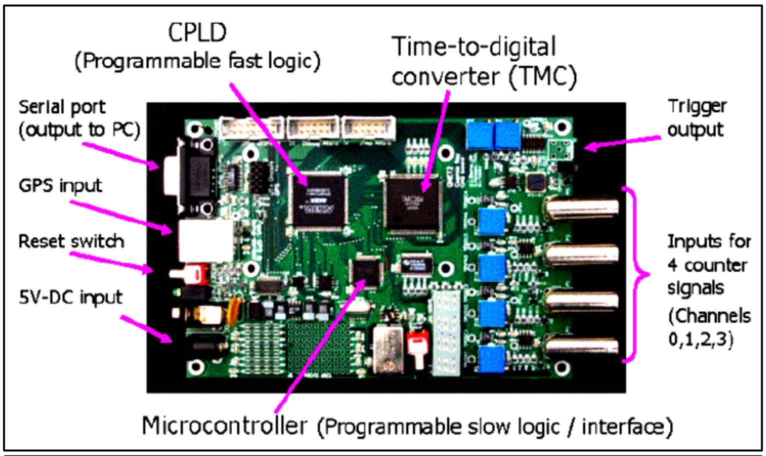

Figure 4 Layout of DAQ Board (Qnet II) with major components labeled

For this setup, the DAQ board takes the signals from the scintillator detectors and provides signal processing and logic basic for a grate variety of nuclear and particle physics experiments. The DAQ board can analyze signals from up to four PMTs. The user can select none, 2, 3, or 4-fold coincidence and also select the effective gate width from 48 ns to 50 μs, based on the fundamental clock cycle of 40 ns. The board produces a record of output data whenever the PMT signal meets a pre-defined trigger criterion (for example, when two or more PMTs have signals above some predetermined threshold voltage, within a chosen time window). The output data record, which can be sent via a standard RS-232 serial interface to any PC, contains information about the PMT signals, including a number of channels with signals exceeding the threshold, their relative arrival times (with the time slicing step equal to $\tau = 1.25$ ns), and the onset and termination times for each detected pulse. In addition, a remote GPS receiver module provides the absolute UTC time of each trigger, accurate within 1 μs interval. This allows several separate counter arrays using the DAQ cards to correlate their timing data.

The GPS receiver sends two types of data streams to the board. The first is RS-232 ASCII data telling what time it is, at what latitude, longitude and altitude the receiver is, and information about the satellites the receiver is using. The other data is a 5V & 100ms pulse telling exactly when the data is true. Each stream of 5V & 100ms pulses arrives every second, thus the 5V pulse is named 1 pulse per second (1PPS). The microcontroller on the board records the counter value during which the pulse is received. The UTC is taking according to a counter running at 25 MHz frequency

Commands can be sent to the board to allow users to define trigger criteria, select various options, and retrieve additional data, such as counting rates, auxiliary GPS data, and environmental (temperature and barometric pressure) sensors data, in addition to the trigger and PMT pulse information.

The card can be operated with a variety of software: a basic serial port terminal, a LabView interface for Windows, and a command-line interface on Linux. The view of the complete measuring and recording facility used is shown in the **figure 5**.

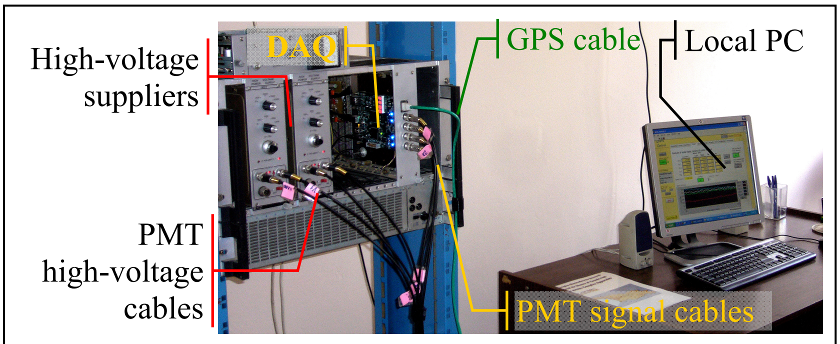

Figure 5 The view of the complete measuring and recording facility with major components labeled