

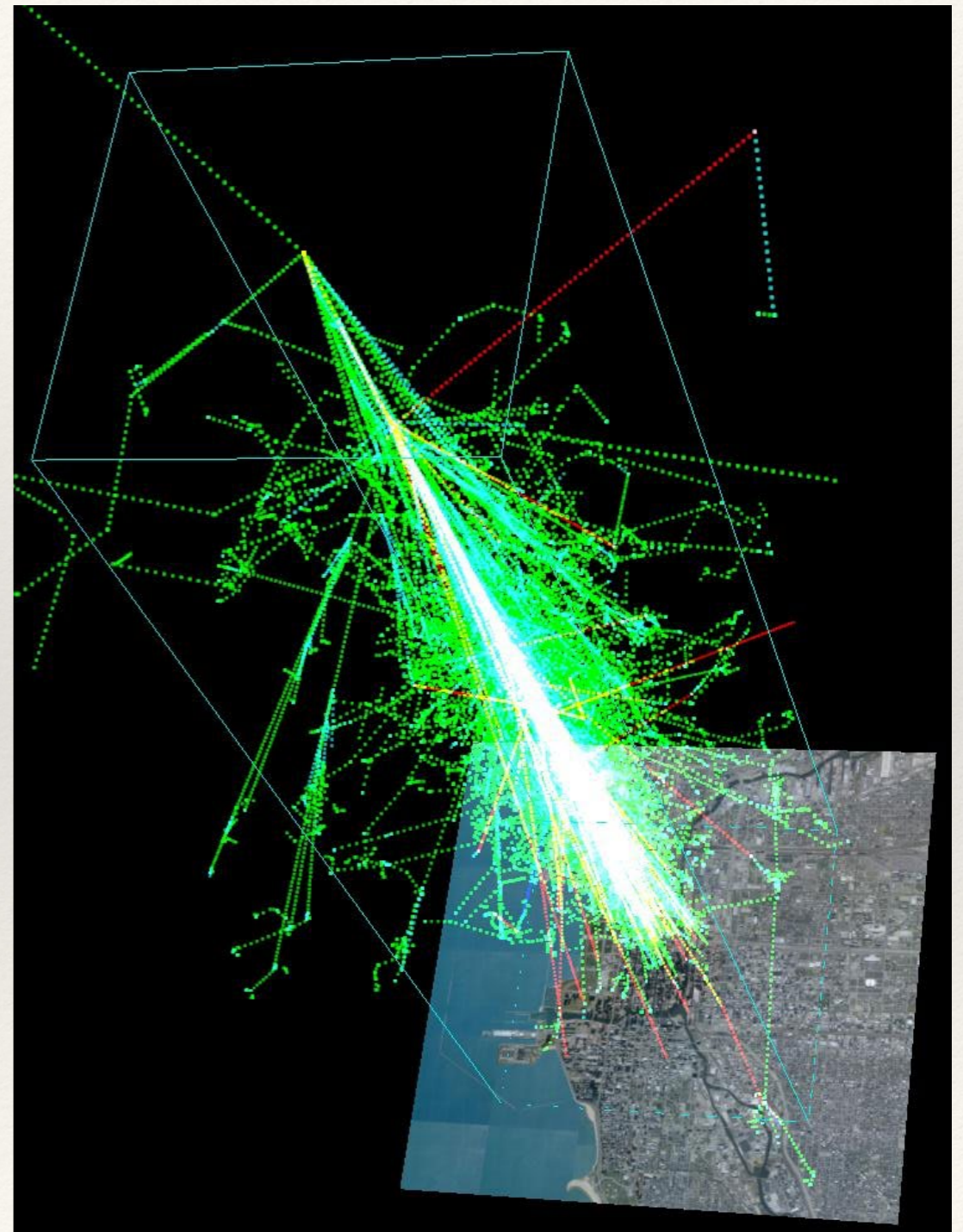
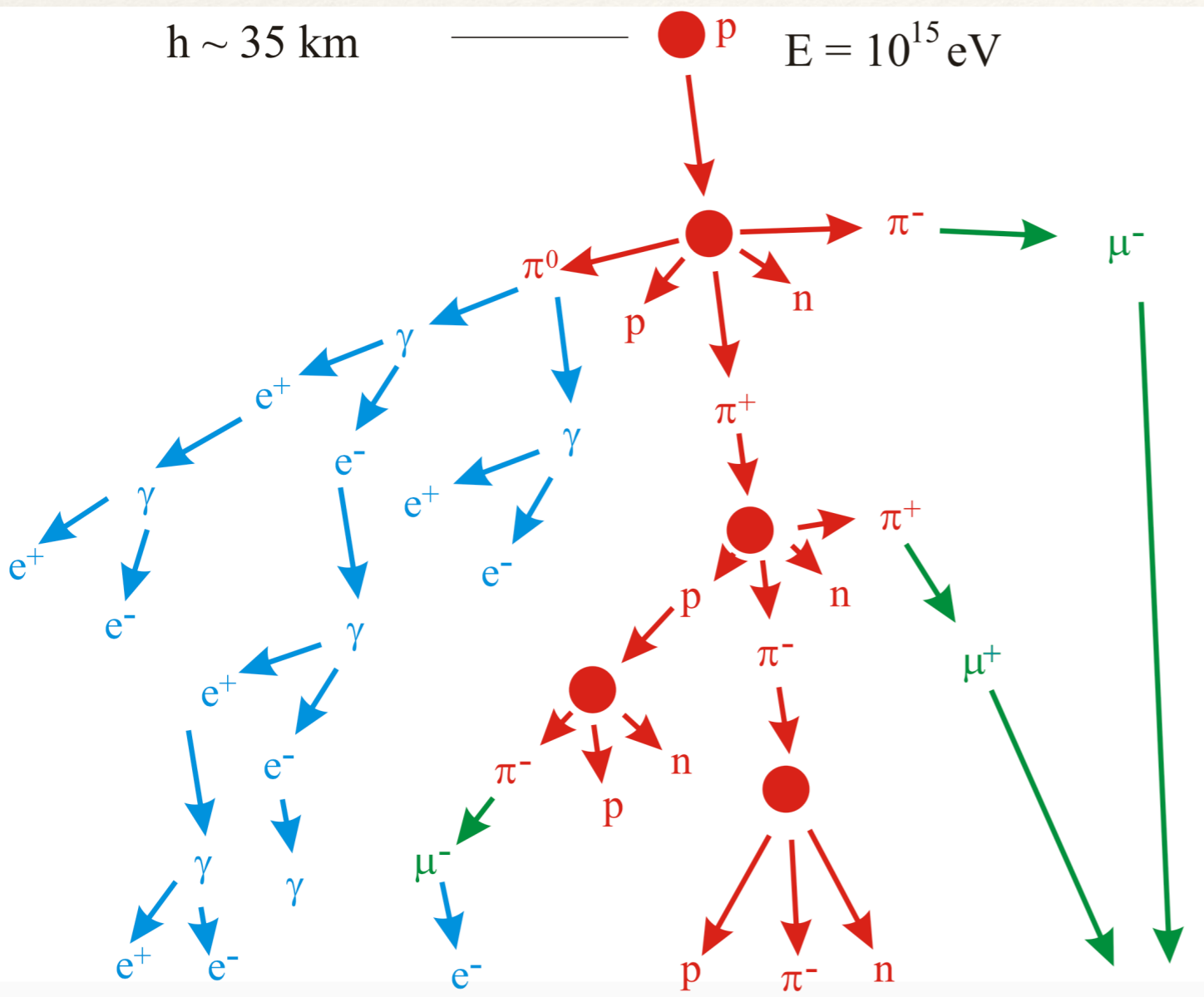
물리학 분야의 남북한 협력 방안

- ❖ D.W. Kim^a, M.C.S. Williams^{a,b,c}
- ❖ a) 강릉원주대학교
- ❖ b) CERN
- ❖ c) INFN-Bologna,

목차

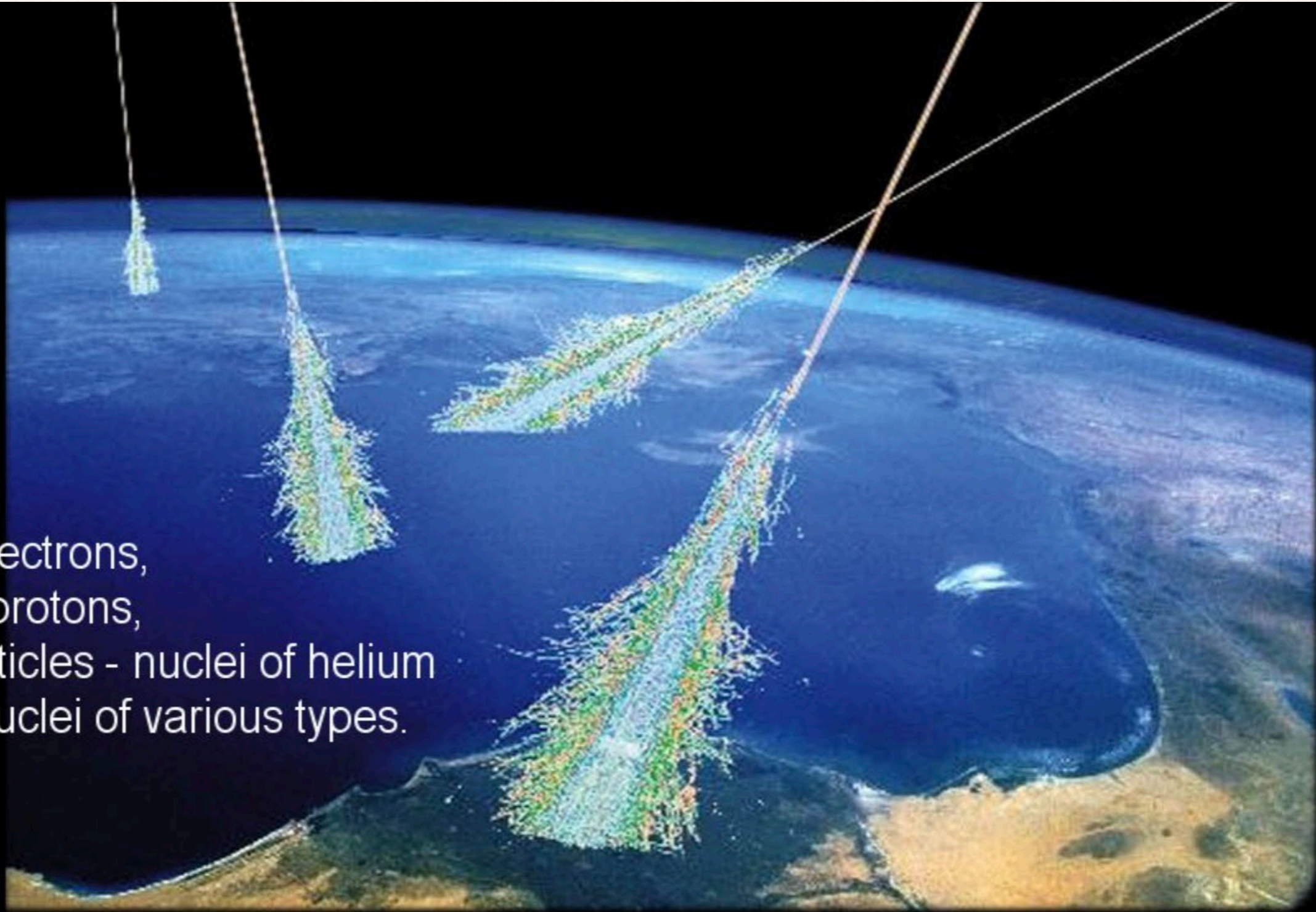
- ❖ 뮤온 단층촬영 (Muon Tomography)
- ❖ EEE 프로젝트
- ❖ 남북한 물리학자 워크숍

❖ 우주(대기) 방사선 : 뮤온



우주에서 지구 대기권으로 입사하는 입자들
전자, 양성자, 헬륨, 중이온

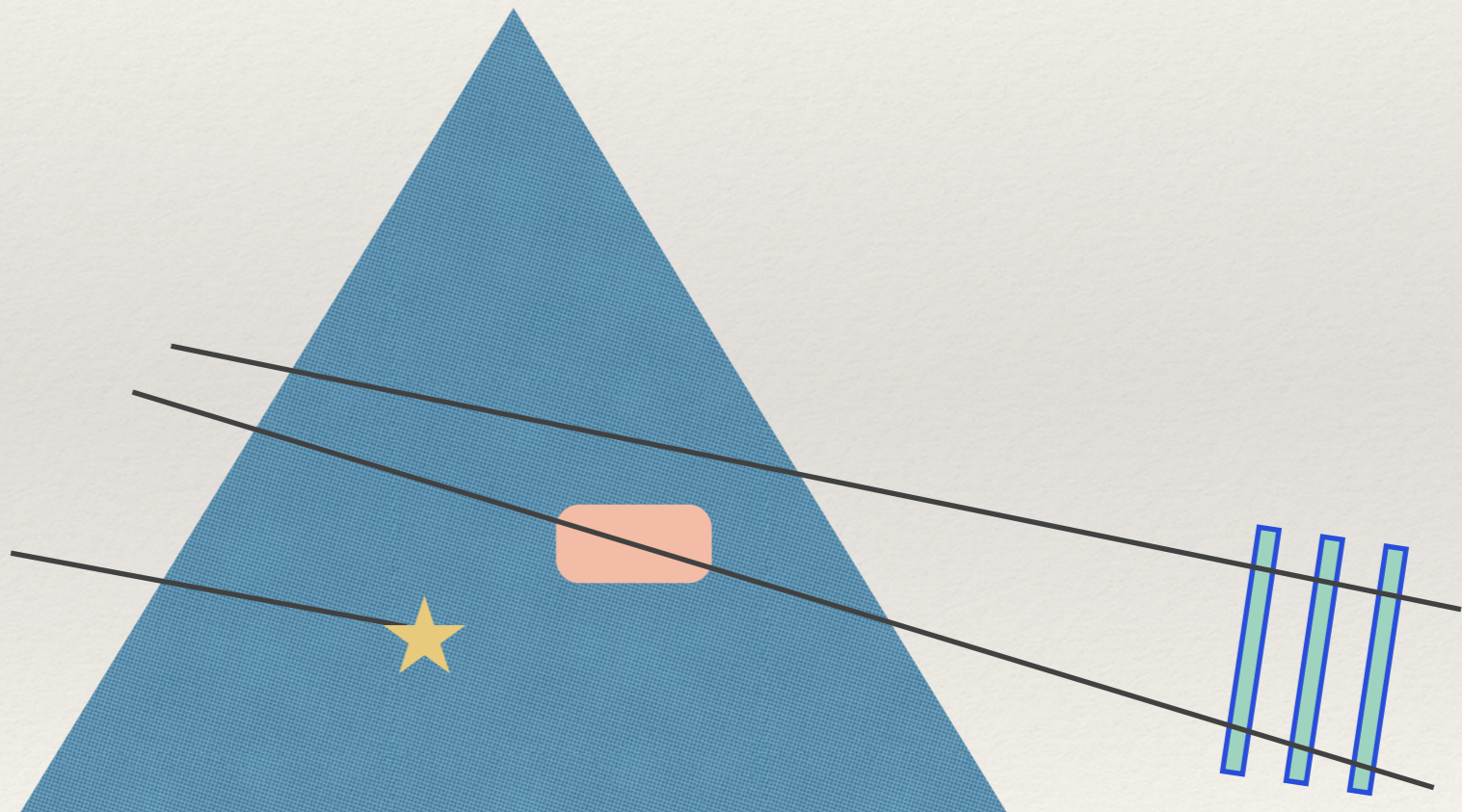
1% are solitary electrons,
90% are solitary protons,
9% are alpha particles - nuclei of helium
1% are heavier nuclei of various types.



이집트 피라미드 속의 빈 공간 탐색

수평으로 입사하는
뮤온의 수를 측정

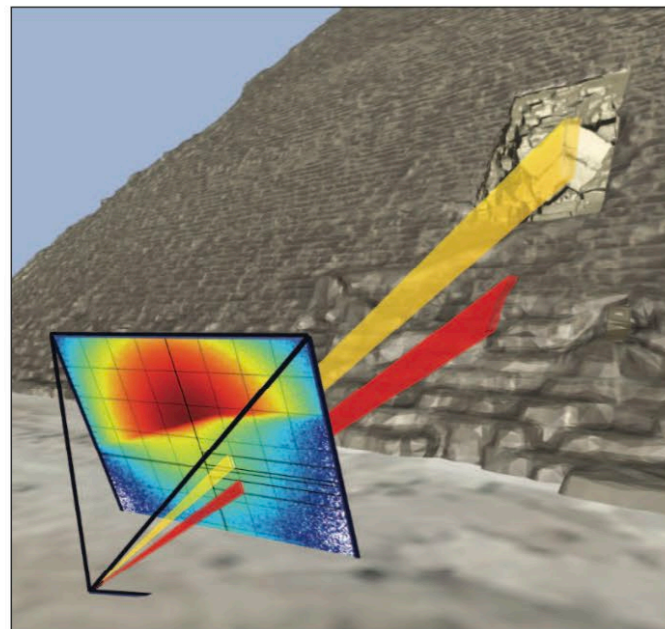
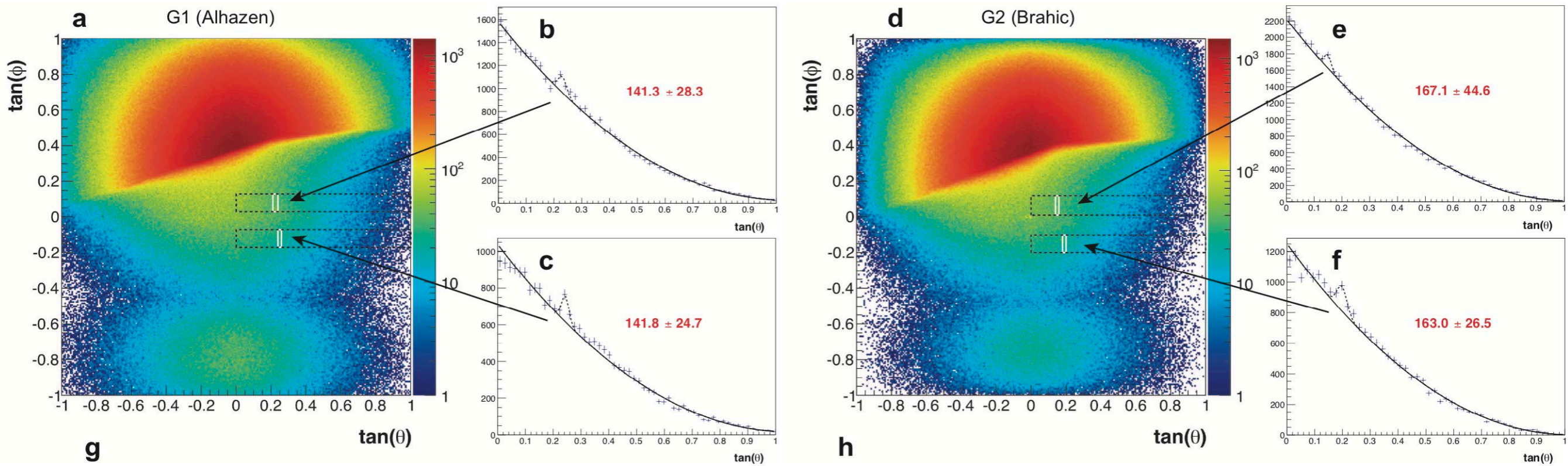
뮤온의 에너지가
충분히 크지
않으면 흡수됨



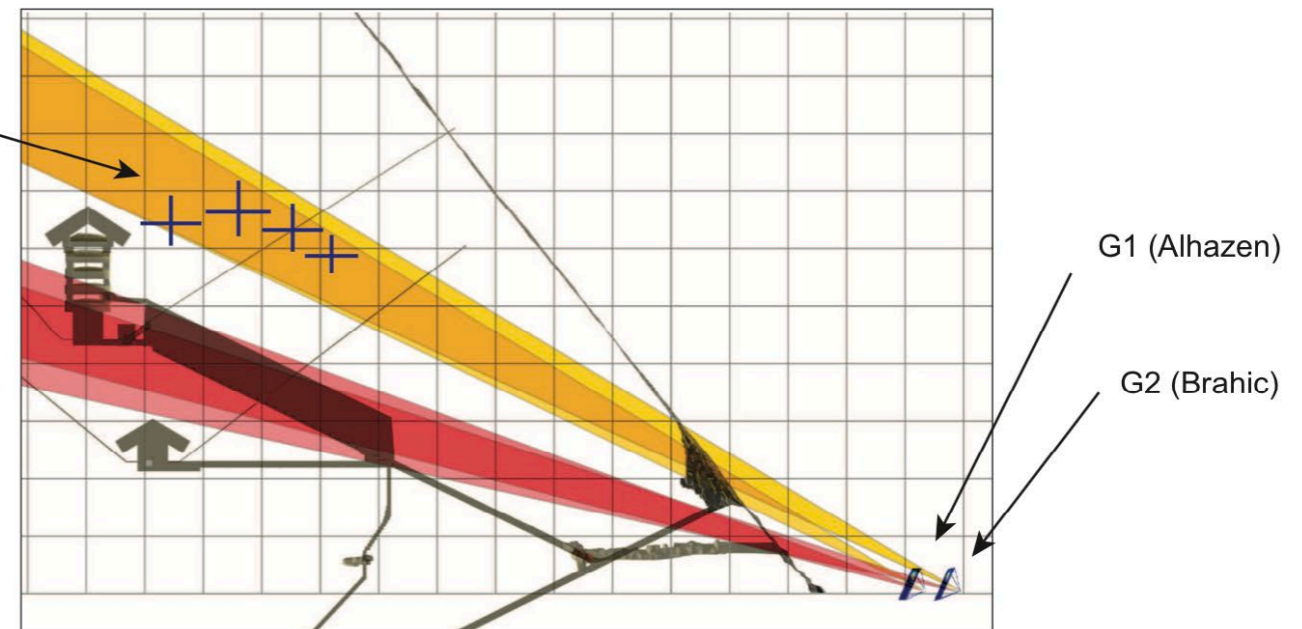
<http://www.nature.com/nature/journal/vaap/ncurrent/full/nature24647.html>

Discovery of a big void in Khufu's Pyramid by observation of cosmic-ray muons

K. Morishima et al.

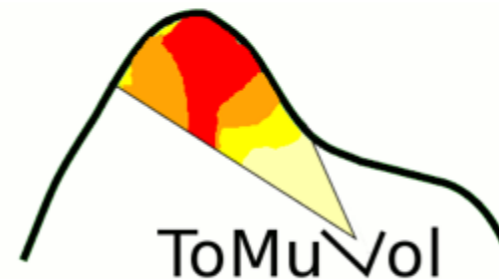


Triangulation positions
from Nagoya University



프랑스 클레르몽페랑 지역의 뷔드돔 화산 이미징

Vienna | 8–13 April 2018



Density Imaging of Puy de Dôme Volcano with Atmospheric Muons in French Massif Central as a Case Study for Volcano Muography

Cristina Cârloganu

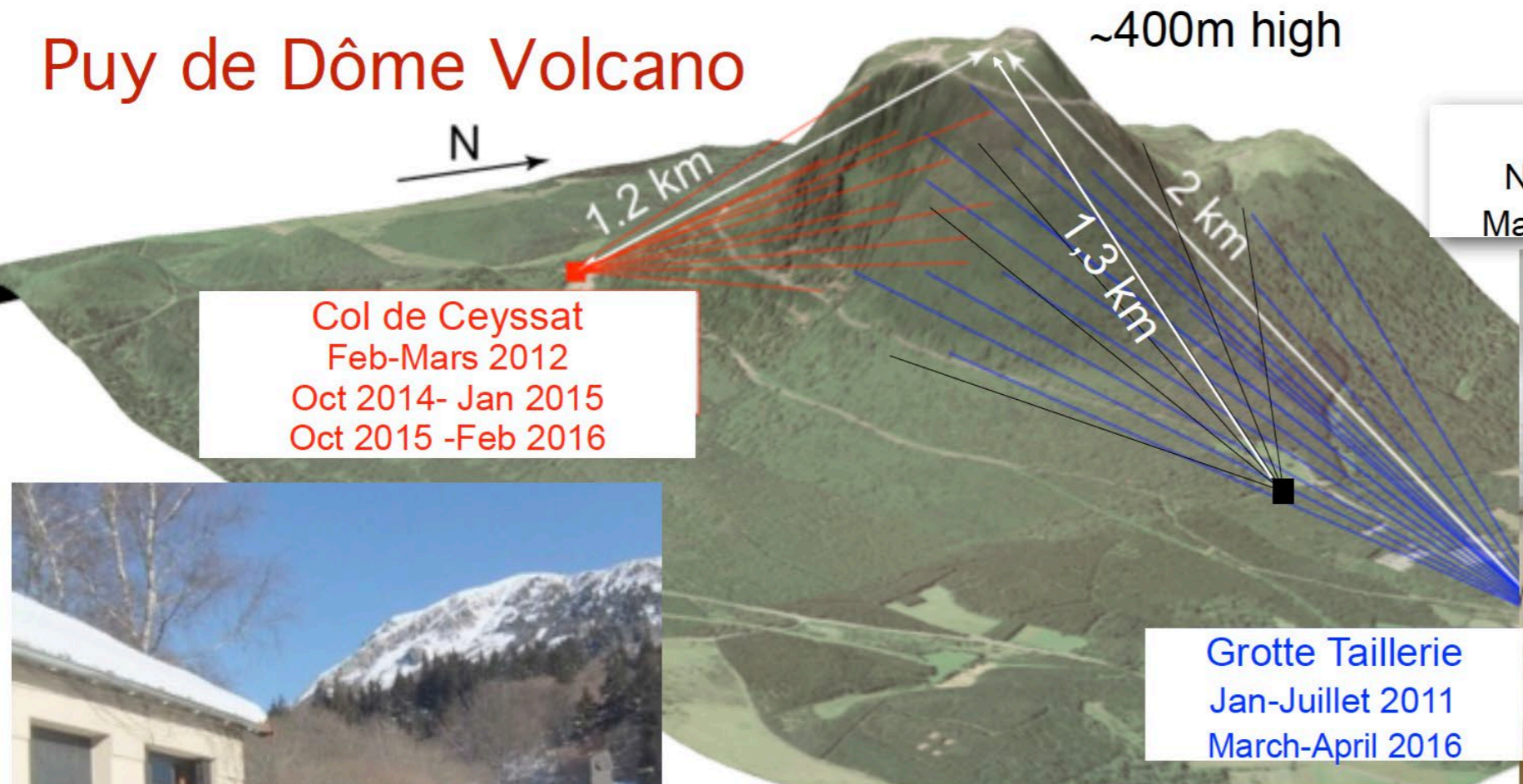


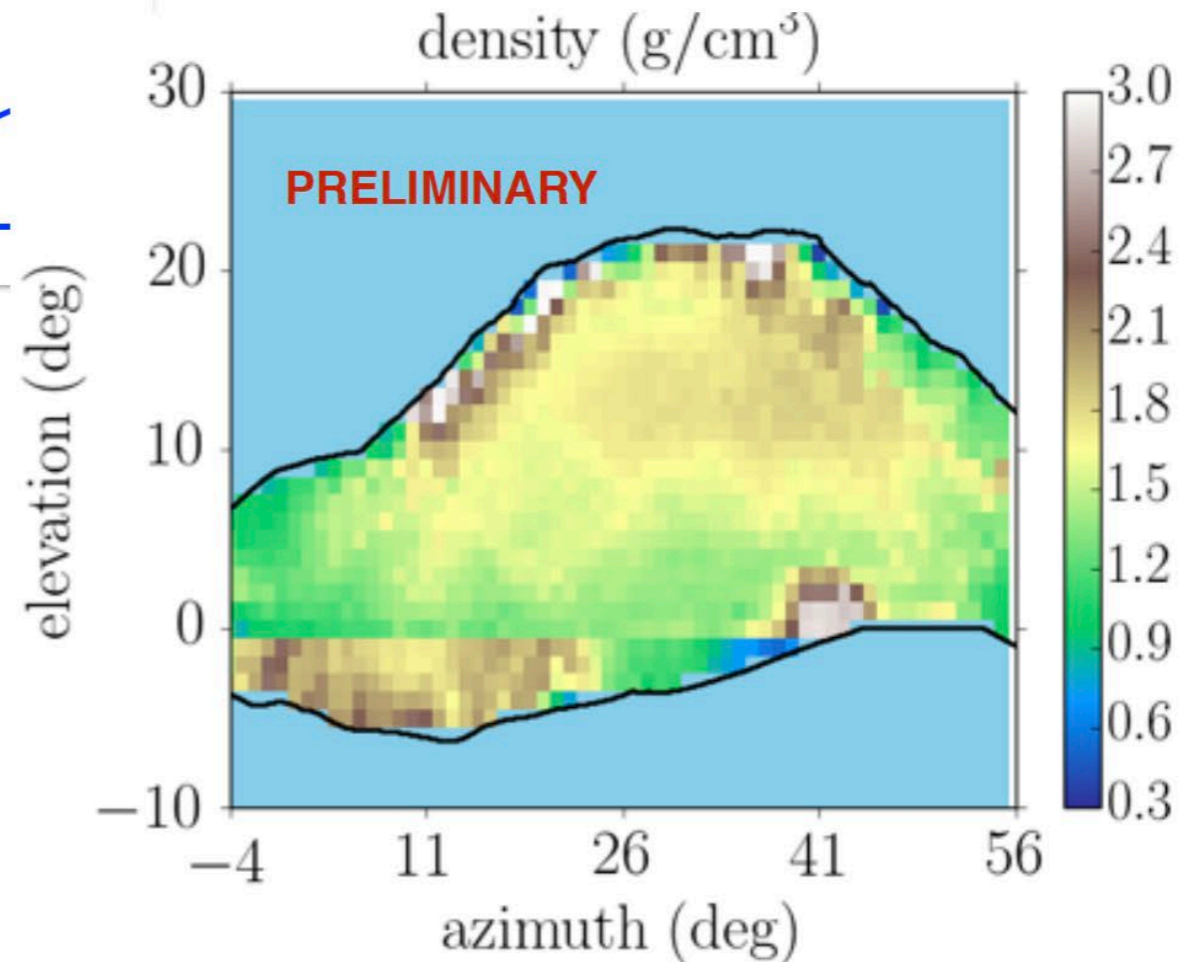
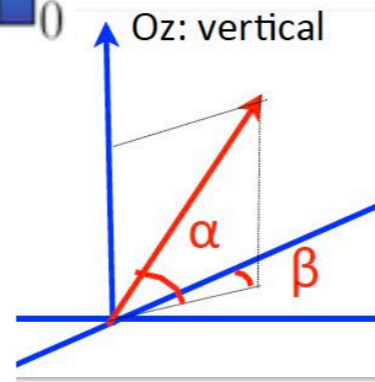
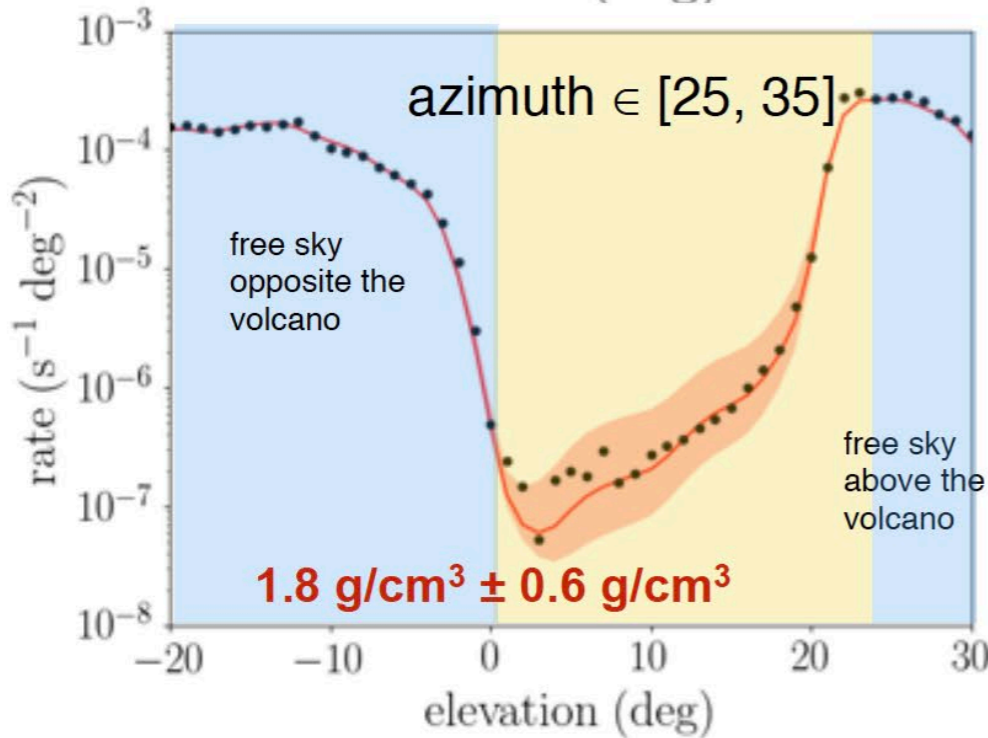
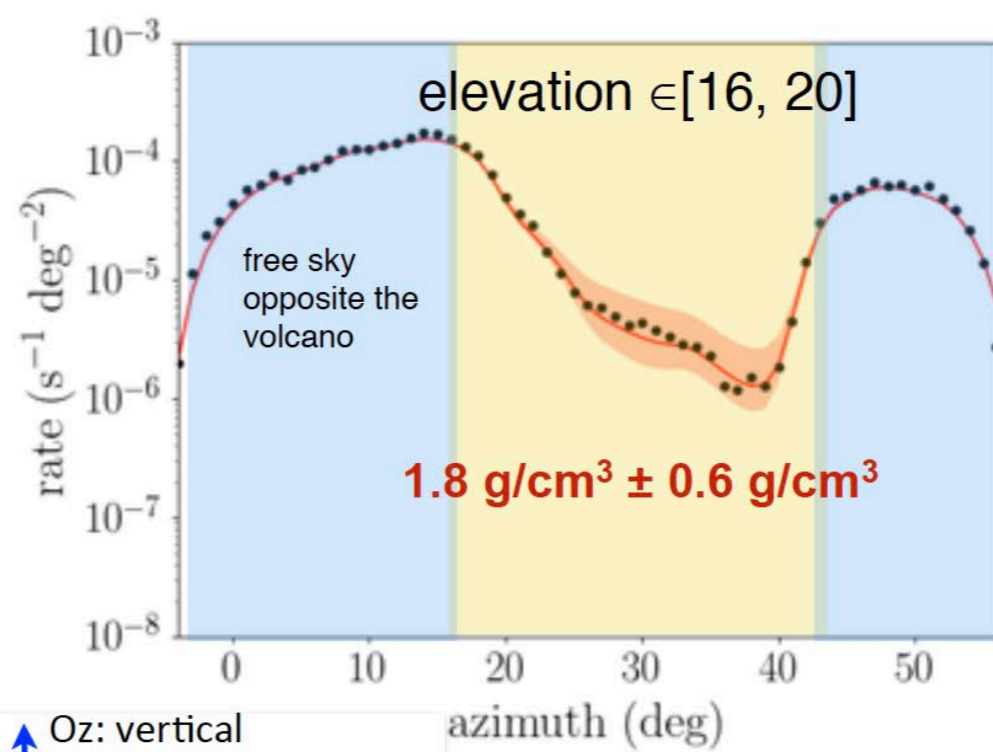
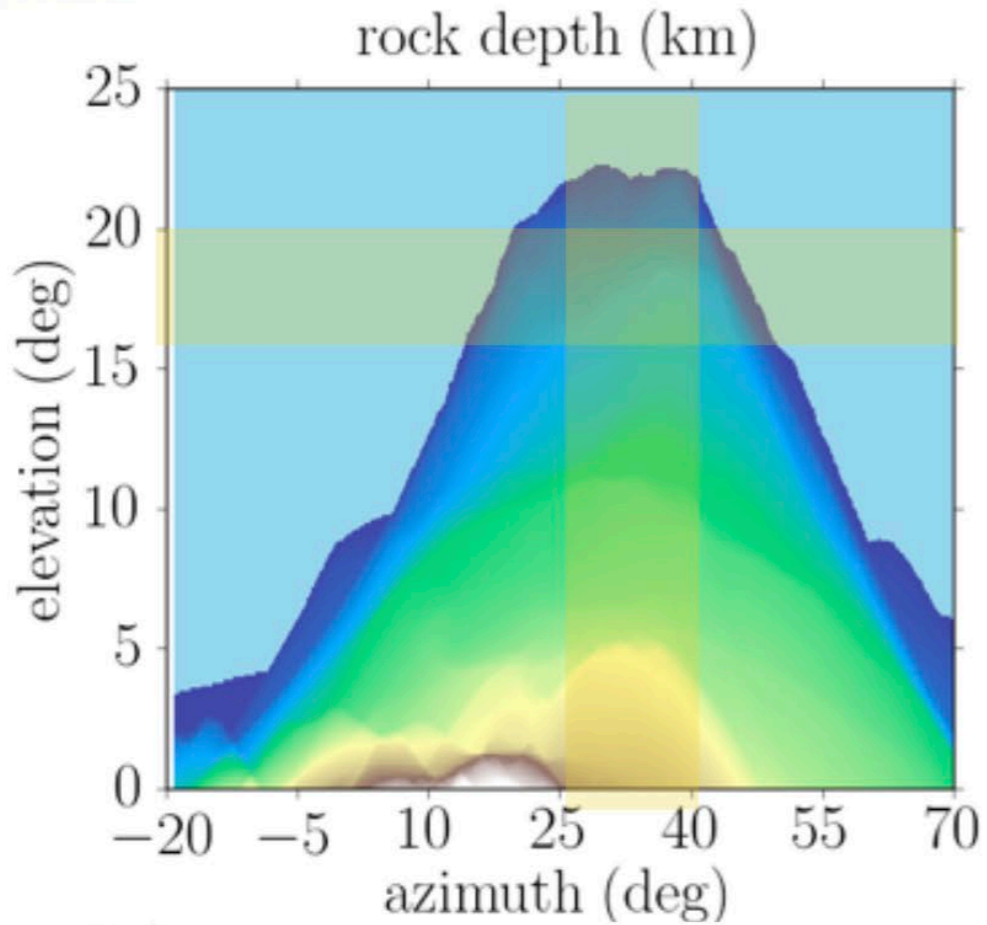
on behalf of the TOMUVOL collaboration



Proof of Principle for Muographic Imaging of Volcanoes

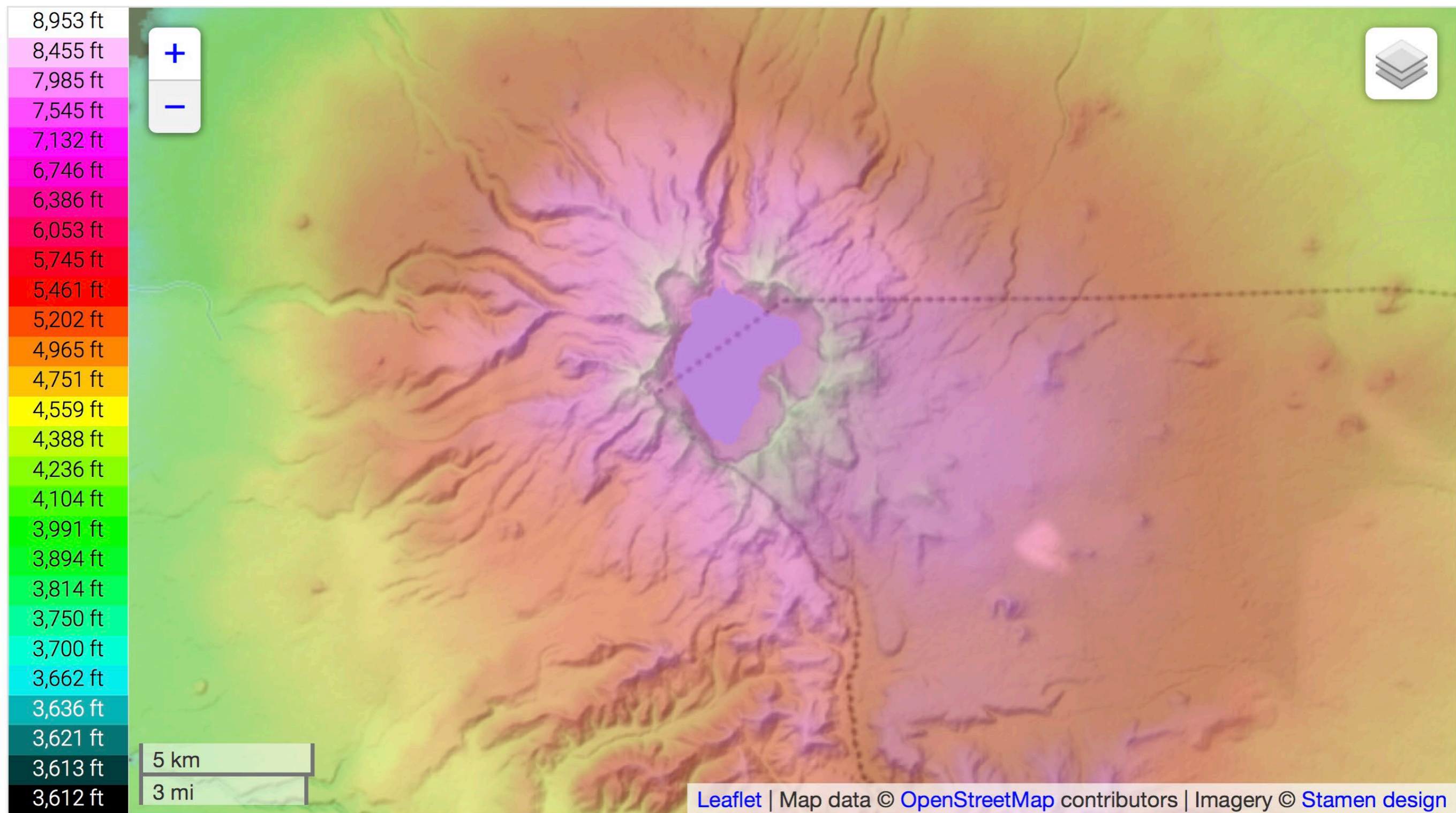
Puy de Dôme Volcano





Data/flux model agreement: ~5%
for free sky

Baekdu mountain is wide – so detectors will have to be placed with care (Cristina Cârloganu is an expert with this)



EEE 프로젝트

- ❖ 우주 방사선의 초고에너지 사건들 (Extreme Energy Events) 측정. 이탈리아 고등학교들이 참여
- ❖ 이탈리아 교육부가 재정지원
- ❖ 학생들과 교사들의 과학에 대한 관심 확대 사업

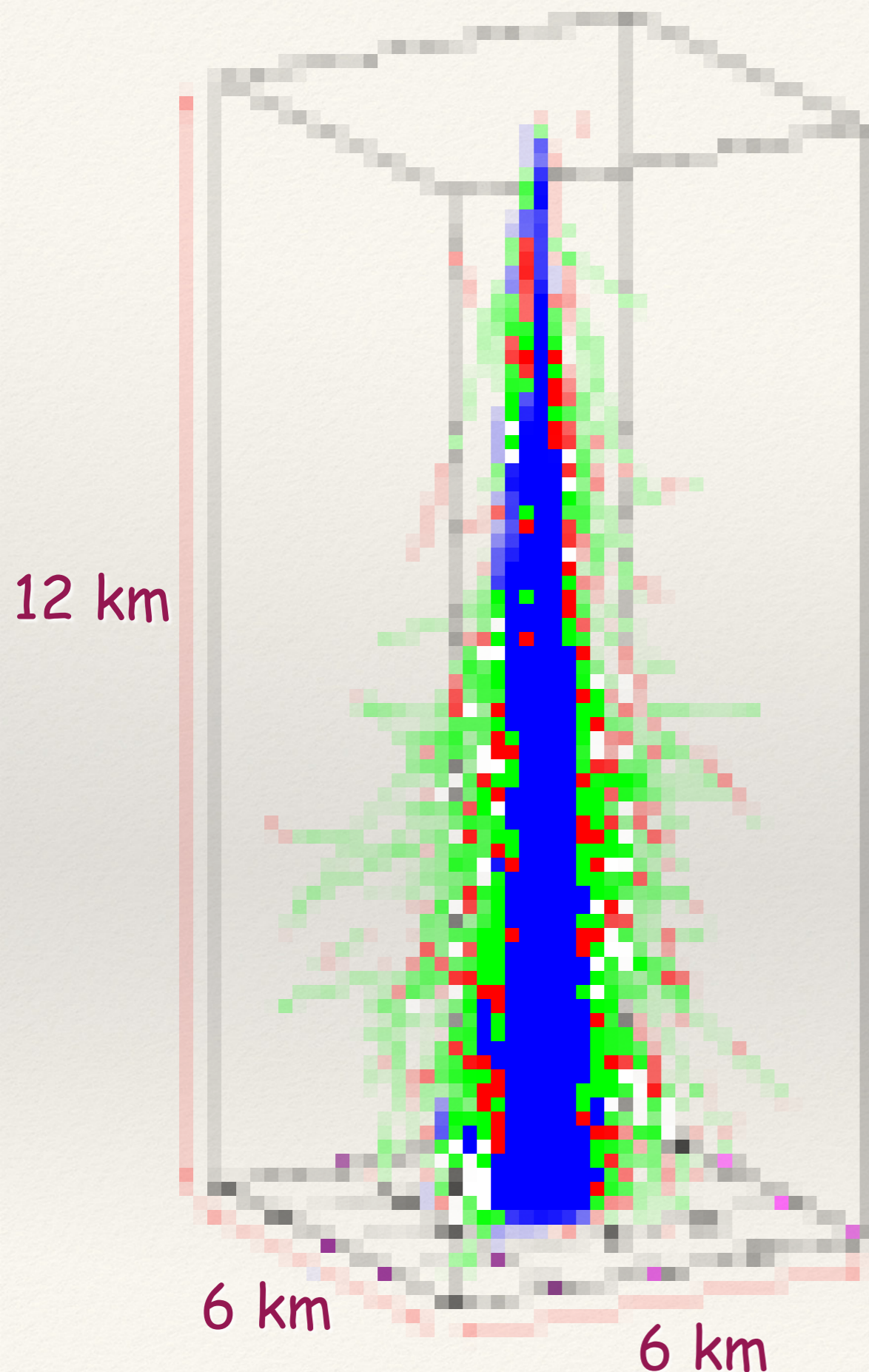
Extreme Energy Events (EEE project)

Simulation of 10^{19} eV shower

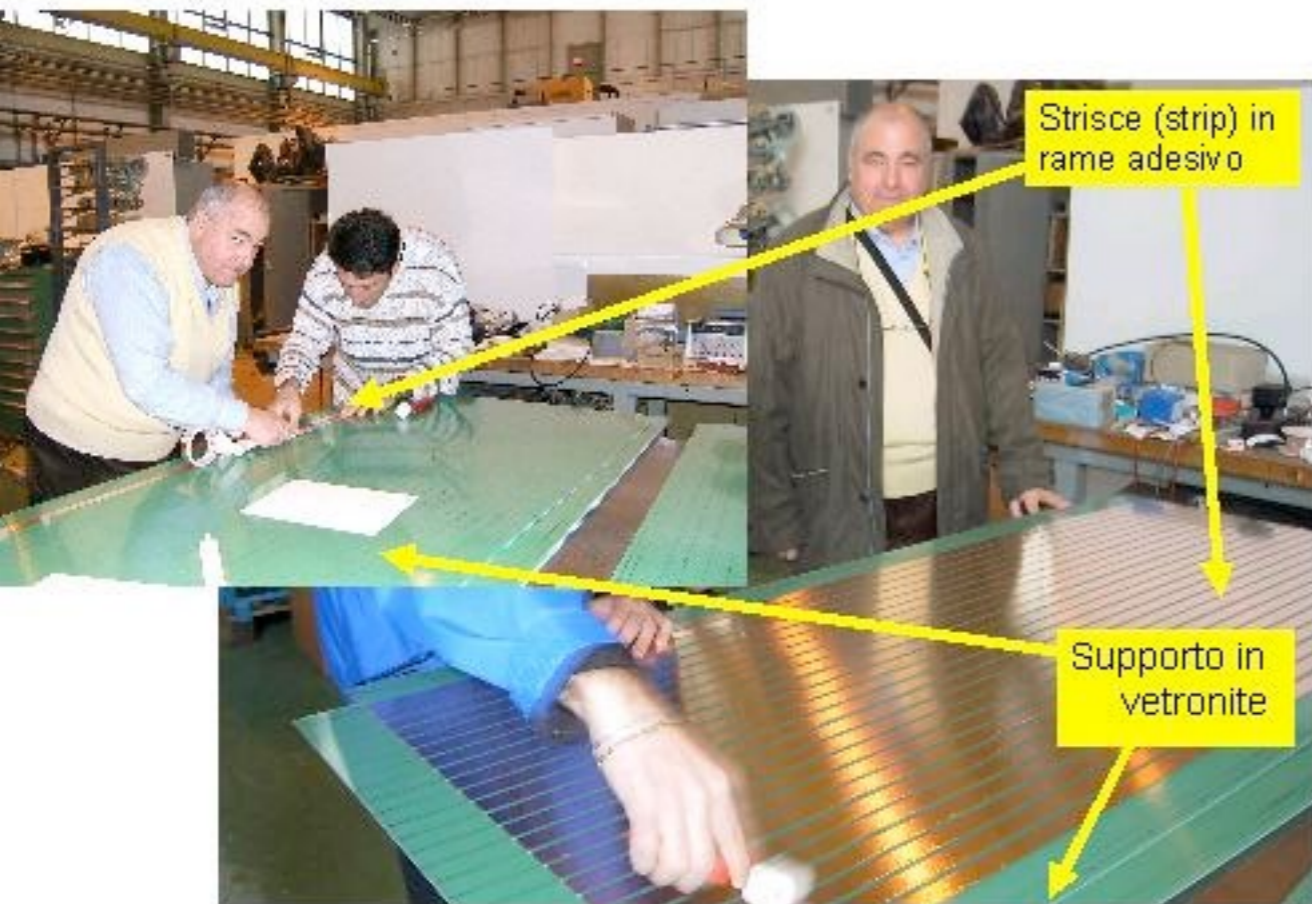
Very very energetic particle interacts in upper atmosphere and generates a 'shower' containing many thousands of particles

'Clusters' of detectors spread over Italy.

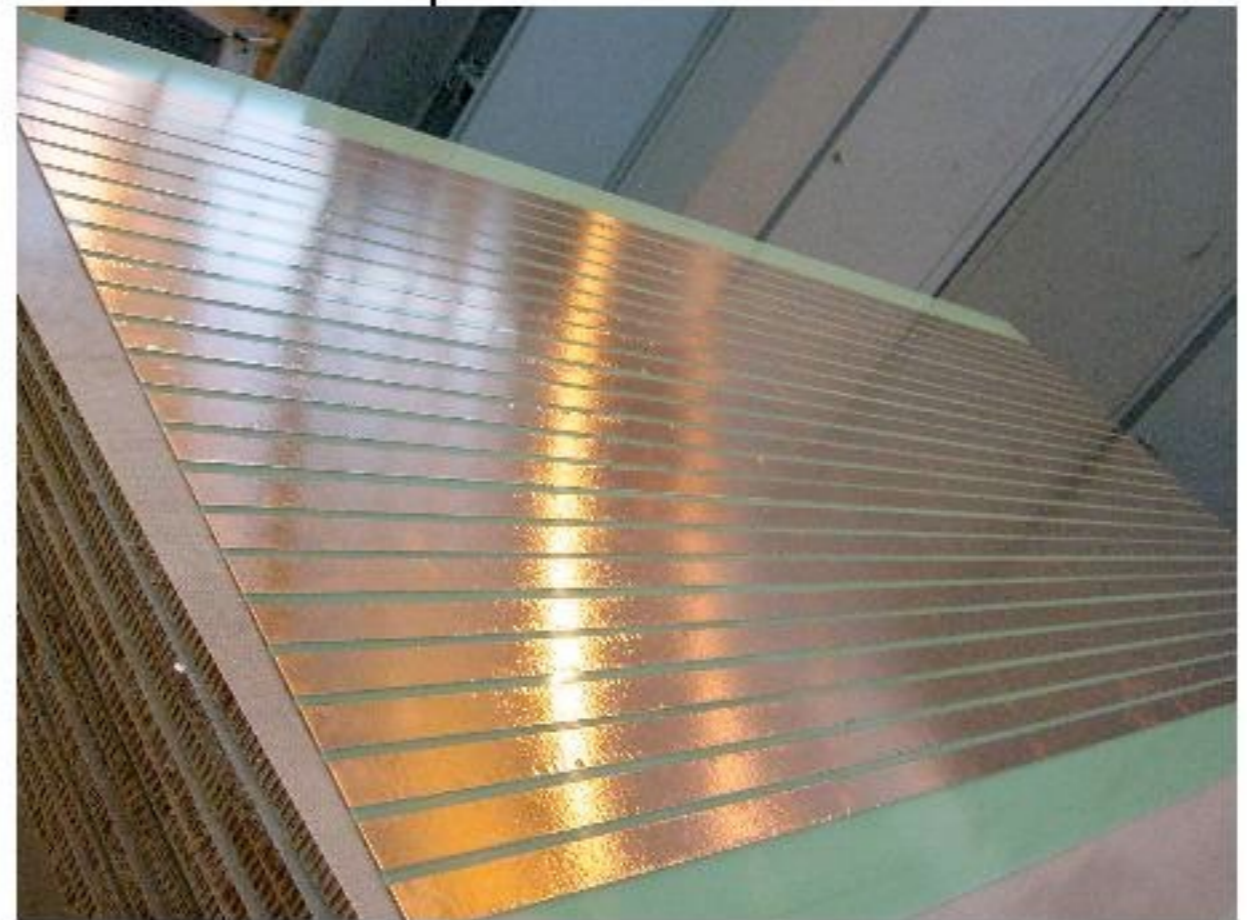
EEE project is to equip many high schools with detectors



Applicazione delle strip in rame

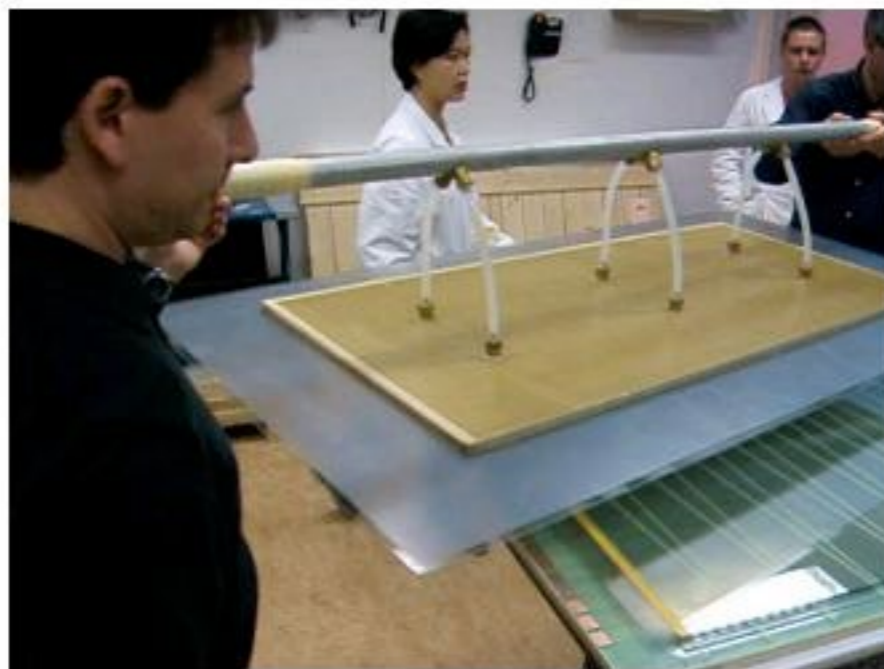


Pannello per il read out ultimato

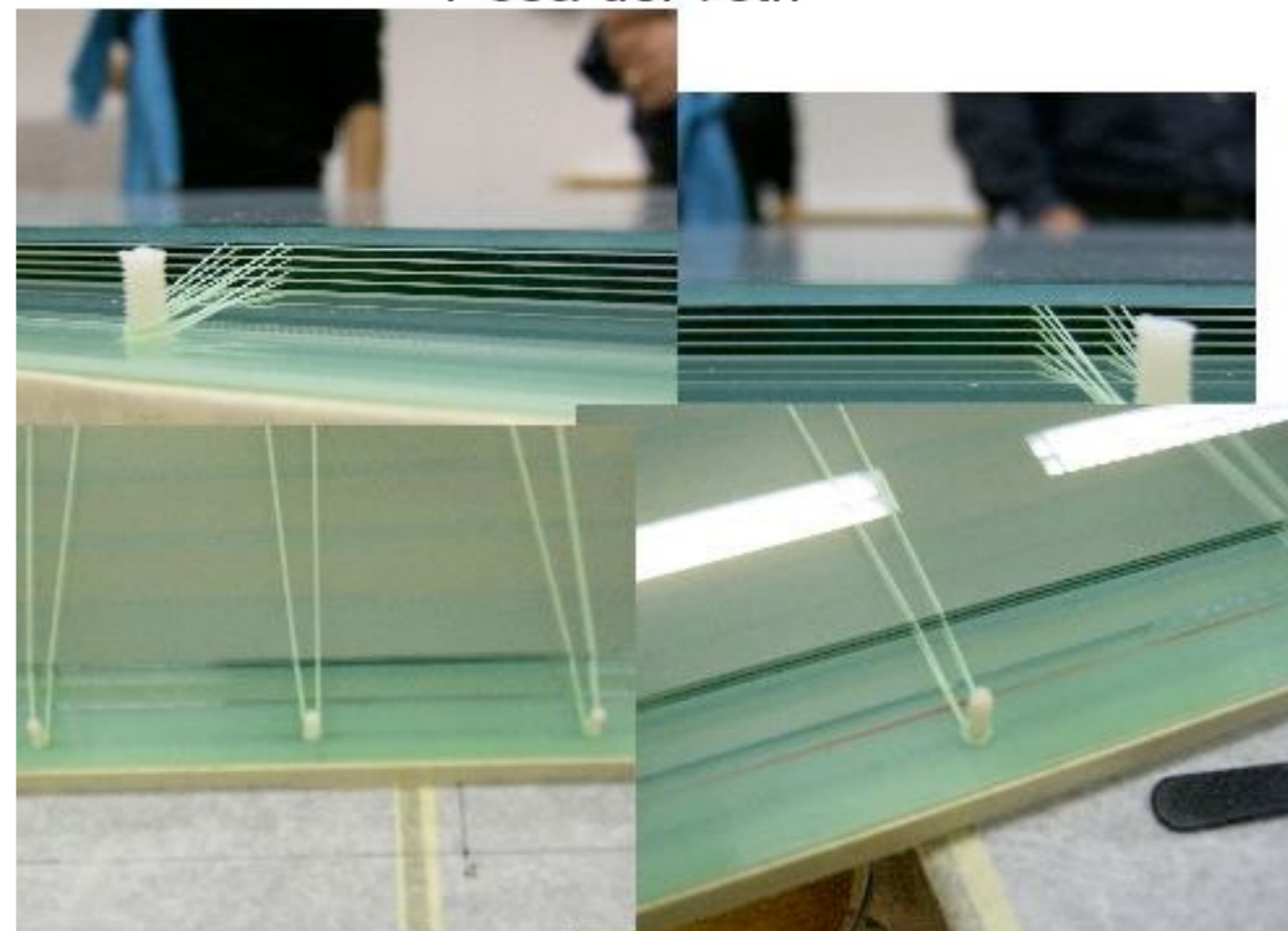


Spostamento dei vetri

(filmato)



Posa dei vetri

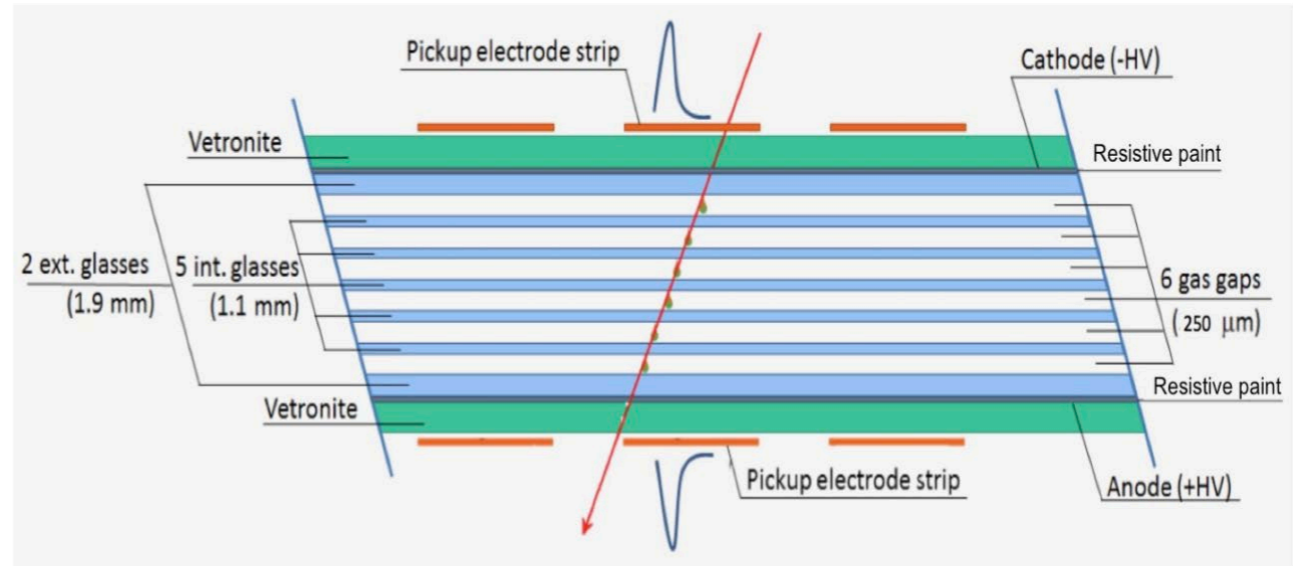


A photograph is taken of each group at the end of the week of chamber construction





(a)

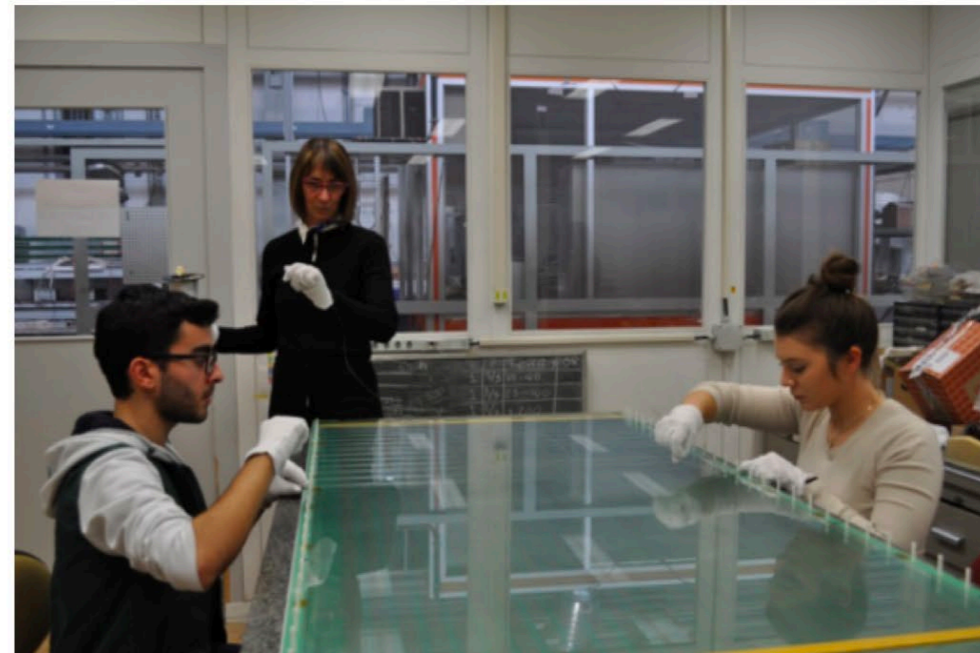


(b)

Figure 1: (a) EEE Project telescope; (b) EEE MRPC basic element



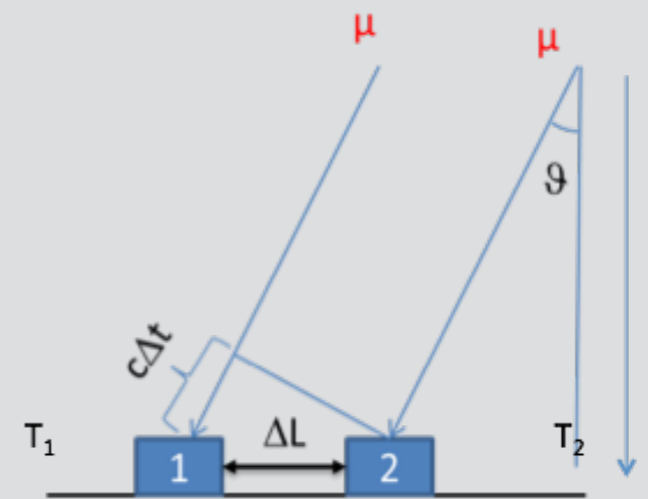
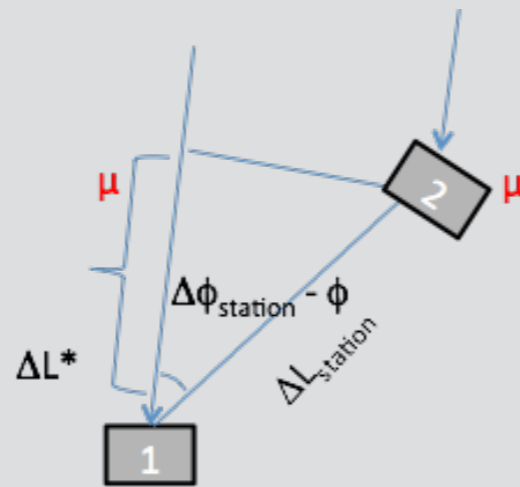
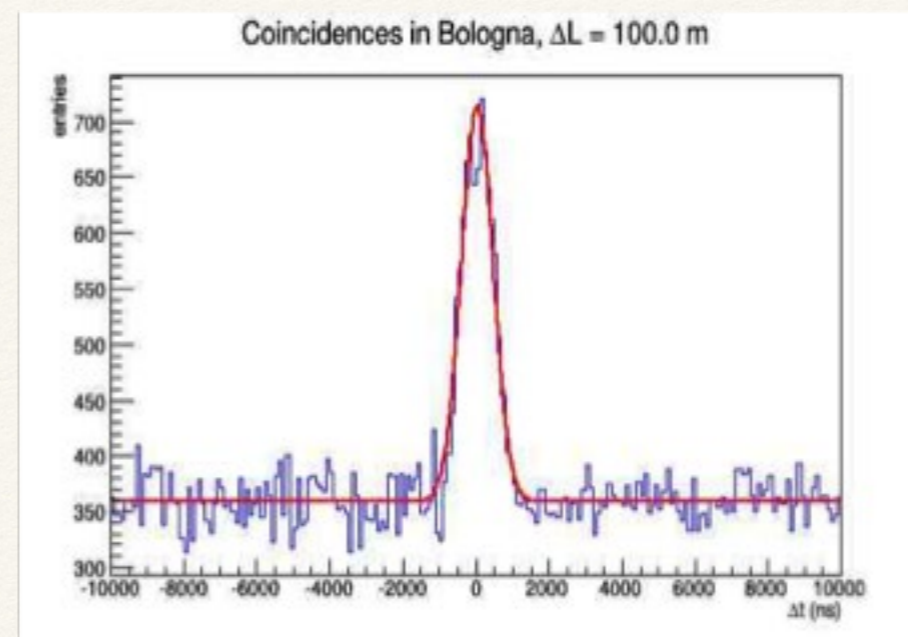
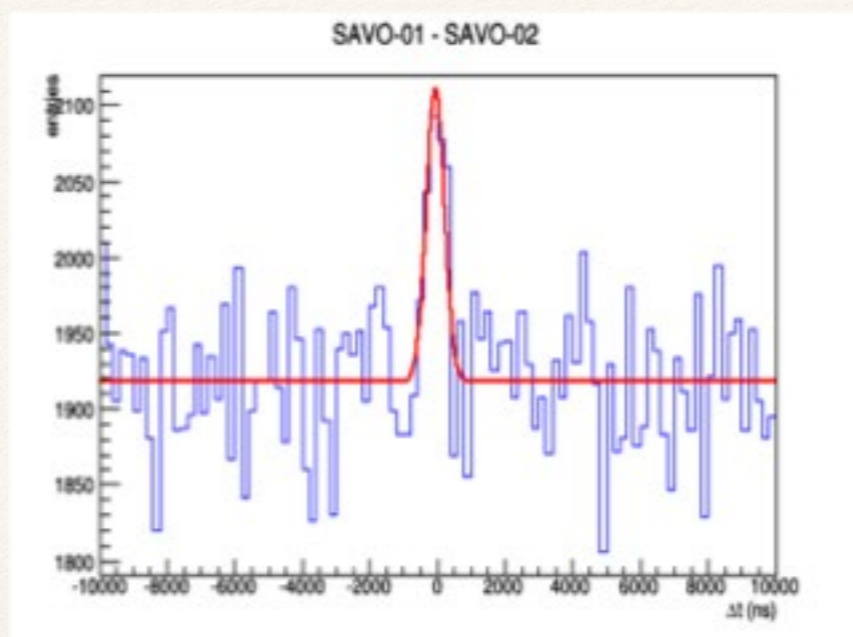
(a)



(b)

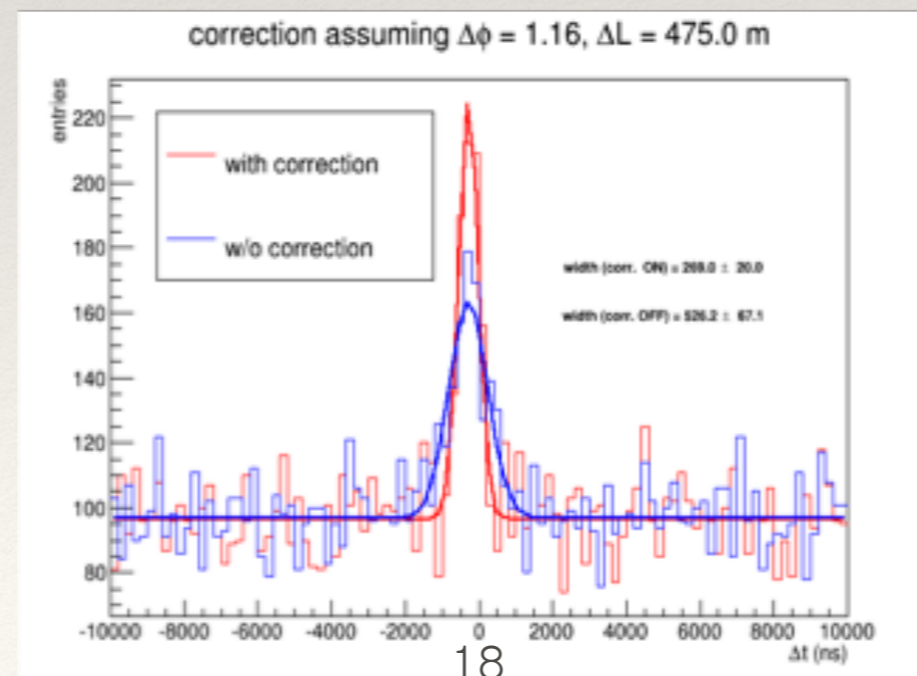
Figure 2(a): Readout electrodes construction by application of copper tape on the vetronite panel. Figure 2 (b): the 250 μm diameter fishing line (used as spacer between glass sheets) stretched across the surface of the glass from one side to the other and around plastic screws fixed at both sides of the chamber (b).

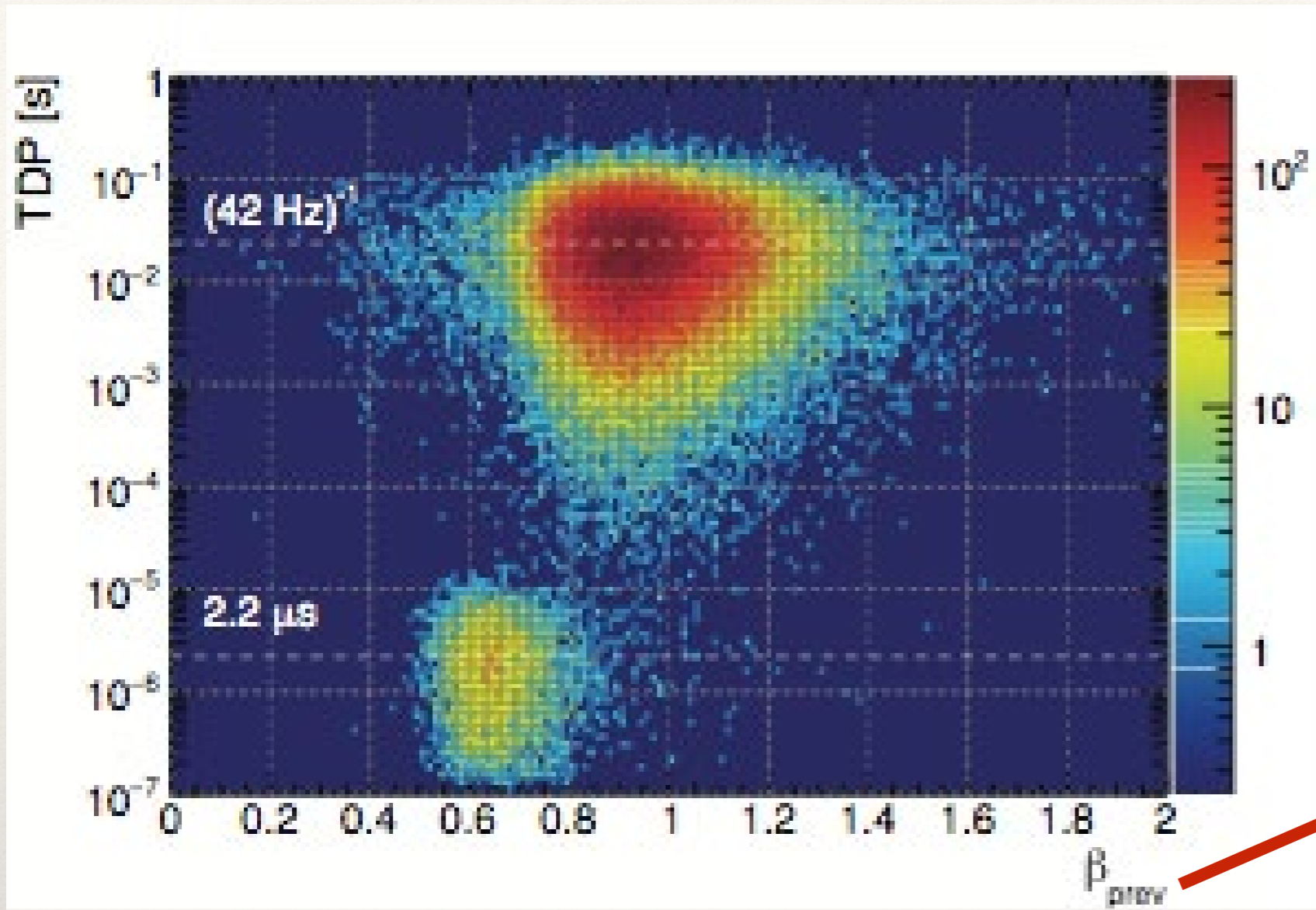




$$\Delta L^* = \cos(\Delta\phi_{\text{station}} - \phi) \Delta L_{\text{station}}$$

$$\Delta T = \Delta L^* \sin\theta / c$$

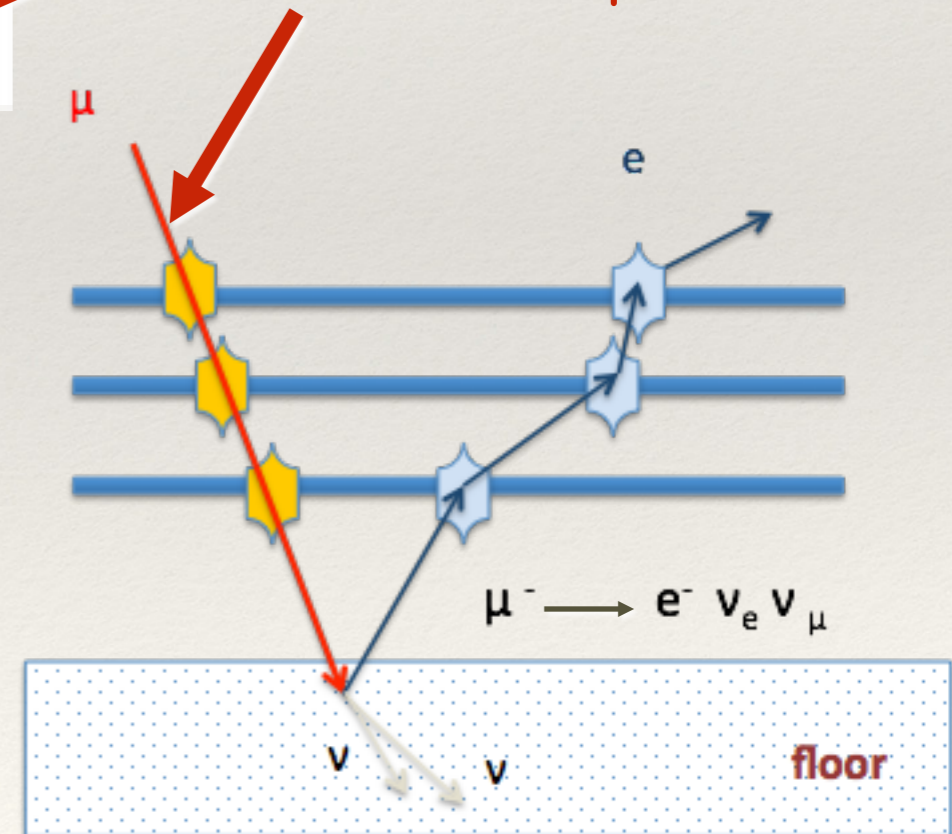




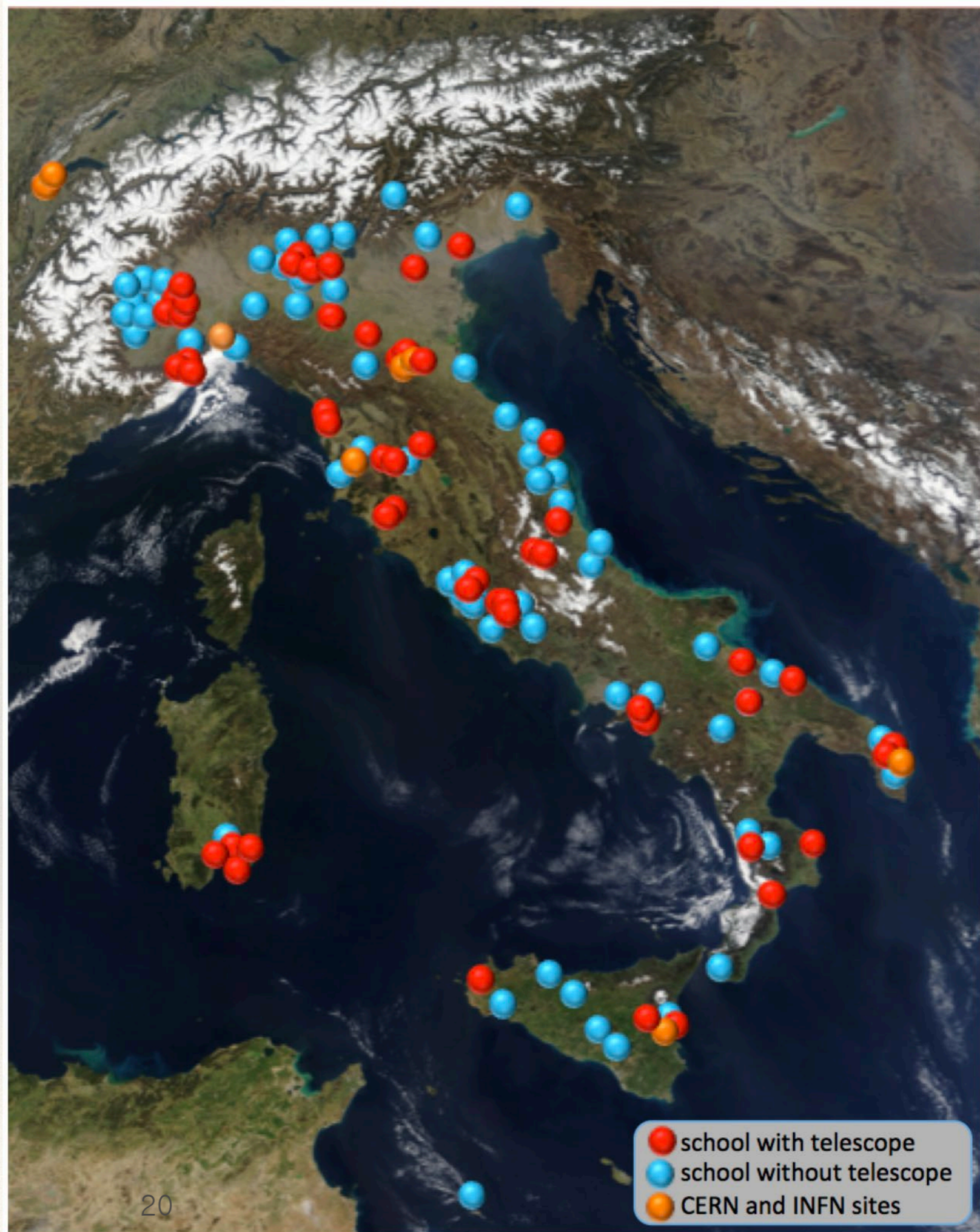
β of previously recorded particle

If initial muon is very energetic (high β) it will penetrate deeply into concrete so that electron will not re-emerge

The MRPC telescope can measure momentum using time-of-flight



이탈리아 전역에서
고등학교들이 EEE
프로젝트에 참여



Science for Peace

The Korean EEE Project:

A project to build Muon telescopes

in Korean high schools

Antonino Zichichi

World Federation of Scientists,

Geneva, Switzerland

한반도의 고등학생들이 CERN을 방문하여 검출기를
제작하고 자신들의 학교에서 우주선 측정하도록
돕겠다는 World Laboratory의 제안

남북한 물리학자와 국제워크숍 조직(안)

- ❖ 남북한 물리학자들을 포함한 국제학술회의. 물리학의 다양한 관심 분야에 관한 논의
- ❖ 행사 장소 : 이탈리아 시실리 섬의 Erice에 소재한 에토레 마요라나 과학문화연구소
- ❖ 행사 시기: 2019년 10월 12일~17일
- ❖ 후원: 대한민국 통일부

에토레 마요라나 과학문화재단 Erice, Sicily



**ETTORE MAJORANA FOUNDATION AND
CENTRE FOR SCIENTIFIC CULTURE**
TO PAY A PERMANENT TRIBUTE TO ARCHIMEDES AND GALILEO GALILEI, FOUNDERS OF MODERN SCIENCE
AND TO ENRICO FERMI, THE "ITALIAN NAVIGATOR", FATHER OF THE WEAK FORCES

Welcome to EMFCSC

The President of EMFCSC: Prof. Antonino Zichichi

The History of EMFCSC

Erice Statement



요약

(a) 뮤온 단층촬영

북한 물리학자, 핵공학자들과 물리학 국제공동연구 가능 분야

(지역대학 우수과학자 연구, 교육부, 2019-2024, 강릉원주대학교)

(b) 한반도 EEE 프로젝트

공동과학활동을 통한 남북 젊은이들의 동질성 회복 추구

(우리 교육부, 과기정통부, 통일부의 의지에 따라 실현 가능)

(c) 에리체 국제 워크숍

남북한 과학자들의 주된 관심 영역 파악, 학술 교류 추진

(2018년 12월 통일부 장관 면담시 지원 약속)