

Hands-on: ALICE masterclass

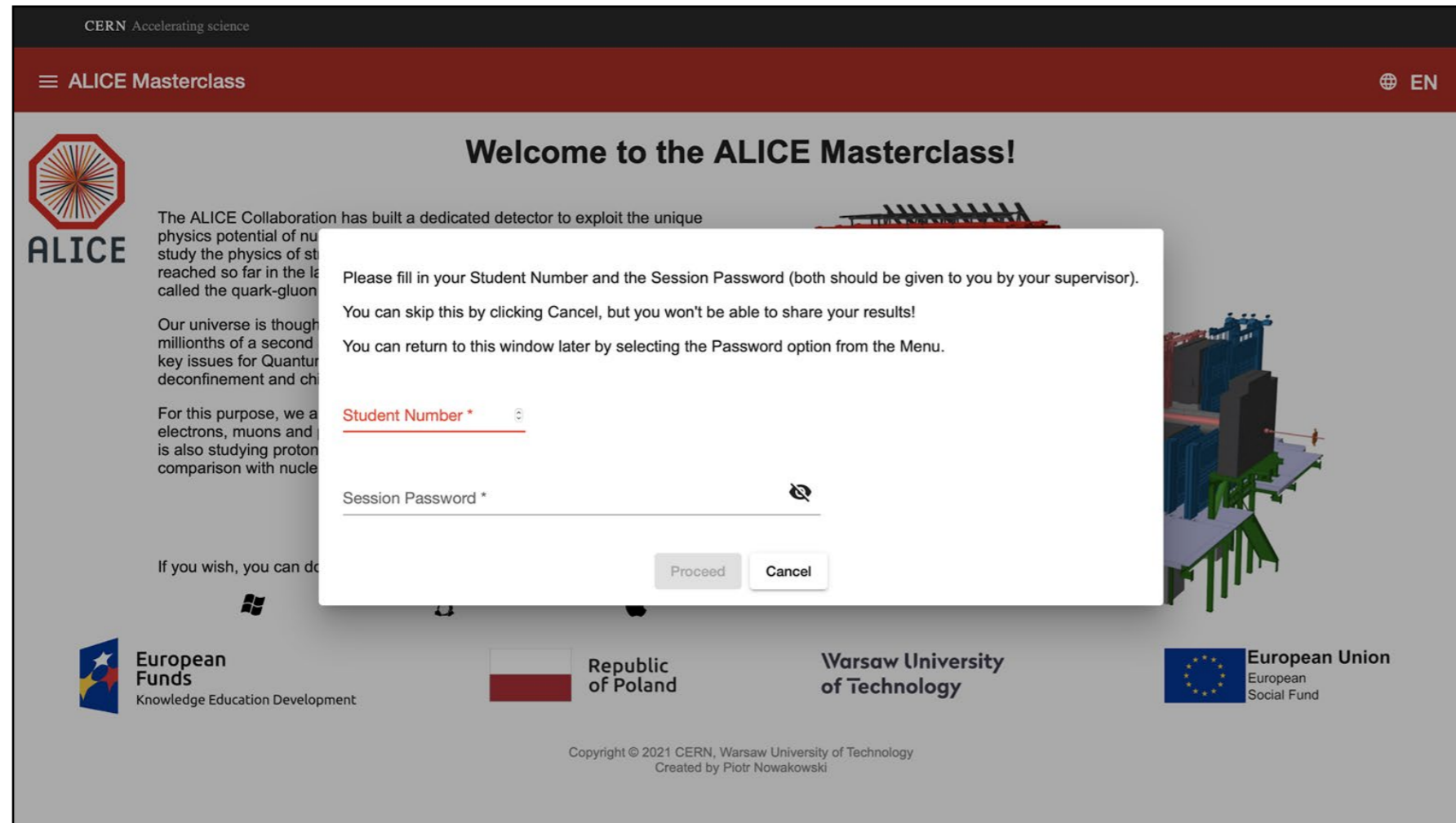
Fabio Colamaria, Domenico Colella

Bari, 25/02/2026

Hands-on – Introduzione

Login su:

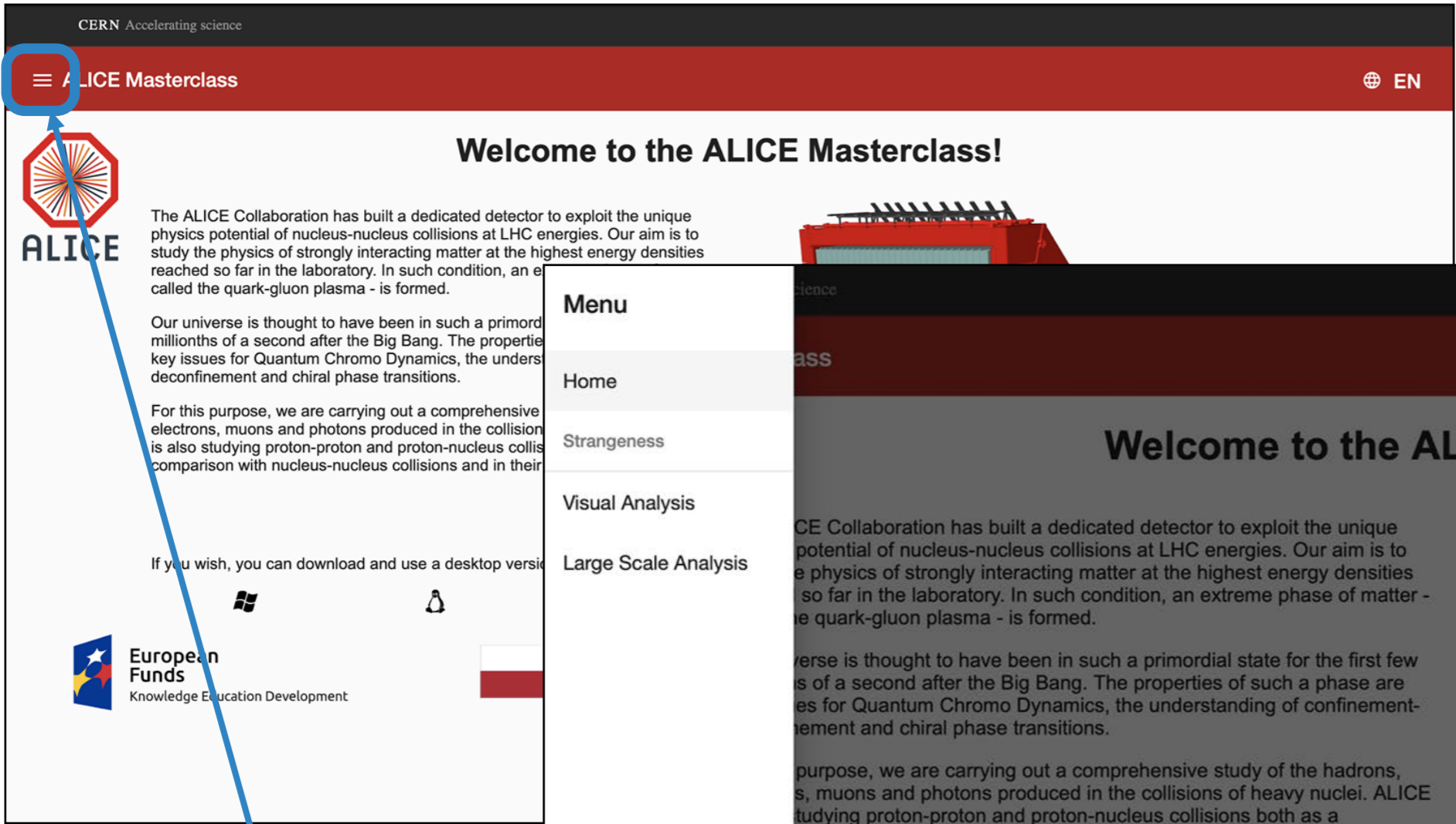
<https://alice-web-masterclass.app.cern.ch/?password=password-per-nulla-creativa>



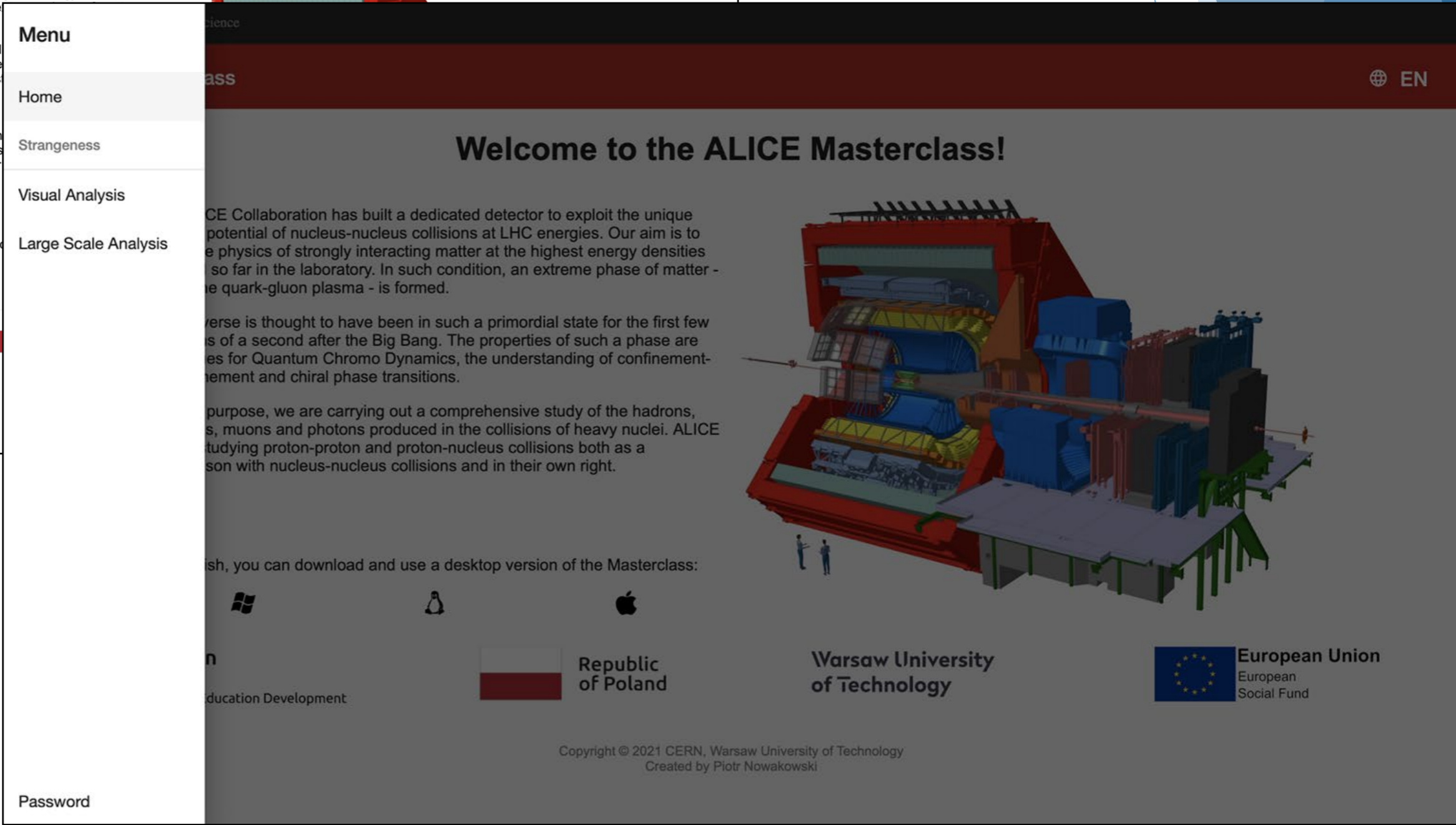
The screenshot shows the ALICE Masterclass website. At the top, there is a header with the CERN logo and the text "CERN Accelerating science". Below the header, the page title is "ALICE Masterclass" and the language is set to "EN". The main content area features the ALICE logo and a welcome message: "Welcome to the ALICE Masterclass!". Below this, there is a paragraph of text about the ALICE Collaboration and its detector. A modal form is overlaid on the page, asking for the user's "Student Number" and "Session Password". The form includes a "Proceed" button and a "Cancel" button. At the bottom of the page, there are logos for the European Funds, the Republic of Poland, Warsaw University of Technology, and the European Union European Social Fund. The footer contains the copyright information: "Copyright © 2021 CERN, Warsaw University of Technology. Created by Piotr Nowakowski".

- Inserite il vostro “Student Number”
 - Corrisponde al numero riportato sulle vostre credenziali WiFi
- Inserite la “Session Password”: **password-per-nulla-creativa**
 - Se utilizzate il link in alto, dovrebbe essere automaticamente riportata
- Cliccate su “Proceed”

Hands-on – Introduzione



Pulsante per il menù principale



Hands-on – Introduzione

Fase 1
Costruire la
distribuzione di
massa invariante

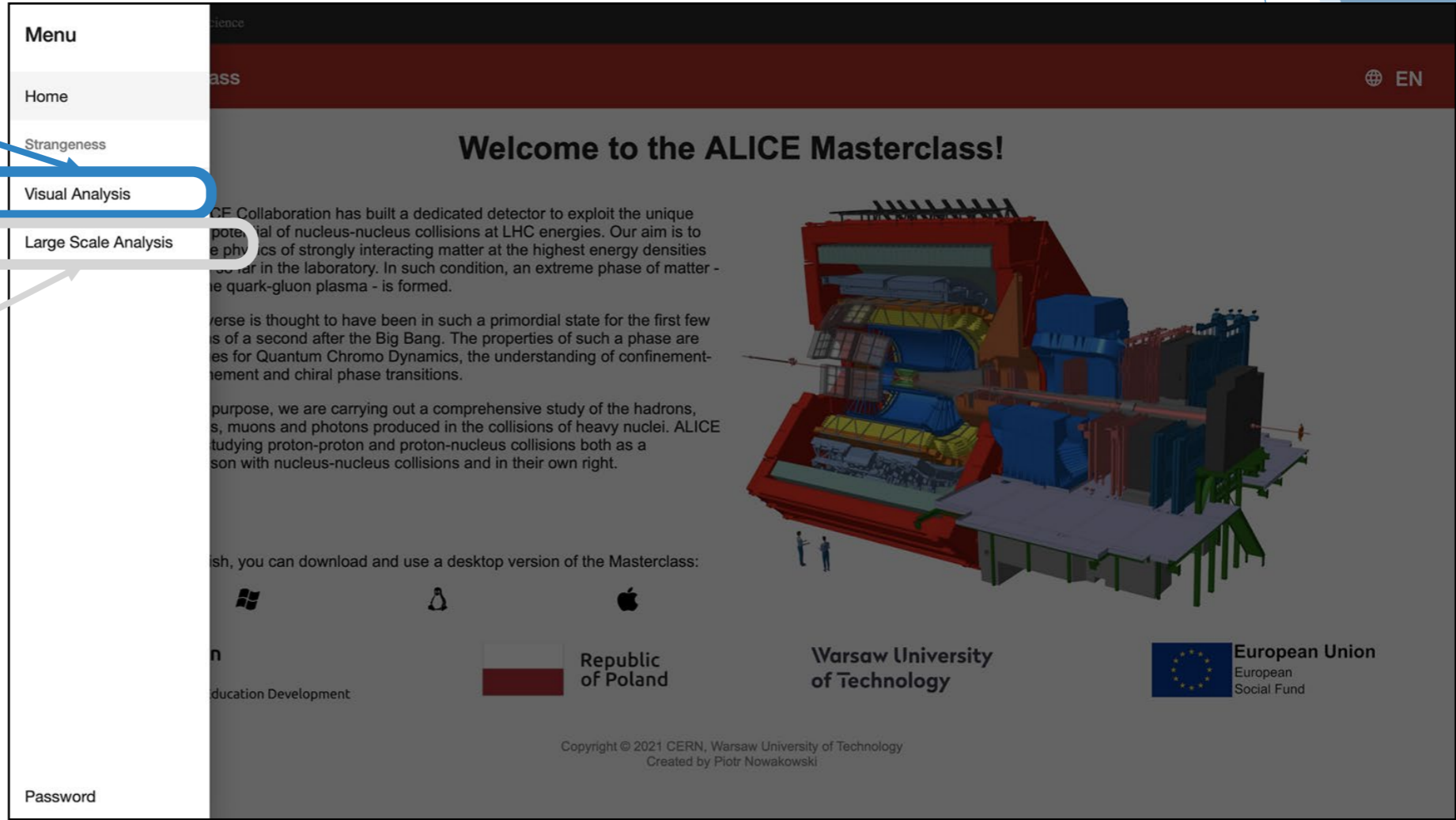
Fase 2
Misurare il tasso di
produzione

The screenshot shows the ALICE Masterclass website. On the left, a 'Menu' sidebar contains the following items: Home, Strangeness, Visual Analysis, and Large Scale Analysis. The 'Visual Analysis' and 'Large Scale Analysis' items are highlighted with blue rounded rectangles. Blue arrows point from the text 'Fase 1' to the 'Visual Analysis' item and from 'Fase 2' to the 'Large Scale Analysis' item. The main content area features a dark red header with 'EN' in the top right. Below the header, the text reads 'Welcome to the ALICE Masterclass!' followed by a 3D cutaway illustration of the ALICE detector. The footer includes logos for the Republic of Poland, Warsaw University of Technology, and the European Union, along with copyright information: 'Copyright © 2021 CERN, Warsaw University of Technology. Created by Piotr Nowakowski'. A 'Password' field is visible at the bottom left of the page.

Hands-on – Introduzione

Fase 1
Costruire la
distribuzione di
massa invariante

Fase 2
Misurare il tasso di
produzione



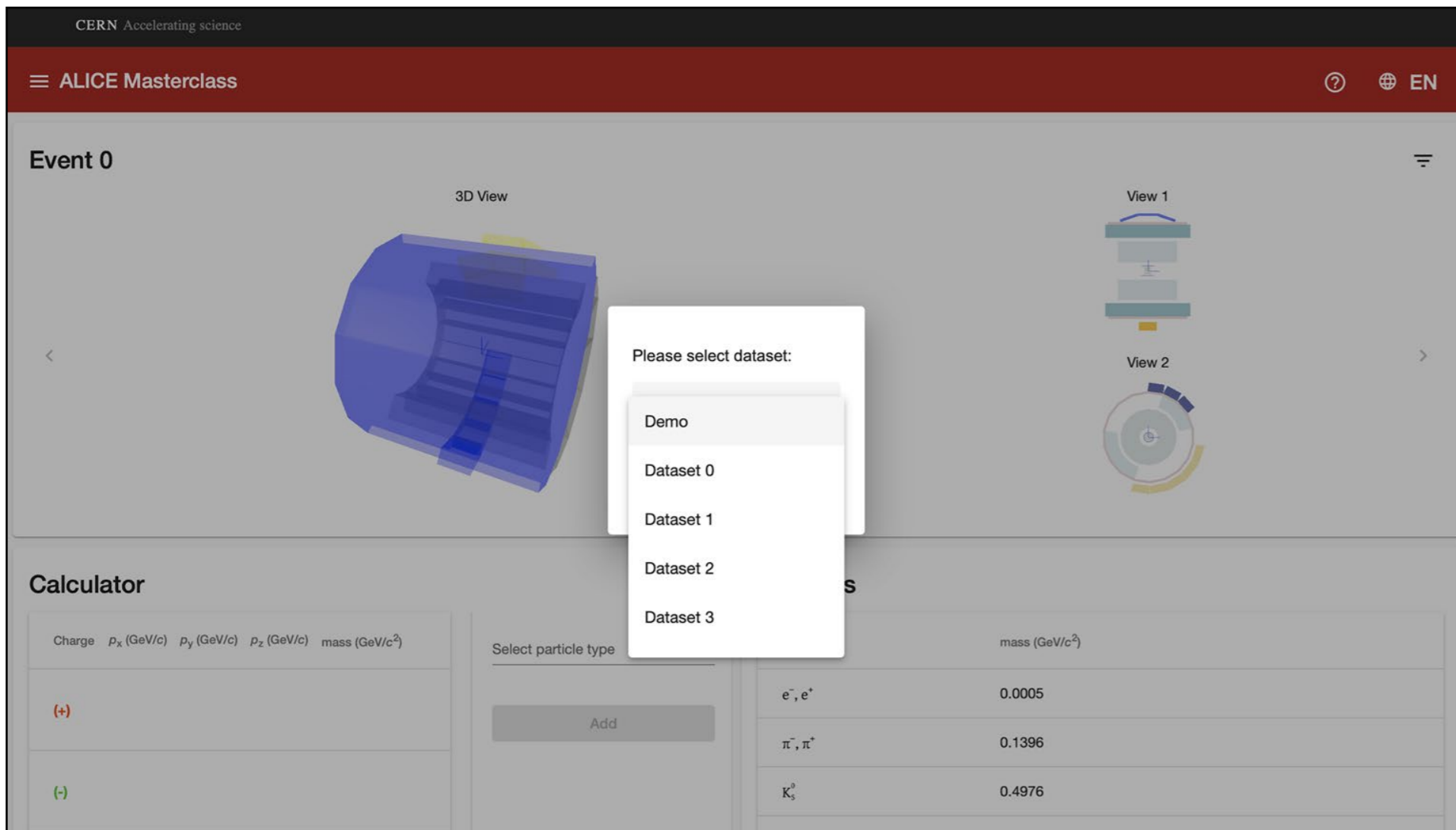
The screenshot shows the ALICE Masterclass website interface. A dark red header contains the text "Welcome to the ALICE Masterclass!" and a globe icon with "EN". Below the header, there is a large 3D cutaway image of the ALICE detector. To the left of the main content, a white menu box is overlaid with the following items: "Menu", "Home", "Strangeness", "Visual Analysis", and "Large Scale Analysis". The "Visual Analysis" item is highlighted with a blue rounded rectangle, and a blue arrow points from the "Fase 1" text to it. The "Large Scale Analysis" item is highlighted with a grey rounded rectangle, and a grey arrow points from the "Fase 2" text to it. The main content area contains text about the ALICE Collaboration and the quark-gluon plasma. At the bottom, there are logos for the Republic of Poland, Warsaw University of Technology, and the European Union. A "Password" field is visible at the bottom left.

Hands-on – Fase 1

19 dataset totali:

Il vostro corrisponde al resto della divisione del vostro “Student Number” per 19

- Student number: 14 → dataset 14
- Student number: 21 → dataset 2
- Student number: 43 → dataset 5



The screenshot shows the ALICE Masterclass interface. At the top, it says "CERN Accelerating science" and "ALICE Masterclass". The main area is titled "Event 0" and features a "3D View" of the detector. A dropdown menu is open, asking "Please select dataset:" with options: "Demo", "Dataset 0", "Dataset 1", "Dataset 2", and "Dataset 3". Below the 3D view is a "Calculator" section with a table for particle properties.

Charge	p_x (GeV/c)	p_y (GeV/c)	p_z (GeV/c)	mass (GeV/c ²)
(+)				
(-)				

Select particle type	mass (GeV/c ²)
e^-, e^+	0.0005
π^-, π^+	0.1396
K_s^0	0.4976

Selezionate il dataset assegnato sulla corrispondente schermata

Hands-on – Fase 1

CERN Accelerating science

ALICE Masterclass

Event 0

3D View

View 1

View 2

Calculator

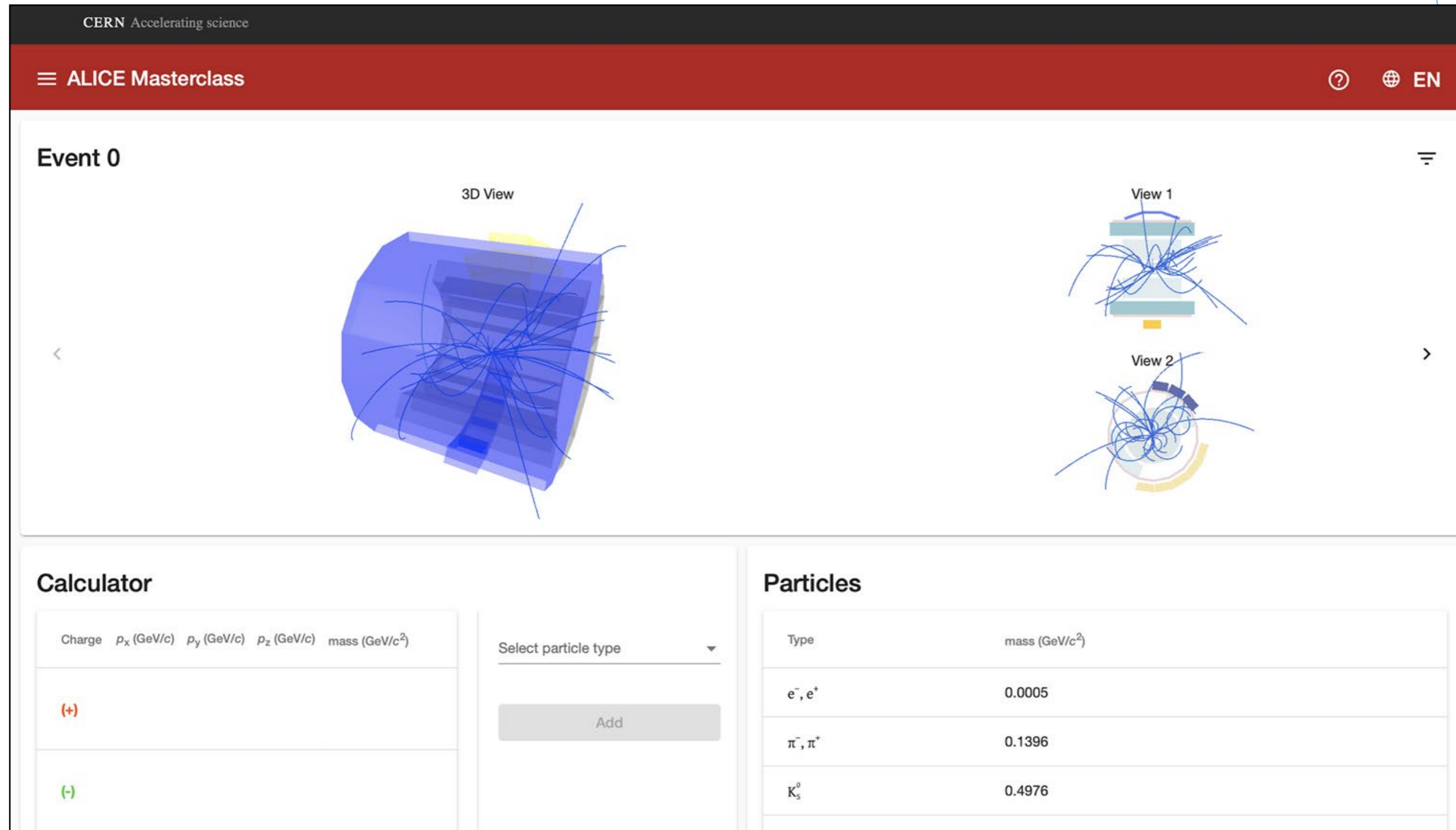
Charge	p_x (GeV/c)	p_y (GeV/c)	p_z (GeV/c)	mass (GeV/c ²)
(+)				
(-)				

Select particle type

Add

Particles

Type	mass (GeV/c ²)
e^-, e^+	0.0005
π^-, π^+	0.1396
K_S^0	0.4976



Ogni dataset contiene un piccolo numero di collisioni (o ‘eventi’) preselezionati, in cui è presente un decadimento di un adrone strano

Hands-on – Fase 1

CERN Accelerating science

ALICE Masterclass

Event 0

3D View

View 1

View 2

Calculator

Charge	p_x (GeV/c)	p_y (GeV/c)	p_z (GeV/c)	mass (GeV/c ²)
(+)				
(-)				

Select particle type

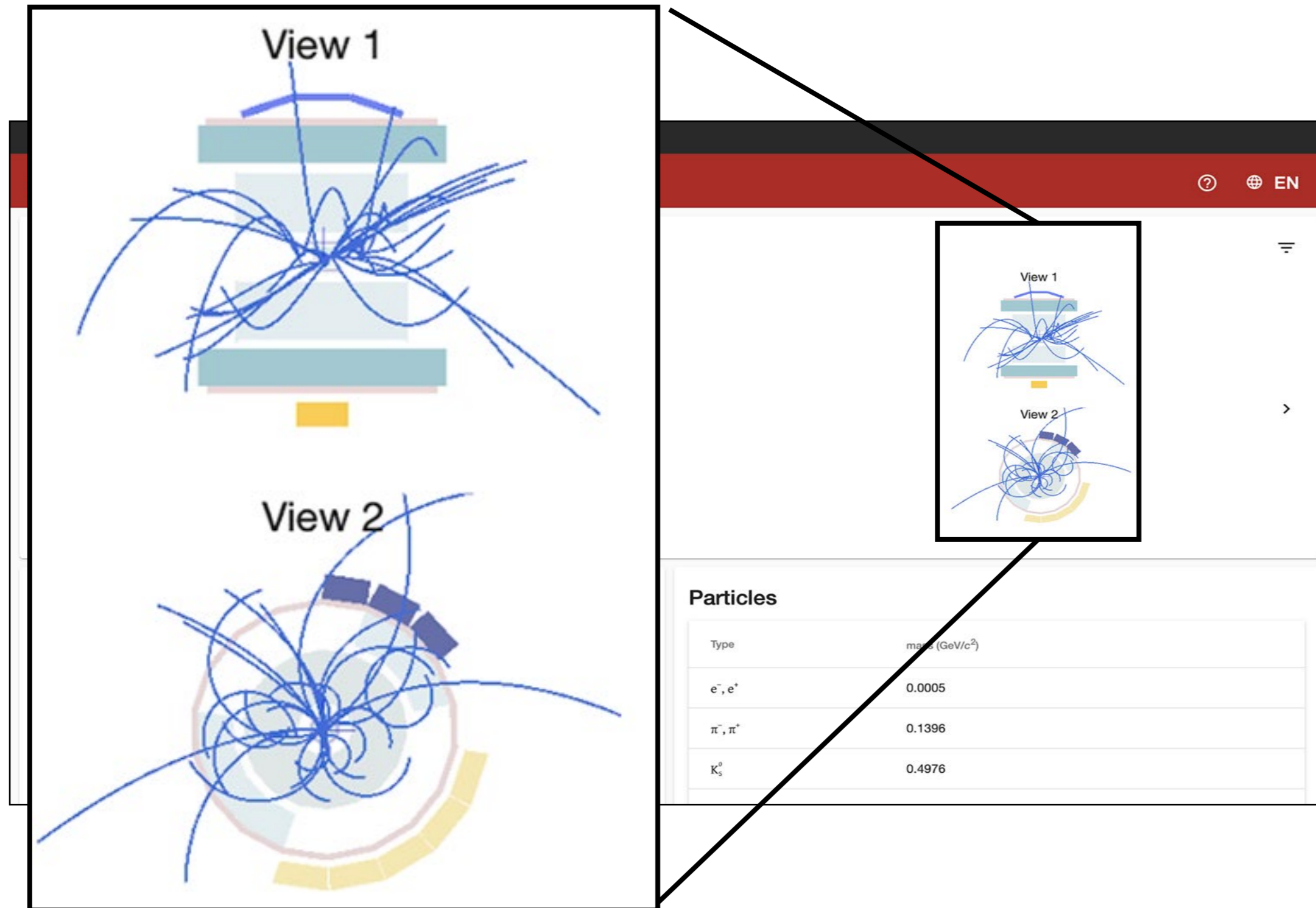
Add

Particles

Type	mass (GeV/c ²)
e^-, e^+	0.0005
π^-, π^+	0.1396
K_S^0	0.4976

Per esplorare le varie collisioni utilizzate le frecce

Hands-on – Fase 1



The image displays a simulation interface for a particle collision event. It features two main views of the event, labeled 'View 1' and 'View 2', showing a complex network of blue tracks originating from a central point. The tracks are overlaid on a schematic of the detector's internal structure, including various layers and components. In 'View 1', some tracks are highlighted in red and green, indicating they are identified as 'strange' baryon daughters. 'View 2' provides a different perspective of the same event. Below the views is a 'Particles' table listing the types and masses of the particles reconstructed from the tracks.

Type	mass (GeV/c ²)
e^-, e^+	0.0005
π^-, π^+	0.1396
K_s^0	0.4976

Ogni collisione contiene tante “tracce” di particelle ricostruite, di colore blu. In questa versione semplificata, le tracce relative a possibili “figlie” di adroni strane sono già identificate, e mostrate in colori diversi (rosso o verde).

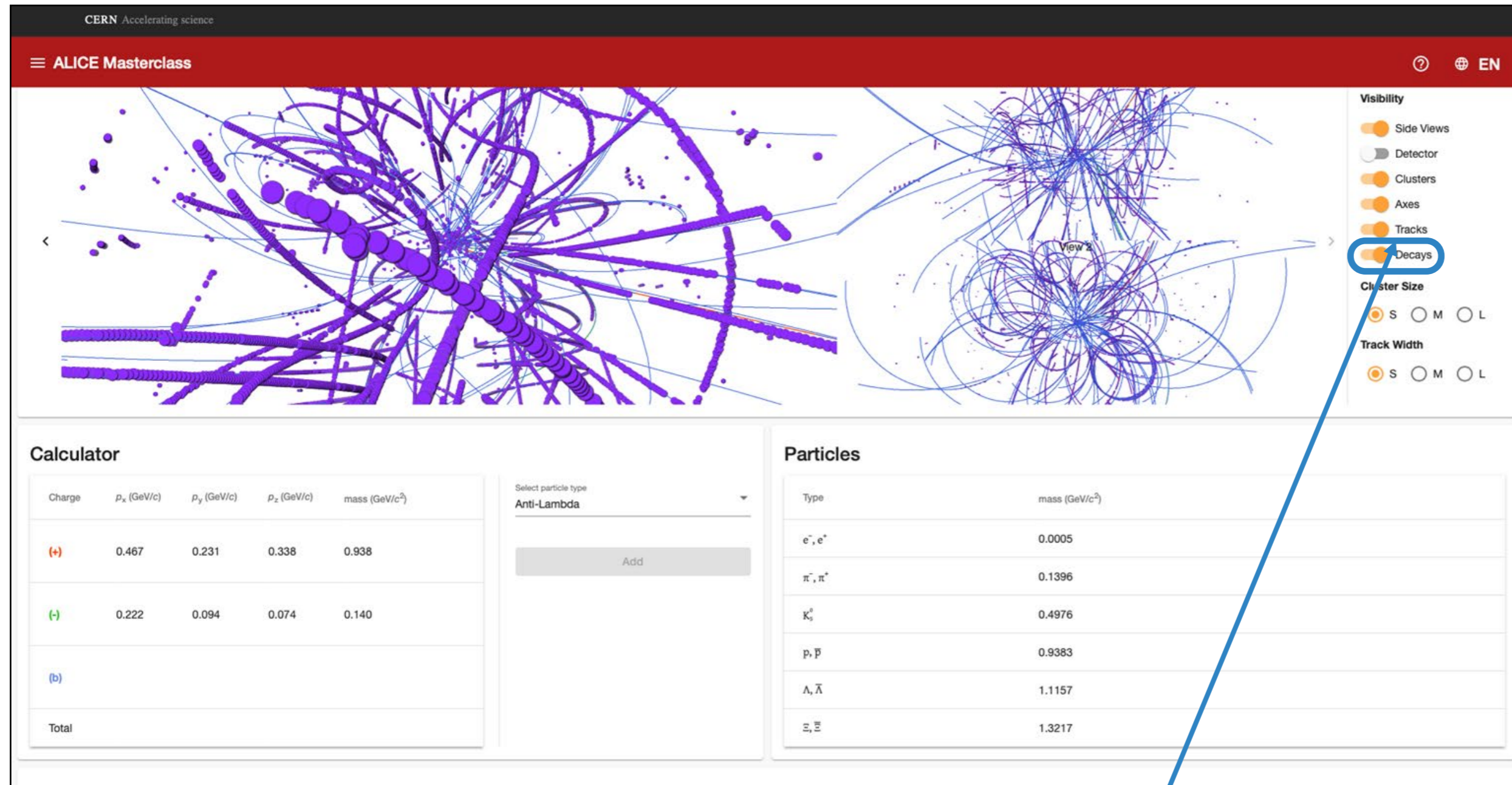
Hands-on – Fase 1

The screenshot shows the ALICE Masterclass interface. At the top, there is a header with "CERN Accelerating science" and "ALICE Masterclass". The main content area is titled "Event 0" and features a "3D View" of a particle event, along with "View 1" and "View 2" thumbnails. A blue box highlights a menu icon in the top right corner. Below the event view, there is a "Calculator" panel with input fields for Charge, p_x (GeV/c), p_y (GeV/c), p_z (GeV/c), and mass (GeV/c²), and a "Select particle type" dropdown menu. To the right of the calculator is a "Particles" table.

Type	mass (GeV/c ²)
e^-, e^+	0.0005
π^-, π^+	0.1396
K_s^0	0.4976

Apertura pannello opzioni

Hands-on – Fase 1



The screenshot displays the ALICE Masterclass interface. At the top, there is a red header with the text "CERN Accelerating science" and "ALICE Masterclass". Below the header, there are two main visualization panels. The left panel shows a complex network of purple tracks and clusters. The right panel shows a similar network but with a different view. A blue circle highlights the "Decays" option in the "Visibility" menu on the right. Below the visualization panels, there are two main sections: "Calculator" and "Particles".

Calculator

Charge	p_x (GeV/c)	p_y (GeV/c)	p_z (GeV/c)	mass (GeV/c ²)
(+)	0.467	0.231	0.338	0.938
(-)	0.222	0.094	0.074	0.140
(b)				
Total				

Select particle type
Anti-Lambda
Add

Particles

Type	mass (GeV/c ²)
e^-, e^+	0.0005
π^-, π^+	0.1396
K_S^0	0.4976
p, \bar{p}	0.9383
$\Lambda, \bar{\Lambda}$	1.1157
$\Xi, \bar{\Xi}$	1.3217

Assicuratevi che l'opzione per visualizzare le possibili figlie degli adroni strani ("Decays") sia attiva

Hands-on – Fase 1

Per rimuovere le tracce blu, (se ostruiscono la visuale), disattivate l'opzione 'Tracks'.
Resteranno visibili solo le potenziali tracce figlie: **rossa (positiva)** e **verde (negativa)**
Selezionatele cliccando su di esse nell'event display.

The screenshot shows the ALICE Masterclass event display interface. The top part displays two views of particle tracks: a 3D view on the left and a 2D view on the right. A control panel on the right allows adjusting visibility of various elements like Side Views, Detector, Clusters, Axes, Tracks, and Decays. Below the views are two panels: 'Calculator' and 'Particles'.

Calculator

Charge	p_x (GeV/c)	p_y (GeV/c)	p_z (GeV/c)	mass (GeV/c ²)
(+)	0.467	0.231	0.338	0.938
(-)	0.222	0.094	0.074	0.140
(b)				
Total				

Particles

Type	mass (GeV/c ²)
e^-, e^+	0.0005
π^-, π^+	0.1396
K_S^0	0.4976
p, \bar{p}	0.9383
$\Lambda, \bar{\Lambda}$	1.1157
$\Xi, \bar{\Xi}$	1.3217

Nel pannello "calculator" vi appariranno le relative informazioni cinematiche, assieme alla massa invariante dell'adrone strano "madre" (riga "Total")

Hands-on – Fase 1

The screenshot displays the ALICE Masterclass interface. At the top, there is a red header with the CERN logo and 'Accelerating science' text. Below the header, the main area shows two views of particle tracks: a purple view on the left and a blue view on the right. A 'Visibility' panel on the right side allows users to toggle various elements like Side Views, Detector, Clusters, Axes, Tracks, and Decays. Below the tracks, there is a 'Calculator' panel with a table of particle properties and a 'Particles' panel with a list of particle types and their masses. A blue arrow points from the text below to the 'Particles' table.

Charge	p_x (GeV/c)	p_y (GeV/c)	p_z (GeV/c)	mass (GeV/c ²)
(+)	0.467	0.231	0.338	0.938
(-)	0.222	0.094	0.074	0.140
(b)				
Total				

Type	mass (GeV/c ²)
e^-, e^+	0.0005
π^-, π^+	0.1396
K^0	0.4976
p, \bar{p}	0.9383
$\Lambda, \bar{\Lambda}$	1.1157
$\Xi, \bar{\Xi}$	1.3217

Potete identificare la natura delle figlie (e della madre) confrontando il valore della massa con quello delle principali particelle note.

Hands-on – Fase 1

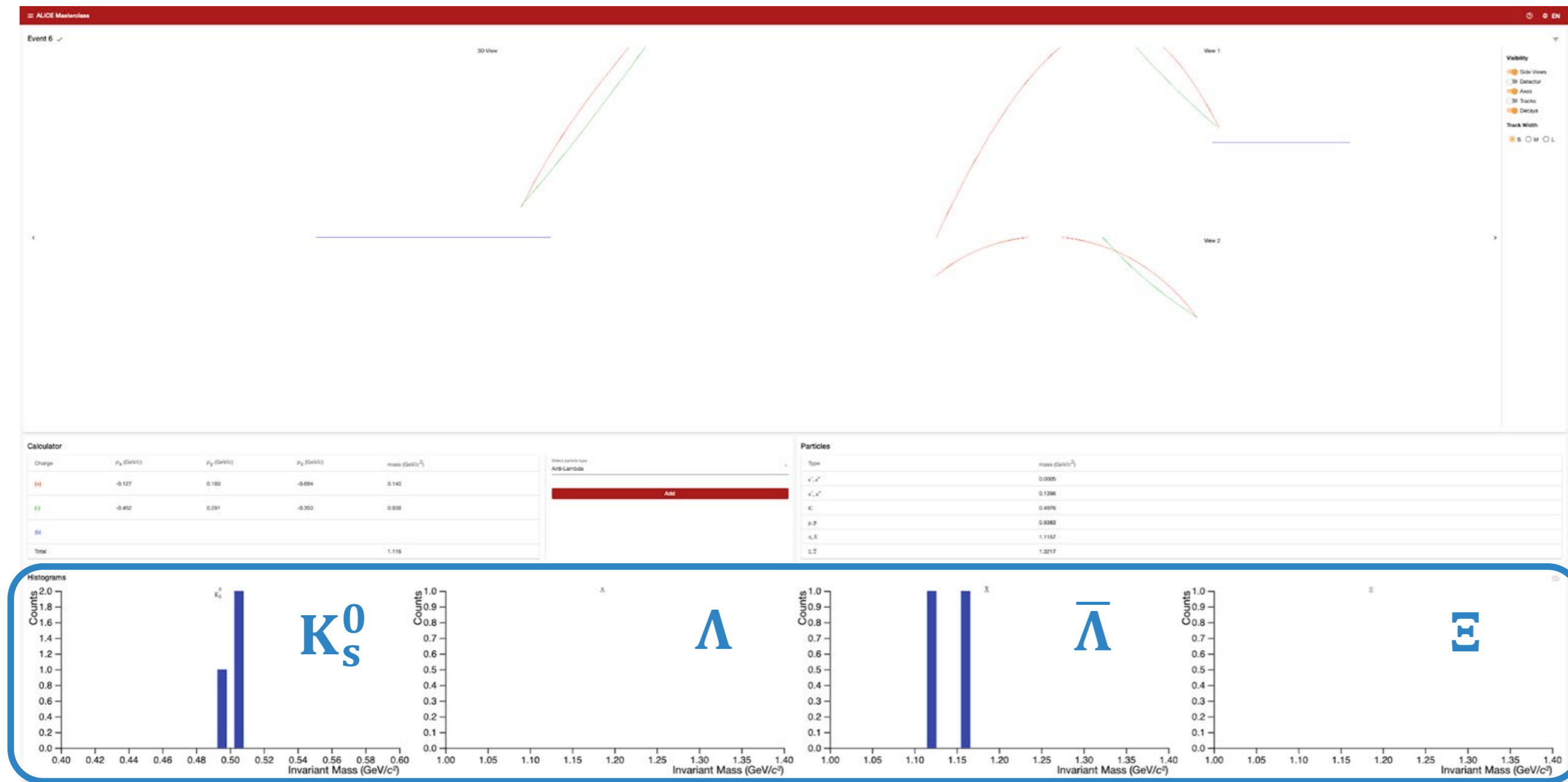
The screenshot displays the ALICE Masterclass interface. At the top, there is a red header with the CERN logo and 'Accelerating science' text. Below the header, the main area shows two views of particle tracks: a purple view on the left and a blue view on the right. A 'View 2' label is visible in the blue view. To the right of the tracks is a 'Visibility' control panel with checkboxes for Side Views, Detector, Clusters, Axes, Tracks, and Decays. Below this is a 'Cluster Size' section with radio buttons for S, M, and L, and a 'Track Width' section with radio buttons for S, M, and L. At the bottom, there are two panels: 'Calculator' and 'Particles'. The 'Calculator' panel has a table with columns for Charge, p_x (GeV/c), p_y (GeV/c), p_z (GeV/c), and mass (GeV/c²). The 'Particles' panel has a table with columns for Type and mass (GeV/c²). A blue box highlights the 'Add' button in the 'Particles' panel, with a blue arrow pointing to it.

Charge	p_x (GeV/c)	p_y (GeV/c)	p_z (GeV/c)	mass (GeV/c ²)
(+)	0.467	0.231	0.338	0.938
(-)	0.222	0.094	0.074	0.140
(b)				
Total				

Type	mass (GeV/c ²)
e^-, e^+	0.0005
π^-, π^+	0.1396
K_S^0	0.4976
p, \bar{p}	0.9383
$\Lambda, \bar{\Lambda}$	1.1157
$\Xi, \bar{\Xi}$	1.3217

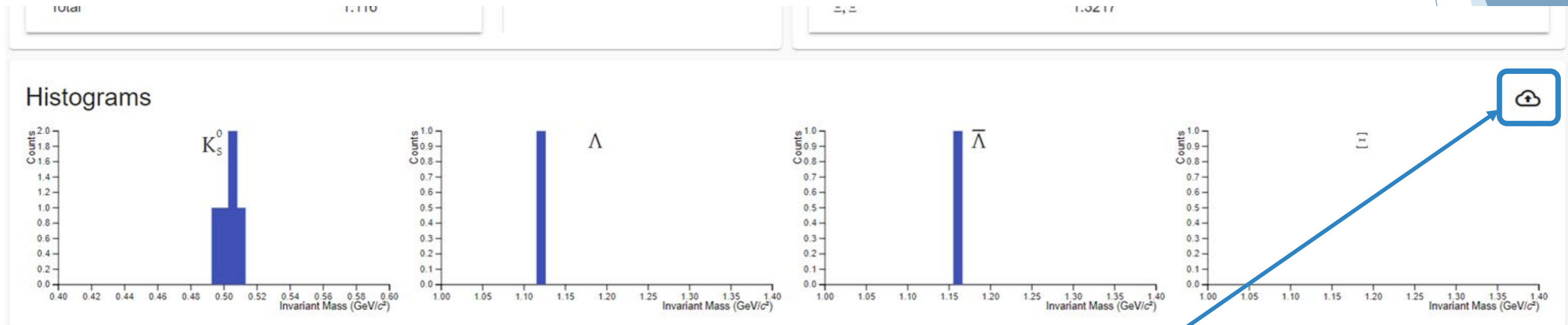
Quando avete identificato la natura della particella madre, selezionatela nell'elenco e cliccate su "Add".

Hands-on – Fase 1

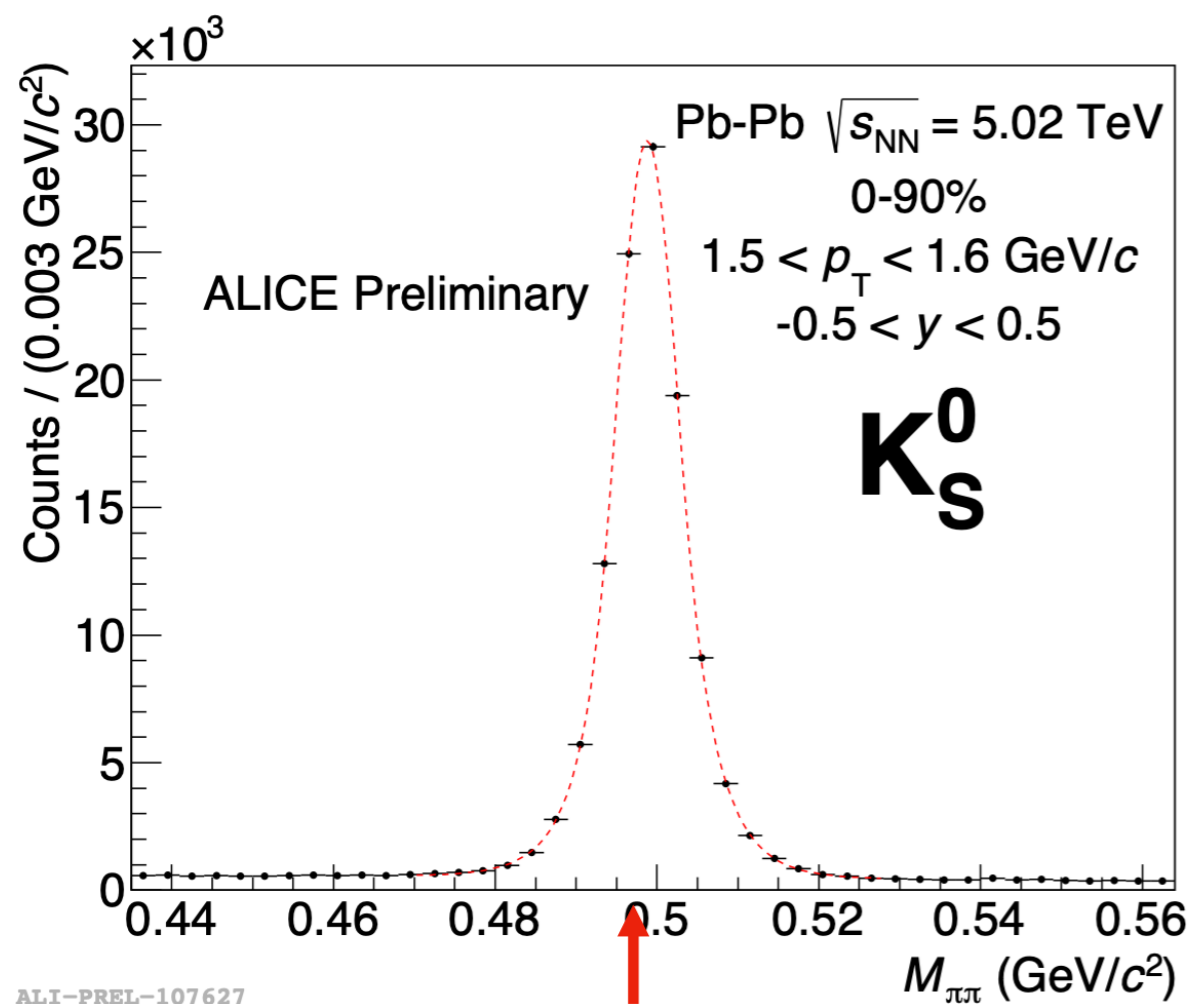


Aggiungendo candidate, queste vi compariranno nei rispettivi plot, che riportano la distribuzione di massa invariante per le potenziali particelle strane ricostruite

Hands-on – Fase 1

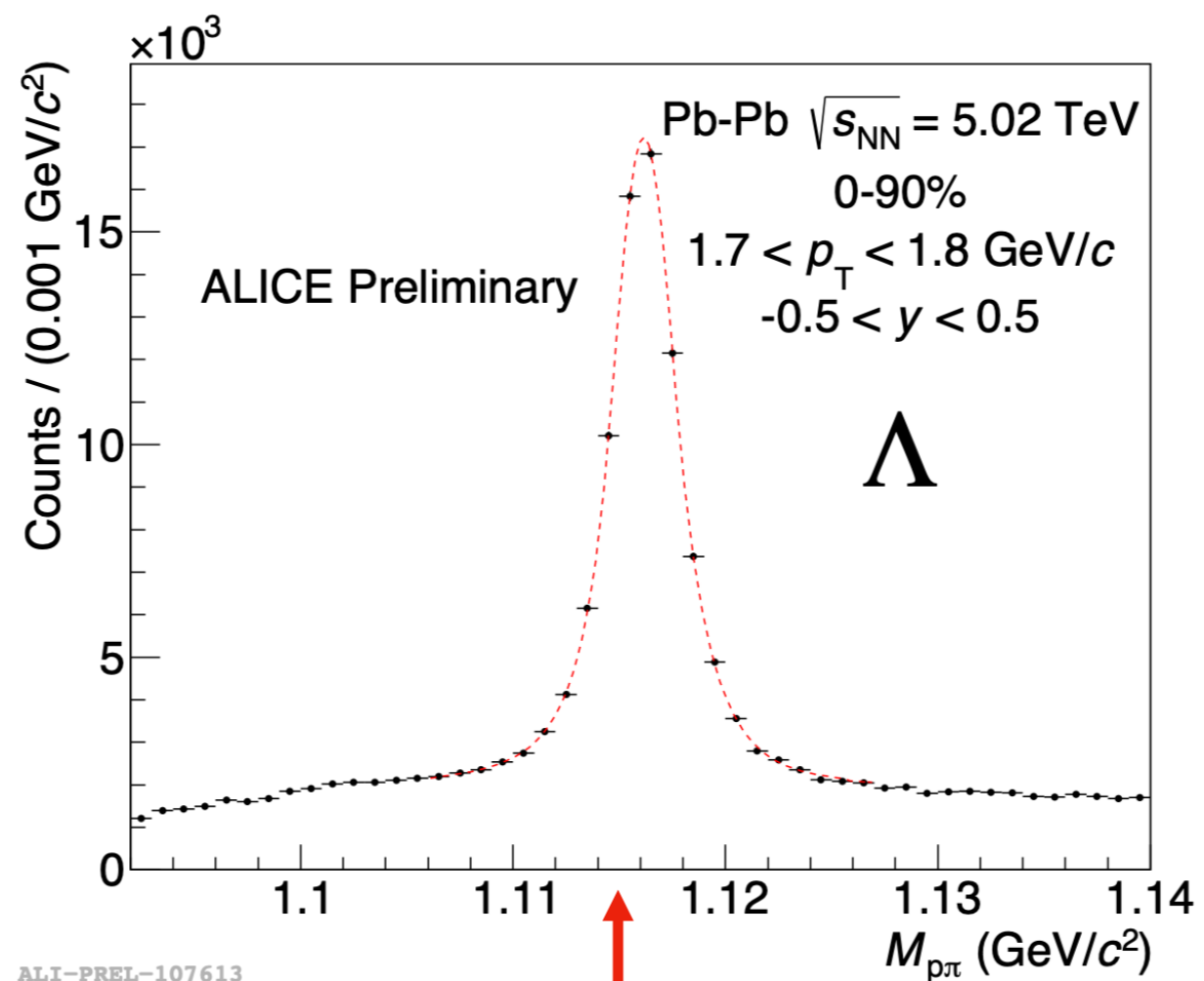


Quando avete terminato di analizzare l'intero dataset (e solo allora), cliccate sull'icona in alto a destra per condividere i risultati



ALI-PREL-107627

Massa reale: $497,614 \pm 0,024 \text{ MeV}/c^2$



ALI-PREL-107613

Massa reale: $1115,683 \pm 0,006 \text{ MeV}/c^2$

**Distribuzioni di massa invariante “ufficiali” misurate dalla
Collaborazione ALICE su un campione (enormemente più
grande) di collisioni piombo-piombo**

Hands-on – Fase 2

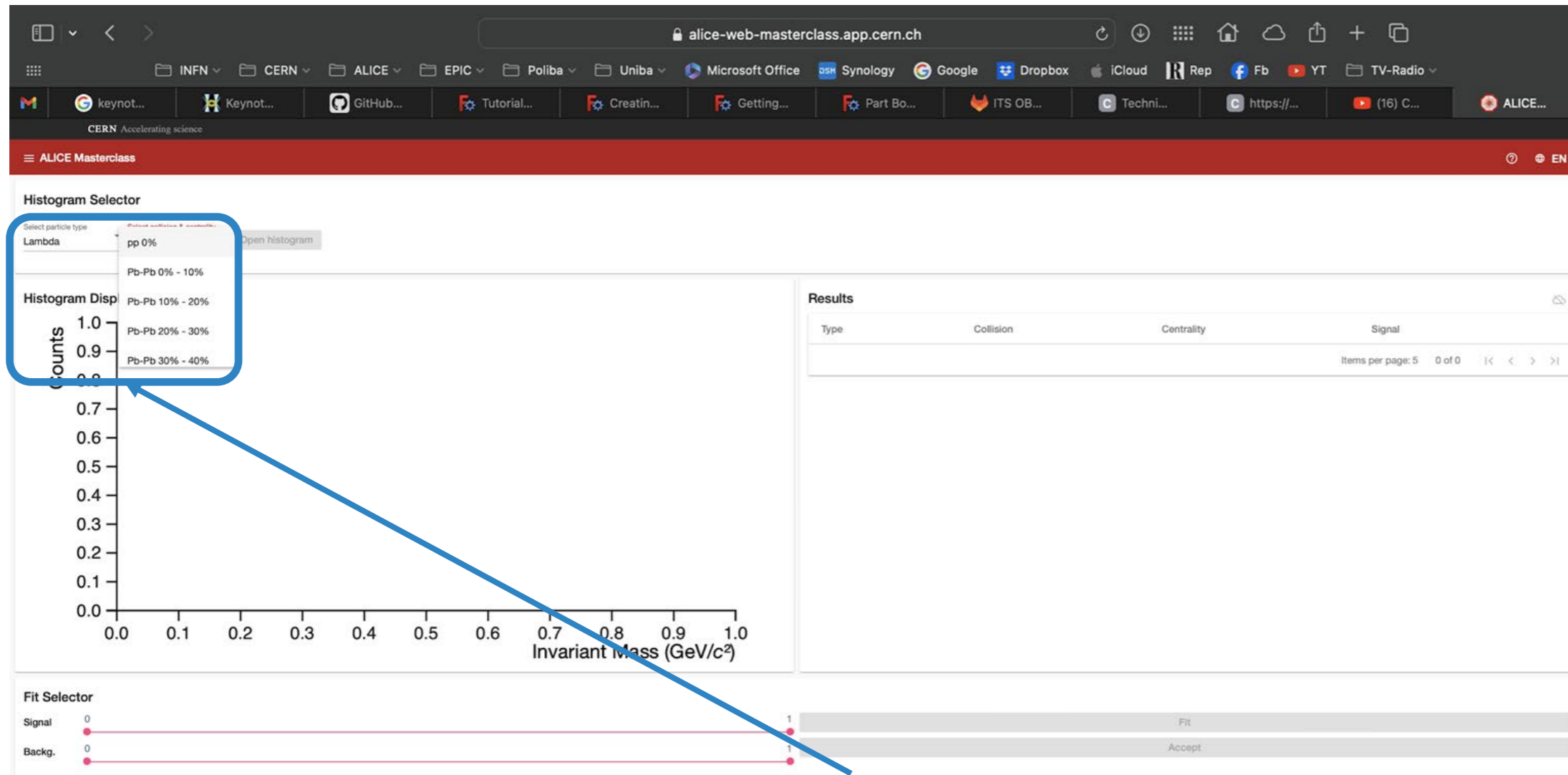
Fase 1
Costruire la
distribuzione di
massa invariante

Fase 2
Misurare il tasso di
produzione

The screenshot shows the ALICE Masterclass website. A white menu box is overlaid on the left side of the page, containing the following items: Menu, Home, Strangeness, Visual Analysis, and Large Scale Analysis. The 'Large Scale Analysis' item is highlighted with a blue circle and a blue arrow pointing from the 'Fase 2' text. The website content includes a header with 'EN', a main heading 'Welcome to the ALICE Masterclass!', and a 3D cutaway diagram of the ALICE detector. At the bottom, there are logos for the Republic of Poland, Warsaw University of Technology, and the European Union. A copyright notice at the bottom reads: 'Copyright © 2021 CERN, Warsaw University of Technology Created by Piotr Nowakowski'. A 'Password' field is visible at the bottom left of the menu overlay.

Hands-on – Fase 2

In questa fase, a partire dalle distribuzioni di massa invariante misurate da ALICE, verrà calcolato il numero di adroni strain prodotti per collisione piombo-piombo (o protone-protone)

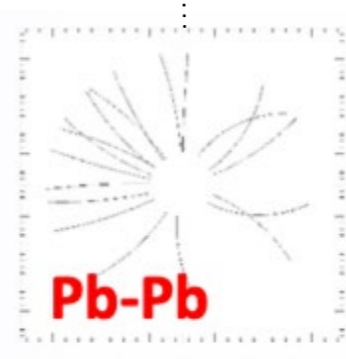
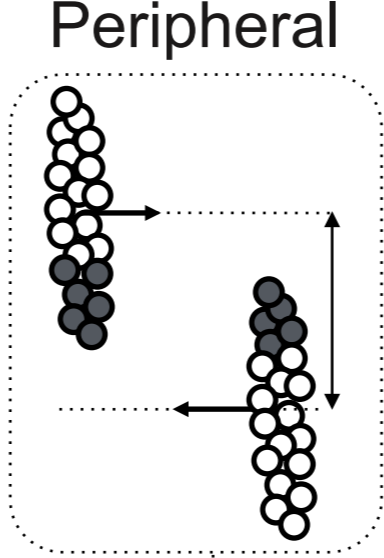
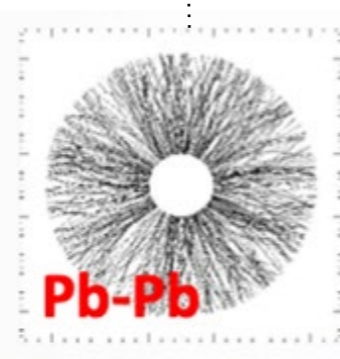
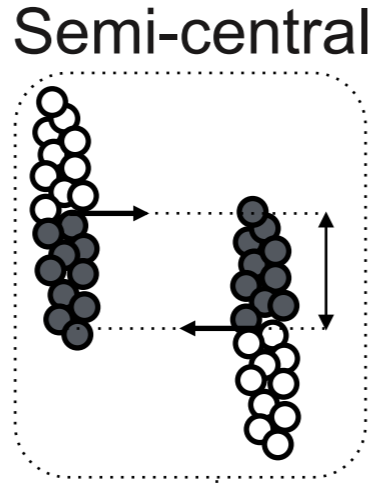
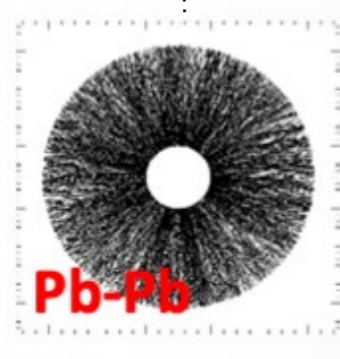
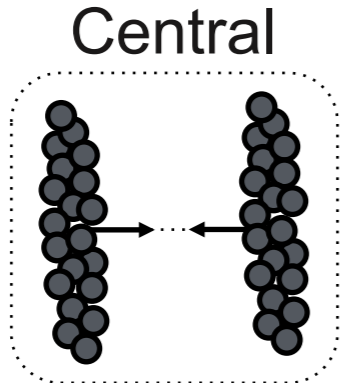


Selezionate la particella da analizzare

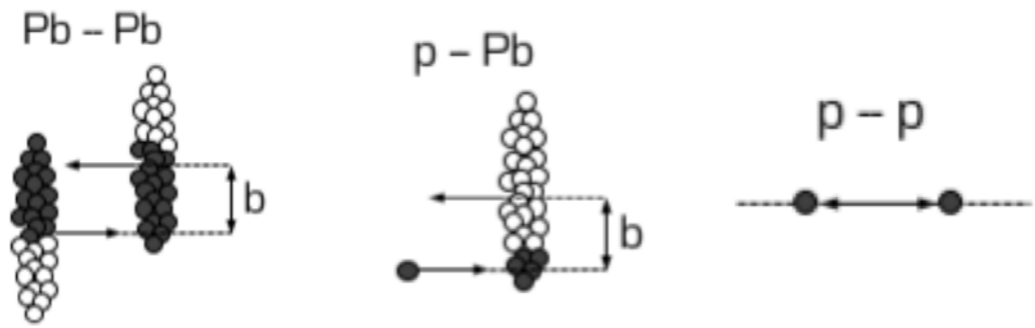
(dividete il vostro ID per 3 e prendetene il resto: $0 = K^0_s$, $1 = \Lambda$, $2 = \bar{\Lambda}$)

Per ciascuna particella, dovete studiare tutti i range di centralità

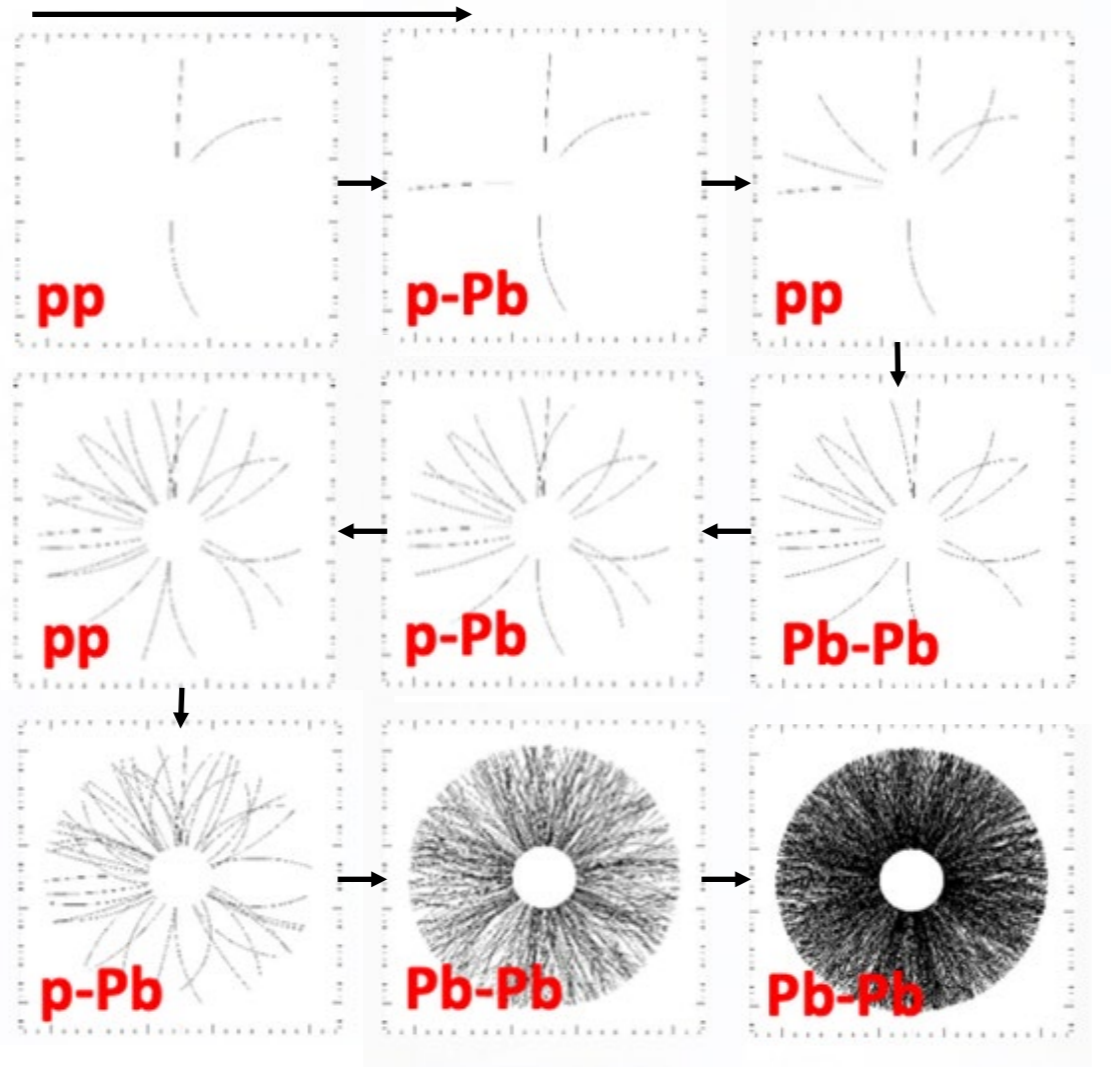
Hands-on – Fase 2



Hands-on – Fase 2



Increasing multiplicity



Hands-on – Fase 2

alice-web-masterclass.app.cern.ch

ALICE Masterclass EN

Histogram Selector

Select particle type: Lambda
Select collision & centrality: pp 0%

Open histogram

Histogram Display

Counts

Invariant Mass (GeV/c²)

Results

Type	Collision	Centrality	Signal

Items per page: 5 0 of 0

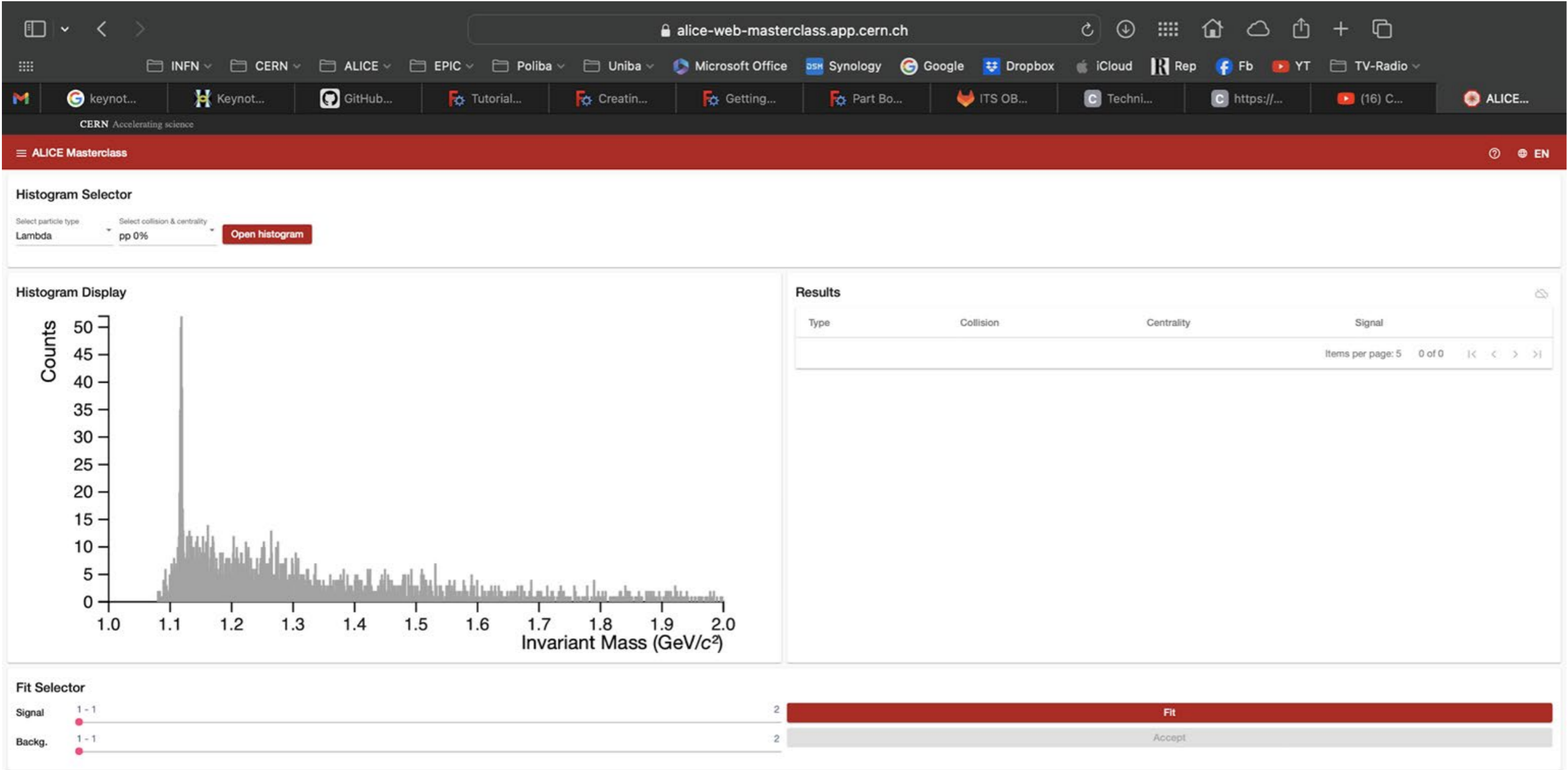
Fit Selector

Signal: 0
Backg.: 0

Fit
Accept

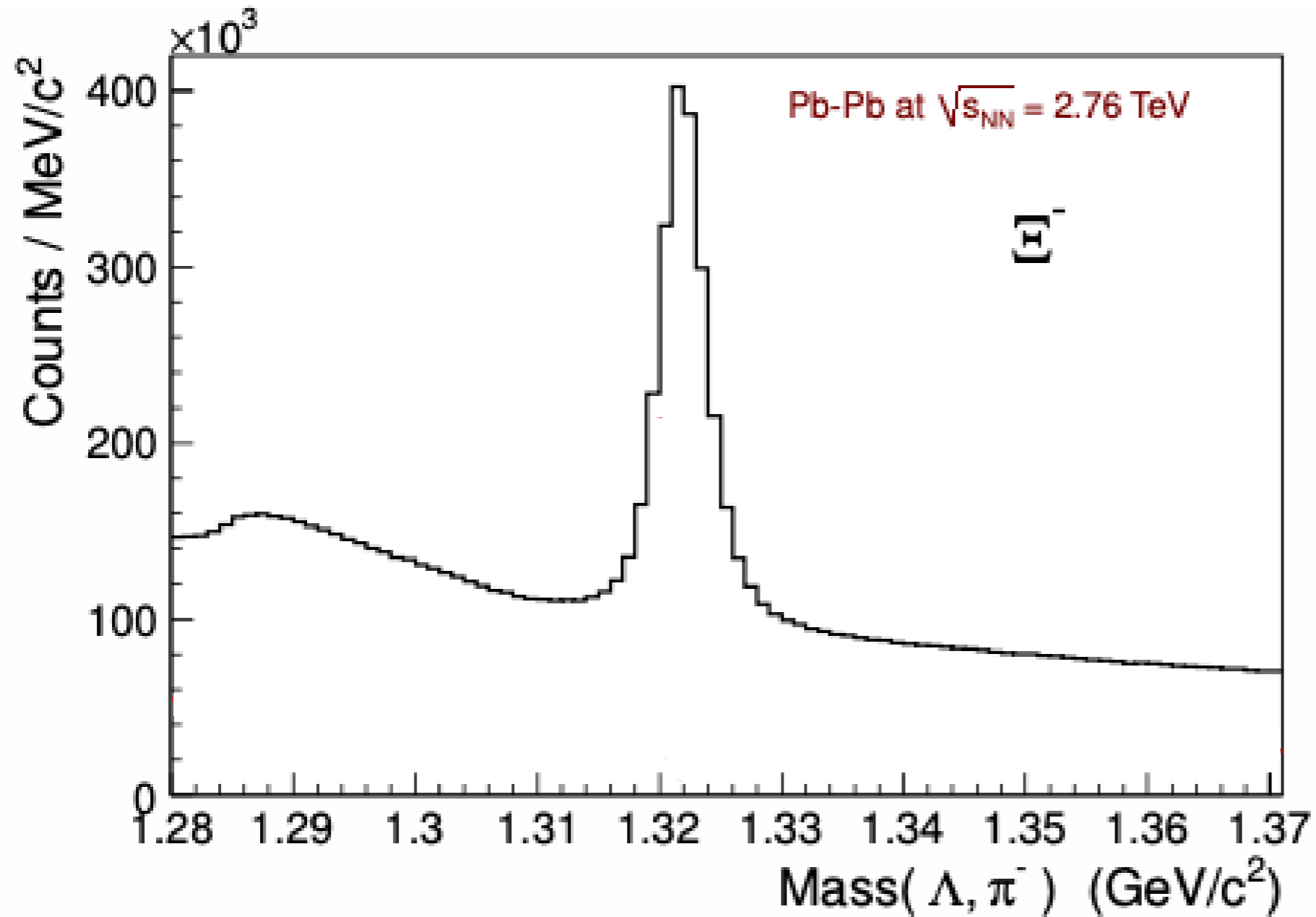
Aprite gli istogrammi corrispondenti (uno per volta)

Hands-on – Fase 2



Esempio di istogramma per la Λ , in collisioni protone-protone

Hands-on – Fase 2

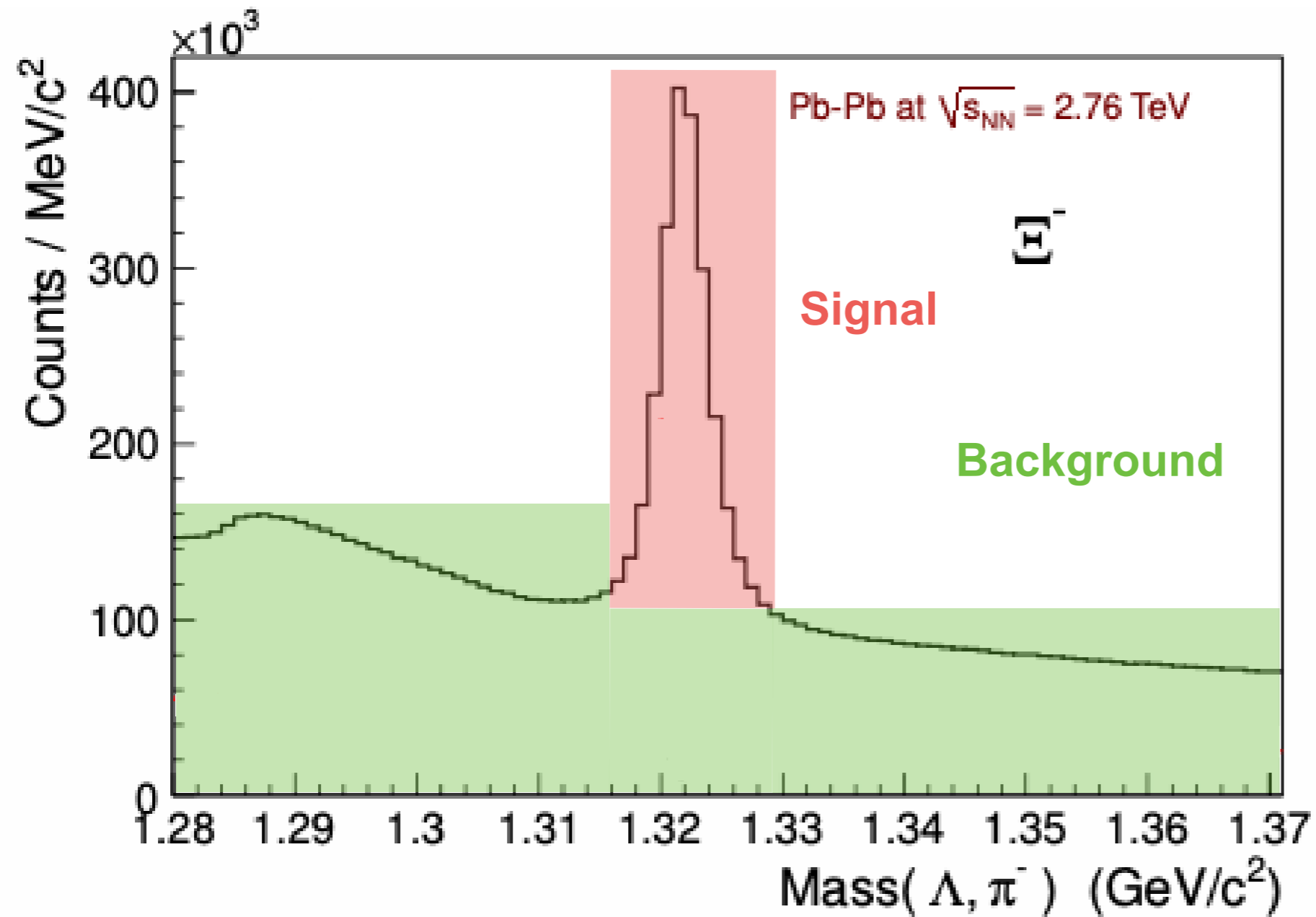


Solo alcune delle entrate dell'istogramma corrispondono a vere particelle, dal cui decadimento abbiamo ricostruito le figlie.

Queste sono contenute nel «**picco di segnale**», vicino al vero valore di massa.

Il resto delle entrate corrisponde a particelle inesistenti, di **fondo**, ottenute combinando tracce positive e negative che non sono prodotte nel decadimento

Hands-on – Fase 2



Solo alcune delle entrate dell'istogramma corrispondono a vere particelle, dal cui decadimento abbiamo ricostruito le figlie.

Queste sono contenute nel «**picco di segnale**», vicino al vero valore di massa. Il resto delle entrate corrisponde a particelle inesistenti, di **fondo**, ottenute combinando tracce positive e negative che non sono prodotte nel decadimento

Hands-on – Fase 2

The screenshot displays the ALICE Masterclass web application interface. At the top, the browser address bar shows `alice-web-masterclass.app.cern.ch`. Below the browser tabs, the application header includes the CERN logo and the text "ALICE Masterclass".

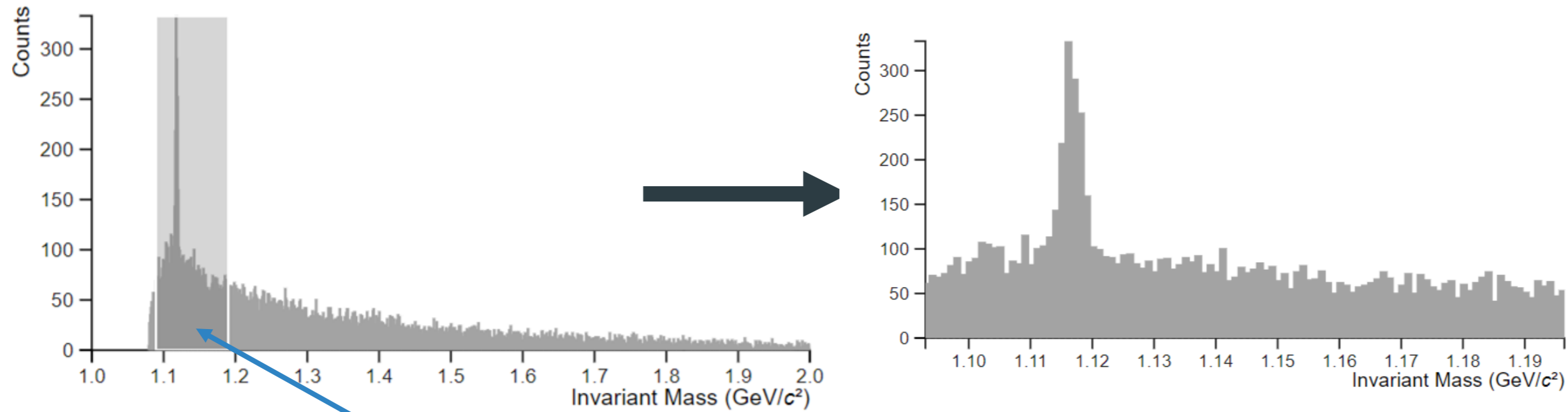
The main content area is divided into several sections:

- Histogram Selector:** Features dropdown menus for "Select particle type" (set to "Lambda") and "Select collision & centrality" (set to "pp 0%"), along with an "Open histogram" button.
- Histogram Display:** A plot showing "Counts" on the y-axis (ranging from 0 to 50) versus "Invariant Mass (GeV/c^2)" on the x-axis (ranging from 1.0 to 2.0). The plot shows a sharp peak at approximately 1.1 GeV/c^2 and a broader background distribution.
- Fit Selector:** A control panel with two horizontal sliders. The "Signal" slider is set from 1.03 to 1.97, and the "Backg." slider is set from 1.02 to 1.91. A blue box highlights this section.
- Results:** A table with columns for "Type", "Collision", "Centrality", and "Signal". Below the table, it indicates "Items per page: 5" and "0 of 0".

At the bottom of the interface, there are two buttons: "Fit" (highlighted in red) and "Accept".

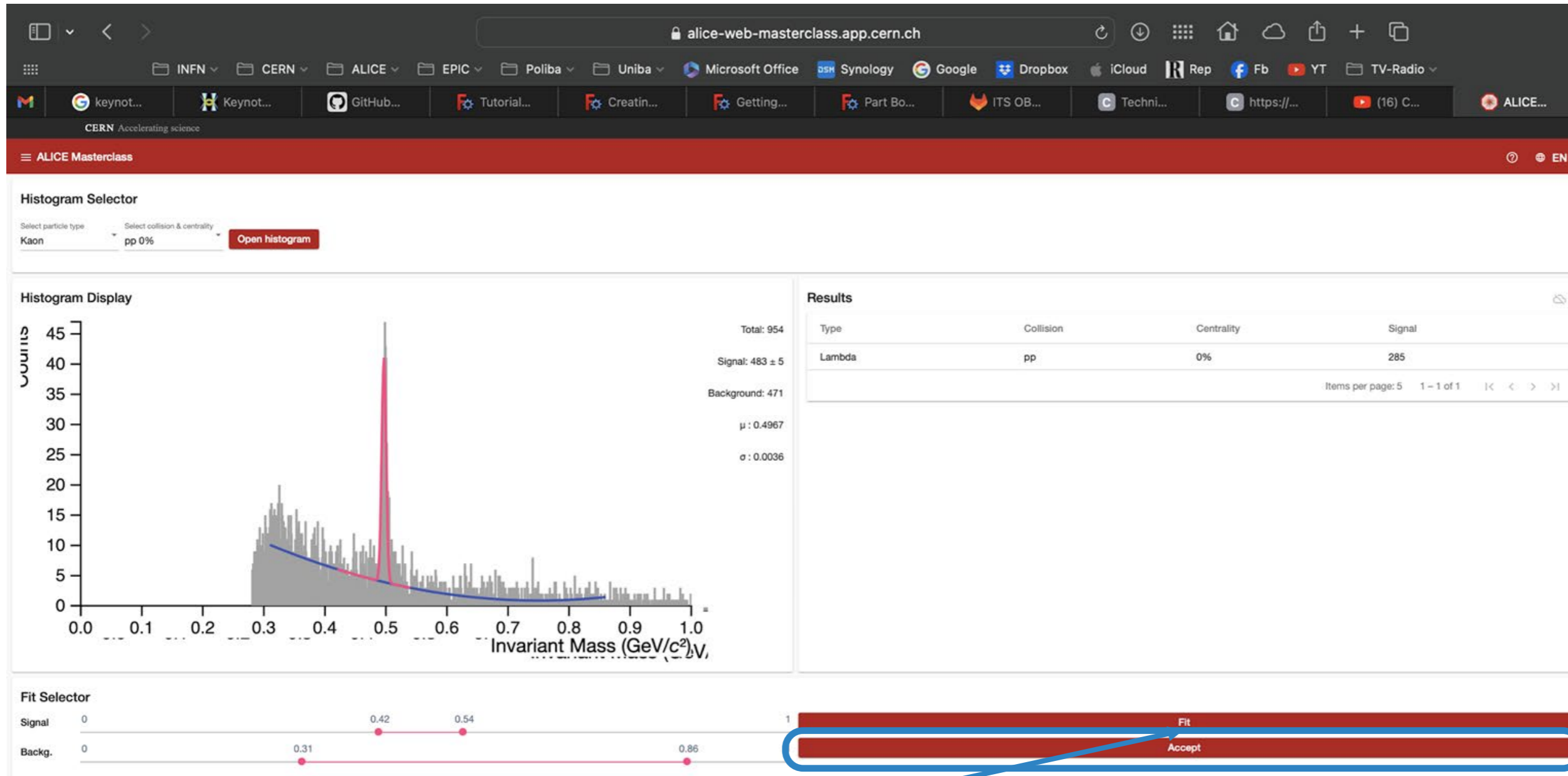
Modificate gli intervalli di massa invariante nei quali vi aspettate di trovare le vere candidate (il picco di segnale) e quelle non vere (il fondo combinatorio) e procedete cliccando su "Fit".

Hands-on – Fase 2



Potete anche cliccare e trascinare il cursore su una regione dell'asse x per effettuare uno zoom della distribuzione in tale regione

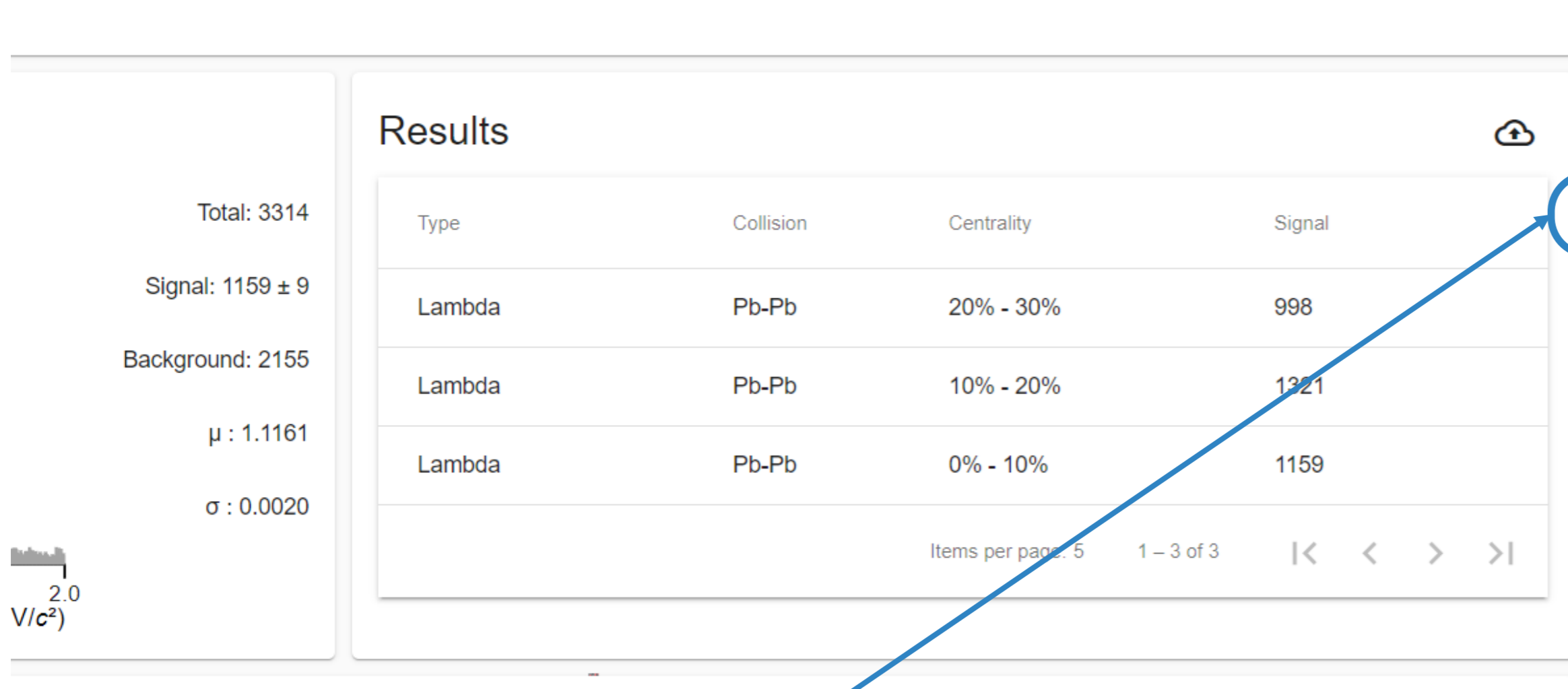
Hands-on – Fase 2



Se siete contenti del fit (sia il picco, sia il resto della distribuzione, sono ben riprodotti) “accettate” il valore trovato.

In “Results”, otterrete il conteggio delle particelle di segnale ricostruite sul campione di dati analizzato. Poi ripeterete l’operazione per le altre centralità.

Hands-on – Fase 2



Quando avete completato tutti i fit, cliccate sull'icona evidenziata per condividere i risultati

In fase di discussione dei risultati condivisi, parleremo di come dare una interpretazione di fisica alle misure da voi effettuate

Hands-on – Fase 2

