

# An Interactive Learning Unit about PET

*Positron-Emission-Tomography*



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**Interactive  
learning units are  
a new, virtual, and  
versatile format for  
classroom and  
distance learning**



# MOTIVATION



COVID-related challenges for  
our visitors to come to CERN



Enhancement of our online offers  
beyond the pandemic times



An Interactive Learning Unit about PET | Sarah Zoechling



Extension of the hands-on  
PET workshop in our lab

# AIM #1

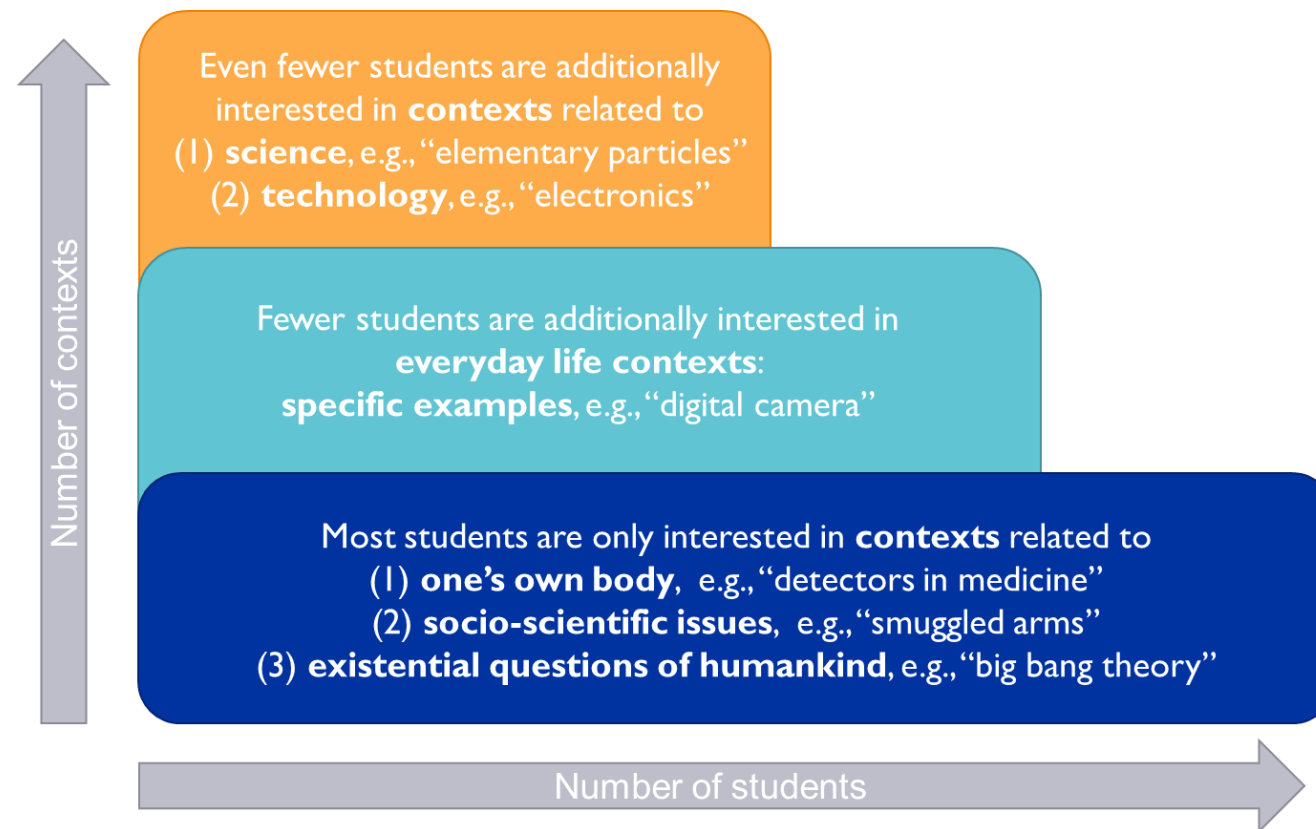
## Foster students' interest in particle physics!

- **Past empirical studies:**  
Most students are interested in medical contexts

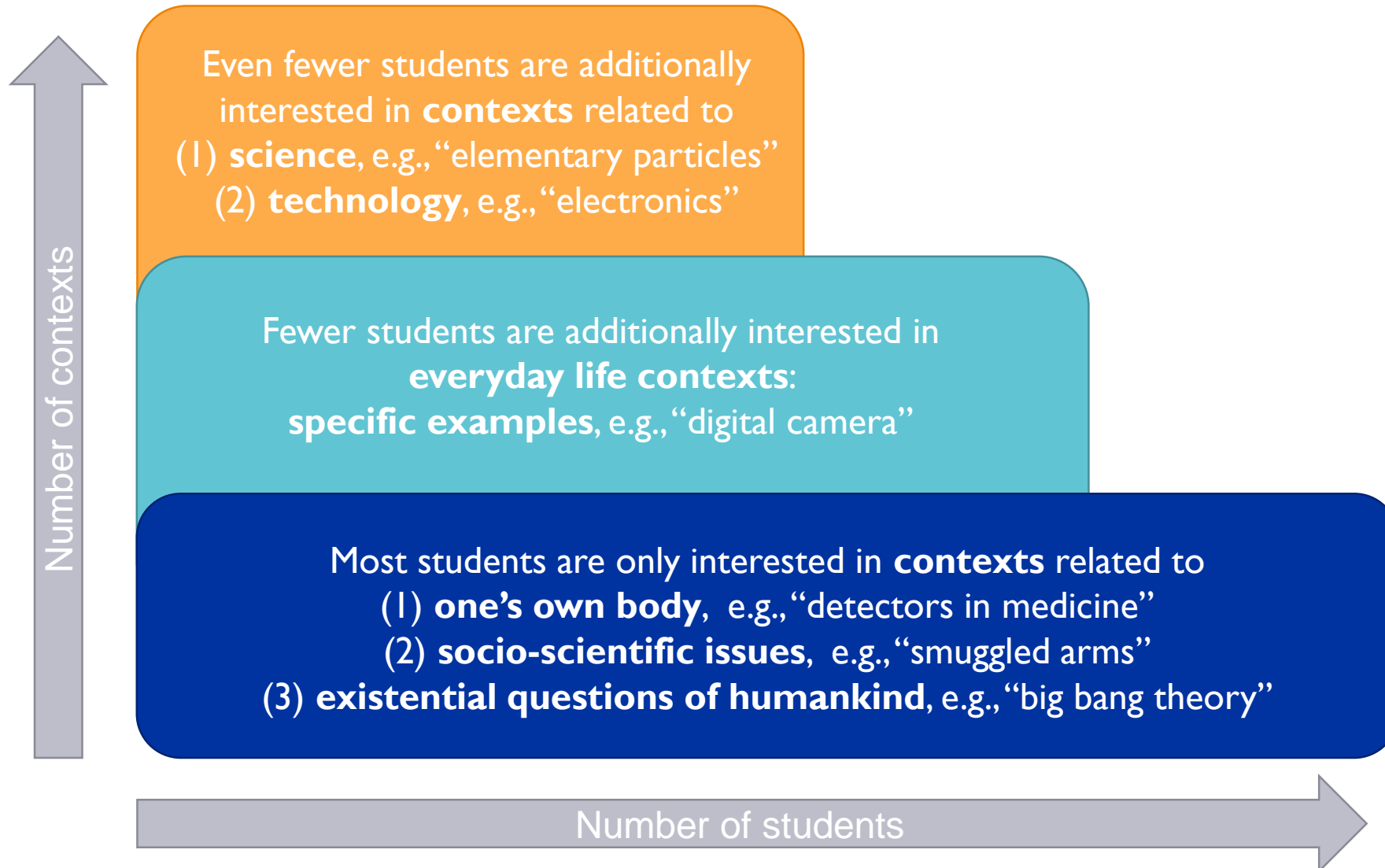
OECD (2016), Levrini et al. (2017)

- **My PhD project:**  
Conceptualisation of interest in Particle Physics

Zöchling et al. (2022)



# Conceptualisation of Interest in Particle Physics



# AIM #2

Easy to use for teachers in  
classroom and distance learning

- **Duration:** 2 school lessons
- Can be done on one's **own laptop or tablet**, in the **school IT room** or with **school tablets**
- **Target age:** 16+





# AIM #2

Easy to use for teachers in  
classroom and distance learning

- **Format:** H5P Module
  - ⇒ Can be easily **embedded in learning platforms** (e.g., Moodle, Blackboard, Brightspace, ...)
- **Link:** [cern.ch/petworkshop](https://cern.ch/petworkshop)

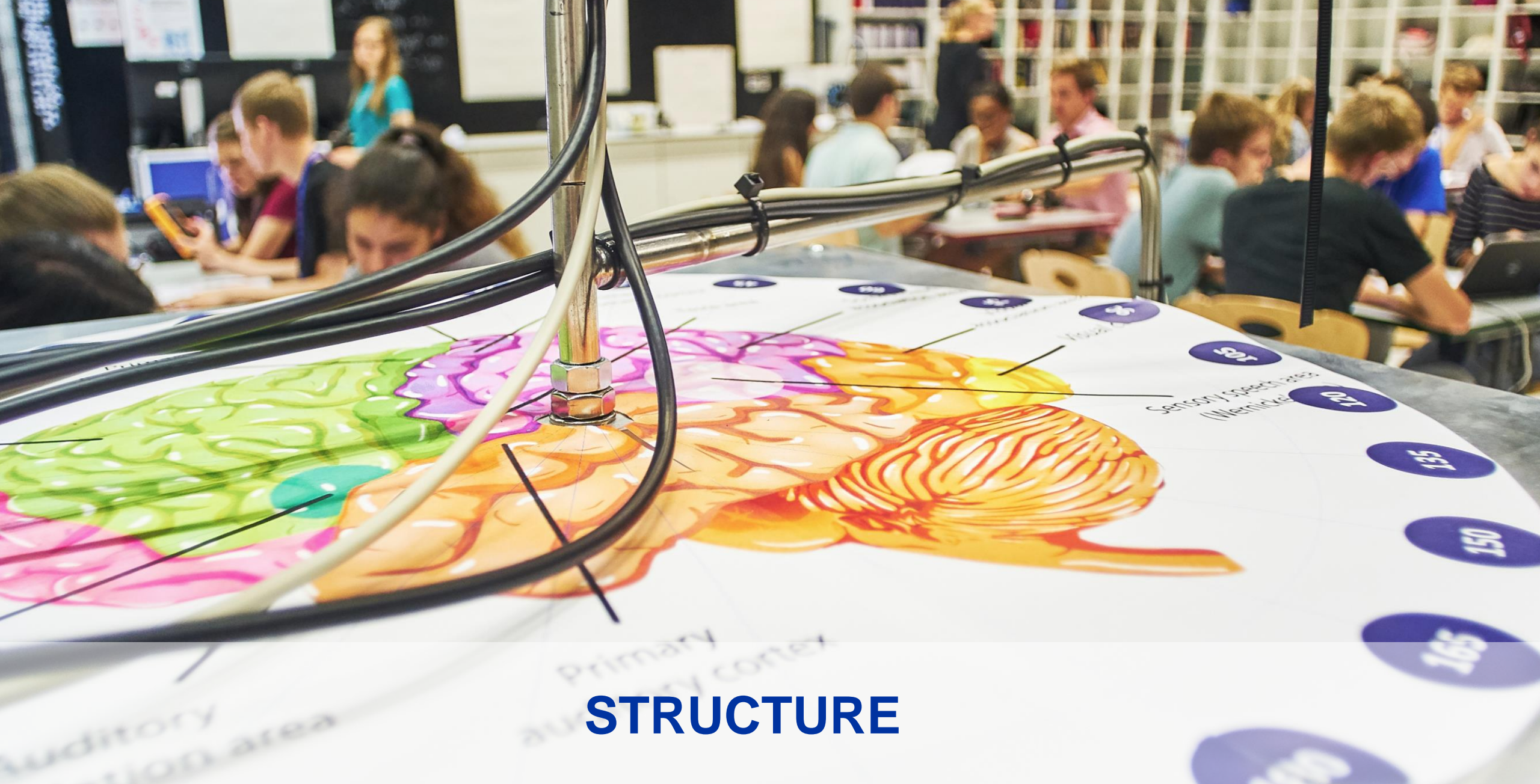


# LANGUAGE

- English
- Subtitles in different languages



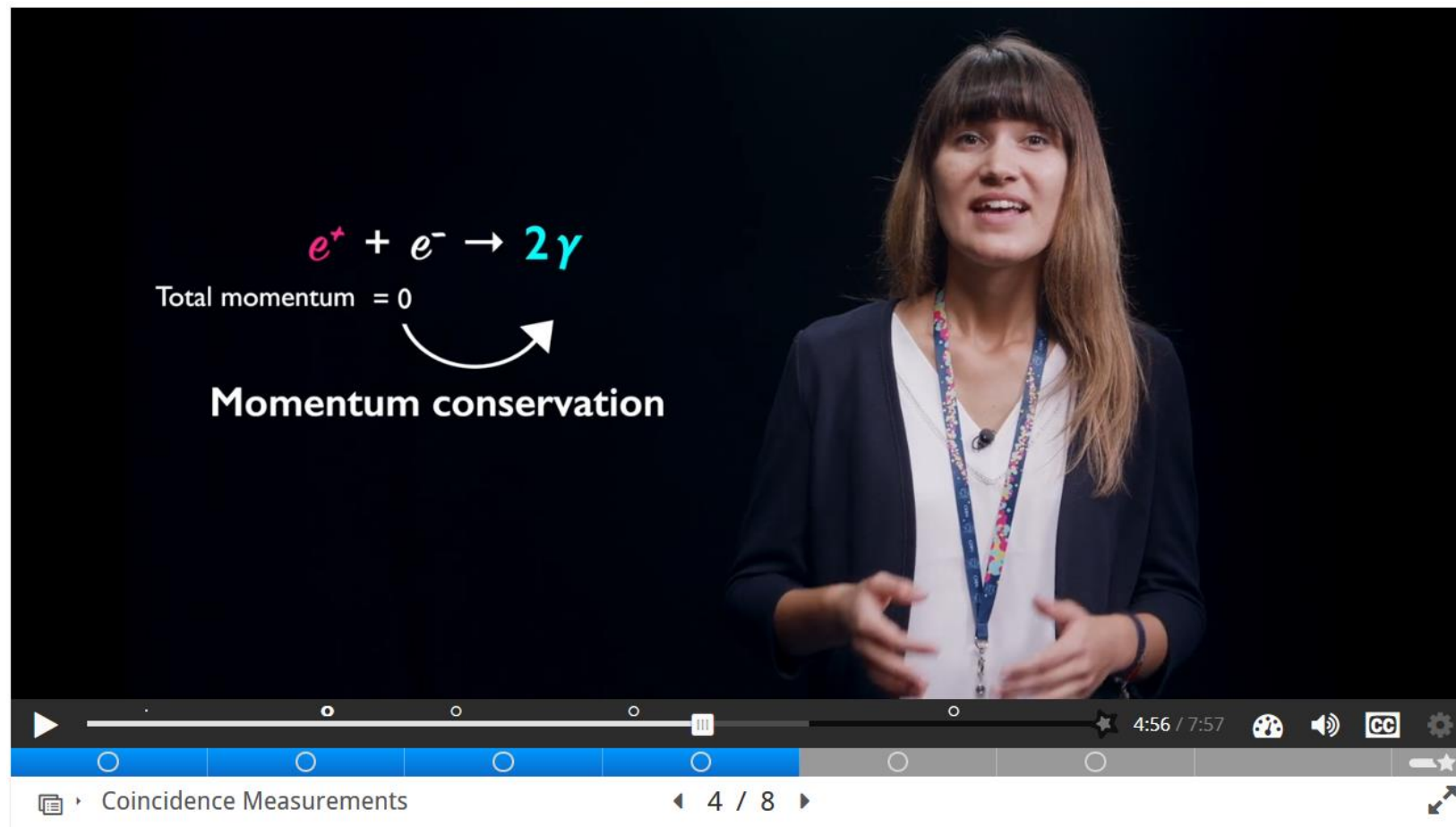




# STRUCTURE

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## Explanatory Videos



The video player displays a woman with long brown hair and bangs, wearing a dark blue blazer over a white shirt and a colorful lanyard. She is speaking and gesturing with her hands. To her left, a diagram illustrates the process of electron-positron annihilation. The equation  $e^+ + e^- \rightarrow 2\gamma$  is shown, with  $e^+$  in red,  $e^-$  in black, and  $2\gamma$  in green. Below the equation, the text "Total momentum = 0" is displayed. A white curved arrow points from this text to the text "Momentum conservation" below it. The video player interface includes a progress bar at the bottom, showing a play button, a progress slider, and a timestamp of 4:56 / 7:57. Below the progress bar, the text "Coincidence Measurements" is visible, followed by a page indicator "4 / 8".

$e^+ + e^- \rightarrow 2\gamma$

Total momentum = 0

Momentum conservation

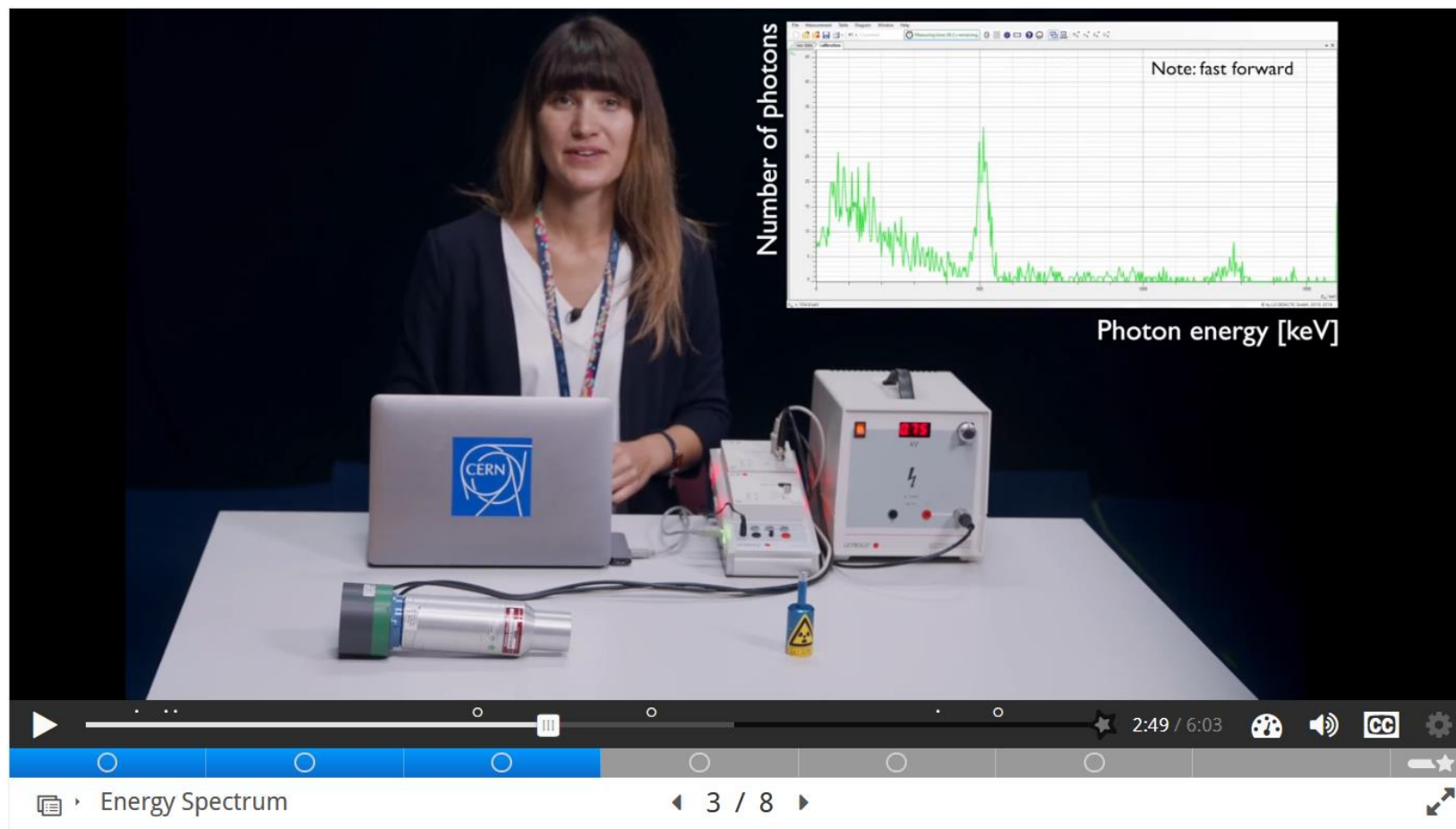
4:56 / 7:57

Coincidence Measurements 4 / 8



# STRUCTURE

## Experiment Videos

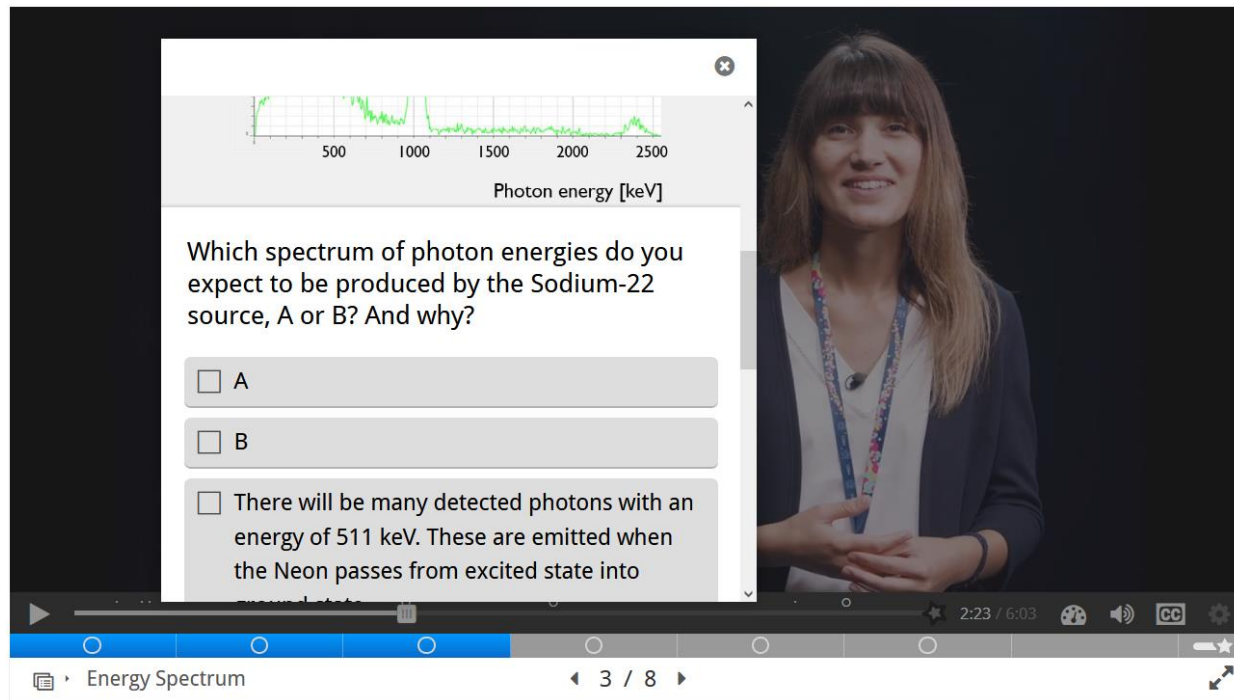


The video player displays a woman with long brown hair and bangs, wearing a dark blazer over a white shirt and a colorful lanyard. She is seated at a white desk. On the desk, there is a silver laptop with a blue CERN logo, a small electronic device with a red digital display showing '0.15', and a larger white power supply unit with a red digital display showing '0.15'. A blue and yellow radiation warning symbol is visible on the desk. The background is dark. An inset window in the top right corner shows a graph titled 'Number of photons' on the y-axis and 'Photon energy [keV]' on the x-axis. The graph displays a green line with a prominent peak around 511 keV. A text box in the top right of the graph area says 'Note: fast forward'. The video player interface at the bottom shows a progress bar, a play button, and a star icon. The video title 'Energy Spectrum' is visible on the left, and the page number '3 / 8' is in the center.



# STRUCTURE

## Interactive Elements



Photon energy [keV]

Which spectrum of photon energies do you expect to be produced by the Sodium-22 source, A or B? And why?

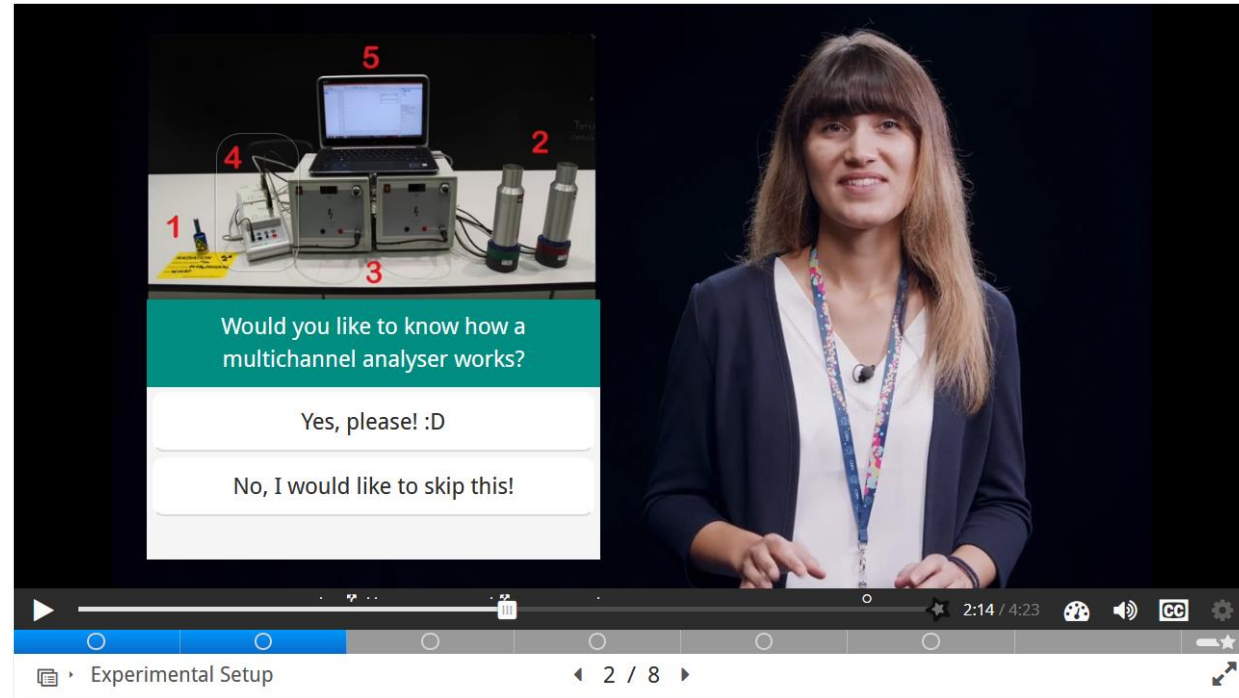
☐ A

☐ B

☐ There will be many detected photons with an energy of 511 keV. These are emitted when the Neon passes from excited state into ground state

Energy Spectrum 3 / 8

## Quizzes



Would you like to know how a multichannel analyser works?

Yes, please! :D

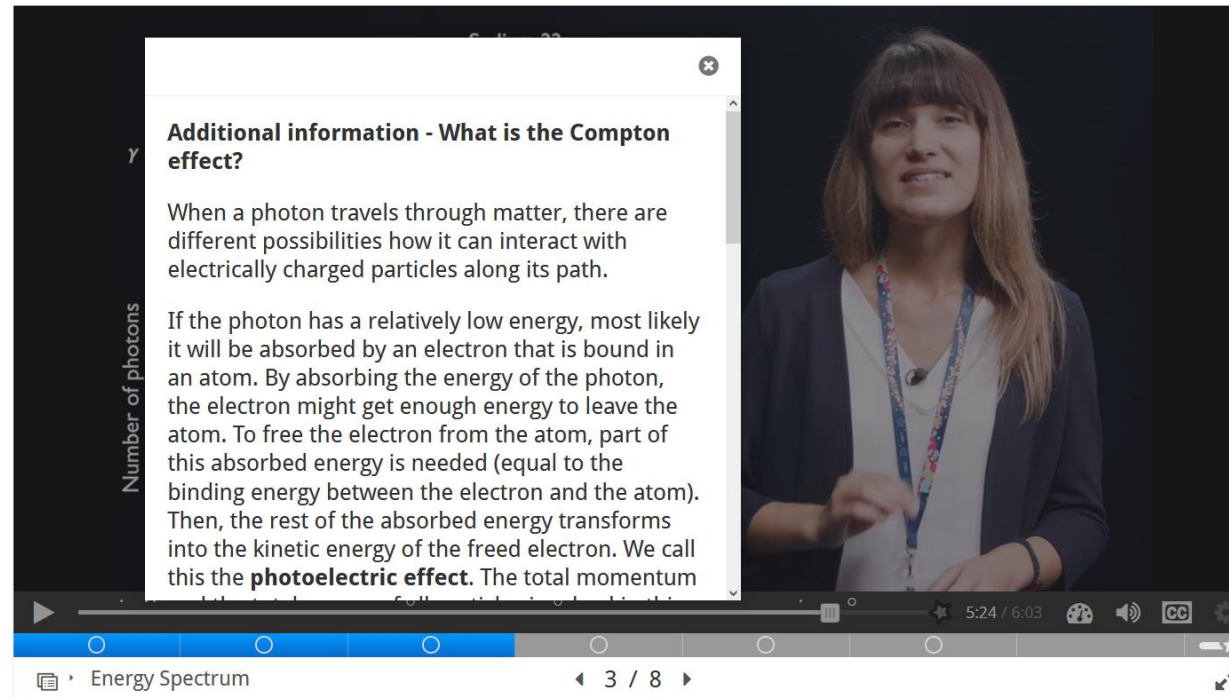
No, I would like to skip this!

Experimental Setup 2 / 8

## Shortcuts

# STRUCTURE

## Interactive Elements



The screenshot shows a video player interface. On the right, a woman with long brown hair and a blue lanyard is speaking. On the left, a white text box with a close button in the top right corner contains the following text:

**Additional information - What is the Compton effect?**

When a photon travels through matter, there are different possibilities how it can interact with electrically charged particles along its path.

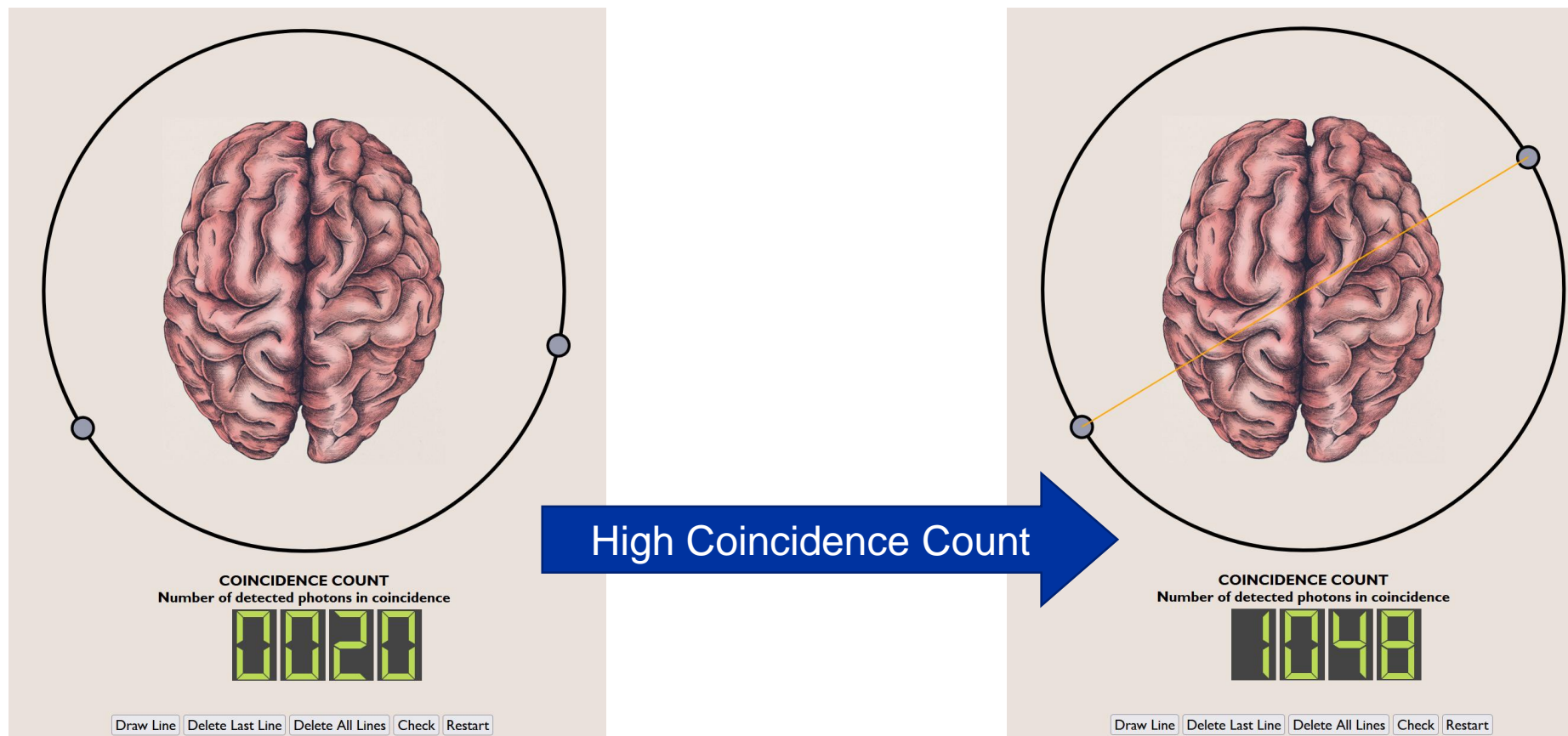
If the photon has a relatively low energy, most likely it will be absorbed by an electron that is bound in an atom. By absorbing the energy of the photon, the electron might get enough energy to leave the atom. To free the electron from the atom, part of this absorbed energy is needed (equal to the binding energy between the electron and the atom). Then, the rest of the absorbed energy transforms into the kinetic energy of the freed electron. We call this the **photoelectric effect**. The total momentum

Below the text box, a video progress bar is visible with a play button, a progress slider, and a timestamp of 5:24 / 6:03. At the bottom of the player, there is a navigation bar with the text 'Energy Spectrum' and a page indicator '3 / 8'.

### Additional Information

# STRUCTURE

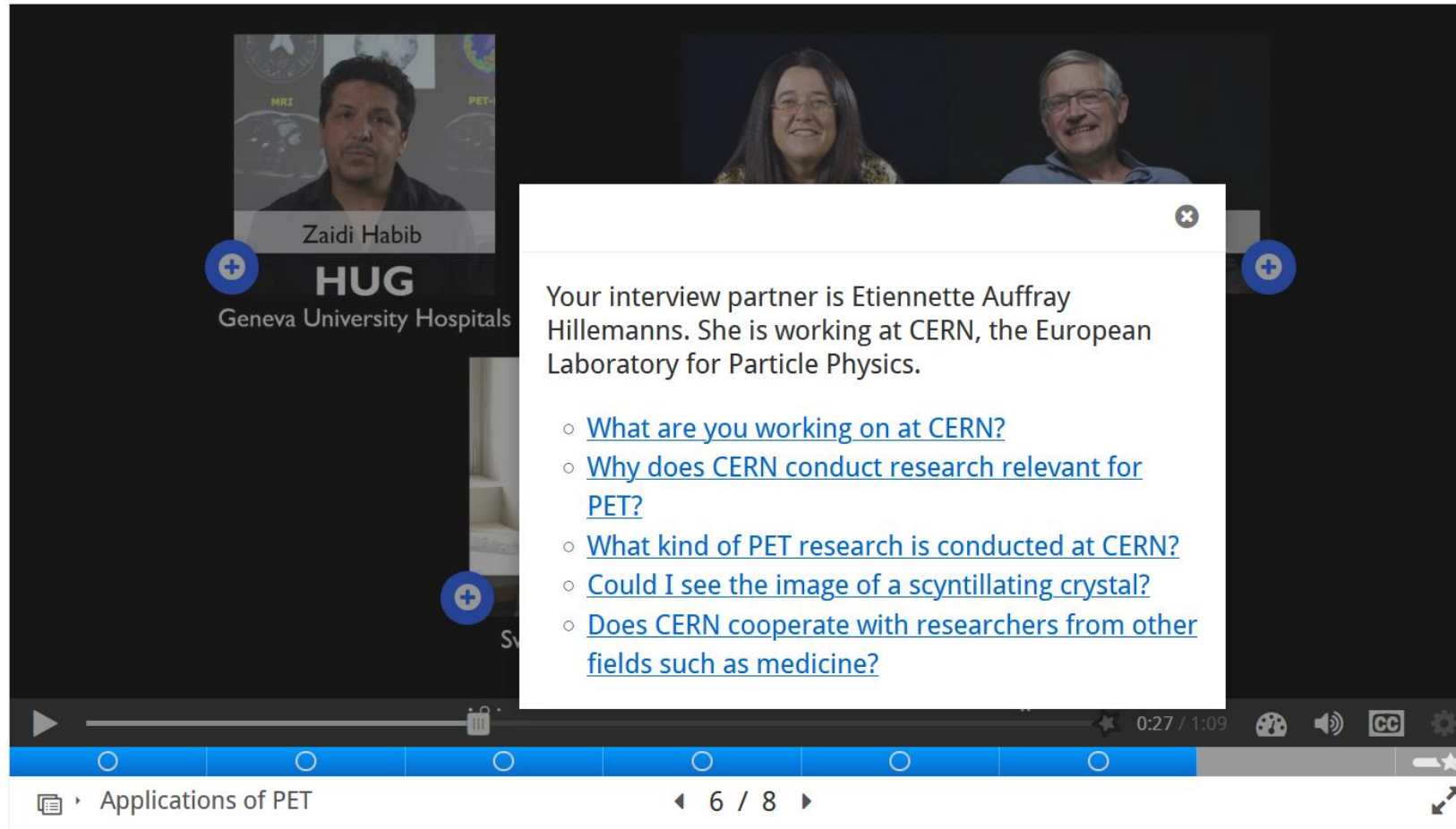
## Interactive PET Experiment





# STRUCTURE

## Interviews with Experts



The screenshot shows a video player interface. On the left, a video frame displays Zaidi Habib, a man with dark hair, wearing a dark shirt. Below his video frame, the text "Zaidi Habib" and "HUG Geneva University Hospitals" is visible. To the right of the video frame, a white pop-up box with a close button (X) in the top right corner contains the following text:

Your interview partner is Etiennette Auffray Hillemanns. She is working at CERN, the European Laboratory for Particle Physics.

- [What are you working on at CERN?](#)
- [Why does CERN conduct research relevant for PET?](#)
- [What kind of PET research is conducted at CERN?](#)
- [Could I see the image of a scyntillating crystal?](#)
- [Does CERN cooperate with researchers from other fields such as medicine?](#)

At the bottom of the video player, a progress bar shows the video is at 0:27 / 1:09. Below the progress bar, the text "Applications of PET" is visible, followed by a navigation bar with 8 icons, the current icon being the 6th one. The video player also features standard controls like play, pause, volume, and a star icon for bookmarks.

# NEXT STEPS



## ❖ **Subtitles:**

Adding further languages

## ❖ **Advertisement:**

Spreading the Interactive Learning Unit about PET among educators

## ❖ **Physics Education Research:**

A new PhD project aims

- to **evaluate** the Interactive Learning Unit about PET and
- to **develop** further Interactive Learning Units

**If you have further  
questions or comments,  
please contact me! :)**



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