

INTENSE Meeting Naples Secondment Update

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- ▶ **Institute** : TECNO IN, Naples, Italy
(Guilio Saracino's team at University of Naples Federico II)
- ▶ **Duration** : 8 days (Sept. 30 – Oct. 08, 2019)

Objectives

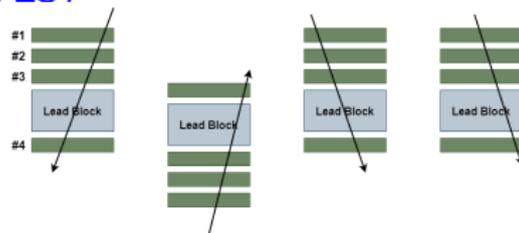
- 1 To get familiar with MURAVES setup and detectors
- 2 To get hands-on experience with the instrumentation and hardware
- 3 To get started with the time of flight (tof) analysis with the help of Naples group

Objective (1/3)

MUon Radiography of **VES**uvius (MURAVES)

MURAVES Detector

- ▶ Consists of **three** identical telescopes
- ▶ Each telescope is composed of four x-y layers of scintillators, with each individual plane containing 64 channels in total
- ▶ 4 available slots (3 in the forward-looking and 1 in the backward-looking mode)
- ▶ Two telescopes (**Nero** and **Rosso**) already mounted at Mt. Vesuvius and are taking data
- ▶ Third telescope (**Blu**) going through final tests and to be mounted soon after the completion of characterization studies of electronic boards



Schematic representation of four available slots



One of the MURAVES telescopes in forward-looking mode for Mt. Vesuvius data-taking.

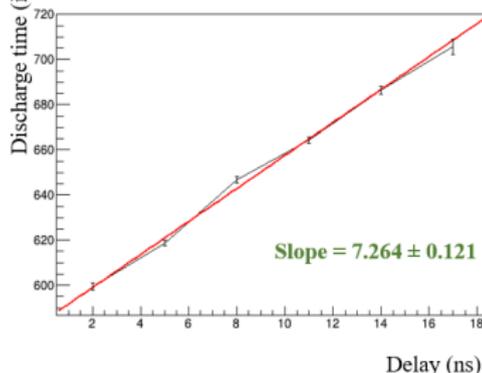
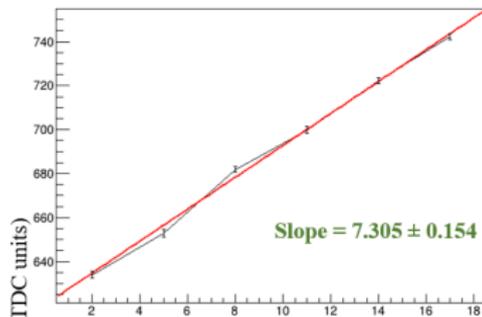
Objective (2/3)

Time Expansion Characterization of the boards for **Blu** telescope

- ▶ Each plane consists of two electronic boards (slave) handling 32 channels each
- ▶ Each layer consists of two planes (x and y views) so a total of 16 electronic boards
- ▶ Due to incorrect capacitance being used, the boards had to be refurbished and their time expansion (E) characterization had to be performed

$$t_{discharge} = E \cdot t_{charge} \quad (1)$$

- ▶ A reference board with known time expansion characteristics and a master board were used to perform this study
- ▶ Stop trigger given by the master board
- ▶ Delays (correlated to the t_{charge}) were introduced from 2ns to 20ns and the subsequent $t_{discharge}$ were read out for each board

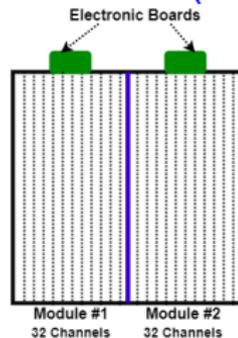


Time expansion characterization for boards 4 (top) and 13 (bottom) with the help of Luigi (Naples group).

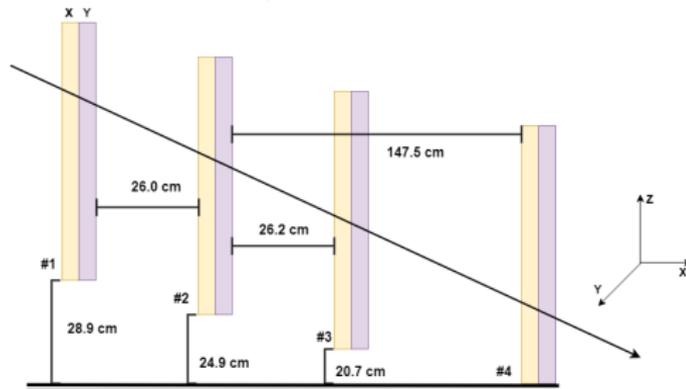
Objective (3/3)

Preliminary time of flight (tof) analysis with MURAVES (Nero) data

- ▶ Raw data replayed by Mariaelena (Naples group)
- ▶ x and y hit positions for each layer can be accessed with ntuples
- ▶ Direction information (θ and ϕ) as well as raw timing information (w/o time expansion correction) can also be accessed
- ▶ Reconstruction software takes the midpoint of the fourth layer as the reference co-ordinate system



Schematic representation of board location

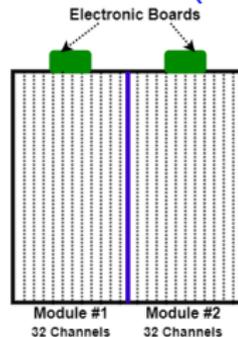


Nero telescope layout in the forward looking mode

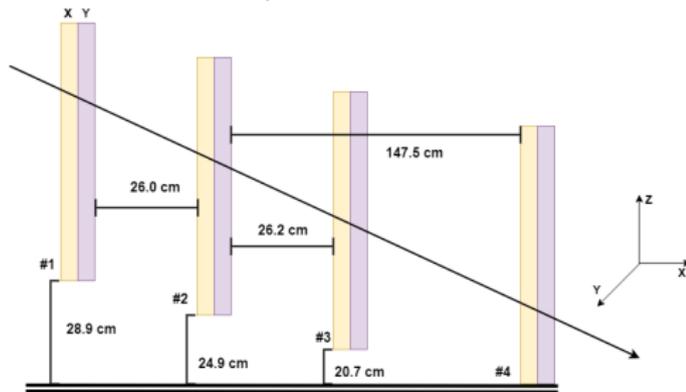
Objective (3/3)

Preliminary time of flight (tof) analysis with MURAVES (Nero) data

- ▶ First raw TDC timing information had to be converted to actual time
- ▶ To do so, the board that took the data had to be determined using the hit location and relevant time expansion factor had to be used
- ▶ Using speed of light in WLS fiber and the distance travelled, time taken for signal to reach to the board was calculated
- ▶ The difference between the two across two different layers gives an estimate of time of flight



Schematic representation of board location



Nero telescope layout in the forward looking mode

Objective (3/3)

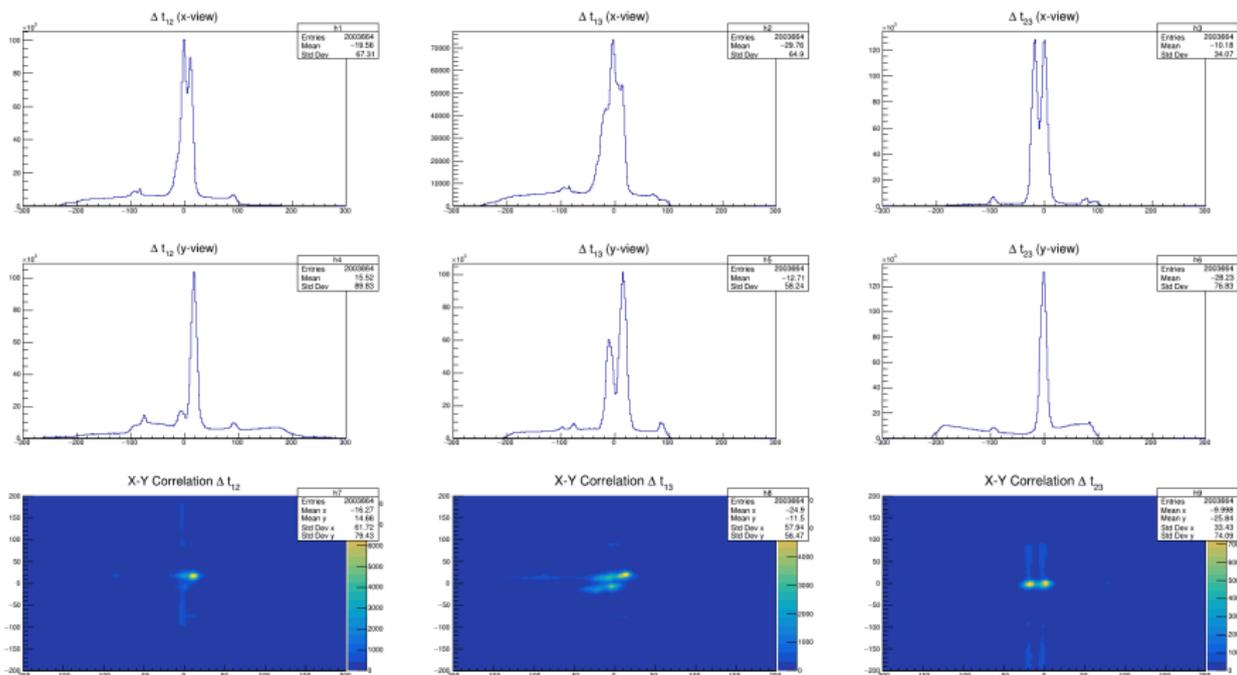


Figure: Time of flight (ToF) comparison between X and Y views between layers 1 and 2; layers 1 and 3; and layers 2 and 3.

To do : Compare these tof results with the expected tof, which can be calculated using θ and ϕ , and the distance between layers

Summary

- ▶ Secondment with TECNO IN, Naples in collaboration with MURAVES team at University of Naples Federico II for 8 days, Sept.-Oct. 2019
- ▶ First hand experience with MURAVES detectors setup
- ▶ More general work on the time expansion characterization of the electronic boards
- ▶ On the analysis side, preliminary results on time of flight (tof) analysis for Mt. Vesuvius data from the Nero telescope
 - ▶ can be continued from Louvain-La-Neuve, Belgium
 - ▶ can also be adapted to other TECNO IN detectors
- ▶ Productive secondment overall!