

Η σημερινή αναζήτηση

$$W^+ \rightarrow e^+ n_e$$

$$W^- \rightarrow e^- \bar{n}_e$$

$$W^+ \rightarrow m^+ n_m$$

$$W^- \rightarrow m^- \bar{n}_m$$

$$Z^0 \rightarrow e^+ e^-$$

$$Z^0 \rightarrow m^+ m^-$$

$$H^0 \rightarrow Z^0 Z^0$$

$$H^0 \rightarrow gg$$

Η άσκηση σήμερα

1. Θα δούμε πως σχεδιάζεται ένας ανιχνευτής σωματιδίων!
2. Θα αναλύσουμε μερικές συγκρούσεις πρωτονίων-πρωτονίων με το CMS
 - Θα ταυτοποιήσουμε κάποια σωματίδια και θα δούμε τι γίνεται
 - Αναλύοντας πολλά γεγονότα μπορούμε να αποκτήσουμε μια ιδέα για την θεμελιώδη φυσική που υπάρχει !

Η σημερινή εξάσκηση

- Θα χωριστείτε σε ομάδες 2 ατόμων
 - Κάθε ομάδα θα εξετάσει 100 γεγονότα
 - Κάντε login στο desktop:
 - **username:** msclX (όπου X αριθμός 01 – 30)
 - **password:** zve0422
 - Ανοίξτε το Firefox και πηγαίνετε στην οικοσελίδα

Τα εργαλεία που θα χρησιμοποιήσουμε

iSPY-webgl: πρόγραμμα απεικόνισης γεγονότων

<https://www.i2u2.org/elab/cms/ispay-webgl/>

CIMA: φύλλο εργασίας excel ειδικά για το CMS

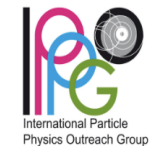
<https://www.i2u2.org/elab/cms/cima-wzh/>

Επιλογή του φύλλου εργασίας της ομάδας σας

<https://www.i2u2.org/elab/cms/cima-wzh/>



Choose your Masterclass	Choose your location	Choose your data file
TestEvents-01Jan2022	IstanbulYTU2024-C	100.1
Santander-13May2024	Nicosia2024-B	100.11
CERN-27Nov2023	Santander2024	100.12
Salo-07Dec2023	Genoa2024	100.13
Sofia-13Dec2023	Split2024-C	100.14
CERN-LAMAP-08Dec2023		100.15
MP-15Jan2024		100.2
Cakovec-24Jan2024		100.3
Bristol-27Mar2024		100.4
CERN-09Feb2024		100.5
Sandbox-31Dec2023		100.6
CERN-20Feb2024		100.7
CERN-26Feb2024		100.8
CERN-29Feb2024		100.9
CERN-22Feb2024		25.1
CERN-01Mar2024		25.11
CERN-04Mar2024		25.12
CERN-06Mar2024		25.13
CERN-08Mar2024		25.14
CERN-11Mar2024		25.15
CERN-13Mar2024		25.16
CERN-19Mar2024		25.17
CERN-22Mar2024		25.18
CERN-27Mar2024		25.19
FNAL-01Mar2024		25.2
FNAL-08Mar2024		25.21
FNAL-09Mar2024		25.22



Φύλλο εργασίας ανάλυσης δεδομένων

Επιβεβαιώστε το δείγμα των
δεδομένων της ομάδας σας

Πιέστε για να πάτε στο
λογισμικό της απεικόνισης

Browser address bar: i2u2.org

Navigation menu: ParticleNet, UCY HEP Tra, Google Sheets, EmacsWiki: Set Fonts, untitled folder, My Support, HPlus-TWiki, Grid, CMS, UCY, CDF, Cost

Back navigation: Events Table (Group 100.100), Mass Histogram (Nicosia2024-A), Results (Nicosia2024-A)

Event Display link in sidebar

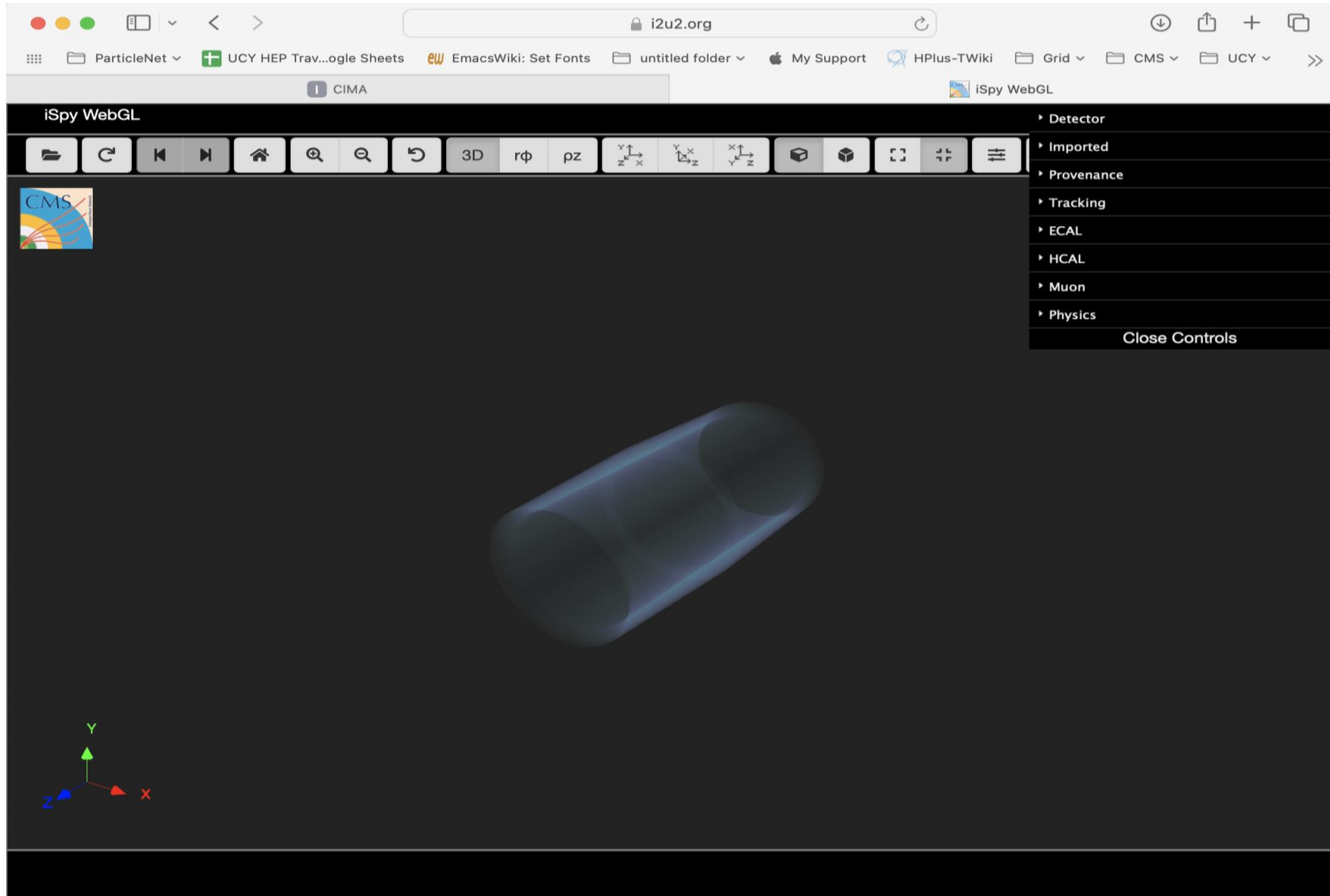
Masterclass: CERN-19Mar2024
Location: Nicosia2024-A
Group: 100.100

Select Event Event index: <input type="text" value="1"/> Event number: 100.100-1	Final State <input type="radio"/> e v <input type="radio"/> μ ν <input type="radio"/> e e <input type="radio"/> μ μ <input type="radio"/> 4e <input type="radio"/> 4μ <input type="radio"/> 2e 2μ	Primary State Charged Particle: <input type="radio"/> W+ <input type="radio"/> W- <input type="radio"/> W± <input type="radio"/> Neutral Particle (Z, H) <input type="radio"/> Zoo	Enter Mass <input type="text"/> GeV/c ² <input type="button" value="Next"/>
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Event index	Event number	Final state	Primary state	Mass
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Το λογισμικό της απεικόνισης γεγονότων: iSpy

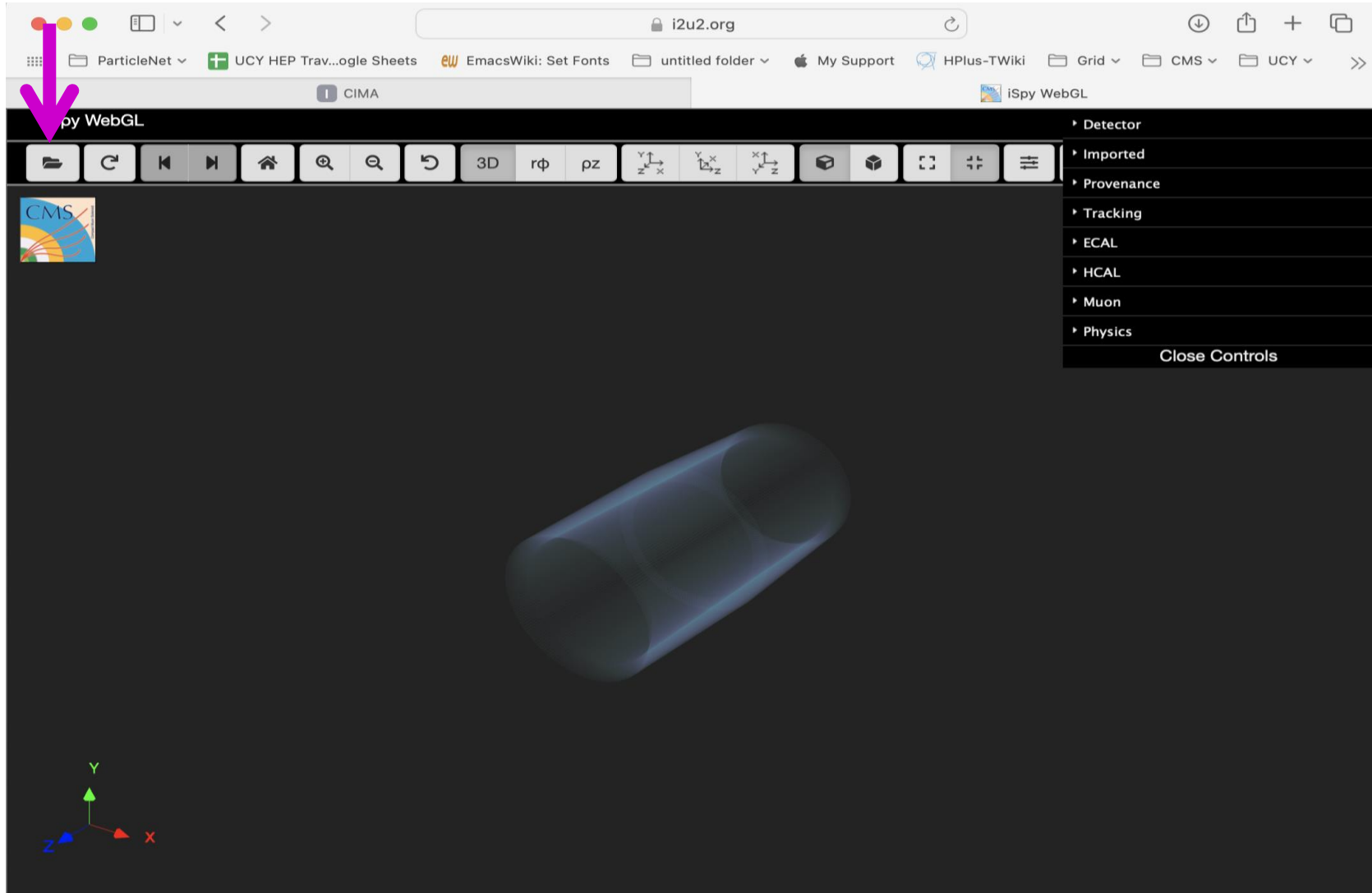
<https://www.i2u2.org/elab/cms/ispay-webgl/>



Το λογισμικό της απεικόνισης γεγονότων: iSpy

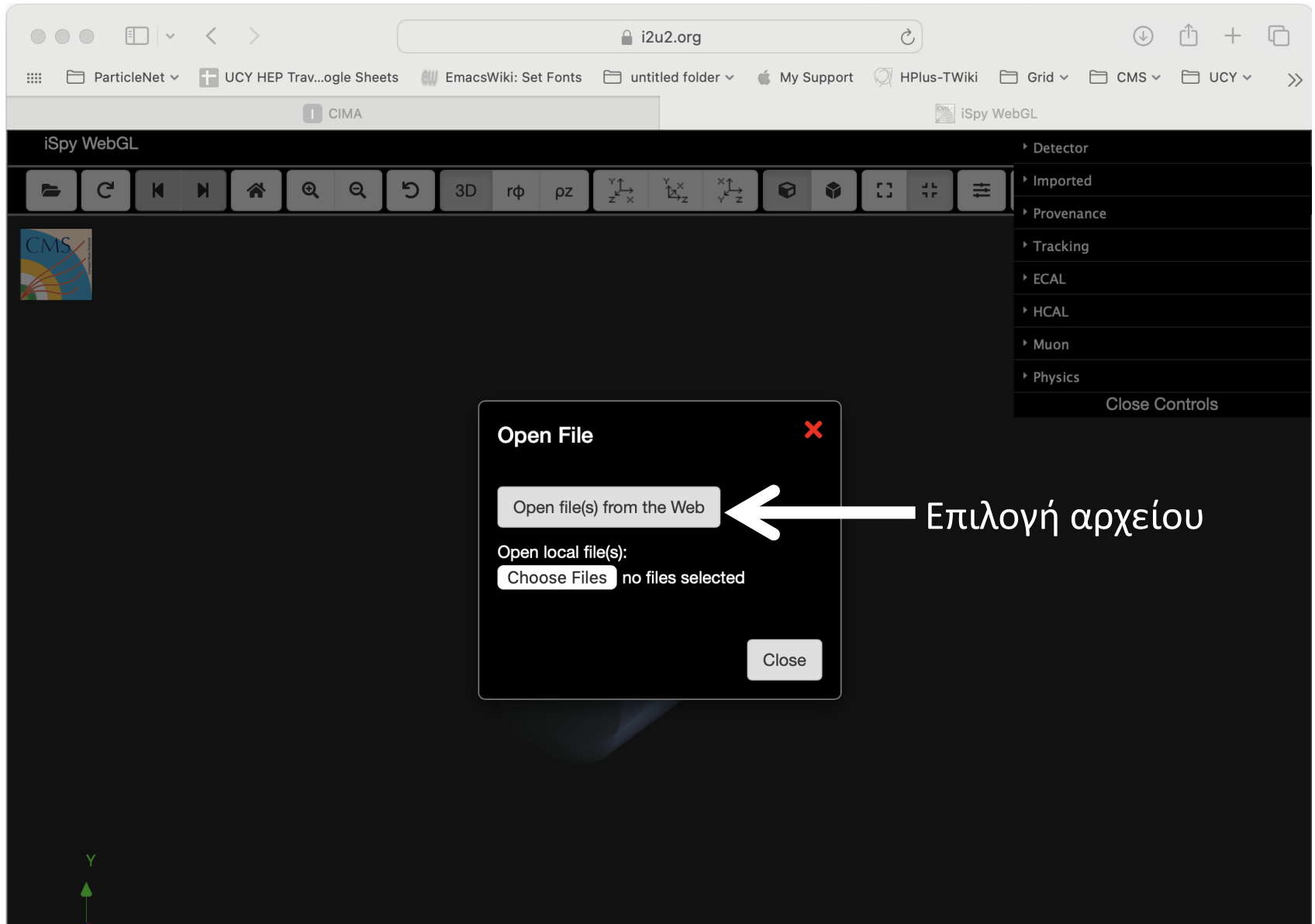
<https://www.i2u2.org/elab/cms/ispay-webgl/>

Επιλογή δεδομένων



Το λογισμικό της απεικόνισης γεγονότων: iSpy

<https://www.i2u2.org/elab/cms/ispay-webgl/>



The image shows a web browser window displaying the iSpy WebGL interface. The browser's address bar shows the URL <https://www.i2u2.org/elab/cms/ispay-webgl/>. The interface includes a top navigation bar with various icons and a sidebar on the right with a tree view of components like Detector, Imported, Provenance, Tracking, ECAL, HCAL, Muon, and Physics. In the center, an 'Open File' dialog box is open, featuring a red close button in the top right corner. The dialog has two main sections: 'Open file(s) from the Web' and 'Open local file(s):'. The 'Open file(s) from the Web' option is highlighted with a white arrow pointing to it from the right. Below this, the 'Open local file(s):' section shows a 'Choose Files' button and the text 'no files selected'. A 'Close' button is located at the bottom right of the dialog. To the right of the dialog, the Greek text 'Επιλογή αρχείου' (File selection) is written in white, with a white arrow pointing to the highlighted 'Open file(s) from the Web' option.

Το λογισμικό της απεικόνισης γεγονότων: iSpy

<https://www.i2u2.org/elab/cms/ispy-webgl/>

The screenshot shows the iSpy WebGL interface. At the top, there is a browser window with the URL <https://www.i2u2.org/elab/cms/ispy-webgl/>. Below the browser, the iSpy WebGL application is running. The interface includes a toolbar with various icons for navigation and viewing. A sidebar on the right lists detector components: Detector, Imported, Provenance, Tracking, ECAL, HCAL, Muon, and Physics. A central dialog box titled "Open Event" is open, displaying a table with two columns: "Files" and "Events". The "Files" column contains the following entries: N5/, N10/, N25/, N50/, and N100/. A blue arrow points to the N100/ entry. The "Events" column is currently empty. Below the table, there is a text input field labeled "Selected event" and two buttons: "Close" and "Load". A text overlay in Greek reads: "Επιλέξτε με το ποντίκι το βασικό data group που σας αντιστοιχεί (N100, N50, N25, N10, N5)".

Files	Events
N5/	
N10/	
N25/	
N50/	
N100/	

Selected event

Close Load

Το λογισμικό της απεικόνισης γεγονότων: iSpy

The image shows a web browser window displaying the iSpy WebGL interface. The address bar shows the URL <https://www.i2u2.org/elab/cms/ispy-webgl/>. The browser tabs include ParticleNet, UCY HEP Trav...ogle Sheets, EmacsWiki: Set Fonts, untitled folder, My Support, HPlus-TWiki, Grid, CMS, UCY, CDF, and Cost. The iSpy WebGL interface features a top toolbar with navigation and viewing controls (3D, rφ, ρz, coordinate axes, zoom, pan, etc.). On the right, a sidebar lists detector components: Detector, Imported, Provenance, Tracking, ECAL, HCAL, Muon, and Physics, with a 'Close Controls' button at the bottom.

An 'Open Event' dialog box is open in the center, displaying a list of event files:

- masterclass_94.ig
- masterclass_95.ig
- masterclass_96.ig
- masterclass_97.ig
- masterclass_98.ig
- masterclass_99.ig
- masterclass_100.ig

A blue arrow points to the file 'masterclass_100.ig'. To the right of the list, there is a text instruction: 'Click στο όνομα του αρχείου για να επιλέξετε το group σας (π.χ. 100.100)'. Below the list is a 'Selected event' input field and two buttons: 'Close' and 'Load'.

In the bottom-left corner, a 3D coordinate system is visible with axes labeled X (red), Y (green), and Z (blue).

Το λογισμικό της απεικόνισης γεγονότων: iSpy

<https://www.i2u2.org/elab/cms/ispy-webgl/>

The screenshot shows the iSpy WebGL interface. At the top, there are tabs for 'CIMA' and 'iSpy WebGL'. Below the tabs is a toolbar with various icons for navigation and viewing. On the right side, there is a sidebar with a list of controls: Detector, Imported, Provenance, Tracking, ECAL, HCAL, Muon, Physics, and Close Controls. In the center, an 'Open Event' dialog box is open. It has a title bar with a close button (X). The dialog contains a table with two columns: 'Files' and 'Events'. The 'Files' column lists several masterclass files (masterclass_1.ig to masterclass_6.ig). The 'Events' column lists seven events (Events/Run_100/Event_1 to Event_7). Below the table is a 'Selected event' field. At the bottom of the dialog are 'Close' and 'Load' buttons. Two white arrows with Greek text point to the 'Events' column and the 'Load' button. The first arrow points to the first event in the list and is labeled 'Κάντε click στο event'. The second arrow points to the 'Load' button and is labeled 'Πιέστε load'.

Files	Events
../	Events/Run_100/Event_1
masterclass_1.ig	Events/Run_100/Event_2
masterclass_2.ig	Events/Run_100/Event_3
masterclass_3.ig	Events/Run_100/Event_4
masterclass_4.ig	Events/Run_100/Event_5
masterclass_5.ig	Events/Run_100/Event_6
masterclass_6.ig	Events/Run_100/Event_7

Κάντε click στο event

Πιέστε load

Το λογισμικό της απεικόνισης γεγονότων: iSpy

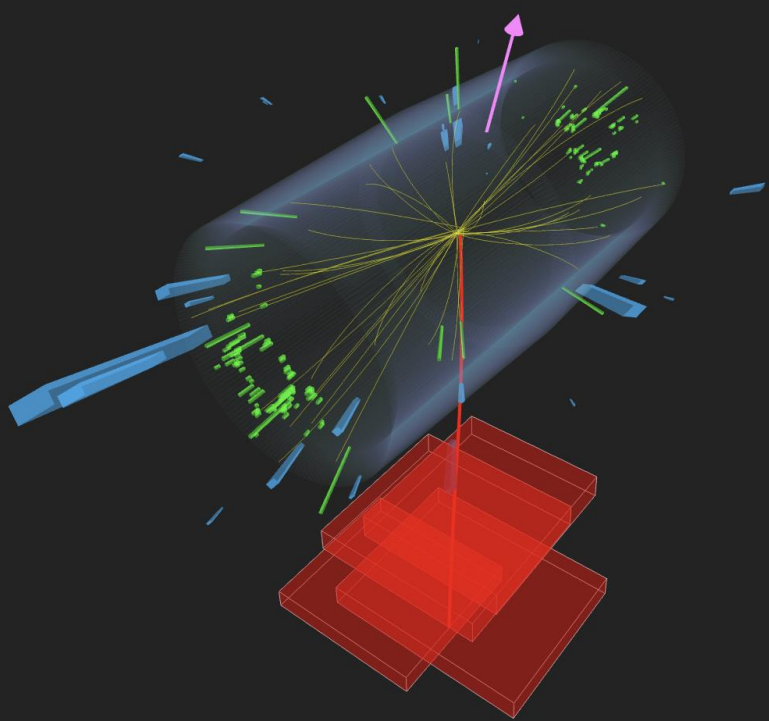
ParticleNet UCY HEP Trav...ogle Sheets EmacsWiki: Set Fonts untitled folder My Support HPlus-TWiki Grid CMS UCY

iSpy WebGL

iSpy WebGL
N100-Events/Run 50/Event 114 of 100

CMS CMS Experiment at the LHC, CERN
Data recorded: 2011-Aug-06 22:23:39.206969 GMT
Run / Event / LS: 172822 / 1741276847 / 1291

- Detector
- Imported
- Provenance
- Tracking
- ECAL
- HCAL
- Muon
- Physics
- Close Controls



Click on a name under "Provenance", "Tracking", "ECAL", "HCAL", "Muon", and "Physics" to view contents in table

CMS detector/event visualization software: iSpy

The screenshot displays the iSpy WebGL interface in a web browser. The browser's address bar shows the URL `i2u2.org`. The browser's tab bar includes several tabs, with the active tab labeled "CIMA". The iSpy WebGL interface features a top toolbar with various navigation and visualization controls, including a "3D" button and a button labeled "rφ" which is circled in green and pointed to by a red arrow. Below the toolbar, the main content area shows a 3D visualization of the CMS detector, with event data represented by colored lines and points. A sidebar on the right contains a list of detector components: "Detector", "Imported", "Provenance", "Tracking", "ECAL", "HCAL", "Muon", and "Physics", each with a dropdown arrow. At the bottom of the sidebar is a "Close Controls" button. The main visualization area includes a 3D coordinate system with X, Y, and Z axes.

iSpy WebGL
N100:Events/Run_50/Event_141 of 100

CMS Experiment at the LHC, CERN
Data recorded: 2011-Aug-06 22:23:39.206969 GMT
Run / Event / LS: 172822 / 1741276847 / 1291

- ▶ Detector
- ▶ Imported
- ▶ Provenance
- ▶ Tracking
- ▶ ECAL
- ▶ HCAL
- ▶ Muon
- ▶ Physics

Close Controls

Click on a name under "Provenance", "Tracking", "ECAL", "HCAL", "Muon", and "Physics" to view contents in table

CMS detector/event visualization software: iSpy

The screenshot displays the iSpy WebGL interface in a web browser. The browser's address bar shows the URL `i2u2.org`. The interface includes a top navigation bar with various icons and a search bar. The main content area features a 3D visualization of the CMS detector, showing the barrel calorimeter (ECAL) and the endcap calorimeter (HCAL). A red arrow points to the search icon in the top navigation bar, with the text "Zoom in" next to it. A green circle highlights the search icon. On the right side, a sidebar menu is visible, with "Tracking", "ECAL", and "HCAL" items circled in white. Three arrows (green, blue, and orange) point from the sidebar to the corresponding components in the 3D visualization. A pink arrow points to a specific hit in the ECAL, and a red arrow points to a hit in the HCAL. The bottom of the interface shows a table of event data for the ECAL barrel region.

Zoom in

CMS Experiment at the LHC, CERN
Data recorded: 2011-Aug-06 22:23:39.206969 GMT
Run / Event / LS: 172822 / 1741276847 / 1291

ECAL: Barrel Rec. Hits

index	energy	eta	phi	time	detid	front_1	front_2	front_3
0	0.124203	-0.0302691	0.861745	32.5588	838861884	0.833479,0.988256,-0.0508939	0.833606,0.988403,-0.0273468	0.849292,0.973281,-0.0
1	0.350554	-0.0302645	2.4	46.4148	838861972	-0.960775,0.865347,-0.0508939	-0.960917,0.865479,-0.0273468	-0.945254,0.880626,-0.0

CMS detector/event visualization software: iSpy

The screenshot displays the iSpy WebGL interface for visualizing CMS detector data. The main view shows a 3D reconstruction of the detector with a central event vertex. A red line indicates a track, and a pink arrow points to a specific hit. The interface includes a top toolbar with navigation and view controls, a left sidebar with event information, and a right sidebar with a hierarchical tree of detector components and their properties.

Annotations in Greek text provide instructions on how to interact with the interface:

- Click για να μην επιλεγεί** (Click to not be selected): Points to the **Tracking** component in the right sidebar.
- Click για να επιλεγεί** (Click to be selected): Points to the **show** checkbox for **Tracks (reco.)** and **Barrel Rec. Hits** in the right sidebar.
- Click για να επιλεγεί** (Click to be selected): Points to the **show** checkbox for **Endcap Rec. Hits** in the right sidebar.
- Click για να επιλεγεί** (Click to be selected): Points to the **show** checkbox for **Barrel Rec. Hits** in the right sidebar.
- Click για να επιλεγεί** (Click to be selected): Points to the **show** checkbox for **Barrel Rec. Hits** in the right sidebar.

The right sidebar shows the following components and their properties:

- Detector**
 - Imported**
 - Provenance**
 - Tracking** (circled in red)
 - Tracks (reco.)**
 - number: 56
 - key: Tracks_V3
 - show: (circled in blue)
 - opacity: 0.5
 - min_pt: 1
 - color: #ffff00
 - ECAL** (circled in blue)
 - Endcap Rec. Hits**
 - number: 190
 - key: EERecHits_V2
 - show: (circled in blue)
 - opacity: 0.5
 - color: #19ff19
 - Barrel Rec. Hits** (circled in blue)
 - number: 64
 - key: EBRecHits_V2
 - show: (circled in blue)
 - opacity: 0.5
 - color: #19ff19
 - HCAL** (circled in red)
 - Barrel Rec. Hits**
 - number: 28
 - key: HBRecHits_V2
 - show: (circled in blue)
 - opacity: 0.5
 - color: #33b2ff

HCAL: Barrel Rec. Hits

index	energy	eta	phi	time	detid	front_1
0	0.629988	-0.4785	-0.305433	-23.7947	1107313477	1.75096,-0.469168,-0.81364
1	0.993199	-1.0005	-3.01069	-7.54512	1107314214	-1.78519,-0.314777,-2.01197

CMS detector/event visualization software: iSpy

Επόμενος γεγονός

The screenshot displays the iSpy WebGL interface. At the top, a toolbar contains various navigation and control icons. A red arrow points to a green circle around the 'Next' (right arrow) button. The main area shows a 3D visualization of the CMS detector, with a central event visualization. A red line extends from the center of the event down to three red rectangular bars representing detector components. A pink arrow points upwards from the center of the event. The bottom of the interface features a table of data for 'HCAL: Barrel Rec. Hits'.

HCAL: Barrel Rec. Hits

index	energy	eta	phi	time	detid	front_1	front_2	front_3
0	0.629988	-0.4785	-0.305433	-23.7947	1107313477	1.75096,-0.469168,-0.81364	1.7034,-0.619989,-0.81364	1.7034,-0.619989,-0.989805
1	0.993199	-1.0005	-3.01069	-7.54512	1107314214	-1.78519,-0.314777,-2.01197	-1.80583,-0.15799,-2.01197	-1.80583,-0.15799,-2.25549

CMS detector/event visualization software: iSpy

The screenshot displays the iSpy WebGL interface for the CMS detector. At the top, it shows the title 'iSpy WebGL' and the URL 'N100-Events/Run_56/Event_1 [1 of 100]'. Below this is a toolbar with navigation and view controls. The main area features a 3D visualization of the CMS detector, with a central collision point and surrounding detector components. A green arrow points to a specific track, labeled 'Θετική τροχιά' (Positive track). Other annotations include 'Ελλειμματικό ισοζύγιο εγκάρσιας ενέργειας (missing ET) There is a neutrino' (Missing transverse energy (missing ET) There is a neutrino), 'Καμπυλώνει σύμφωνα με τη φορά των δεικτών του ρολογιού:' (Curves according to the clockwise direction of the clock:), 'Όταν περάσετε με το ποντίκι πάνω Από την τροχιά αυτή αλλάζει χρώμα και μπορείτε να την επιλέξετε' (When you click with the mouse on the track, its color changes and you can select it), 'Ανιχνευτές μιονίων' (Muon detectors), and 'Τροχιά μιονίου' (Muon track). A small 3D coordinate system is visible in the bottom left corner. The bottom of the interface shows a table of physics data for 'Global Muons (Pico)'. The table has columns for index, pt, charge, phi, eta, E, px, py, pz, and calo_energy, with corresponding numerical values.

Detector

- Imported
- Provenance
- Tracking
- ECAL
- HCAL
- Muon
- Physics

Close Controls

Ελλειμματικό ισοζύγιο εγκάρσιας ενέργειας (missing ET)
There is a neutrino

Καμπυλώνει σύμφωνα με τη φορά των δεικτών του ρολογιού:

Θετική τροχιά

Όταν περάσετε με το ποντίκι πάνω Από την τροχιά αυτή αλλάζει χρώμα και μπορείτε να την επιλέξετε

Ανιχνευτές μιονίων

Τροχιά μιονίου

Physics: Global Muons (Pico)

index	pt	charge	rp	phi	eta	E	px	py	pz	calo_energy	
0	37.6667			0.0006638,0.000497136,-0.0099402	-1.5215	0.0128385	37.6042	1.8562	-37.621	0.483596	0

The excel spread sheet

Notice: Trying to access array offset on value of type int in `/home/quarkcat/sw/www-php/cima-wzh/DataTable.php` on line 114

Back Events Table (Group 100.56) Mass Histogram (NicosiaCyprus2024) Results (NicosiaCyprus2024) [➔ Event Display](#)

Masterclass: CERN-08Mar2024

Location: NicosiaCyprus2024

Group: 100.56

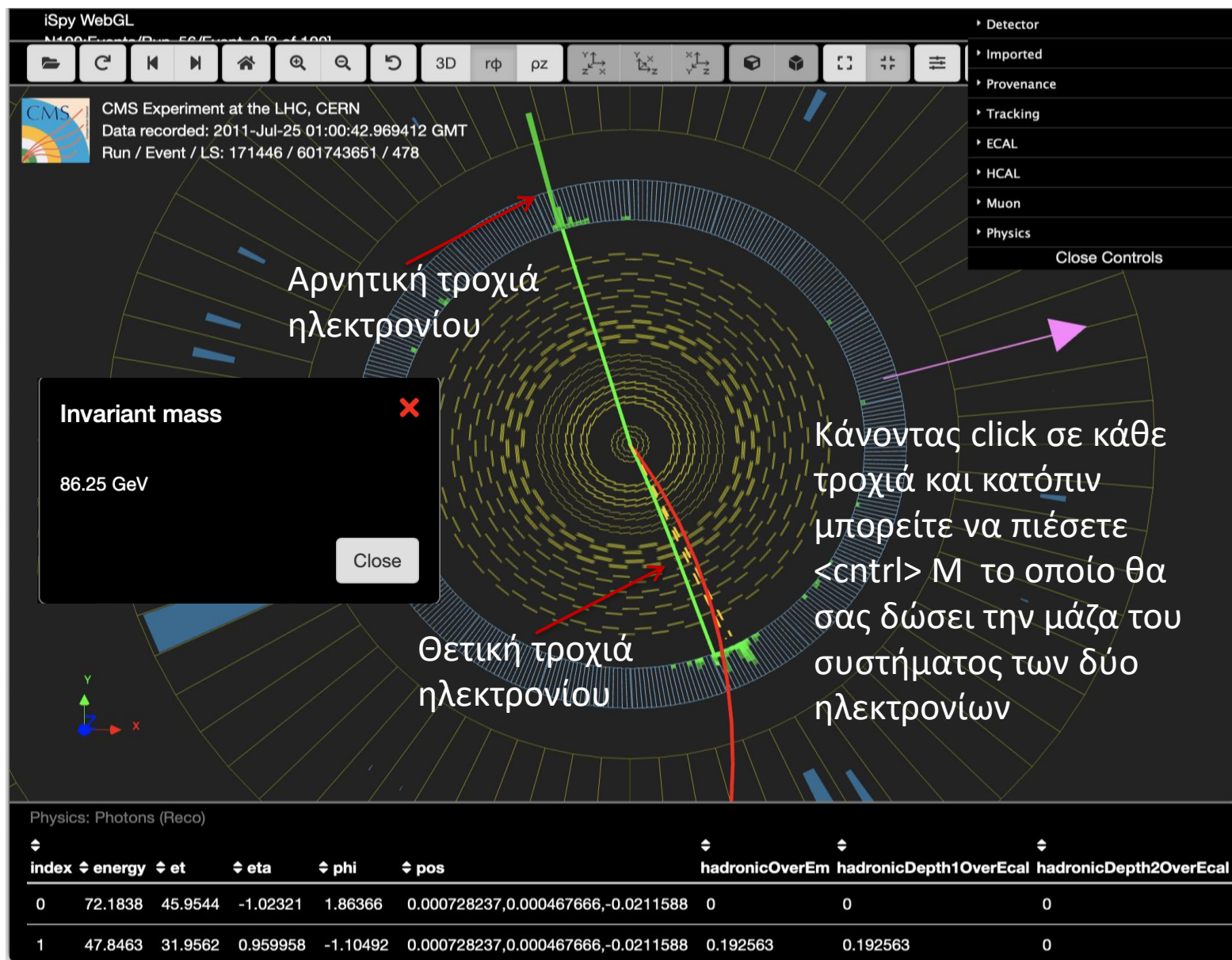
Select Event Event index: <input type="text" value="2"/> Event number: 100.56-2	Final State <input type="radio"/> e v <input checked="" type="radio"/> μ v <input type="radio"/> e e <input type="radio"/> μ μ <input type="radio"/> 4e <input type="radio"/> 4 μ <input type="radio"/> 2e 2 μ	Primary State Charged Particle: <input checked="" type="radio"/> W+ <input type="radio"/> W- <input type="radio"/> W \pm <input type="radio"/> Neutral Particle (Z, H) <input type="radio"/> Zoo	Enter Mass <input type="text"/> GeV/c ² <input checked="" type="button" value="Next"/>
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Event index	Event number	Final state	Primary state	Mass
146001	100.56-1	μ v	W+	

CMS detector/event visualization software: iSpy

Παραγωγή και διάσπαση ενός ουδέτερου σωματιδίου



The excel spread sheet

Back

Events Table (Group 100.56)

Mass Histogram (NicosiaCyprus2024)

Results (NicosiaCyprus2024)

➔ Event Display

Masterclass: CERN-08Mar2024

Location: NicosiaCyprus2024

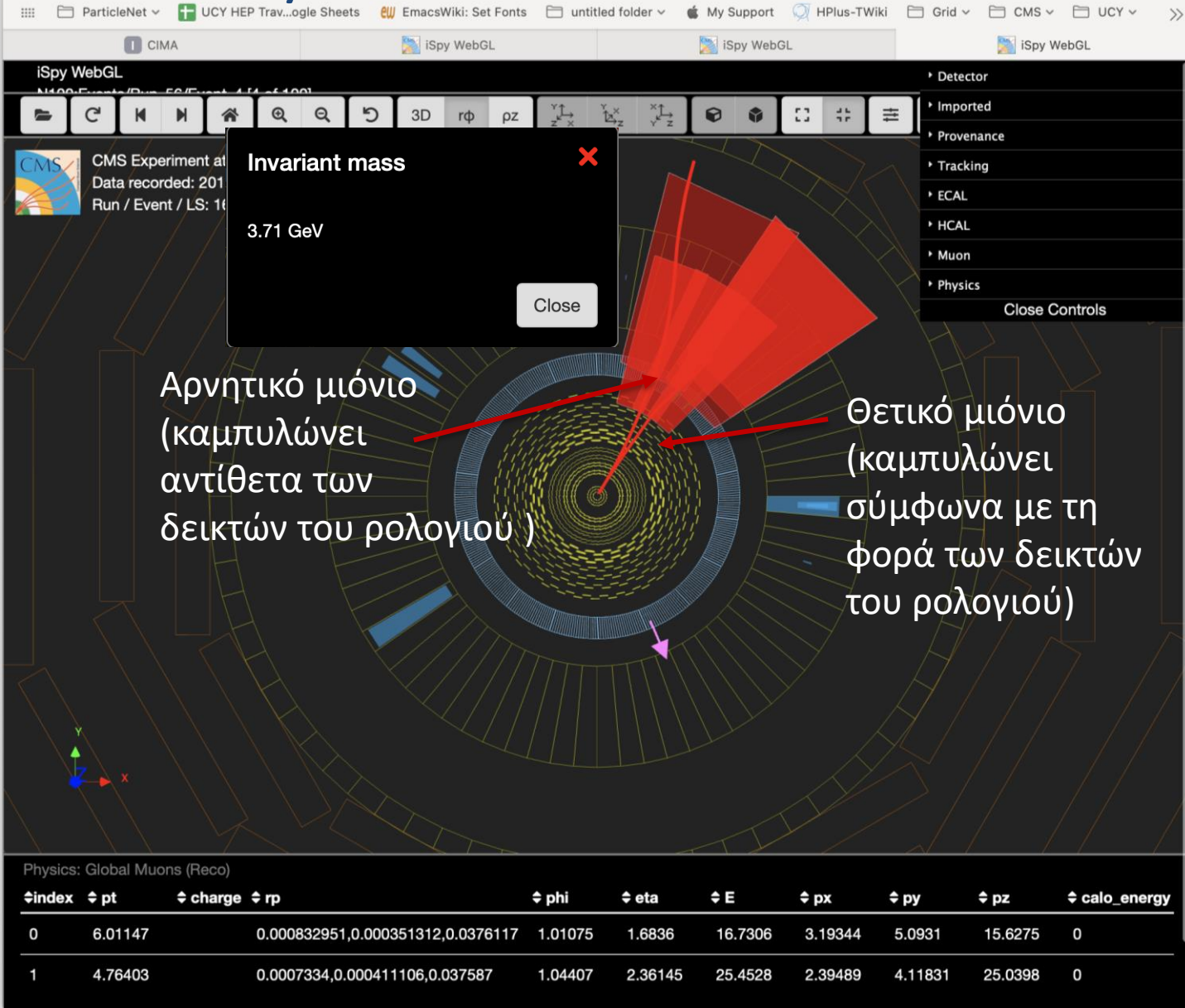
Group: 100.56

Select Event Event index: <input type="text" value="2"/> Event number: 100.56-2	Final State <input type="radio"/> e ν <input checked="" type="radio"/> e e <input type="radio"/> 4e <input type="radio"/> 2e 2 μ <input type="radio"/> μ ν <input type="radio"/> μ μ <input type="radio"/> 4 μ	Primary State Charged Particle: <input type="radio"/> W+ <input type="radio"/> W- <input type="radio"/> W \pm <input checked="" type="radio"/> Neutral Particle (Z, H) <input type="radio"/> Zoo	Enter Mass <input type="text" value="86.25"/> GeV/c ² <input type="button" value="Next"/>
--	--	---	---

You should type
in the mass from
the previous step:

Event index	Event number	Final state	Primary state	Mass
146001	100.56-1	$\mu\nu$	W+	

CMS detector/event visualization software: iSpy



The excel spread sheet

Notice: Trying to access array offset on value of type int in /home/quarkcat/sw/www-php/cima-wzh/DataTable.php on line 114

Back Events Table (Group 100.56) Mass Histogram (NicosiaCyprus2024) Results (NicosiaCyprus2024) [Event Display](#)

Masterclass: CERN-08Mar2024

Location: NicosiaCyprus2024

Group: 100.56

Select Event Event index: <input type="text" value="3"/> Event number: 100.56-3	Final State <input type="radio"/> e v <input type="radio"/> e e <input type="radio"/> 4e <input type="radio"/> 2e 2μ <input type="radio"/> μ v <input checked="" type="radio"/> μ μ <input type="radio"/> 4μ	Primary State Charged Particle: <input type="radio"/> W+ <input type="radio"/> W- <input type="radio"/> W± <input checked="" type="radio"/> Neutral Particle (Z, H) <input type="radio"/> Zoo	Enter Mass <input type="text" value="3.71"/> GeV/c <input type="button" value="Next"/>
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Event index	Event number	Final state	Primary state	Mass
146002	100.56-2	2e	neutral	86.25
146001	100.56-1	μν	W+	

CMS detector/event visualization software: iSpy

Ενδιαφέρον γεγονός: Ζεύγος e^+e^- και $\mu^+\mu^-$ → 2 ουδέτερα σωματίδια

Γεγονός με υποψήφιο Higgs: $H^0 \rightarrow ZZ^*$

iSpy WebGL
CMS Experiment at the LHC, CERN
Data recorded: 2012-Jul-04 03:19:28.393790 GMT
Run / Event / LS: 198213 / 27000461 / 31

Detector
Imported
Provenance
Tracking
ECAL
HCAL
Muon
Physics
Close Controls

Invariant mass
121.50 GeV
Close

Θετική τροχιά → e^+
Αρνητική τροχιά → e^-
Θετική τροχιά → μ^+
Αρνητική τροχιά → μ^-

Επιλέγοντας όλες τις τροχιές και πιέζοντας (cntrl-M)

CIMA - The excel spreadsheet

Notice: Trying to access array offset on value of type int in /home/quarkcat/sw/www-php/cima-wzh/DataTable.php on line 114

Back

Events Table (Group 100.56)

Mass Histogram (NicosiaCyprus2024)

Results (NicosiaCyprus2024)

➔ Event Display

Masterclass: CERN-08Mar2024

Location: NicosiaCyprus2024

Group: 100.56

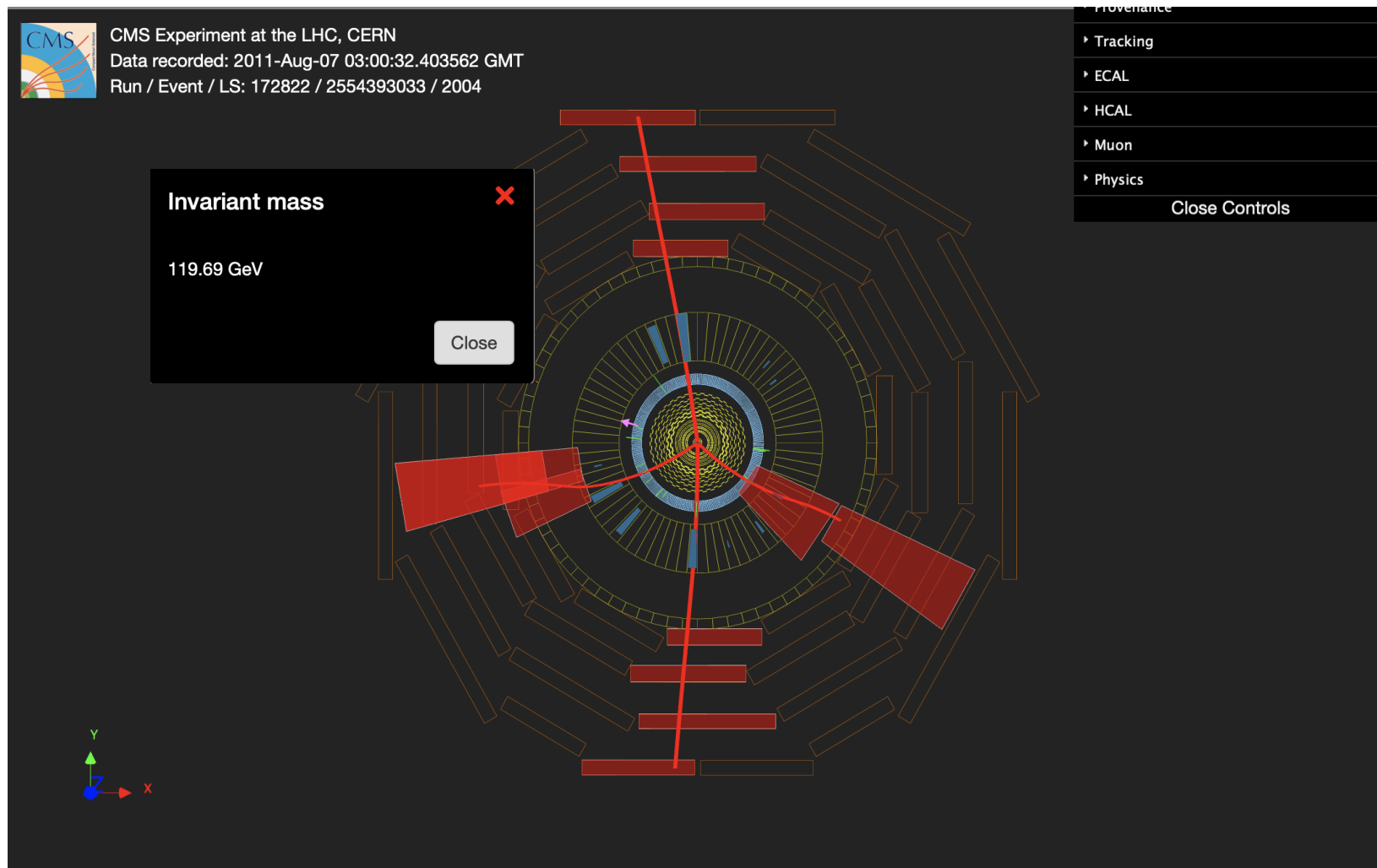
Select Event Event index: <input type="text" value="4"/> Event number: 100.56-4	Final State <input type="radio"/> e v <input type="radio"/> μ v <input type="radio"/> e e <input type="radio"/> μ μ <input type="radio"/> 4e <input type="radio"/> 4 μ <input checked="" type="radio"/> 2e 2 μ	Primary State Charged Particle: <input type="radio"/> W ⁺ <input type="radio"/> W ⁻ <input type="radio"/> W \pm <input checked="" type="radio"/> Neutral Particle (Z, H) <input type="radio"/> Zoo	Enter Mass <input type="text" value="121.5"/> GeV/c ² <input type="button" value="Next"/>
--	---	---	---

Event index	Event number	Final state	Primary state	Mass
146003	100.56-3	$\mu\mu$	neutral	3.71
146002	100.56-2	2e	neutral	86.25
146001	100.56-1	$\mu\nu$	W ⁺	

CMS detector/event visualization software: iSpy

Ενδιαφέρον γεγονός: Two pairs of $\mu^+\mu^-$ → 2 neutral particles

Γεγονός με υποψήφιο Higgs: $H^0 \rightarrow ZZ^*$



CIMA - The excel spread sheet

Back

Events Table (Group 100.56)

Mass Histogram (NicosiaCyprus2024)

Results (NicosiaCyprus2024)

➔ Event Display

Masterclass: CERN-08Mar2024

Location: NicosiaCyprus2024

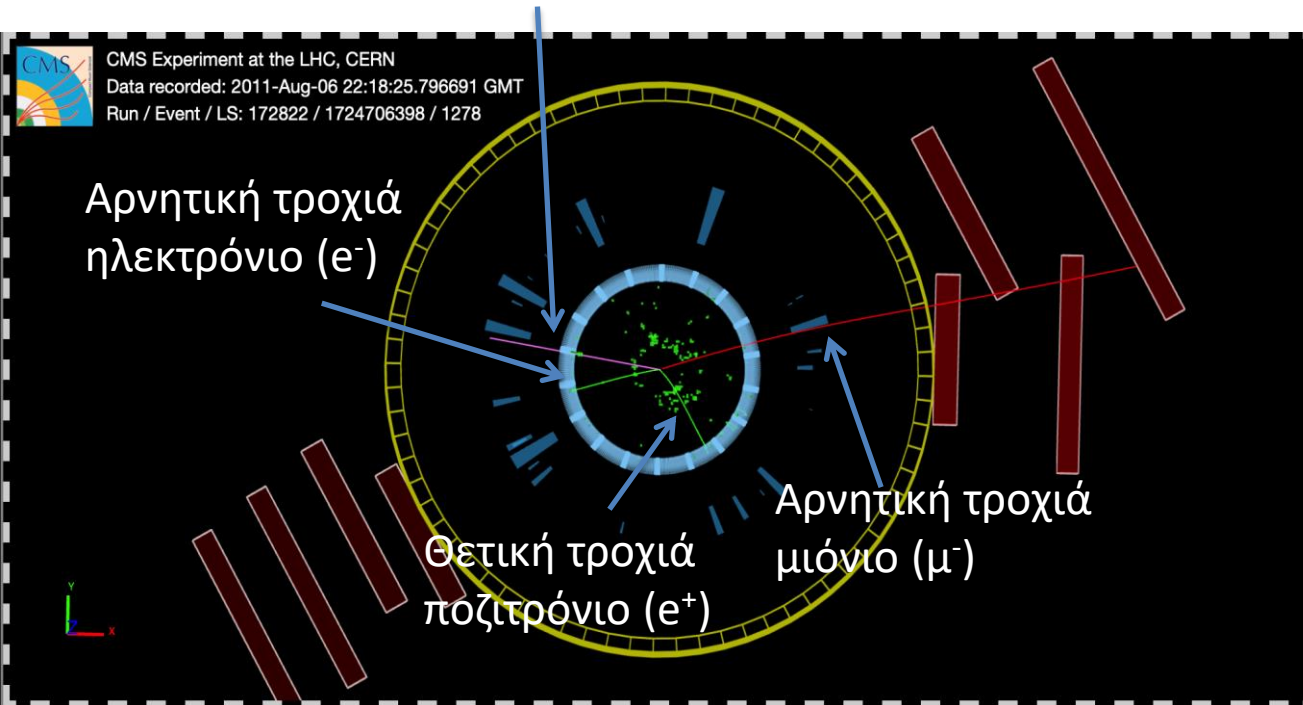
Group: 100.56

Select Event Event index: <input type="text" value="5"/> <input type="button" value="v"/> Event number: 100.56-5	Final State <input type="radio"/> e v <input type="radio"/> μ v <input type="radio"/> e e <input type="radio"/> μ μ <input type="radio"/> 4e <input checked="" type="radio"/> 4 μ <input type="radio"/> 2e 2 μ	Primary State Charged Particle: <input type="radio"/> W ⁺ <input type="radio"/> W ⁻ <input type="radio"/> W \pm <input checked="" type="radio"/> Neutral Particle (Z, H) <input type="radio"/> Zoo	Enter Mass <input type="text" value="119.69"/> GeV/c ² <input type="button" value="Next"/>
---	---	---	--

Event index	Event number	Final state	Primary state	Mass
146004	100.56-4	4 μ	neutral	119.4
146003	100.56-3	$\mu\mu$	neutral	3.71
146002	100.56-2	2e	neutral	86.25
146001	100.56-1	μ v	W ⁺	

Το λογισμικό της απεικόνισης γεγονότων: iSpry

Έλλειμα εγκάρσιας
ενέργειας (missing ET)
Υπάρχει νεutrino



Περίεργο γεγονός

$e^- e^+$ και $1 \mu^-$

Ουδέτερο σωματίο?

ΟΧΙ

τα προϊόντα δεν είναι ίδιου τύπου

Έλλειμα ενέργειας
➔ ≥ 1 νεutrino

Θα μπορούσε να είναι $Z^0 W^-$

Κατηγοροποιείται ως
Z00

CIMA - Το φύλλο εργασίας

Notice: Undefined index: finalState in /home/quarkcat/sw/www-php/cima-wzh/DataTable.php on line 41

[Back](#) [Events Table \(Group 100.12\)](#) [Mass Histogram \(NicosiaA2020\)](#) [Results \(NicosiaA2020\)](#)

[Event Display](#)

Masterclass: CERN-07Mar2020

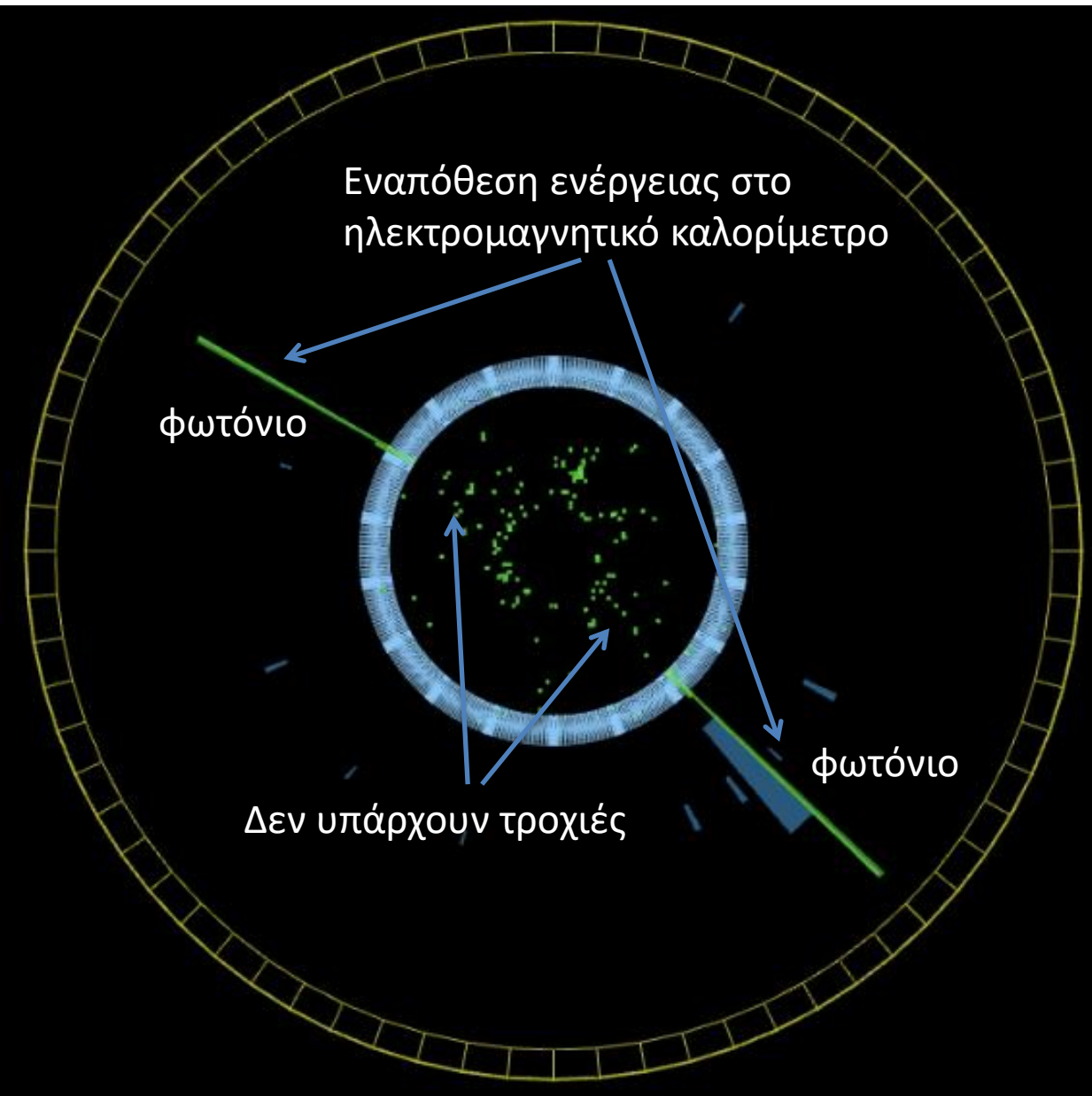
Location: NicosiaA2020

Group: 100.12

Select Event Event index: <input type="text" value="1"/> Event number: 100.12-1	Final State <input type="radio"/> e v <input type="radio"/> μ v <input type="radio"/> e e <input type="radio"/> μ μ <input type="radio"/> 4e <input type="radio"/> 4 μ <input type="radio"/> 2e 2 μ	Primary State Charged Particle: <input type="radio"/> W+ <input type="radio"/> W- <input type="radio"/> W \pm <input type="radio"/> Neutral Particle (Z, H) <input type="radio"/> Zoo	Enter Mass <input type="text"/> GeV/c ² <input type="button" value="Next"/>
--	--	---	---

Event index	Event number	Final state	Primary state	Mass
102012	100.12-12		zoo	
102004	100.12-4	2e	neutral	2.73

Το λογισμικό της απεικόνισης γεγονότων: iSpry



Υποψήφιο γεγονός
Higgs

$$H^0 \rightarrow gg$$

CIMA - Το φύλλο εργασίας

Masterclass: CERN-13Mar2019

location: CyprusA2019

Group: 62

Instructions (also available as [screencast](#)):

- For each event, identify the final state and select a primary state candidate.
 - For Higgs or Zoo candidate, no final state is chosen
 - If you cannot decide between W^+ and W^- , choose W instead
- If you think the final state is a neutral particle (like a Z), but you don't know its exact type, select NP for "neutral particle." Find its mass from the Event Display and enter it.
- Once you have selected everything, click "Submit".

In case of an error, double clicking the data line will reload it; you can then try it again.

Select Event Event index: <input type="text" value="44"/> Event number: 62-44	final state <input type="checkbox"/> Electron <input type="checkbox"/> Muon (μ)	primary state candidate <input type="checkbox"/> W^- <input type="checkbox"/> W^+ <input type="checkbox"/> NP <input type="checkbox"/> W <input checked="" type="checkbox"/> Higgs <input type="checkbox"/> Zoo	NP Mass: <input type="text"/> GeV/c ² <input type="button" value="Submit"/>
--	--	--	---

Event index

Event number

Chosen Values

Mass

29	62-29	H	121.89
13	62-13	e, NP	88.17
4	62-4	μ , NP	9.44
2	62-2	e, W^-	
1	62-1	μ , W^+	

Σχεδιάζοντας έναν ανιχνευτή: Τι θέλουμε να βρούμε?

Τα σταθερά σωματίδια τα οποία απόμειναν από την διάσπαση κάποιων σωματιδίων, όπως του W^+ , W^- , Z^0 (και H^0)

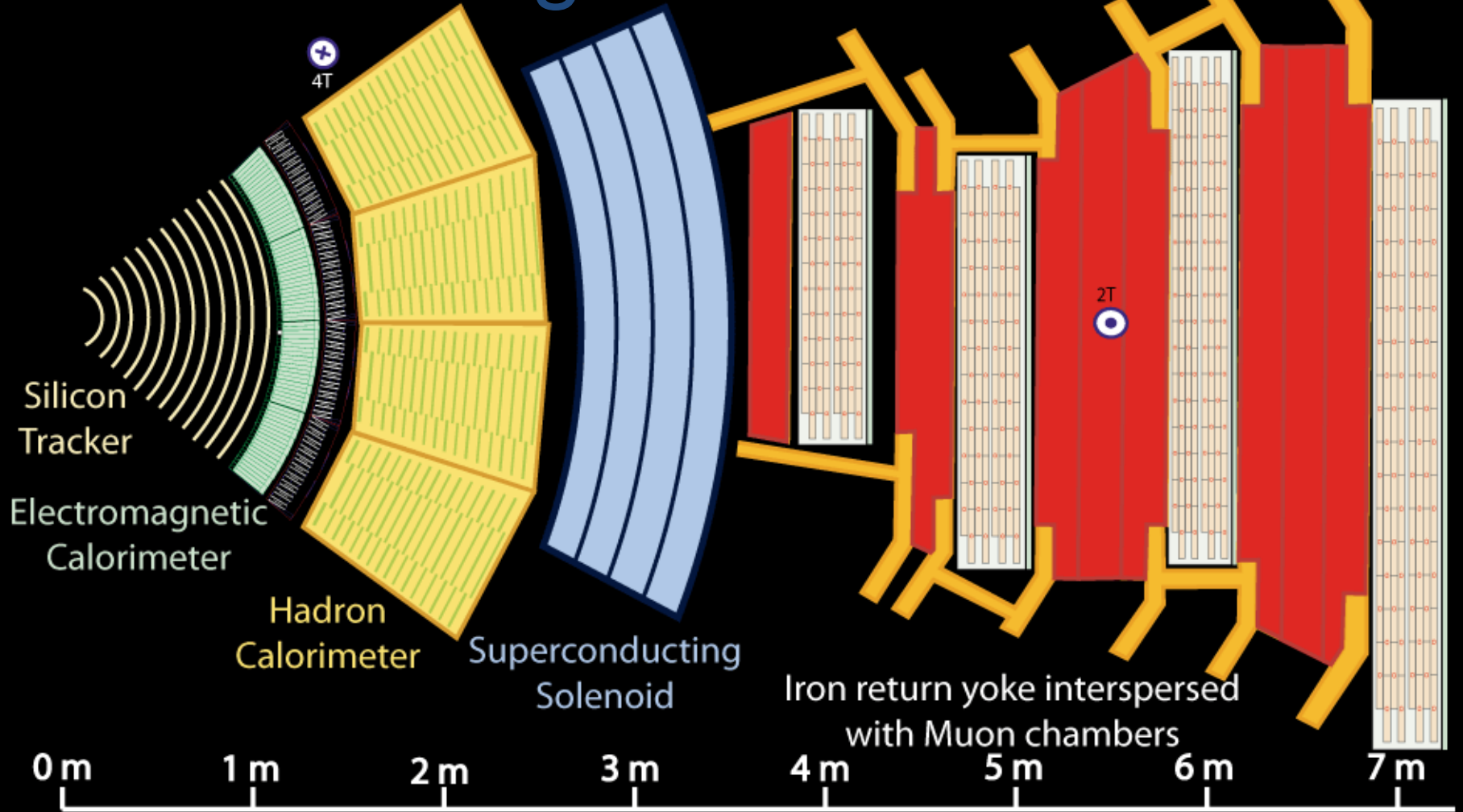
- $W^+ \rightarrow \{ \pi^+ \pi^+ \}$
- $W^+ \rightarrow e^+ + \{ \nu_e \}$
- $W^- \rightarrow \{ \pi^- \pi^+ \}$
- $W^- \rightarrow e^- + \{ \nu_e \}$
- $Z^0 \rightarrow e^+ + e^-$
- $Z^0 \rightarrow \{ \pi^+ \pi^- \}$
- $H^0 \rightarrow \text{C} + \text{C}$
- $W^\pm \rightarrow \text{hadrons}$

Hadrons could be:

π^+ , π^- , K^+ , K^- , ρ .

- Ένα σωματίδιο “ i ” θα φύγει από το σημείο σκέδασης με ορμή p_i και ενέργεια E_i

A slice through the CMS detector



Key:

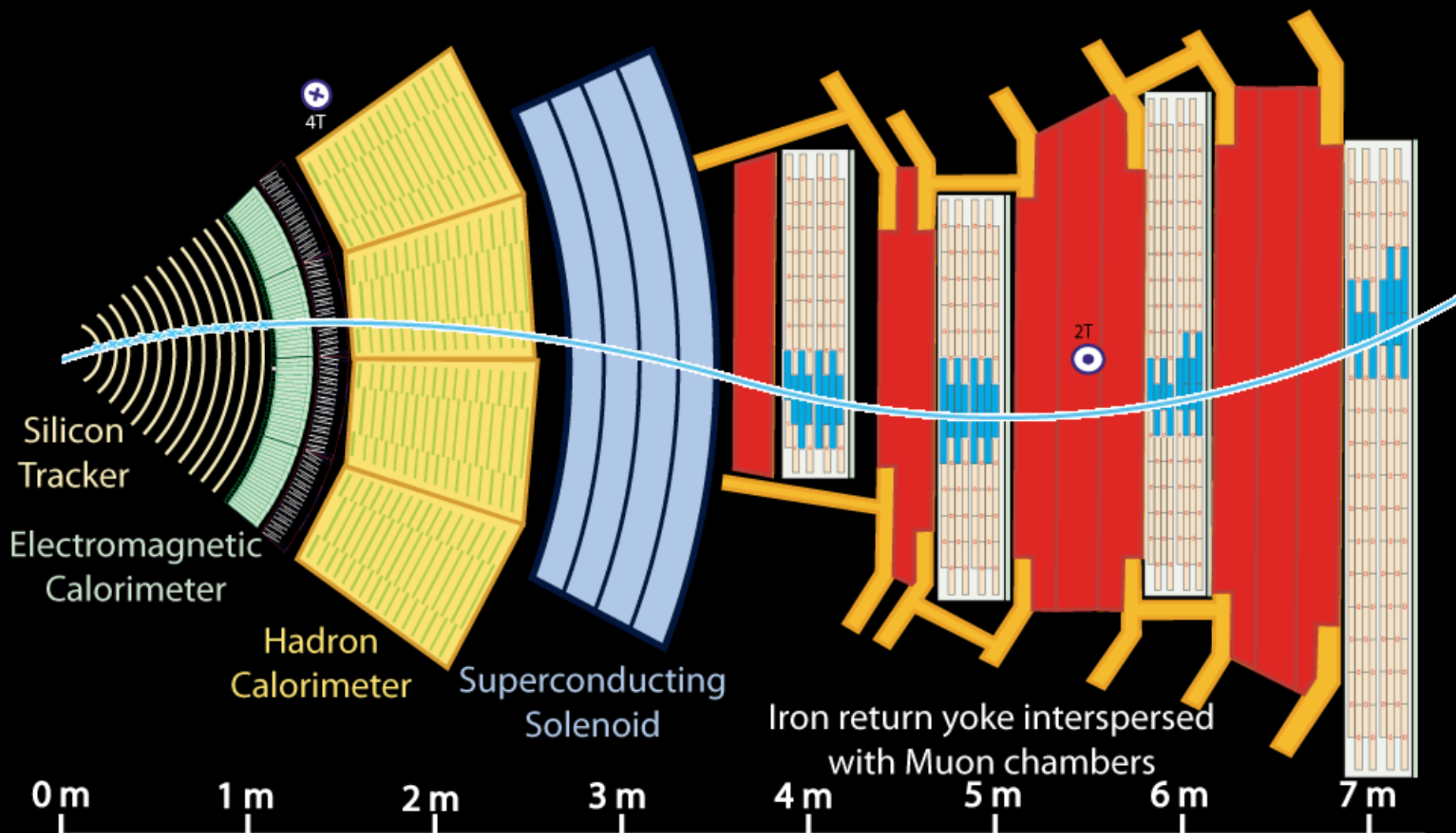
— Muon

— Electron

— Charged Hadron (e.g. Pion)

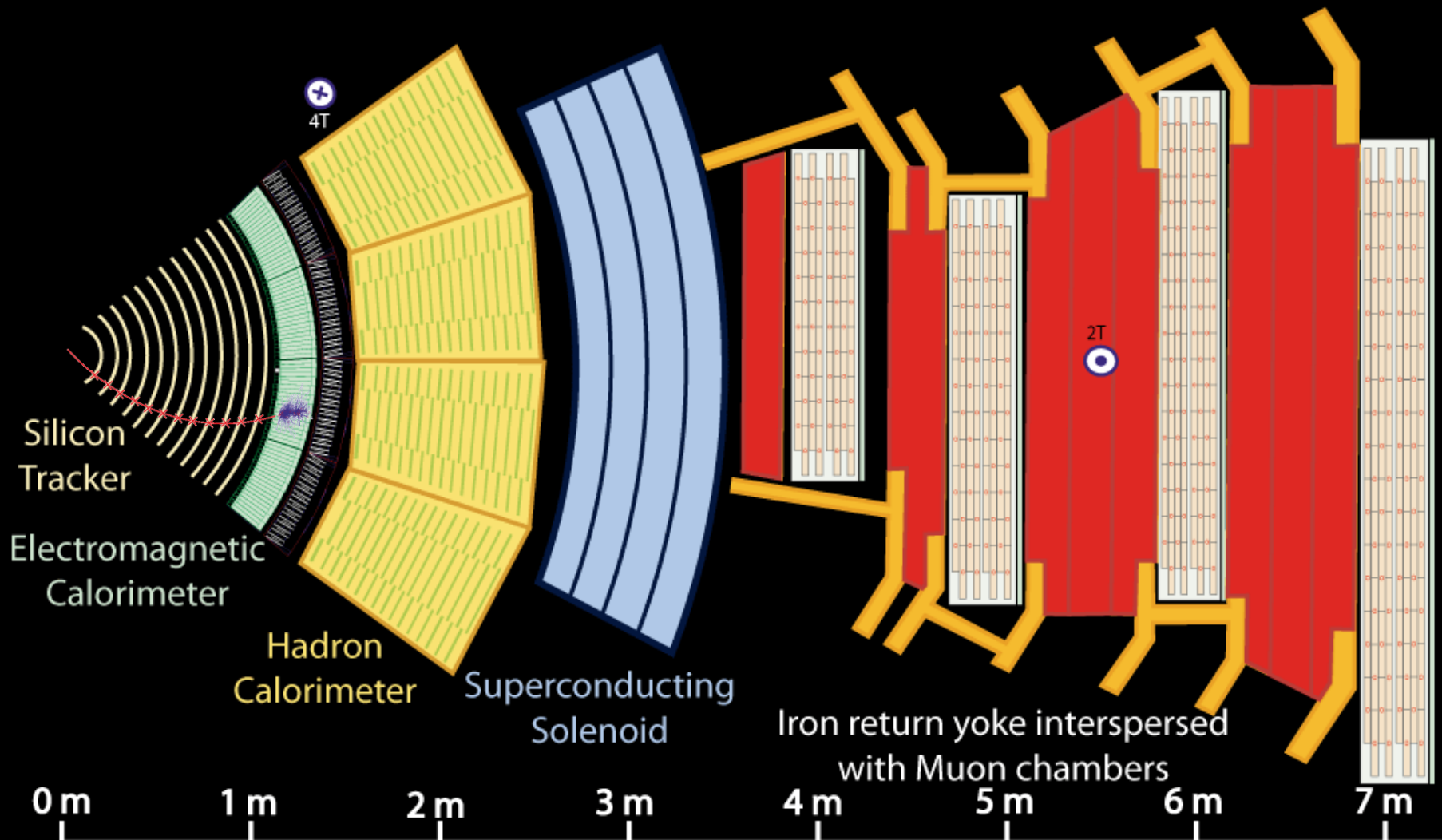
- - - Neutral Hadron (e.g. Neutron)

- - - Photon



Key:

- Muon
- Electron
- Charged Hadron (e.g. Pion)
- - - Neutral Hadron (e.g. Neutron)
- - - Photon



Key:

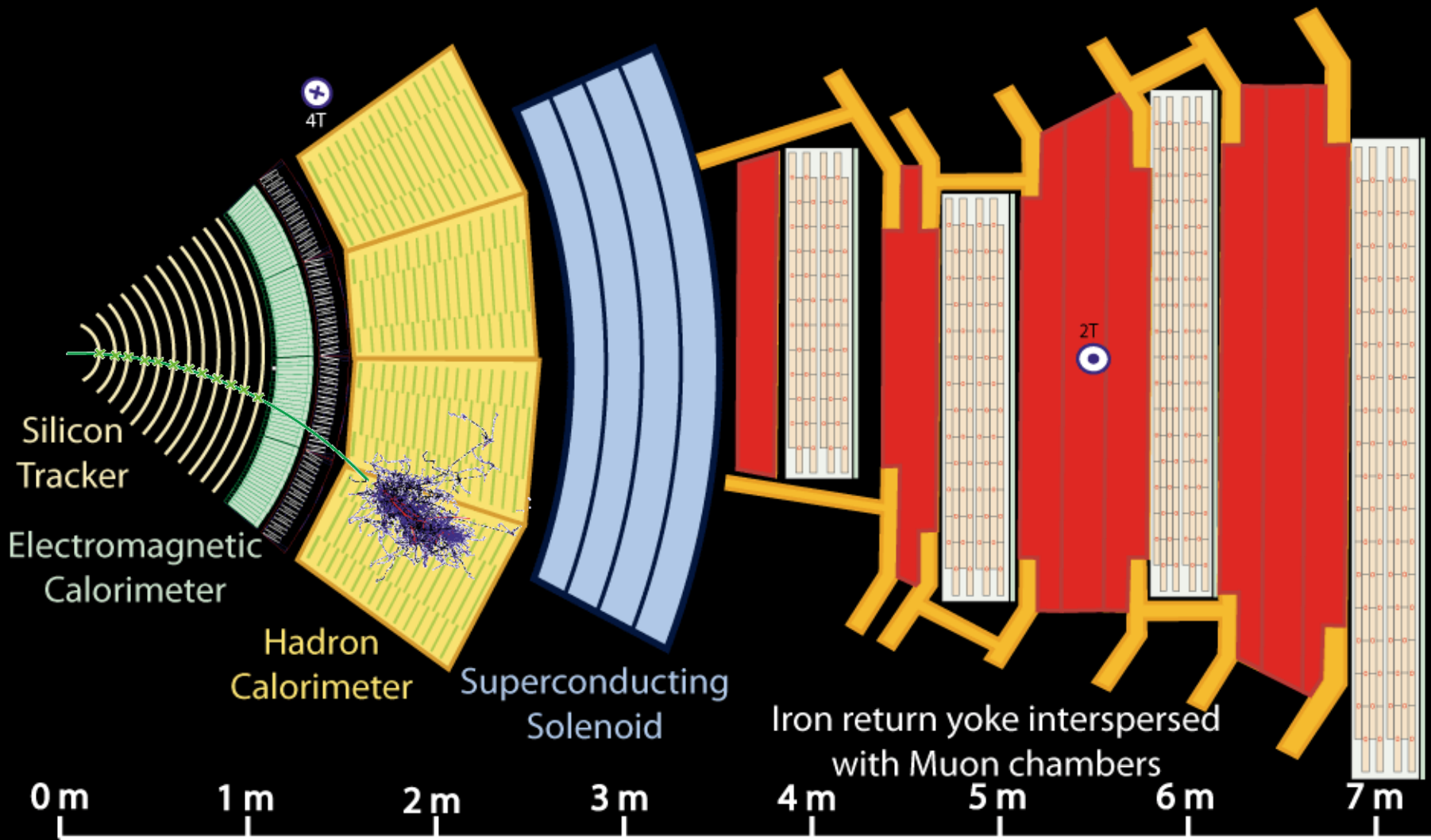
— Muon

— Electron

— Charged Hadron (e.g. Pion)

- - - Neutral Hadron (e.g. Neutron)

- - - Photon



Key:

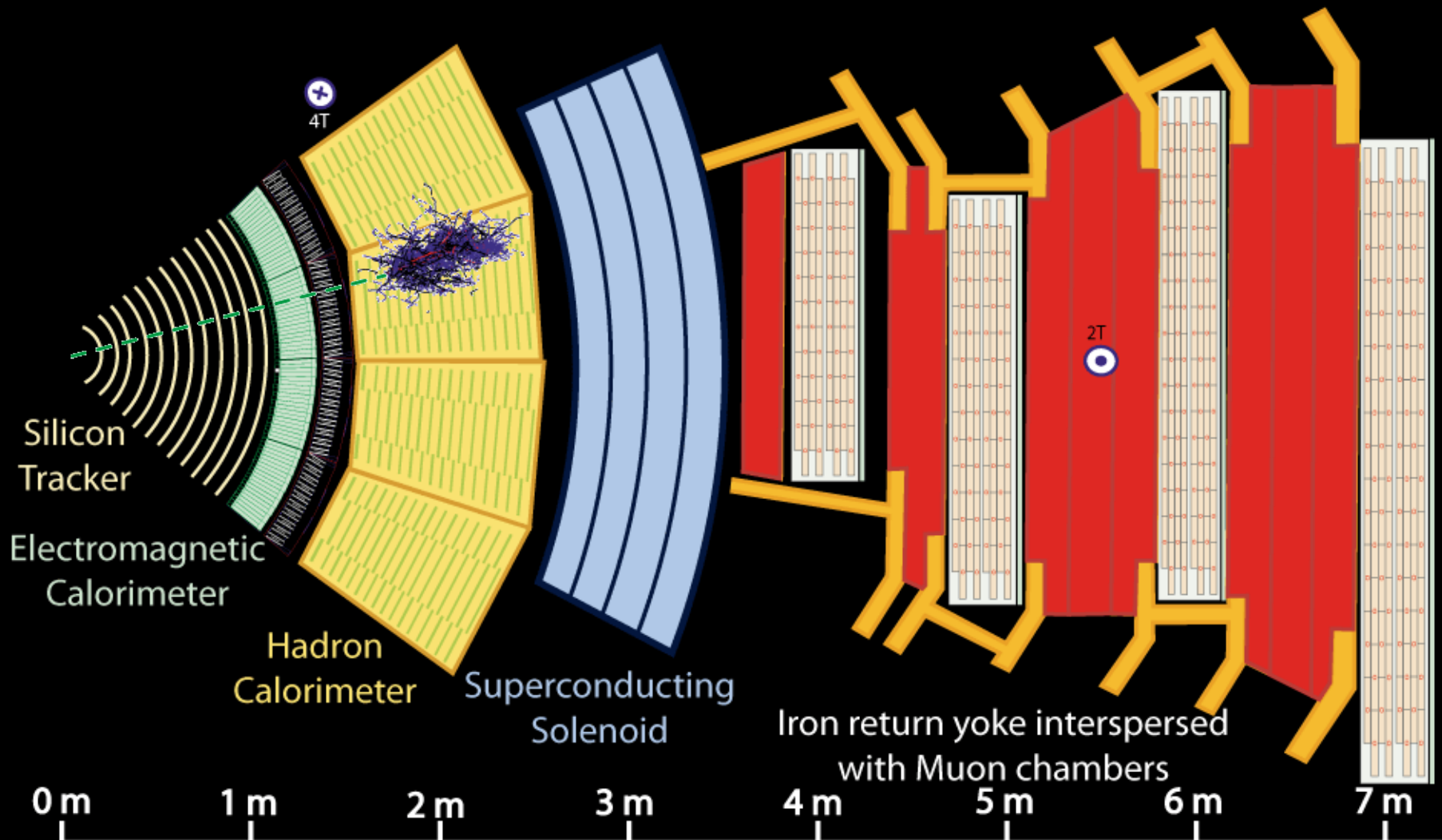
— Muon

— Electron

— Charged Hadron (e.g. Pion)

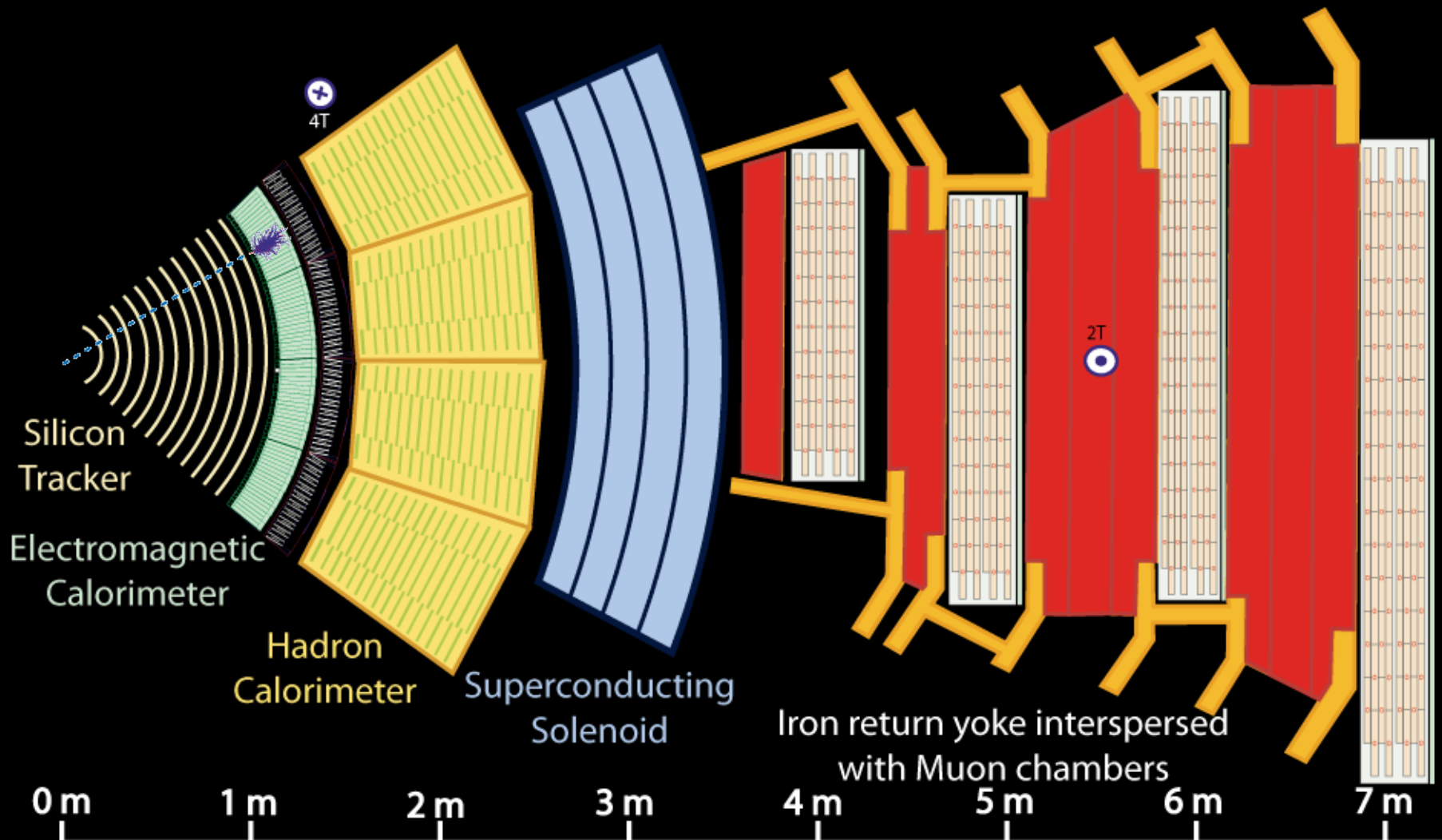
- - - Neutral Hadron (e.g. Neutron)

- - - Photon



Key:

- Muon
- Electron
- Charged Hadron (e.g. Pion)
- Neutral Hadron (e.g. Neutron)
- Photon

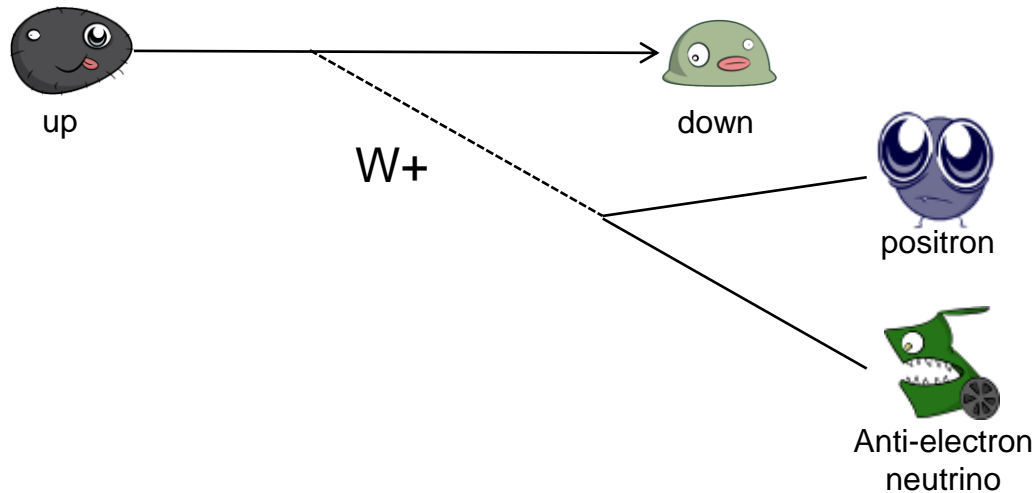


Key:

- Muon
- Electron
- Charged Hadron (e.g. Pion)
- - - Neutral Hadron (e.g. Neutron)
- - - Photon

Ο σκοπός της σημερινής άσκησης

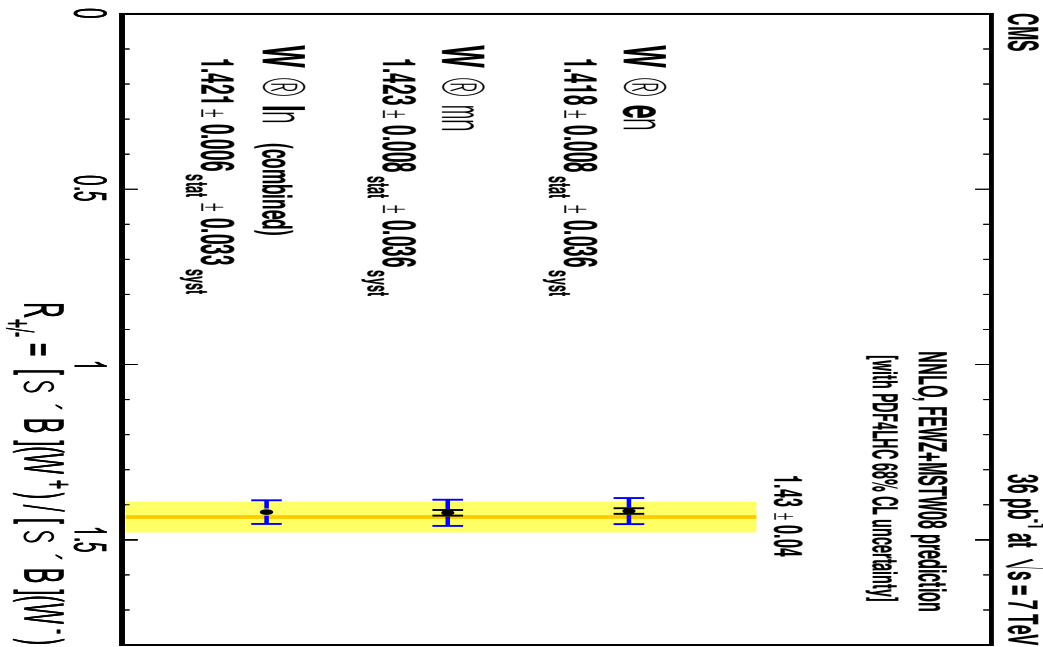
- Τα quarks μέσα στο πρωτόνιο μπορεί να είναι «διεγερμένα» (εξαιτίας της υψηλής ενέργειας της σύγκρουσης), και μετασχηματίζονται σε άλλου τύπου quark, εκπέμποντας ένα W



- Το down quark μπορεί να μετασχηματιστεί σε up quark εκπέμποντας ένα W^-
- Σήμερα: Μέρος της άσκησης είναι η μέτρηση του αριθμού των W^+ and W^- που παράγονται σε συγκρούσεις στο CMS
 - Γιατί? – θα δούμε αργότερα!

Συζήτηση ενός αποτελέσματος

- Ο λόγος W^+/W^- : δίνει πληροφορία για την εσωτερική δομή του πρωτονίου
- Τι περιμένετε να βρείτε?

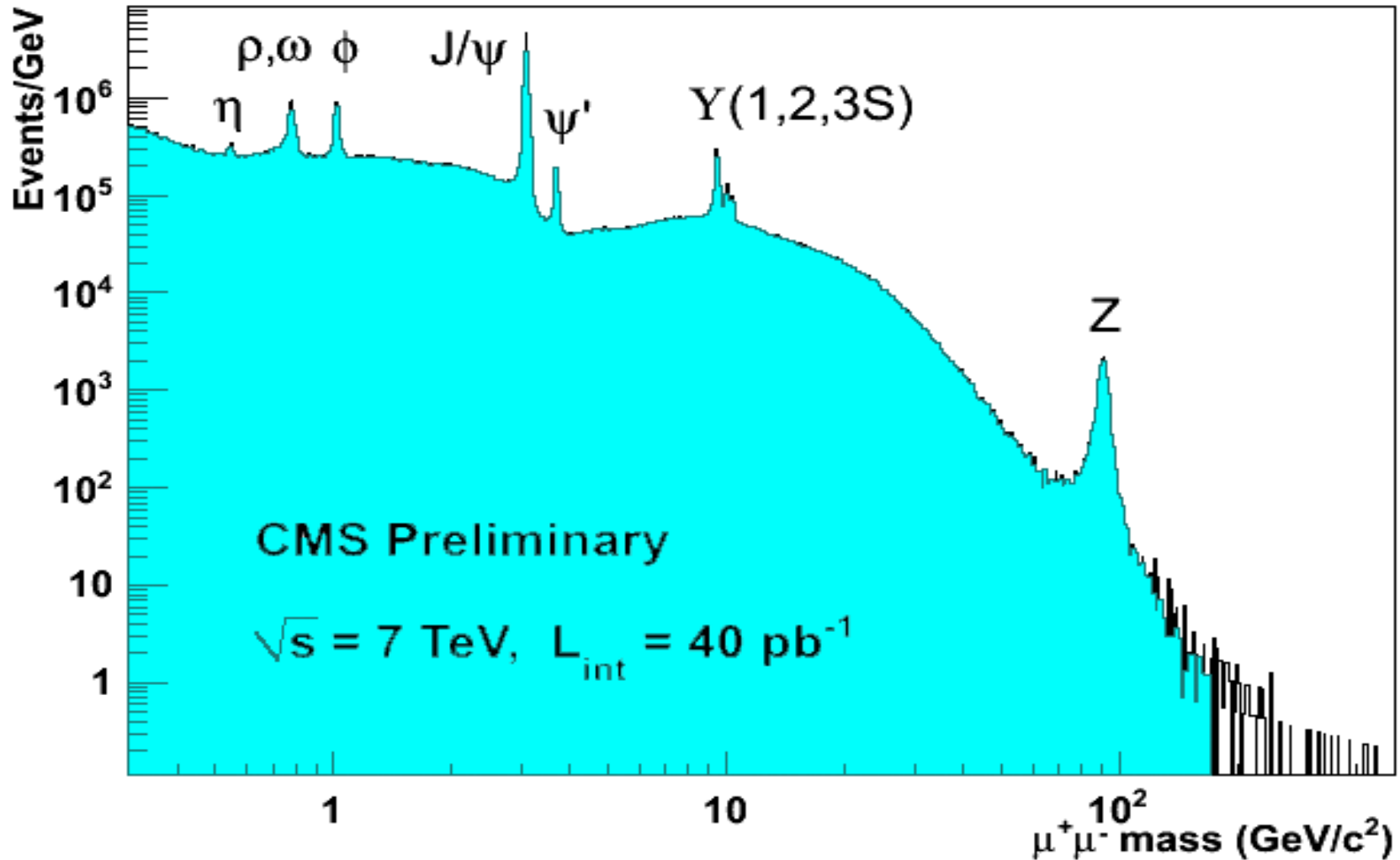


Τι σημαίνει αυτό?

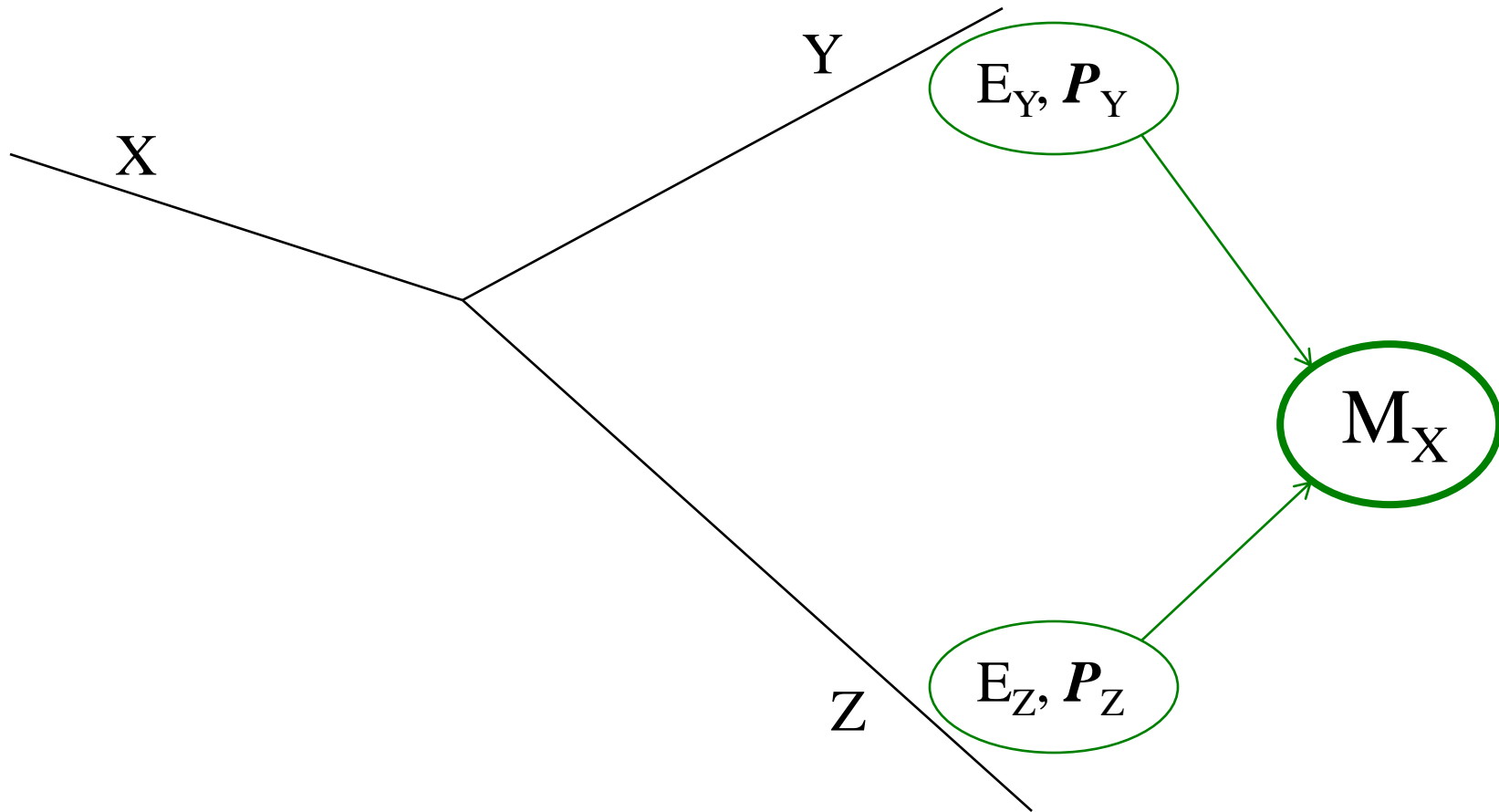
ότι το απλό μοντέλο του πρωτονίου (uud) δεν ισχύει.....

Backup

Κατανομή μαζών ζευγών μιονίου

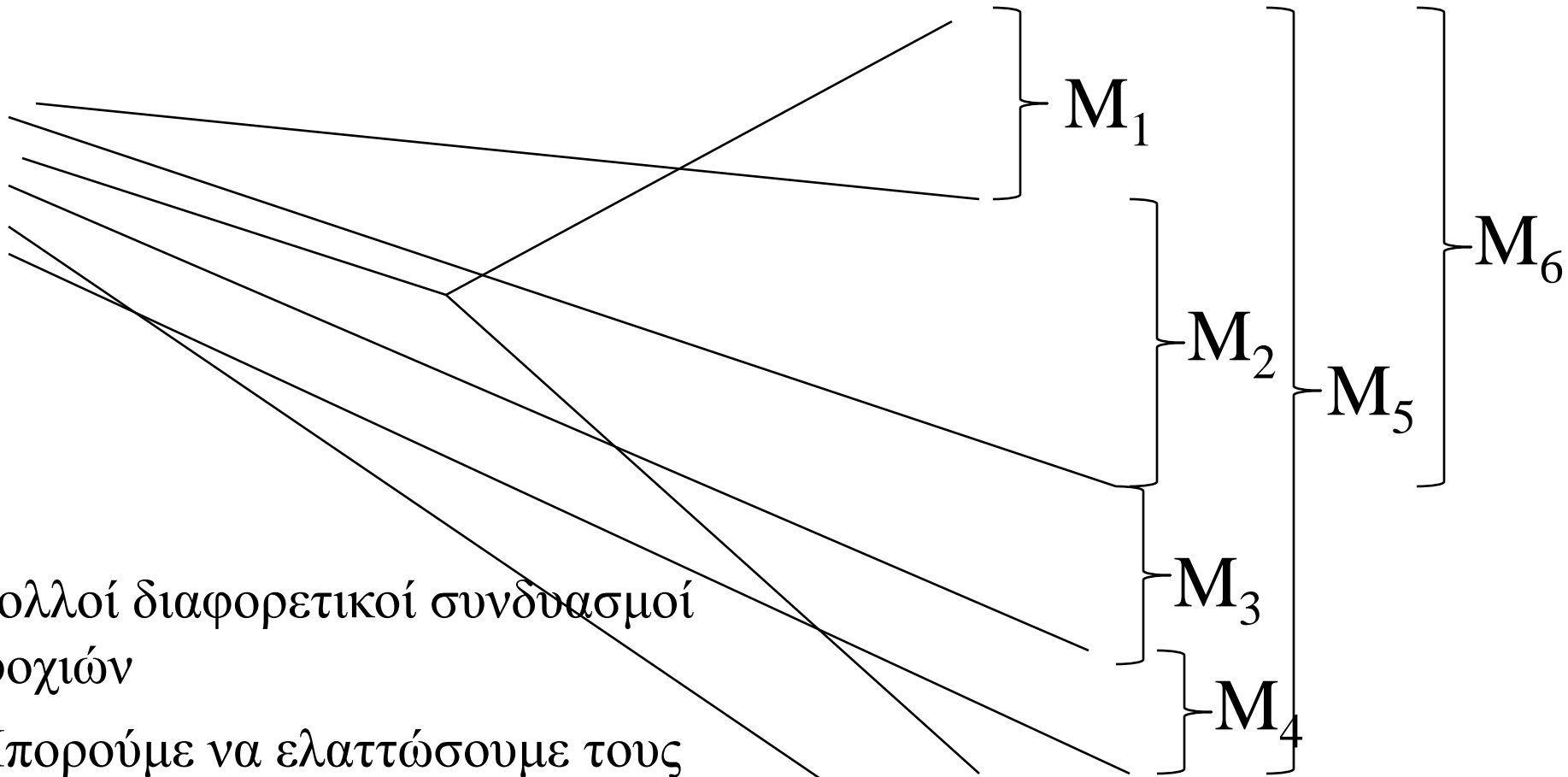


“Αναλοίωτη μάζα”



Συνδιασμός σωματιδίων δίνει την “αναλοίωτη μάζα” του σωματιδίου που μπορεί να τα παρήγαγε.

Αναλοίωτη μάζα (cont.)



Etc.

Πολλοί διαφορετικοί συνδυασμοί τροχιών

Μπορούμε να ελαττώσουμε τους συνδιασμούς επιλέγοντας στην ποιότητα, ορμή των τροχιών ετω, .

Εναπομένει κάποιο υπόβαθρο. Ακόμα το M δεν μπορεί να μετρηθεί τέλεια – εξαρτάται από τον ανιχνευτή

Εύρεση του Higgs



Αυτό είναι το σήμα που βλέπουμε στον ανιχνευτή για το Higgs που διασπάται σε 2 φωτόνια...

Το εύρος του σήματος οφείλεται στην ακρίβεια του ανιχνευτή και στο φυσικό εύρος της μάζας του σωματιδίου