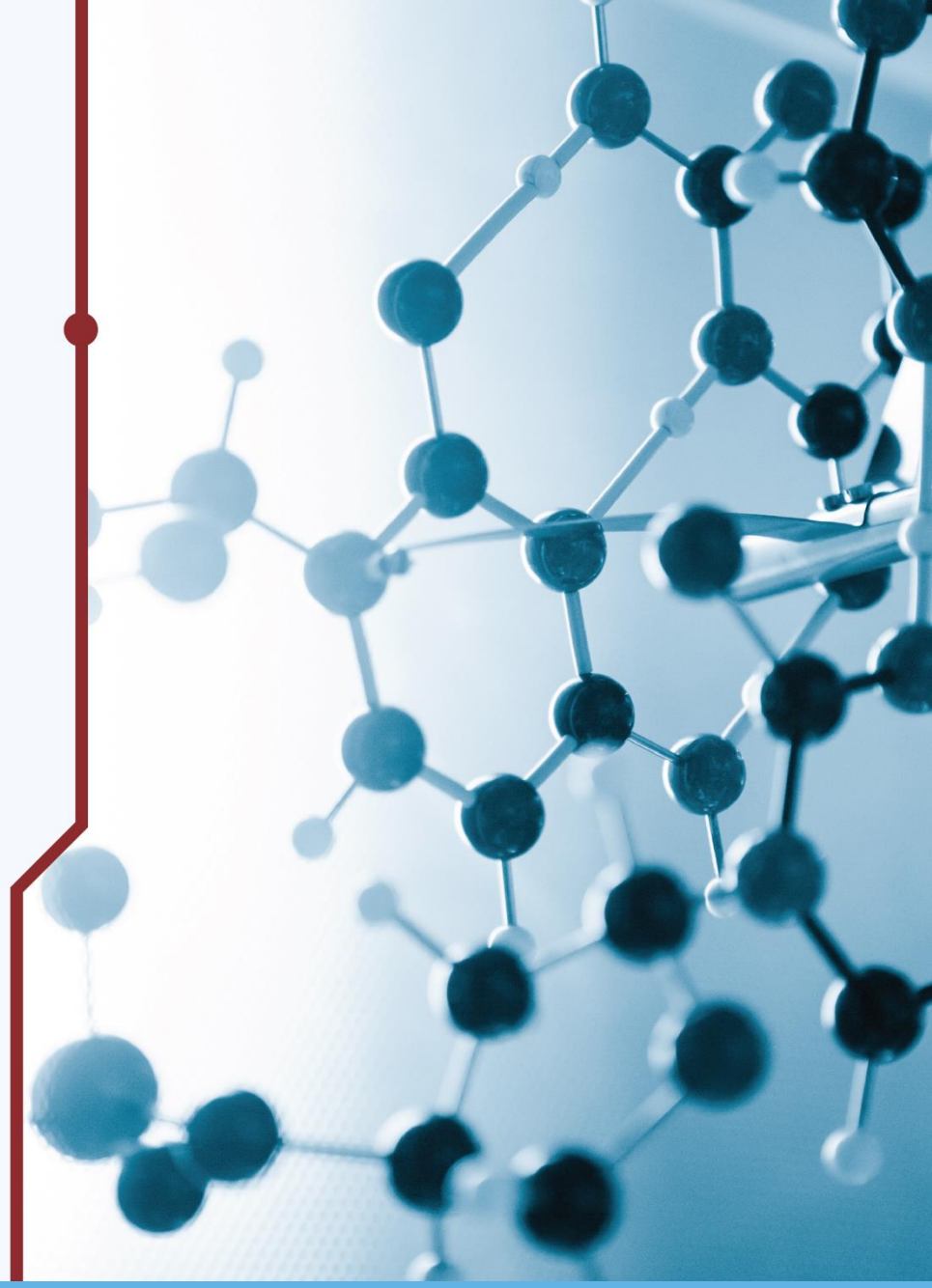
REINFORCE

REsearch INfrastructures FOR Citizens in Europe



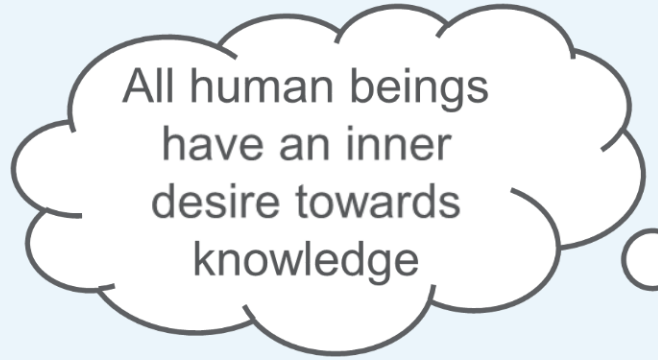
Muons in the particles Zoo

Theodore Avgitas

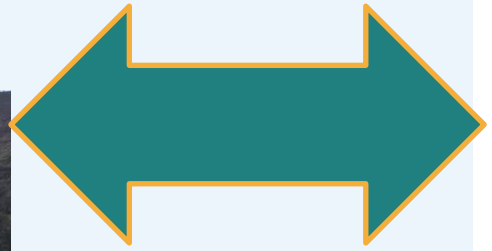
WEBINAR

May 11, 2021, 15:00 CEST

What is our Goal?



- Open a global channel of communication

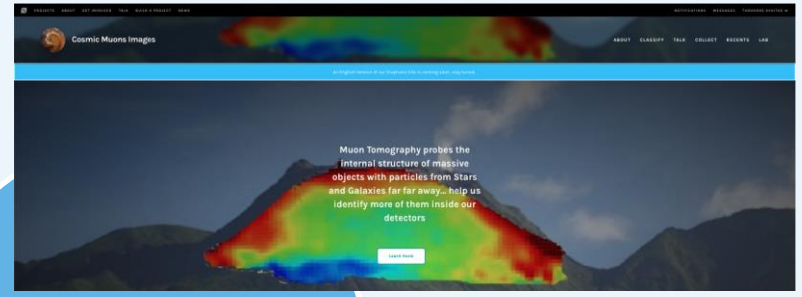


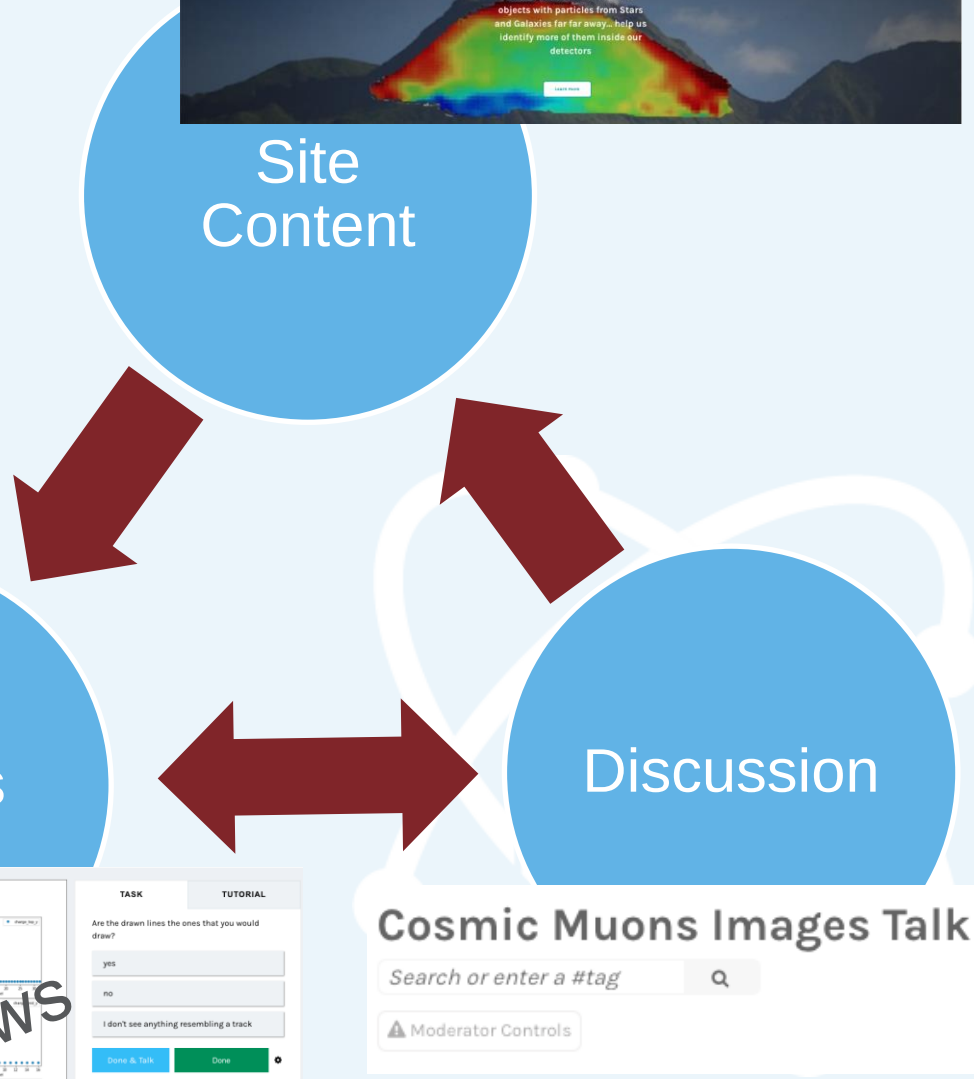
Diverse Scientific Disciplines

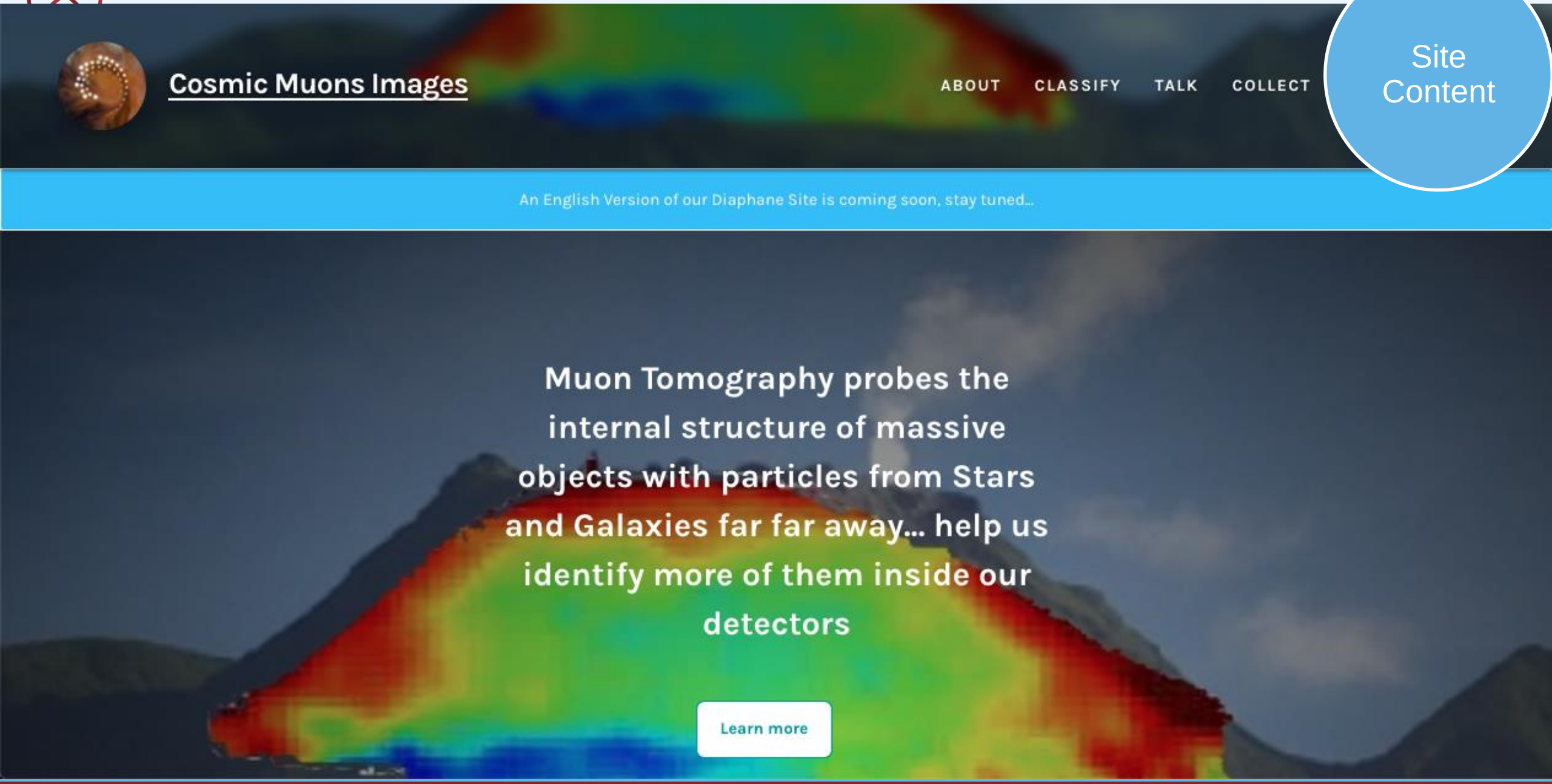
Diverse Community

Why ZOOniverse?

- A toolset to facilitate a communication cycle
- Trigger Curiosity
- Navigate the research landscape with citizens interested in science
- Practical applications through workflows
- **Benefits for all** through data processing and free time structuring







Site Content

Site Content

Cosmic Muons Images

ABOUT CLASSIFY TALK COLLECT

An English version of our Diaphane Site is coming soon, stay tuned...

Research The Team Education FAQ

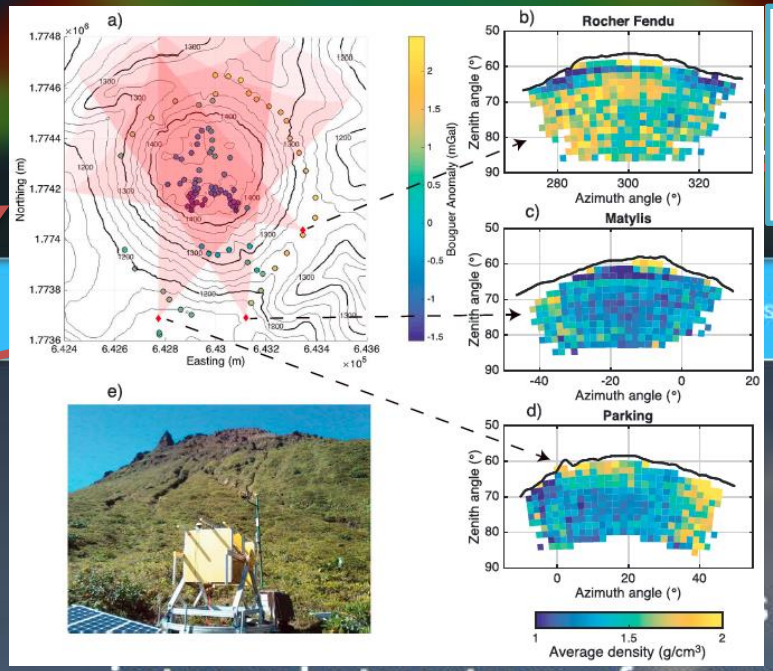
Muon Tomography

Muon tomography is a non-invasive method for the dete
used successfully in many expeditions where the remote
been proven most successful in volcanology either as a s
like gravimetry (Fig. 1) and electric resistivity. Since 2008
Grande Soufrière volcano in Guadeloupe while simultane
most recently archaeology.

Muon Tomography probes the internal structure of massive objects with particles from Stars and Galaxies far far away... help us identify more of them inside our detectors

Learn more

Cosmic Muons Images



1) Example: Muography + Gravimetry

Site Content

stay tuned...

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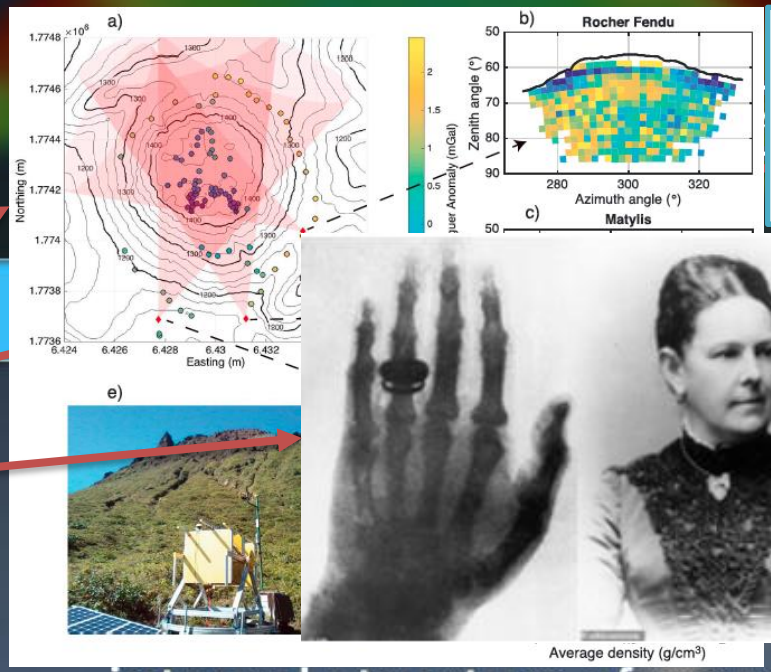

2) Muography / X-ray Analogy

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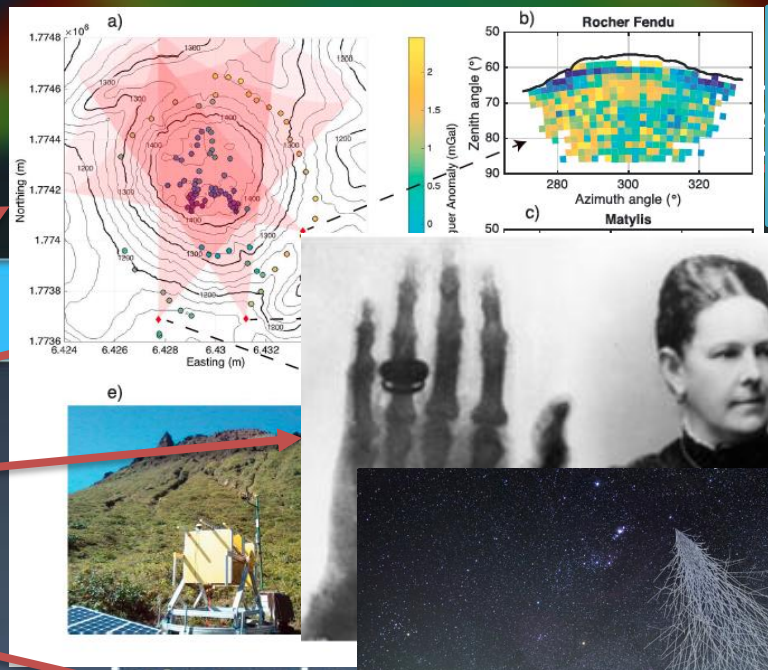

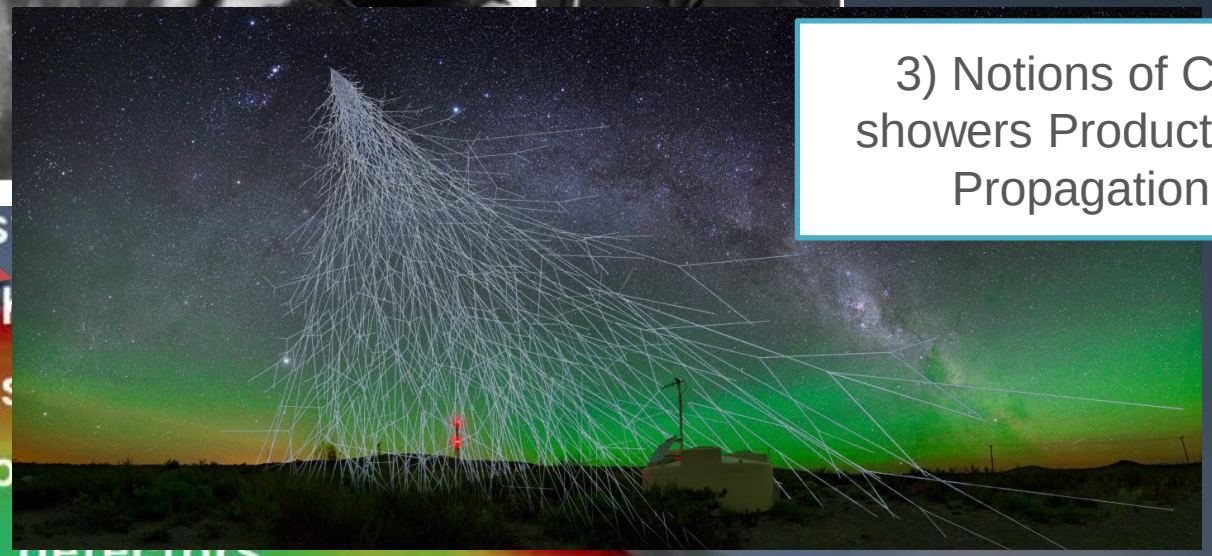

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1) Example: Muography + Gravimetry

2) Muography / X-ray Analogy

3) Notions of CR-showers Production - Propagation

Site Content

Site Content

1) Example: Muography + Gravimetry

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4) Principle behind the method

Cosmic Muons Images

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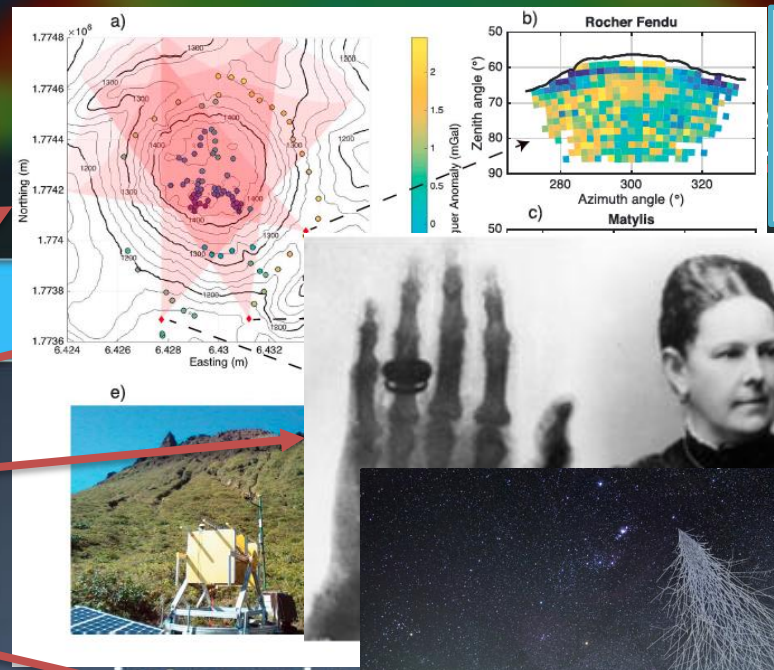

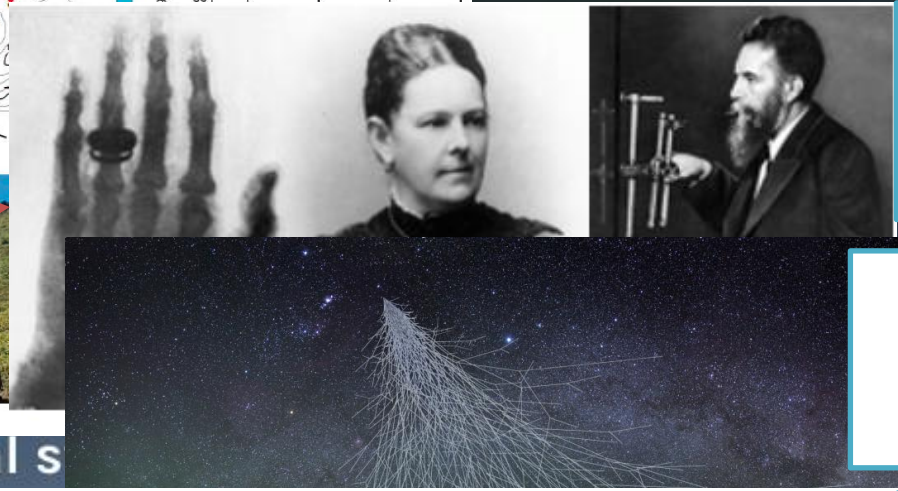

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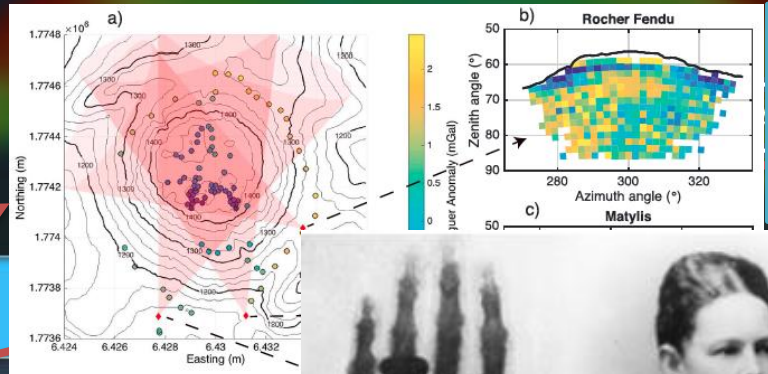

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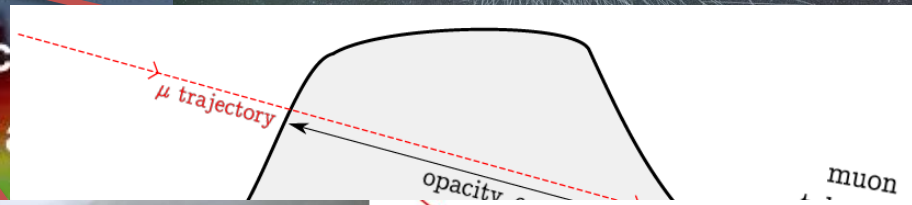
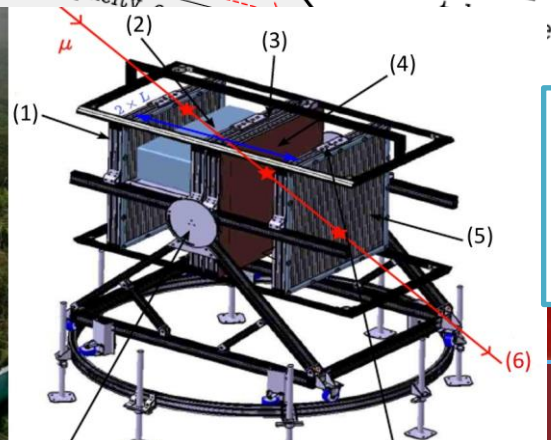


4) Principle behind the method



5) Our muon-telescope description

Site Content

1) Example: Muography + Gravimetry

2) Muography / X-ray Analogy

3) Notions of CR-showers Production - Propagation

4) Principle behind the method

5) Our muon-telescope description

6) Signal vs Background

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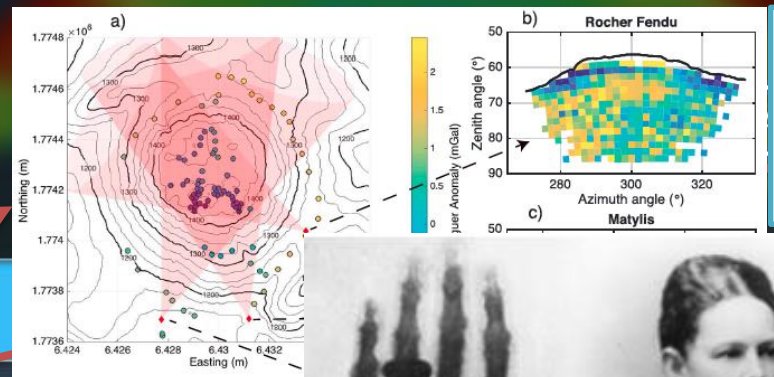

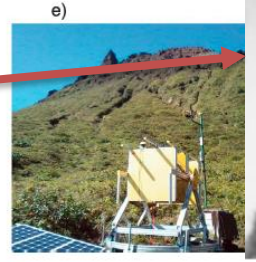

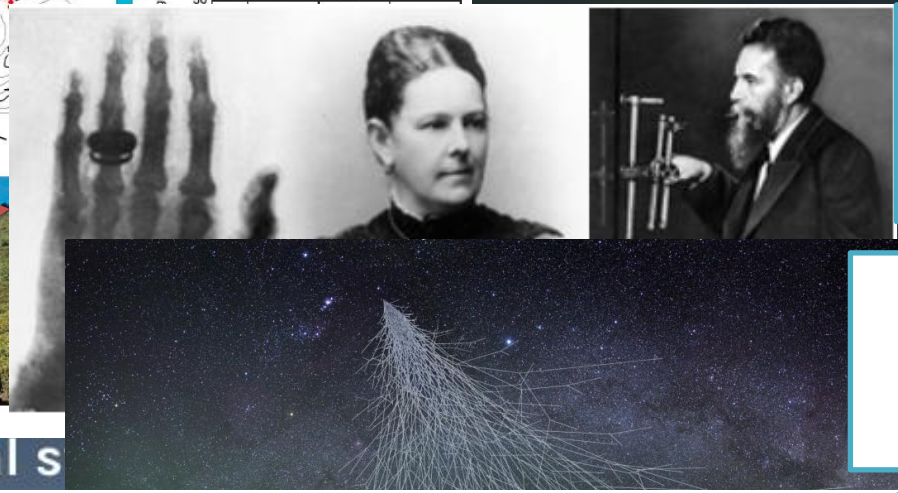

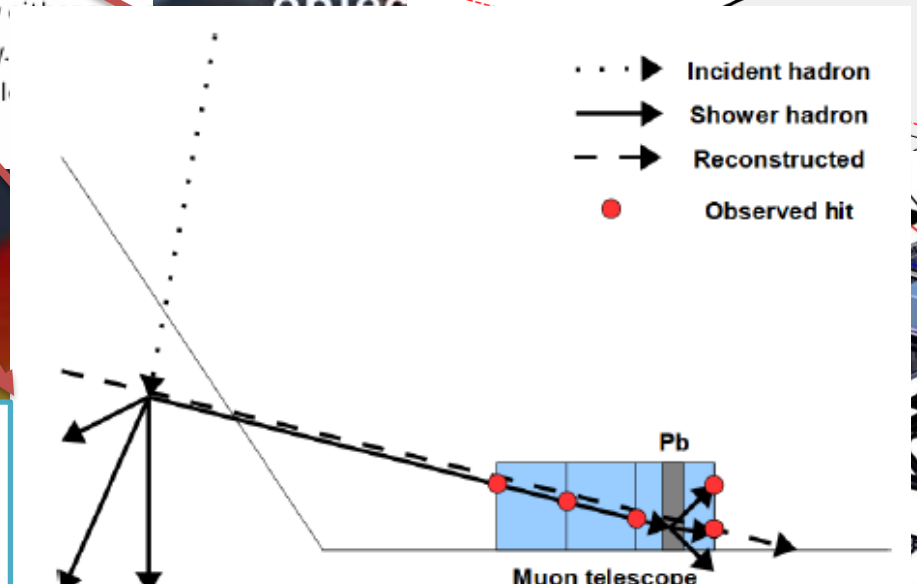

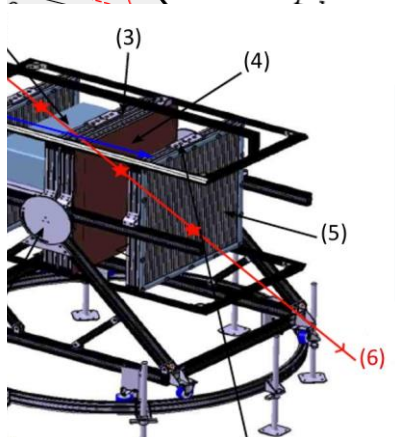

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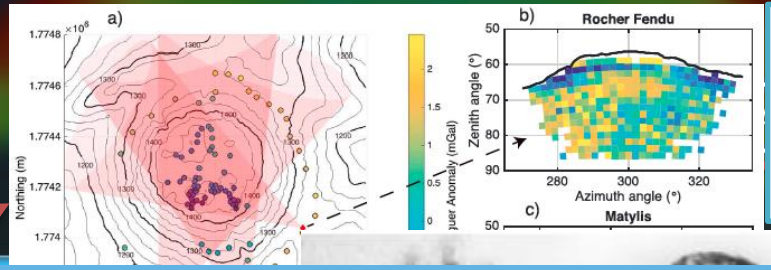
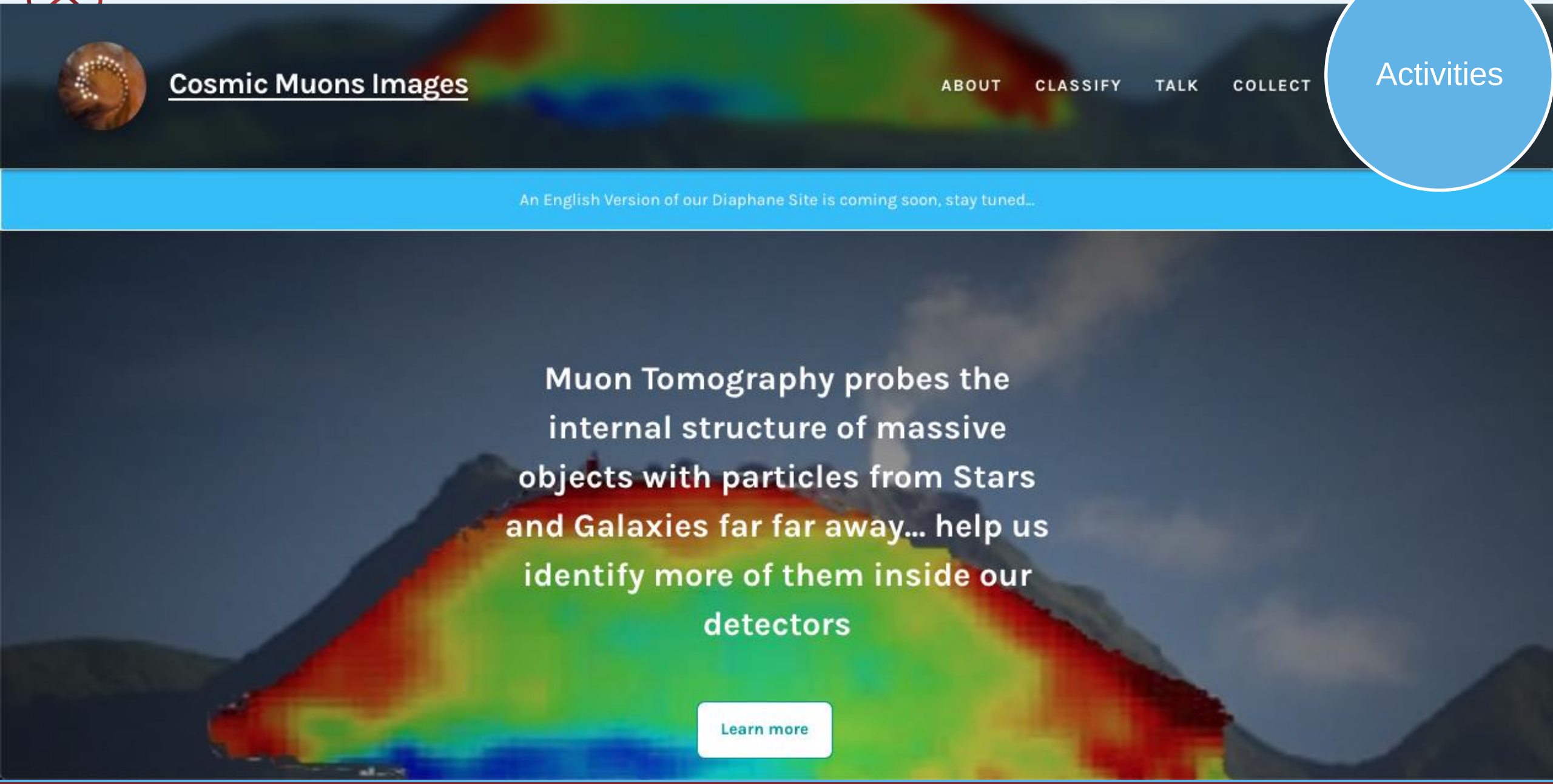


1) Example: Muography + Gravimetry

Site Content

Intention behind the text:

- Fast to read
- Easy to grasp
- Steppingstone towards:
  - Workflows
  - Discussion boards
  - Education
- Respect readers' time and attention span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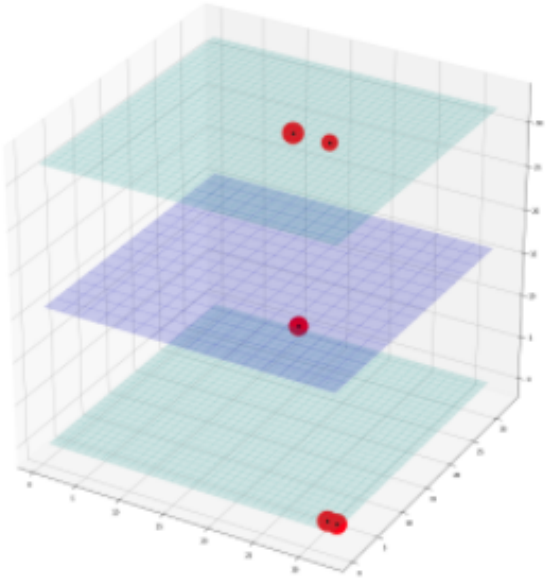
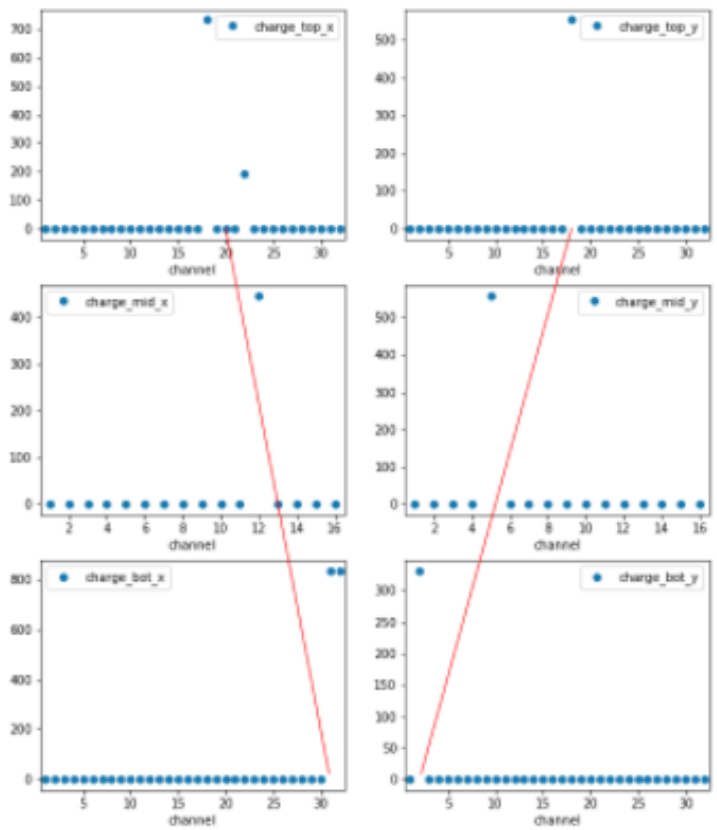




TASK | TUTORIAL

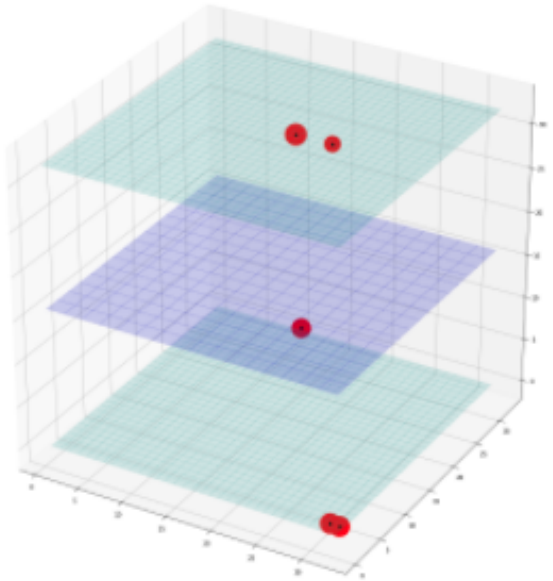
Are the drawn lines the ones that you would draw?

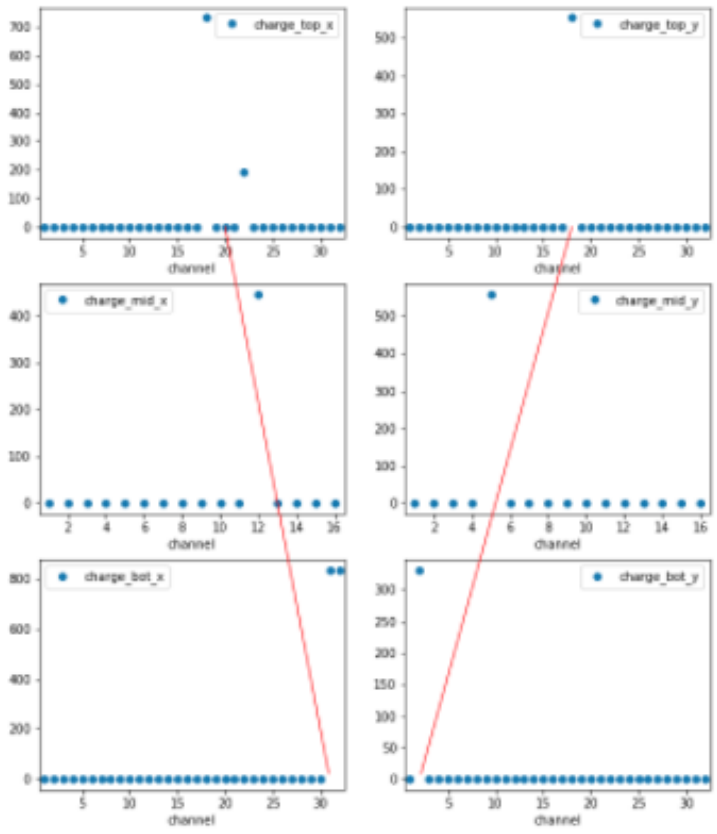
- yes
- no
- I don't see anything resembling a track

Done & Talk | Done

Cosmic Muons Images

ABOUT CLASSIFY TALK COLLECT





TASK TUTORIAL

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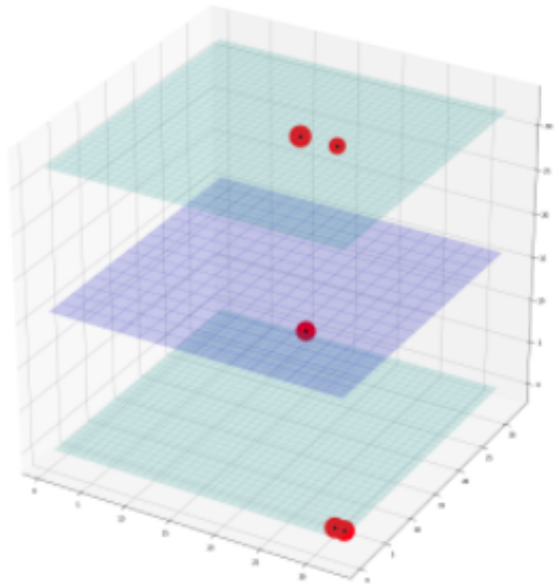
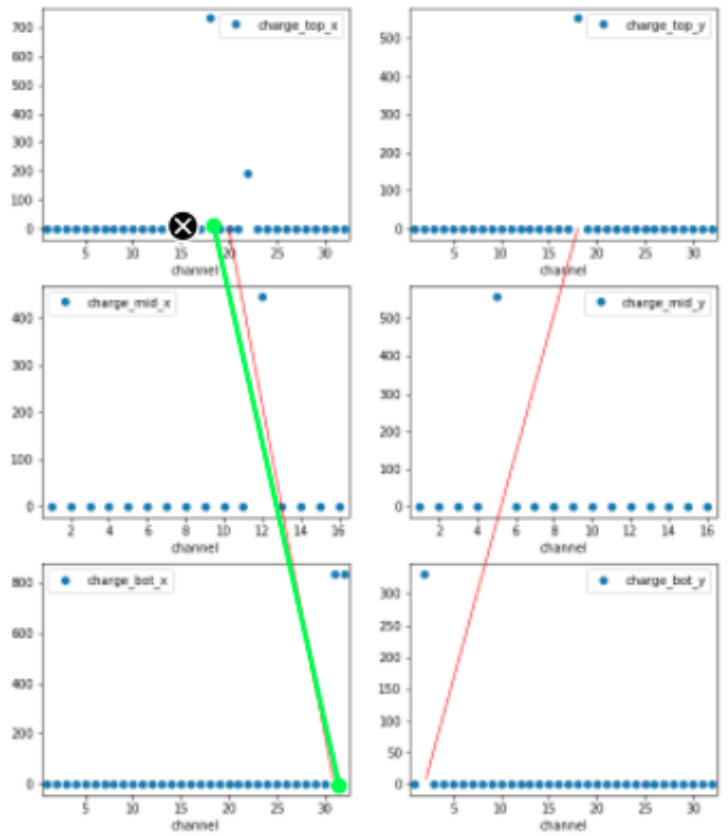
Next →





TASK TUTORIAL

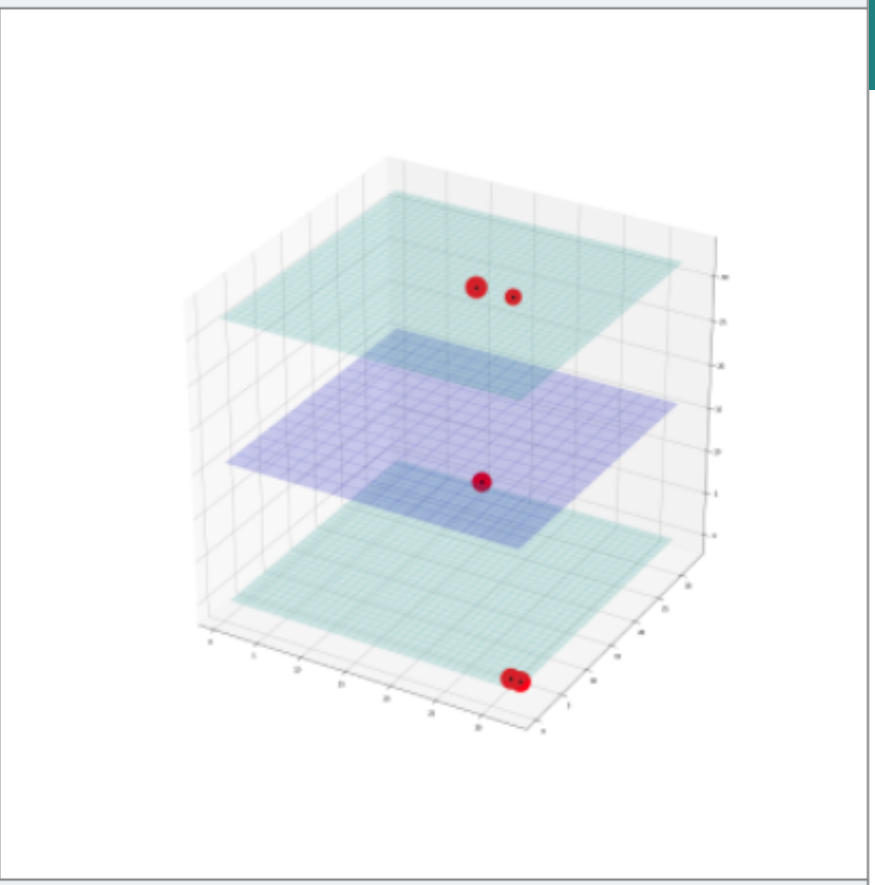
Draw the proper line(s) for this event

Track Drawer — 1 of 1 required, 11 maximum drawn

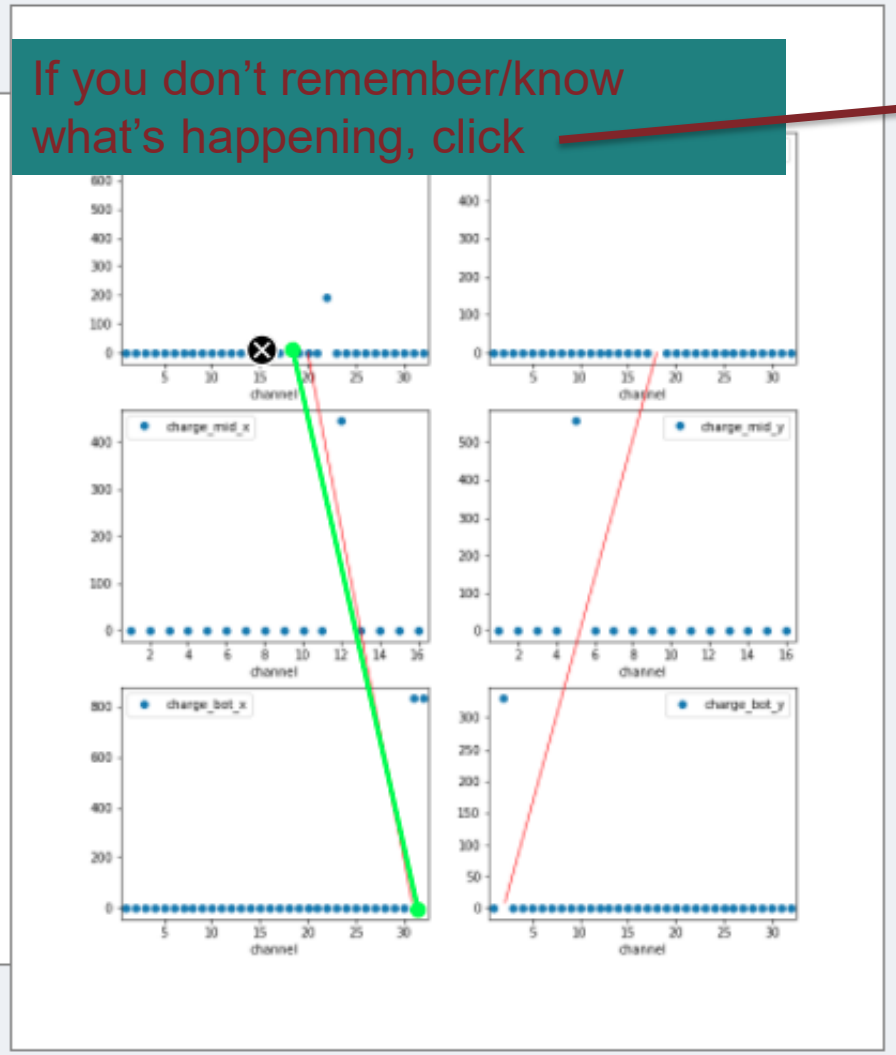
Extra Particle Strikes — 0 of 0 required, 6 maximum drawn

Back | Done & Talk | Done

Activities



If you don't remember/know what's happening, click



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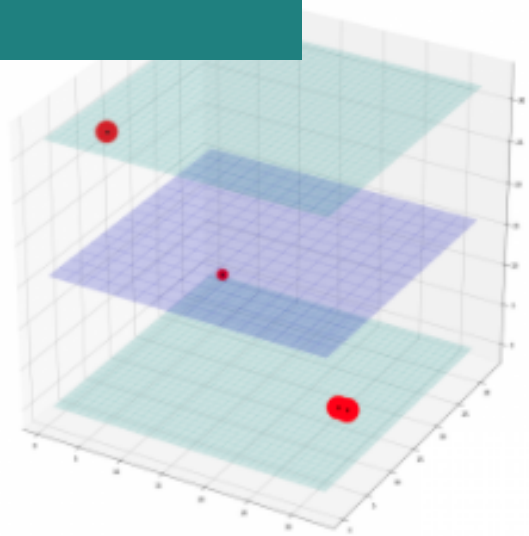
New Dialog Box Opens With Instructions



A 3D representation of the event is provided for an easier visualization of each event. Each plane denotes a detector plane. A red sphere is used to denote the places on the plane that a particle crossed. The size of these spheres are proportional to the energy this particles left on our detector.

Continue

TASK | TUTORIAL

Are the drawn lines the ones that you would draw?

yes

no

I don't see anything resembling a track

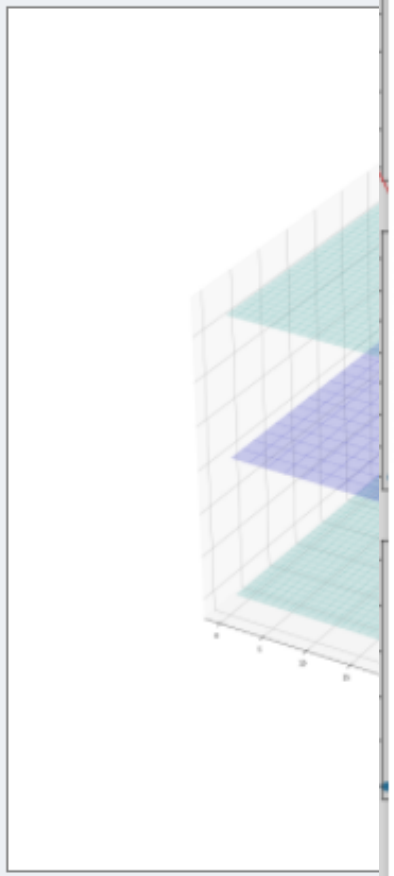
Done & Talk | Done

Activities

TUTORIAL

Done

New Dialog Box Opens With Instructions
You can go through all the steps



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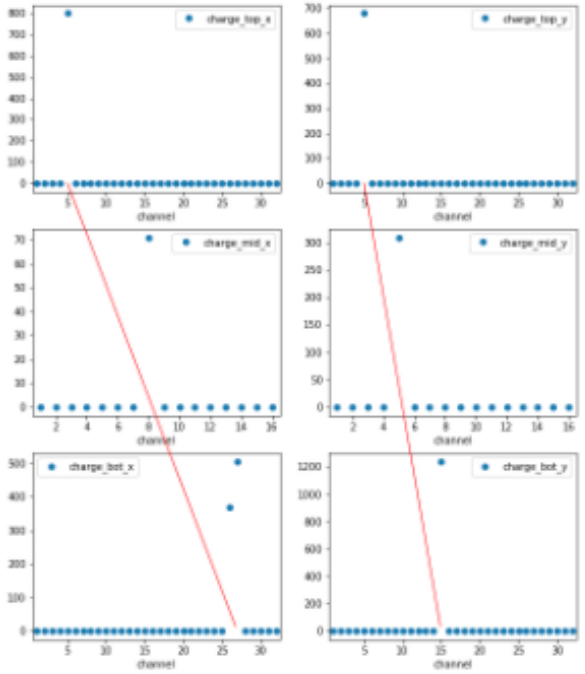

An algorithm is used that provides a possible track based on the registered signals. In this case the algorithm did a pretty good job identifying

Continue

TASK

TUTORIAL

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Done

Activities

TUTORIAL

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Done

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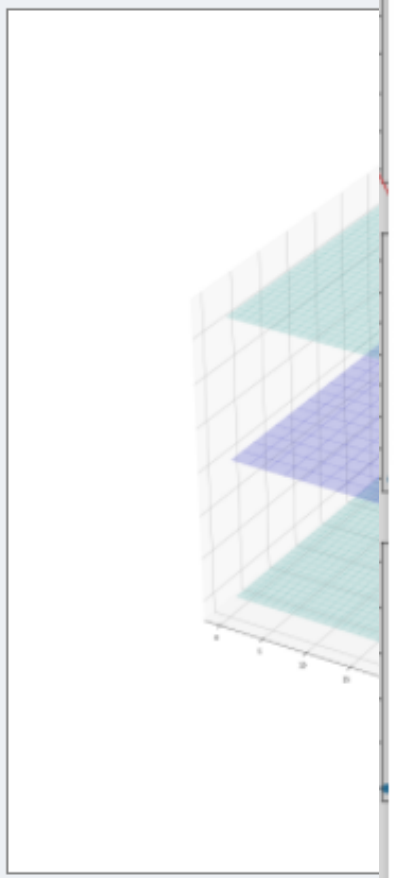

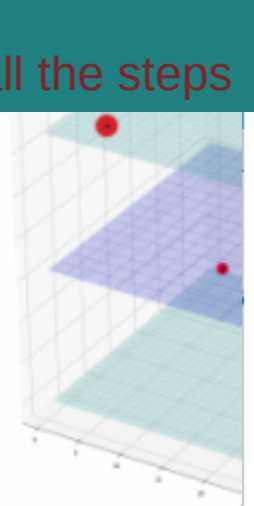

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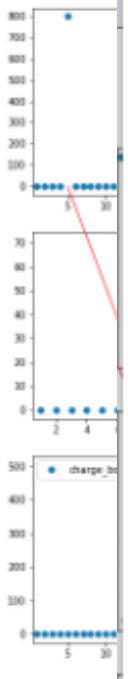

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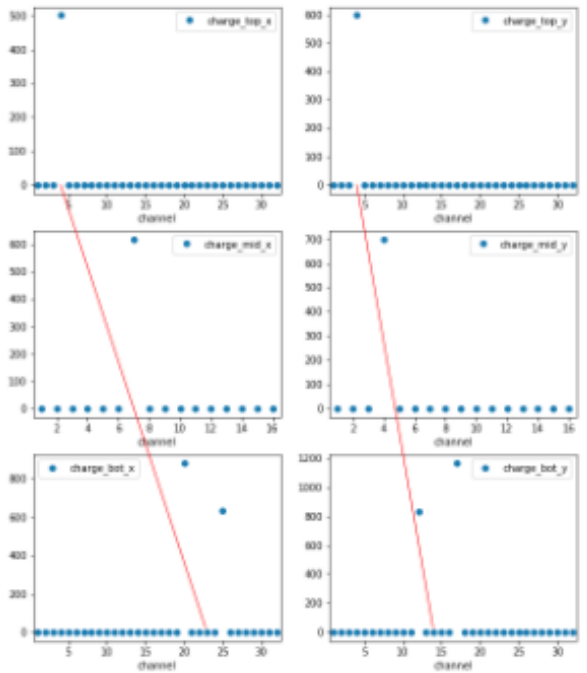

There is also more complicated events where the algorithm finds a track but a closer look makes it clear that it's not right.

Continue

TASK

TUTORIAL

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TUTORIAL

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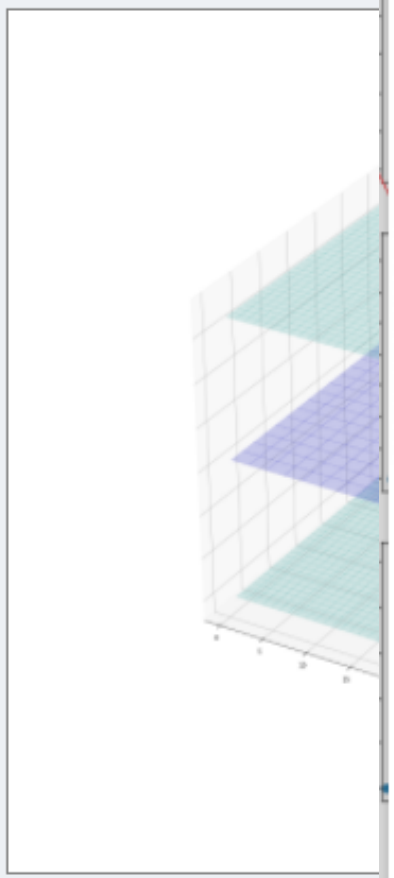
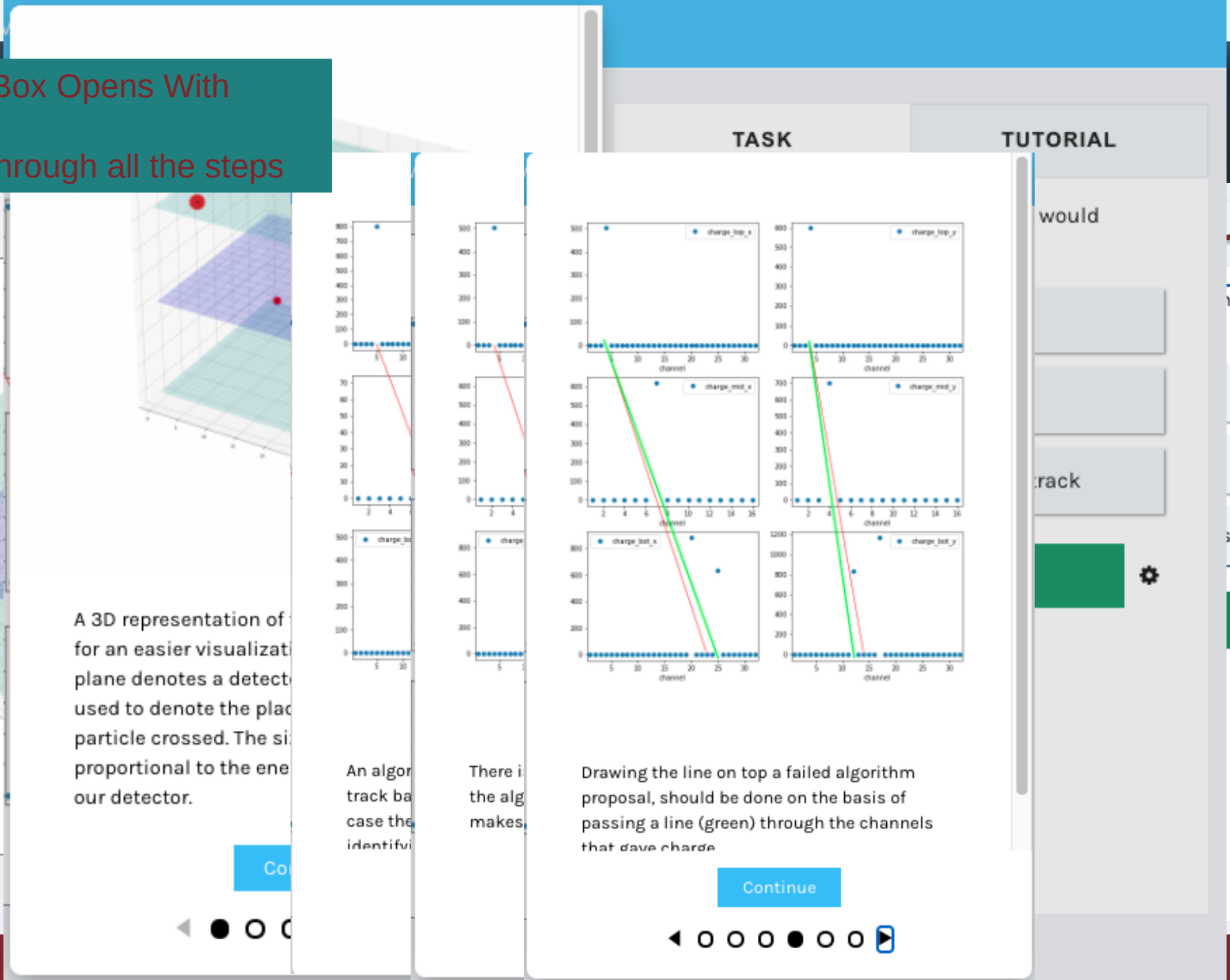
New Dialog Box Opens With Instructions
You can go through all the steps





Activities

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Activities

TASK

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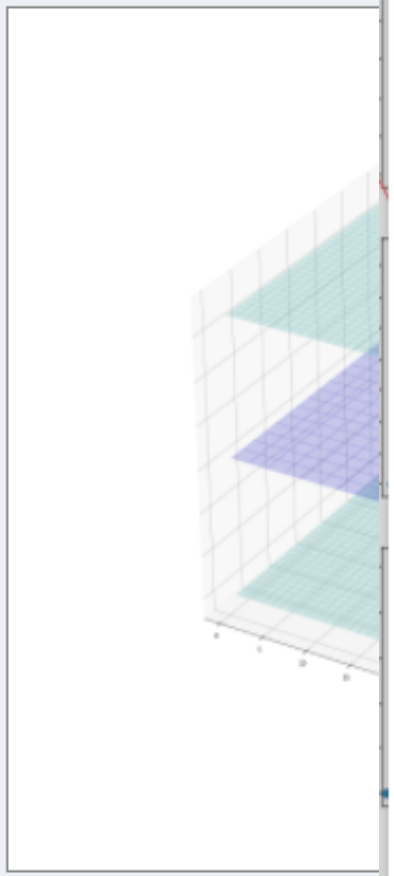

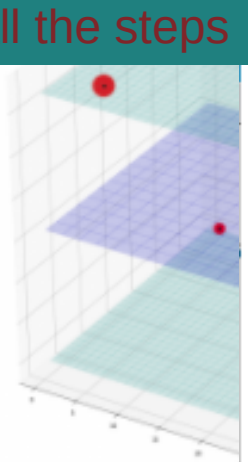

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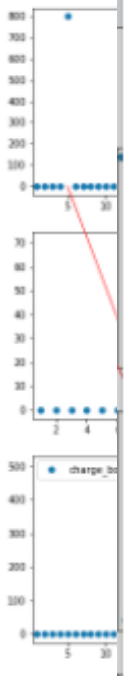

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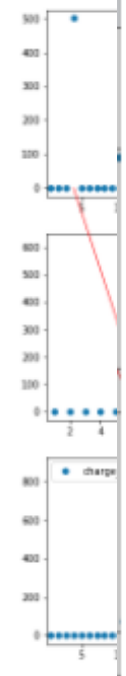

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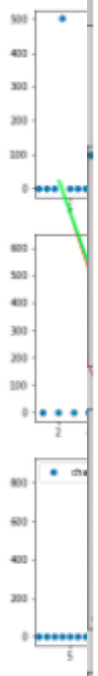

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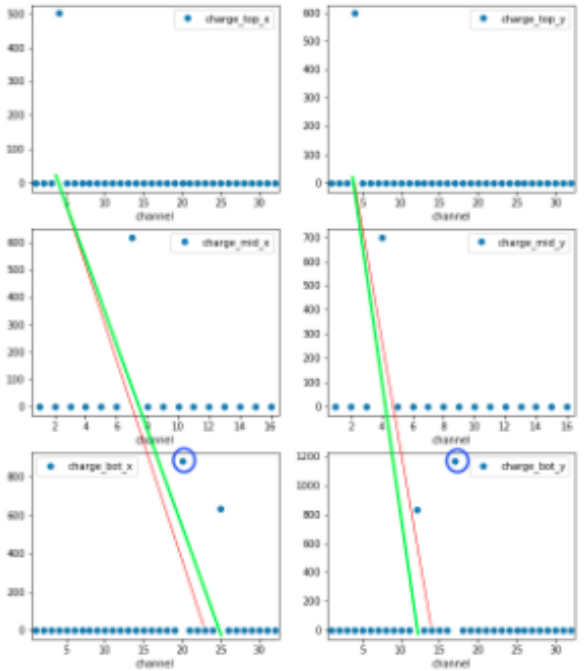


After the "proper" track lines have been drawn we see that in both the lower part of the detector (charge_bot_x and charge_bot_y) two "orphan" points remain

Continue

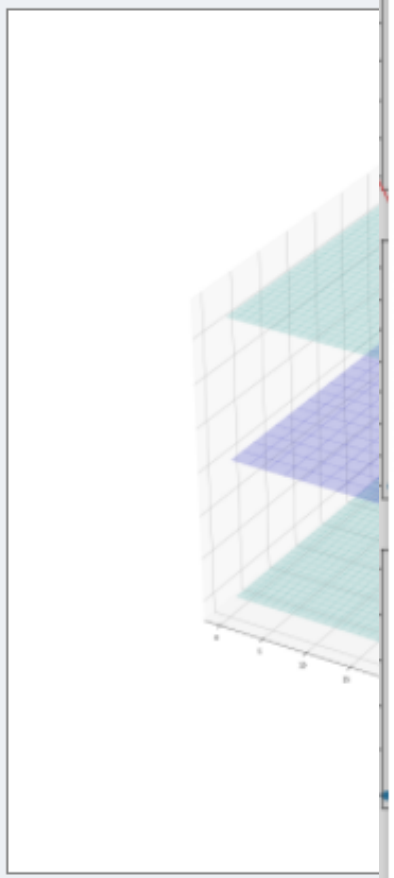
TUTORIAL

es that you would

sembling a track

Done

New Dialog Box Opens With Instructions
You can go through all the steps
Ending with a takeaway thought



Activities

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Done

2 Workflows: 1st – Introductory & Guided

2nd – Same approach with moderate difficulty

- Goal:
  - Familiarize citizen scientists with muon-telescopes
    - Geometry
    - Response to particles
  - Use the results of this work to better understand our detectors
    - Categorize patterns
    - Revisit reconstruction algorithms with different approach
  - Travel through different domains of this scientific field
    - Calibration
    - Detection
    - Simulation

Cosmic muons images - Outlook

- Professional & Amateur Scientists join forces to do Muography
- Discuss Geology, Environment and Particle physics interplay
- Open up our Lab to society (virtual visits, webinars, talks…)
- Citizen Scientists event categorization helps:
  - Revisit our reconstruction/event selection algorithms efficiency
  - Investigate potential Machine Learning/Deep Learning event identification through pattern recognition
  - Develop/test Monte Carlo Simulations of our detector-target system to study signal/background effects

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ZOOniverse Summer 2021

url: https://www.reinforceeu.eu/demonstrators/cosmic-muons-images

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BACKUP SLIDES