Report on secondments in Naples

INTENSE MEETING

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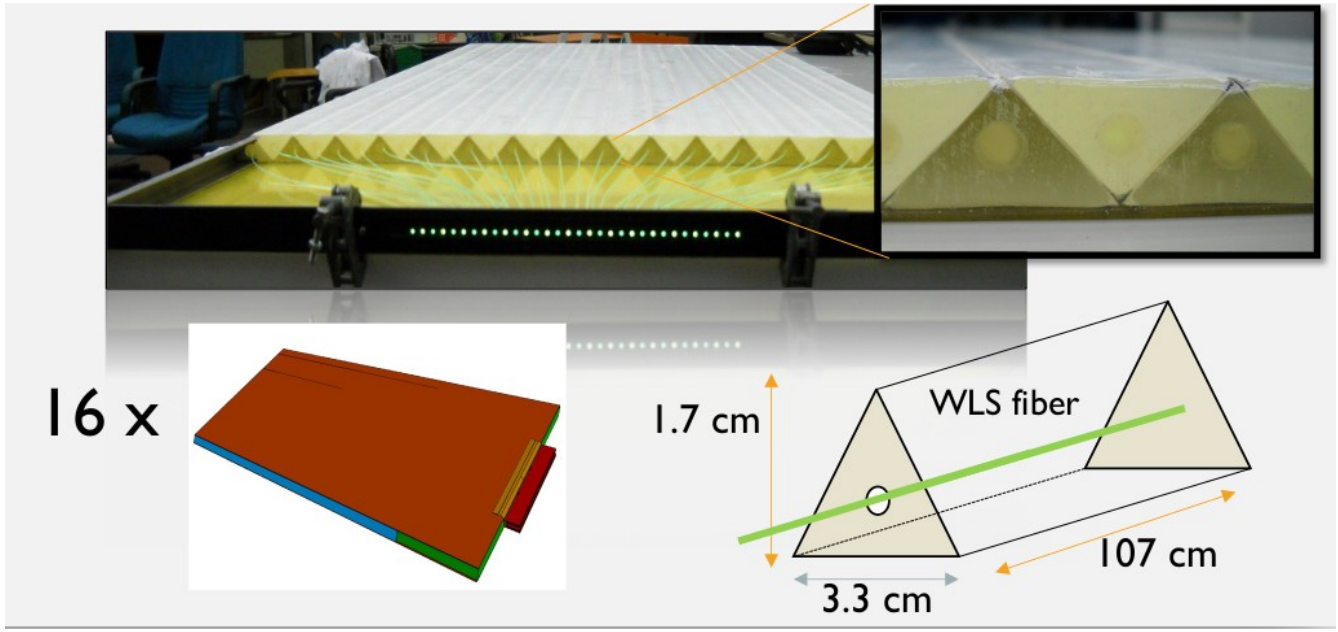
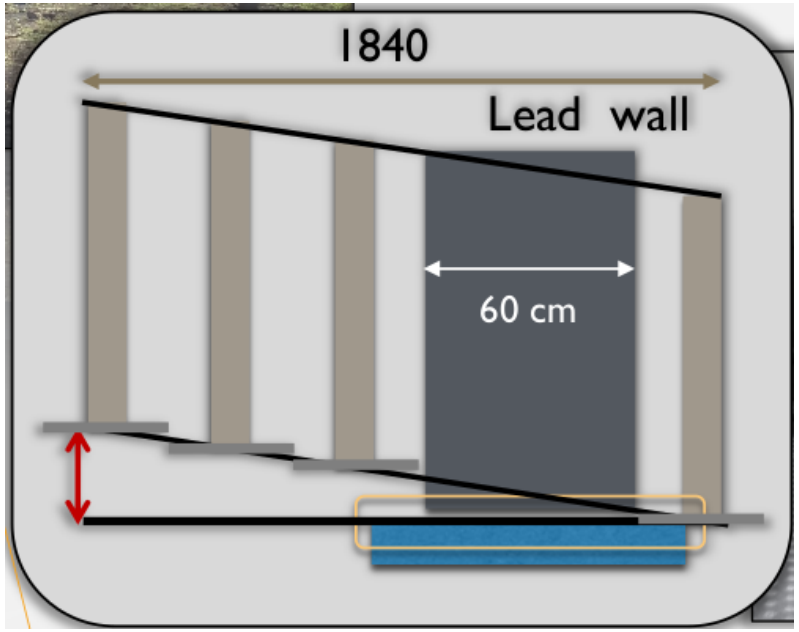
Outline

- MURAVES experiment
- First secondment
- Second secondment
- Third secondment
- Future plans
- Summary

From **UCLouvain** to **TECNO IN*** company, Naples

* In practice, work with INFN Naples team on MURAVES project (immediate motivation) **BUT** work done is also of broader interest !





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MURAVES experiment **In a nutshell**

- GOAL : Looking inside an active volcano, Mt. Vesuvius
- HOW : Muon Radiography
- WHY : Provides information on the distribution of density
- WHO : 4 main actors from the University of Naples Federico II & INFN Naples, people from INGV and from the University of Florence and **us** (UCLouvain)
- SET-UP : 3 muon trackers with 4 X-Y planes (~1m^2) based on plastic scintillators (named as ROSSO, NERO and BLU), 35 tons of lead for shielding
- STATUS : 2 telescopes installed, data acquisition ongoing & expected to last at least 1 or 2 years

First secondment (May 12->26)
Introduction to MURAVES

- Each team member presented her/his work :

  - Global presentation by team leader, Giulio Saracino

  - Data reconstruction software + online monitoring by Luca Scognamiglio

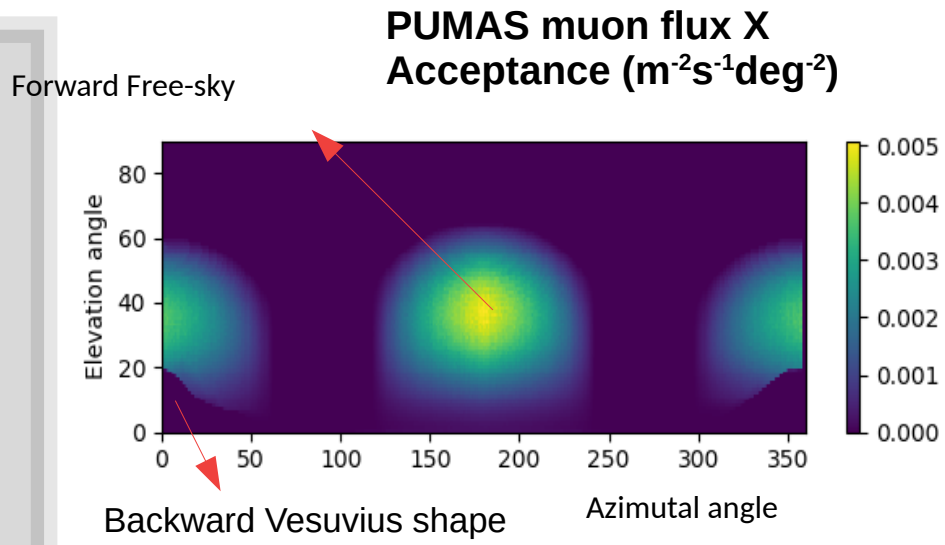
  - Simulation with PUMAS by Mariaelena D'Errico

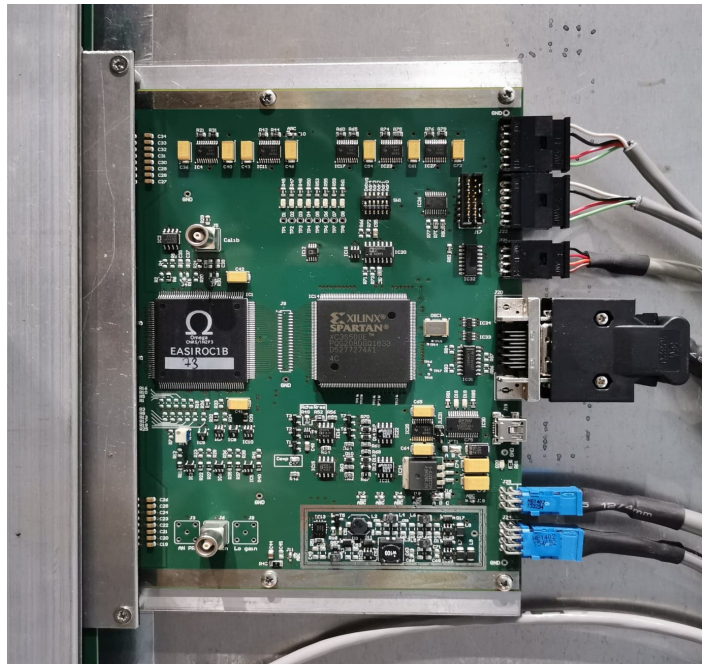
  - Hardware work by Luigi Cimmino

- Contributions :

  - Mainly focused on hardware tasks i.e electronic boards characterization

  - Simulation of the cosmic muon flux convoluted with detector acceptance (! Not yet normalized to data)





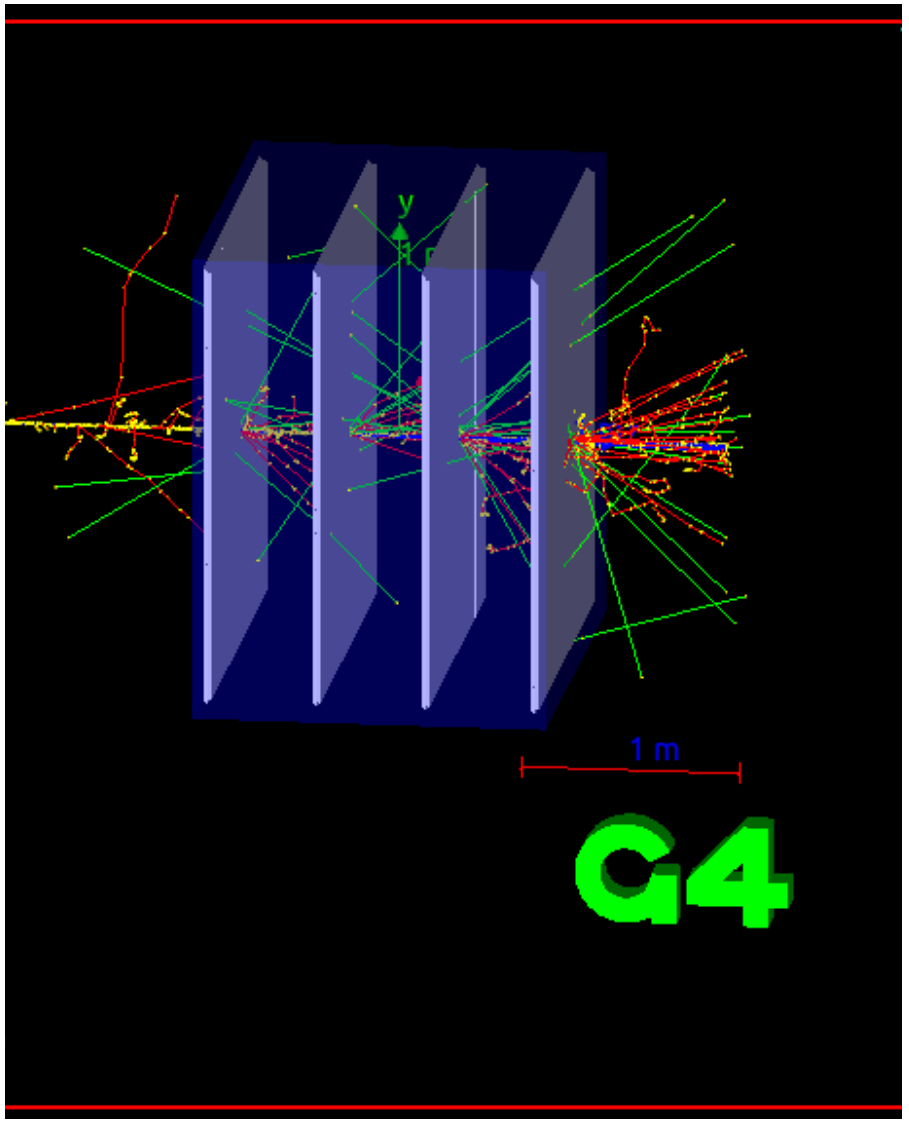
Second secondment (July 8->28)

NERO installation & time of flight study

- ROSSO already installed in free-sky position (for calibration)
- NERO finally ready to be installed after a few adjustments on boards (problem spotted with time of flight study)
- NERO installed in volcano direction

Third secondment (September 30->October 12)
Geant4 simulation (I)

- New task : Simulate MURAVES detector as close as possible to real-life detector with focus on digitization of information for efficiency and timing studies
- Software Geant4 : Toolkit for the simulation of the passage of particles through matter using Monte Carlo methods
- Inspiration from Nicola Mori's work for MuRay detector in 2013

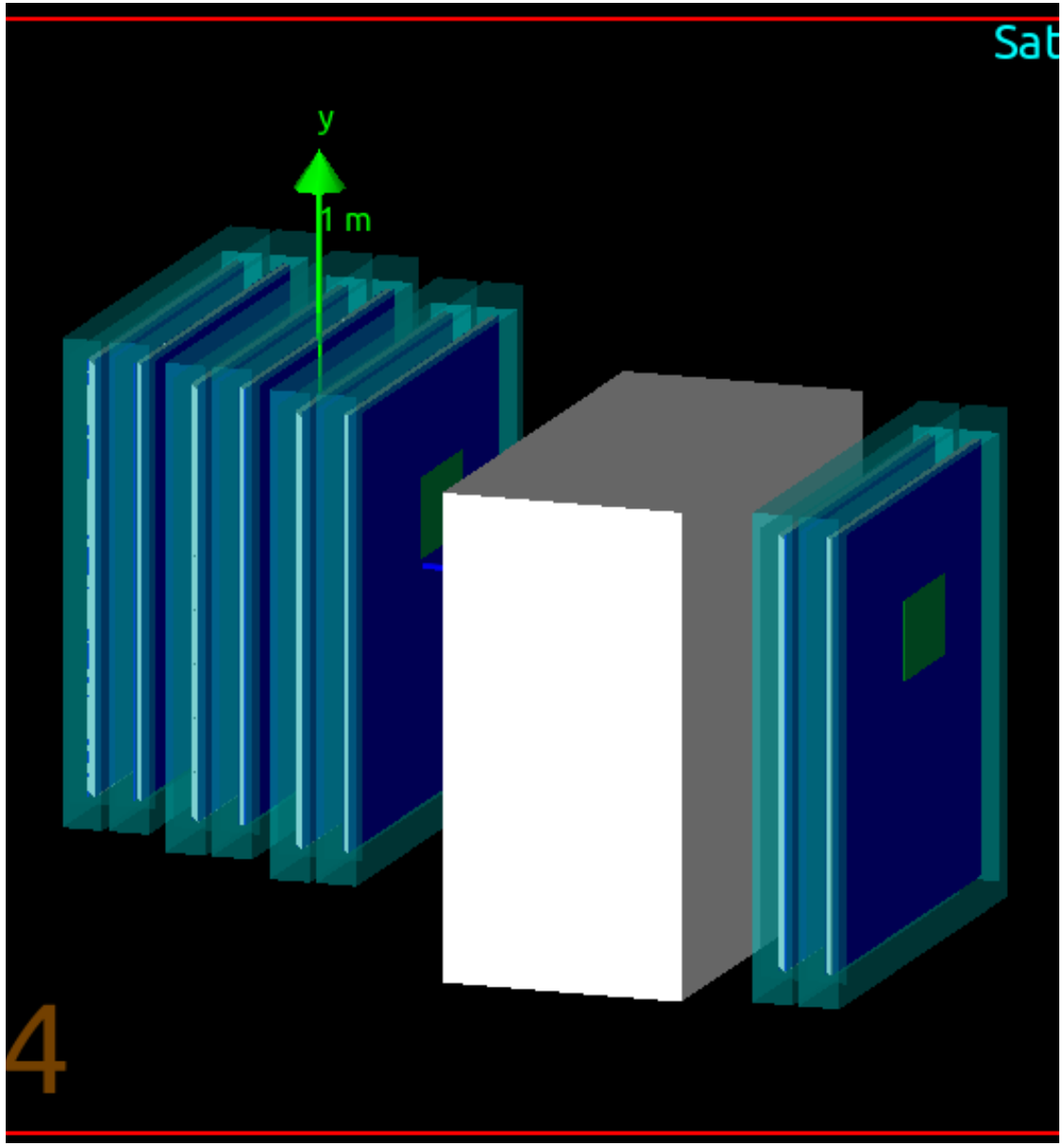


Third secondment
Geant4 simulation (II)

<u>A. Geometry</u>

- Geometry similar to real one

  => to match electronic requirements
- 1 module made of 16 + 16 triangular scintillator bars
- 1 plane = 2 modules
- 1 station = 1 plane X + 1 plane Y
- 1 telescope = 4 stations



Third secondment
Geant4 simulation (III)

B. Physics

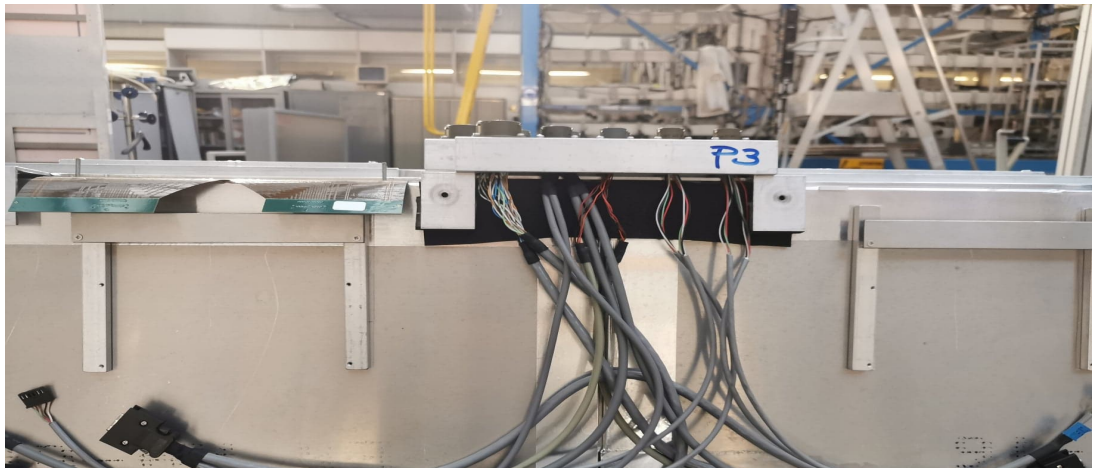
- Step 1 : MC simulation : Energy deposition and hits in scintillator bars (associated to specific module)
- Step 2 : Digitization of signals (RAW-like data format) :

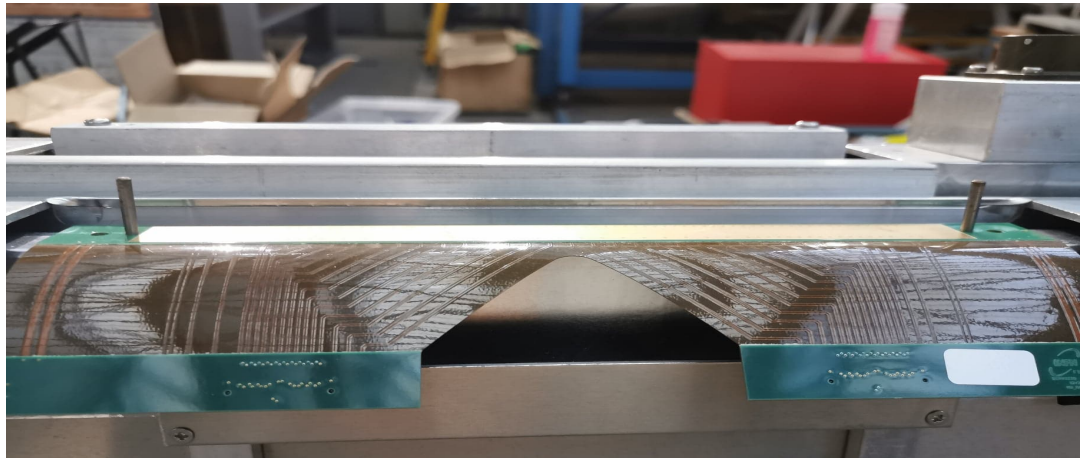
=> module ~ board & scintBar~electronic channel

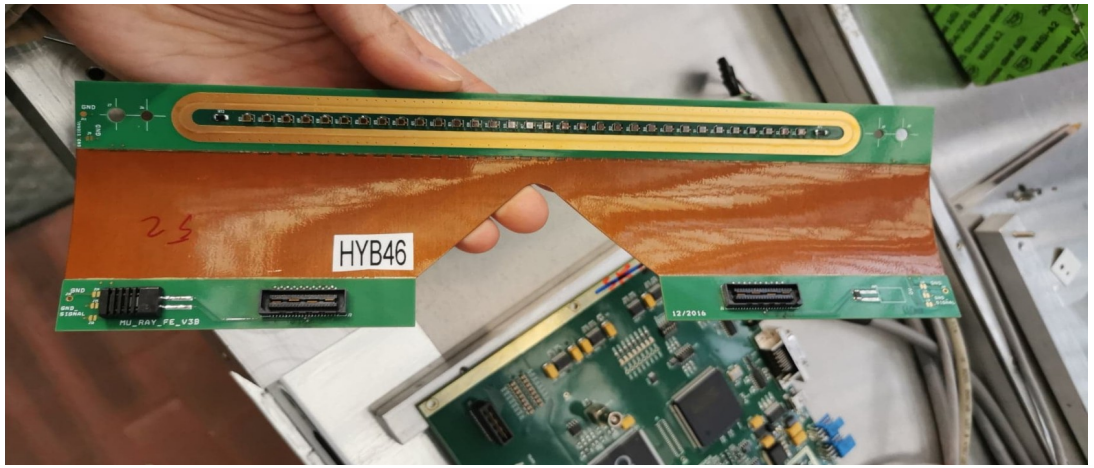
- Step 3 : Interface to attach ADCs (TDCs) to each electronic channel
- Step 4 : Geometrical reconstruction with data-Framework and efficiency studies

Third secondment
ROSSO SHIFT & BLU Hardware

- ROSSO moved from free-sky position to volcano position
- PMTs mounted on BLU (2 missing)
- Starting of BLU mounting in the lab







Future plans

- Hardware : Installation of BLU at Mt. Vesuvius
- Focus on Geant4 project with side project :
  - Simulation of a single scintillating bar with high level of detail
  - Goal : Get the energy released in scintillator as accurate as possible
  - Parametrization of the response as a matrix
  - Full simulation vs complex scintillator : look-up tables
- Adaptation of Geant4 simulation code to our own set-up @UCLouvain or to TECNO-IN detectors

Summary

- Secondments very instructive globally !
- 1st secondment got me familiar with all sides of work ongoing and to be done in MURAVES experiment
- 2nd secondment allowed me to be part of the installation of one of the muon tracker on site (Mt. Vesuvius), as well as to study physics aspects like time of flight
- 3rd secondment was about what could be my major contribution to the project, that was found as Geant4 simulation of MURAVES

  => + + : this work could be applied to any cosmic muon experiment

Thanks to Giulio, Fabio, Samip, Andrea and the whole Naples team for their support and help.