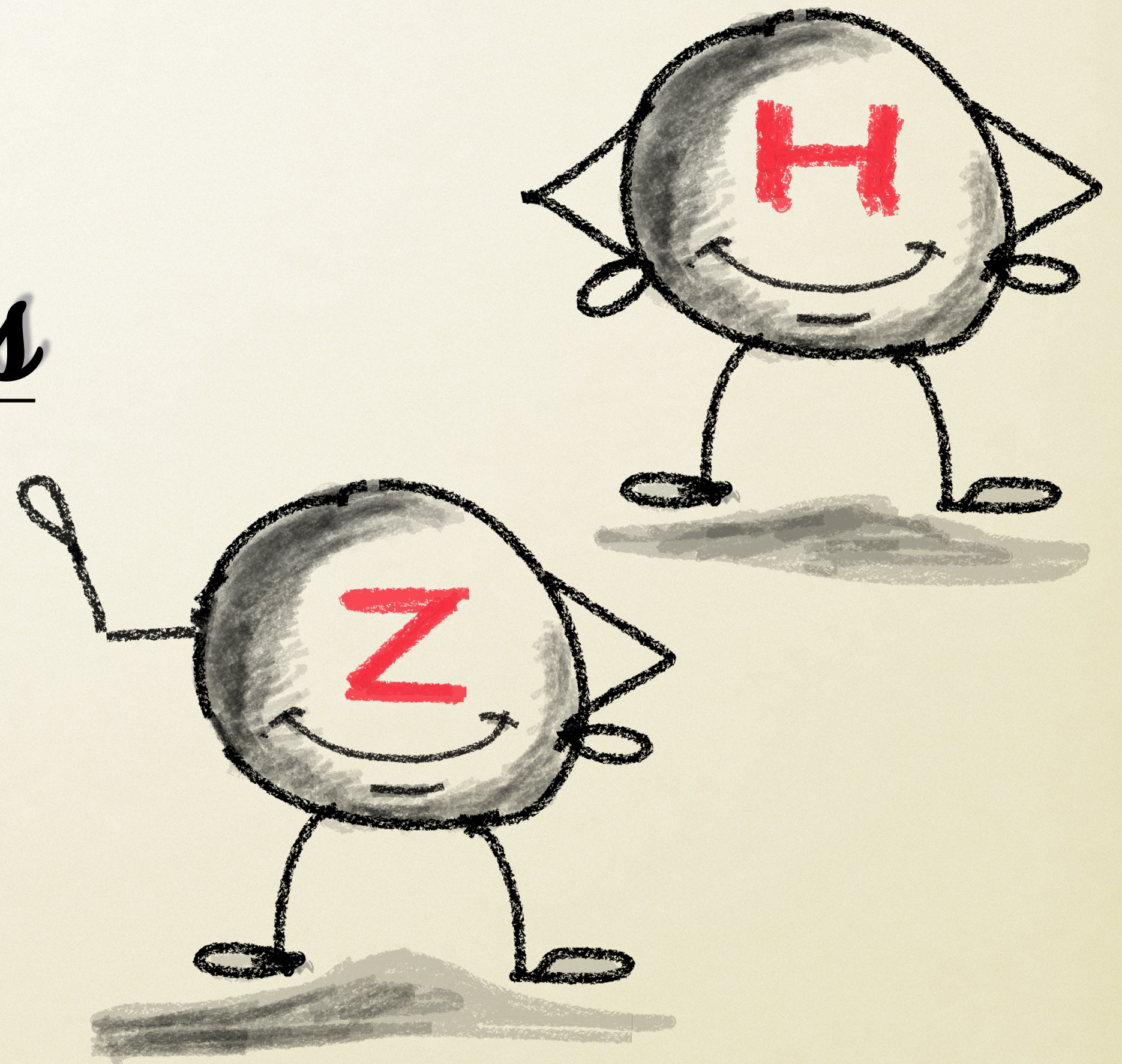


Cerchiamo le particelle:
il bosone Z e il bosone di Higgs

MONICA VERDUCCI
monica.verducci@cern.ch

ATLAS PISA Università' e INFN di Pisa

ATLAS Z-Path - 28 Febbraio 2025



Quali particelle cerchiamo? Come le cerchiamo?

- Molte di queste particelle attraversando il rivelatore (materia) interagendo con esso e lasciando quindi "tracce" visibili e misurabili del loro passaggio.

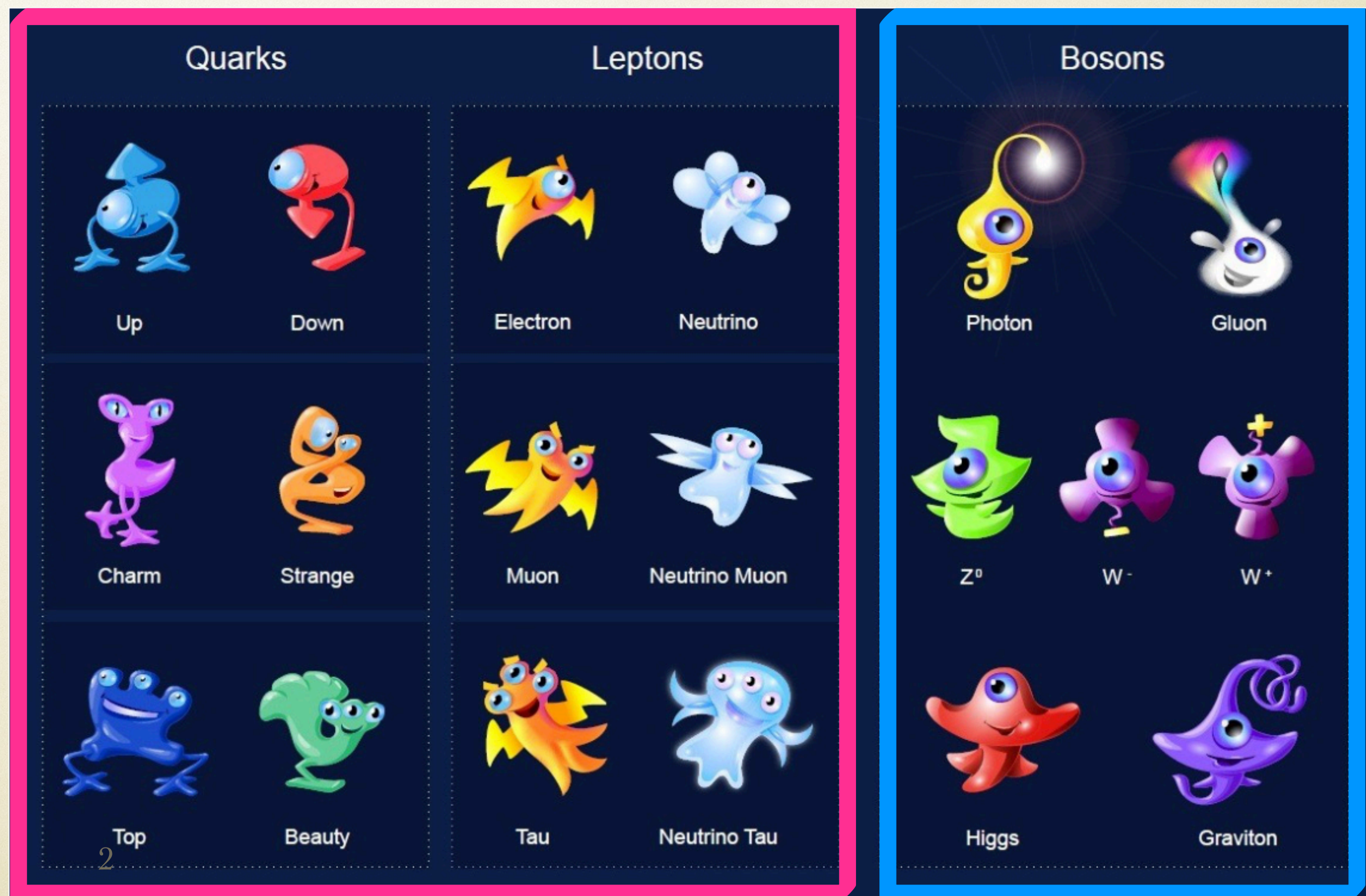


- L'interazione con il rivelatore comporta un rilascio di energia da parte della particella, che viene trasformata in un opportuno segnale elettrico (qualcosa di misurabile) analizzabile dal computer (come faremo oggi!!!)

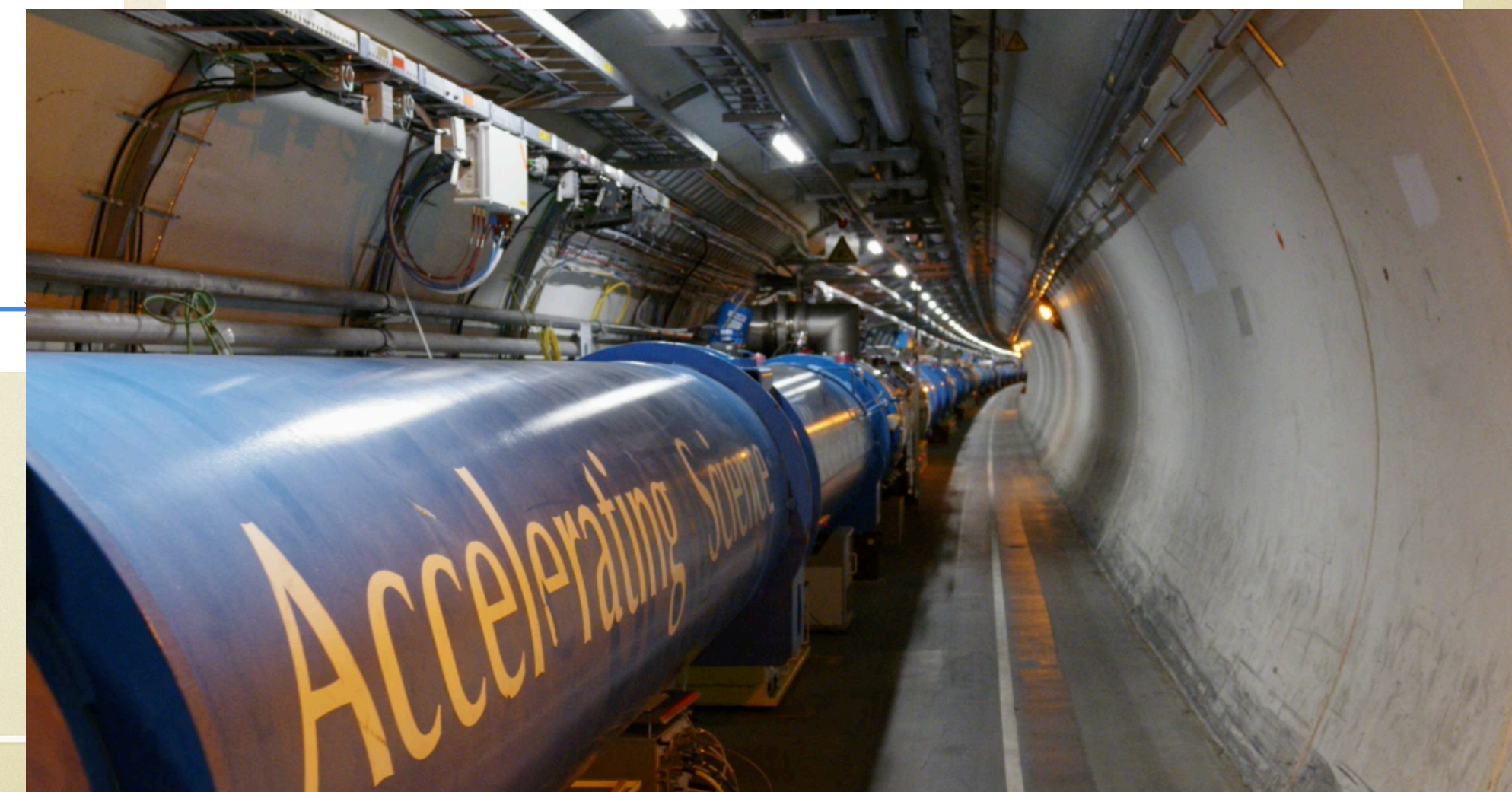
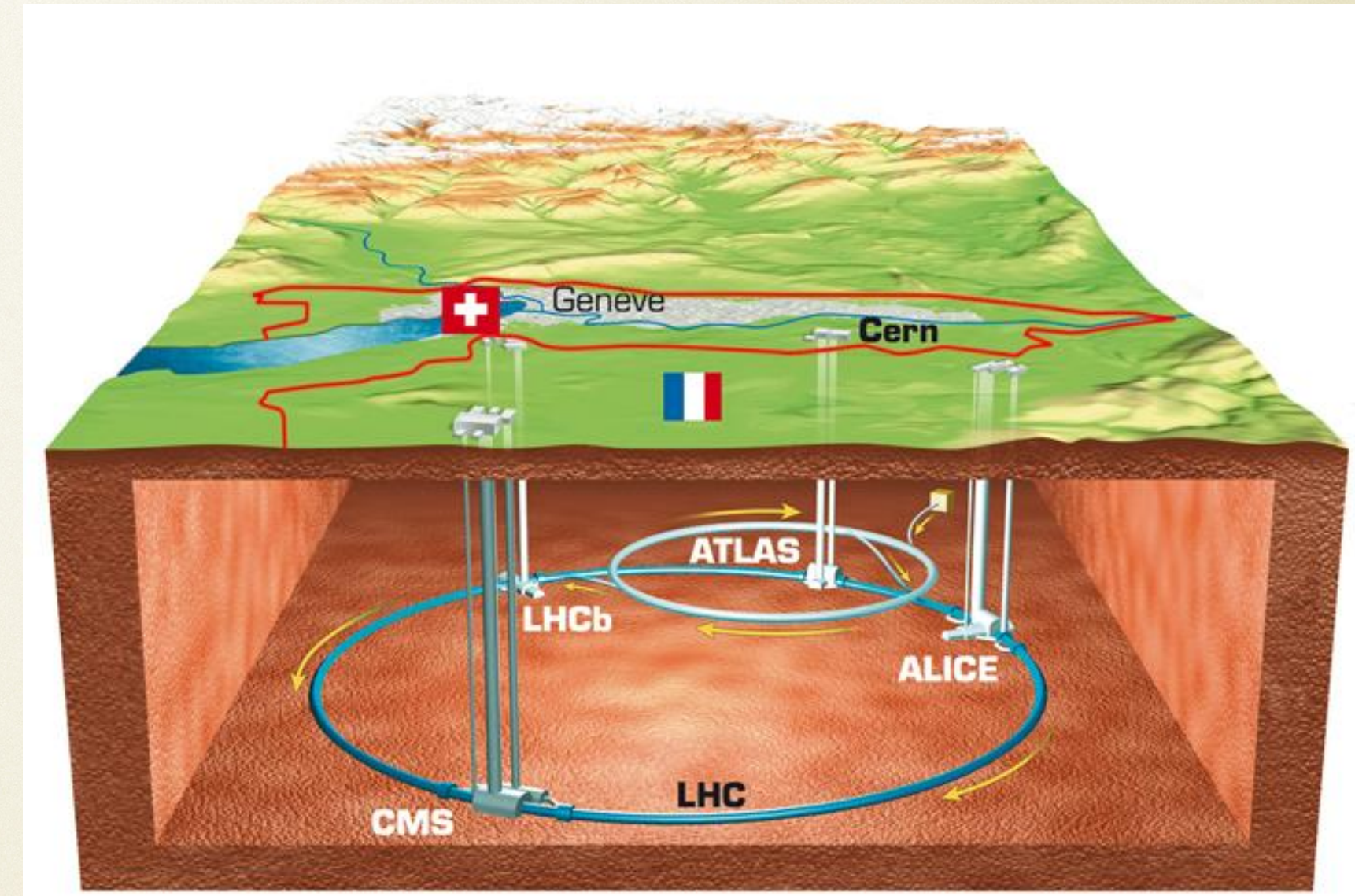
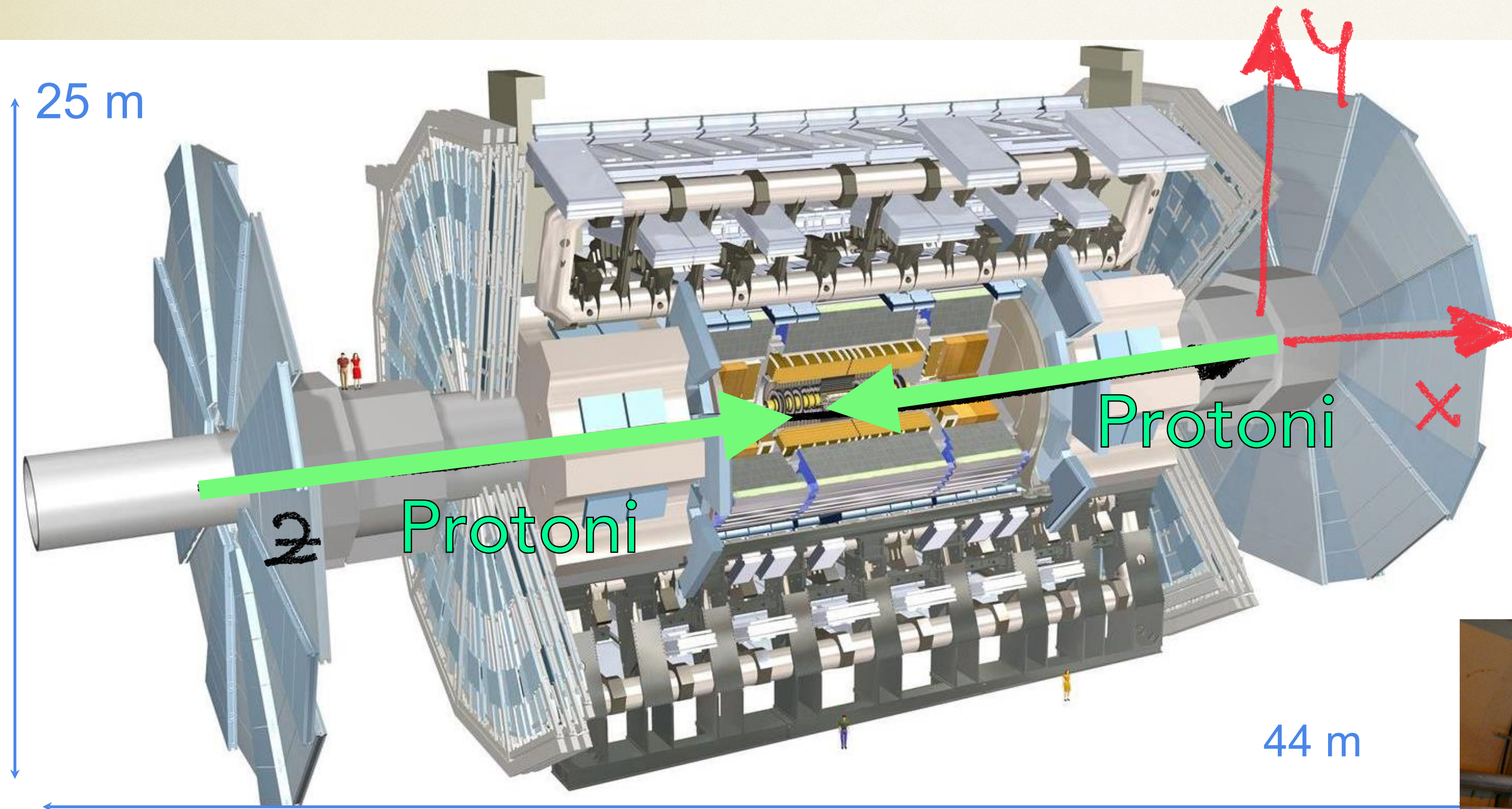


QUARK E LEPTONI: I COSTITUENTI ELEMENTARI DELLA MATERIA

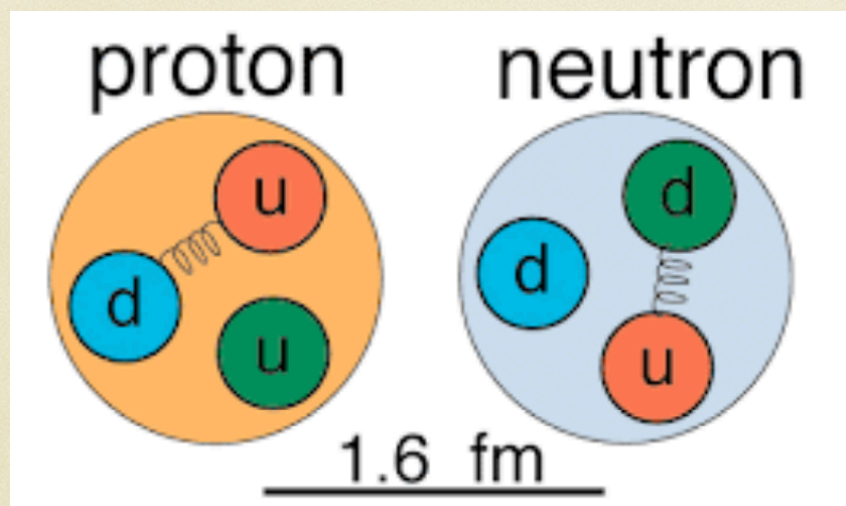
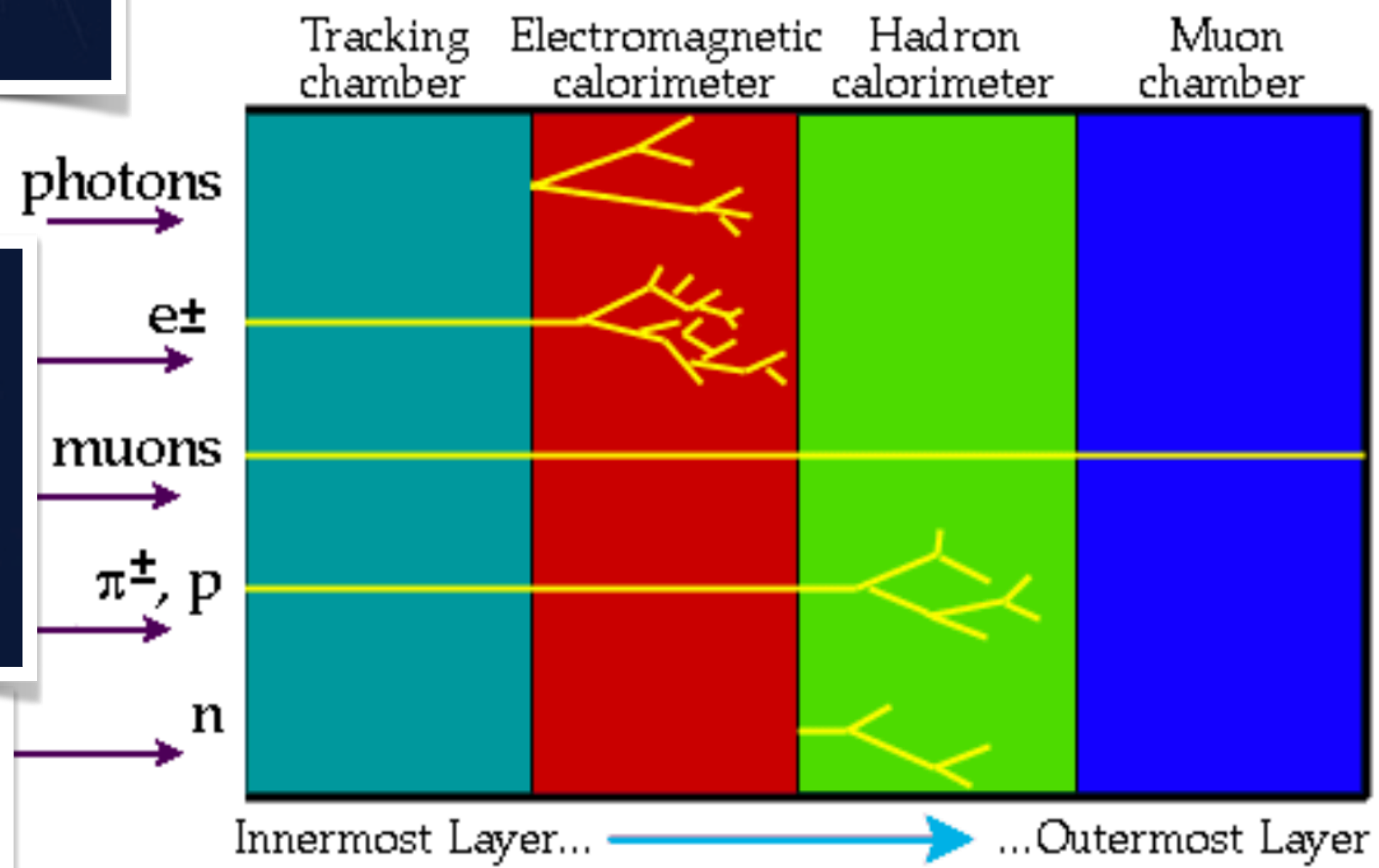
BOSONI: TRASMETTITORI DELLE INTERAZIONI



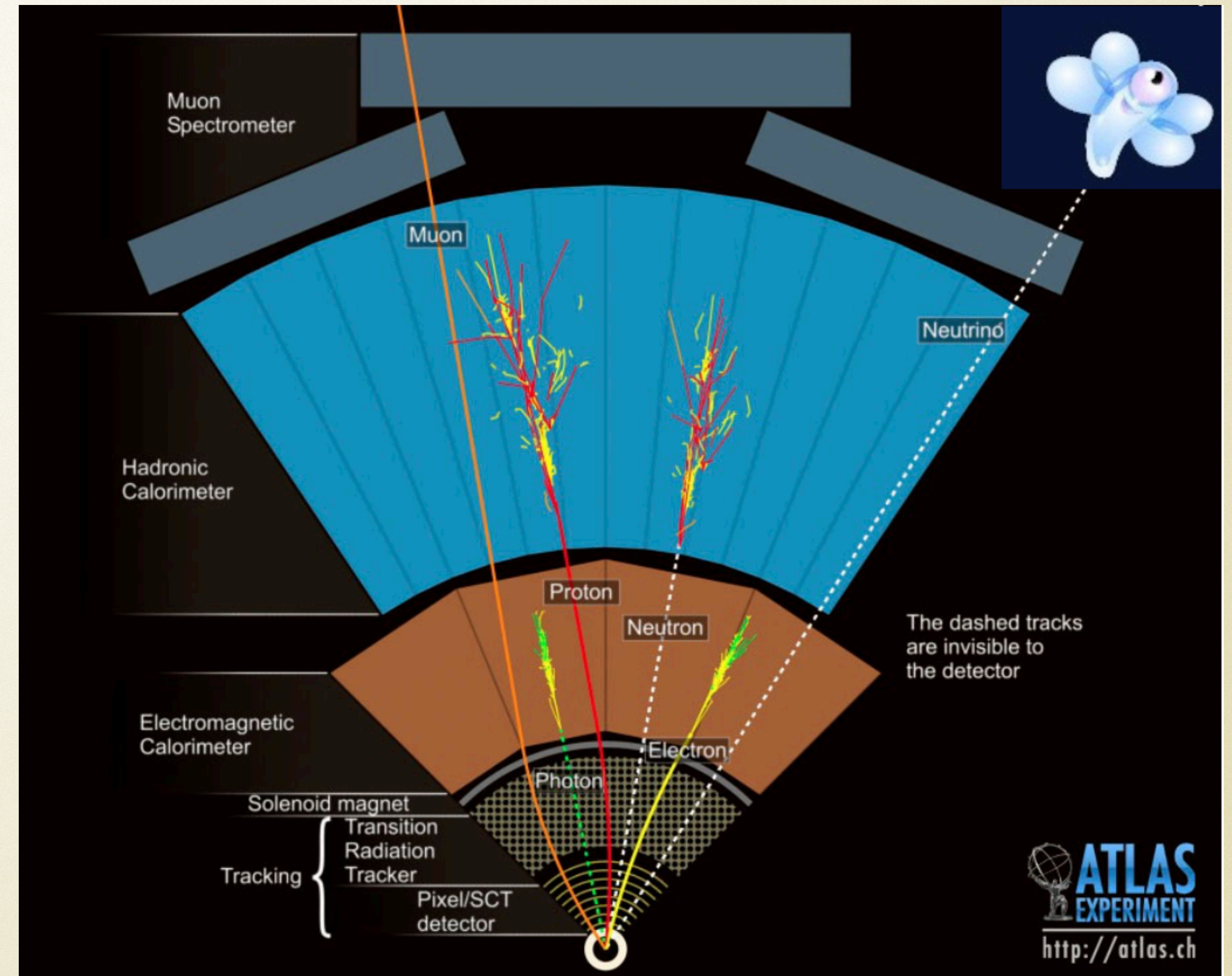
Come le cerchiamo? Con il rivelatore ATLAS



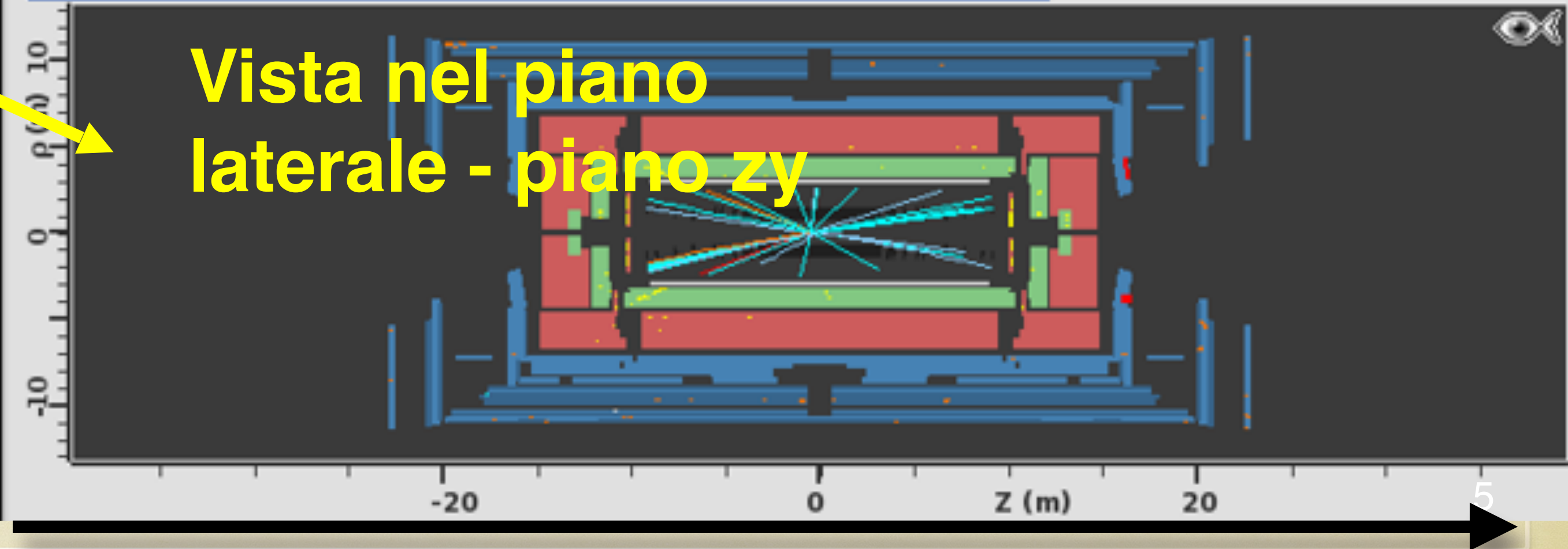
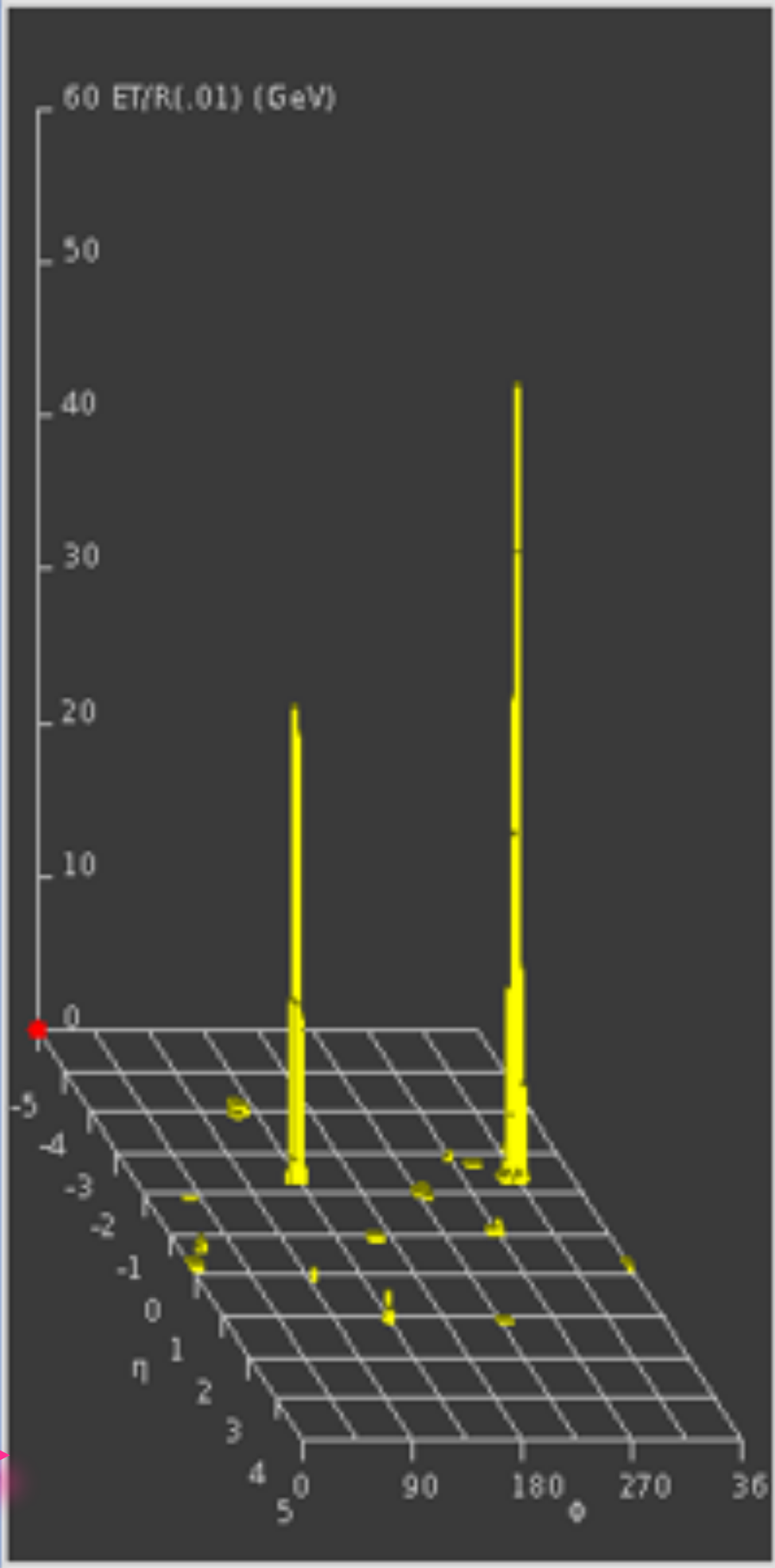
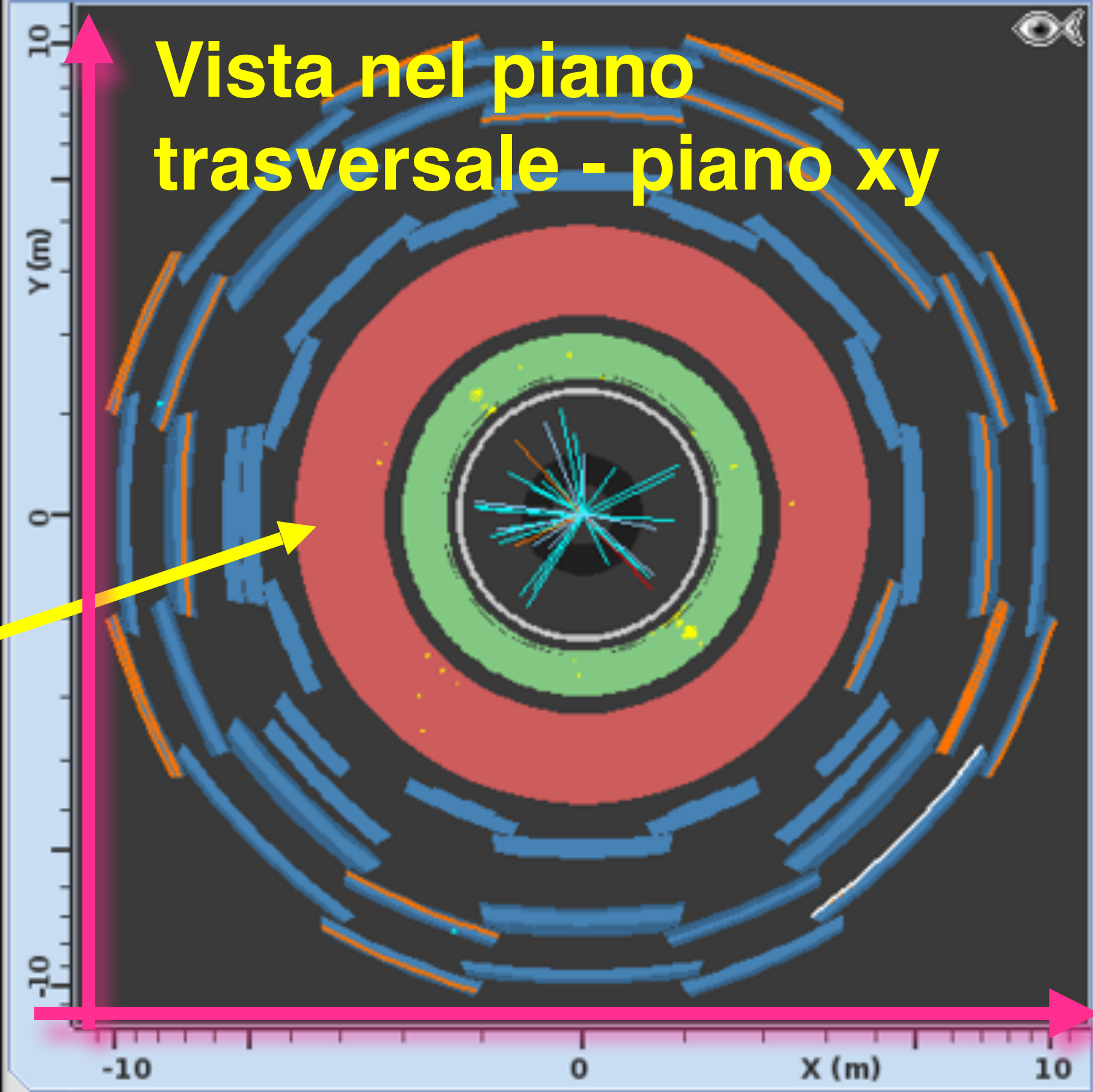
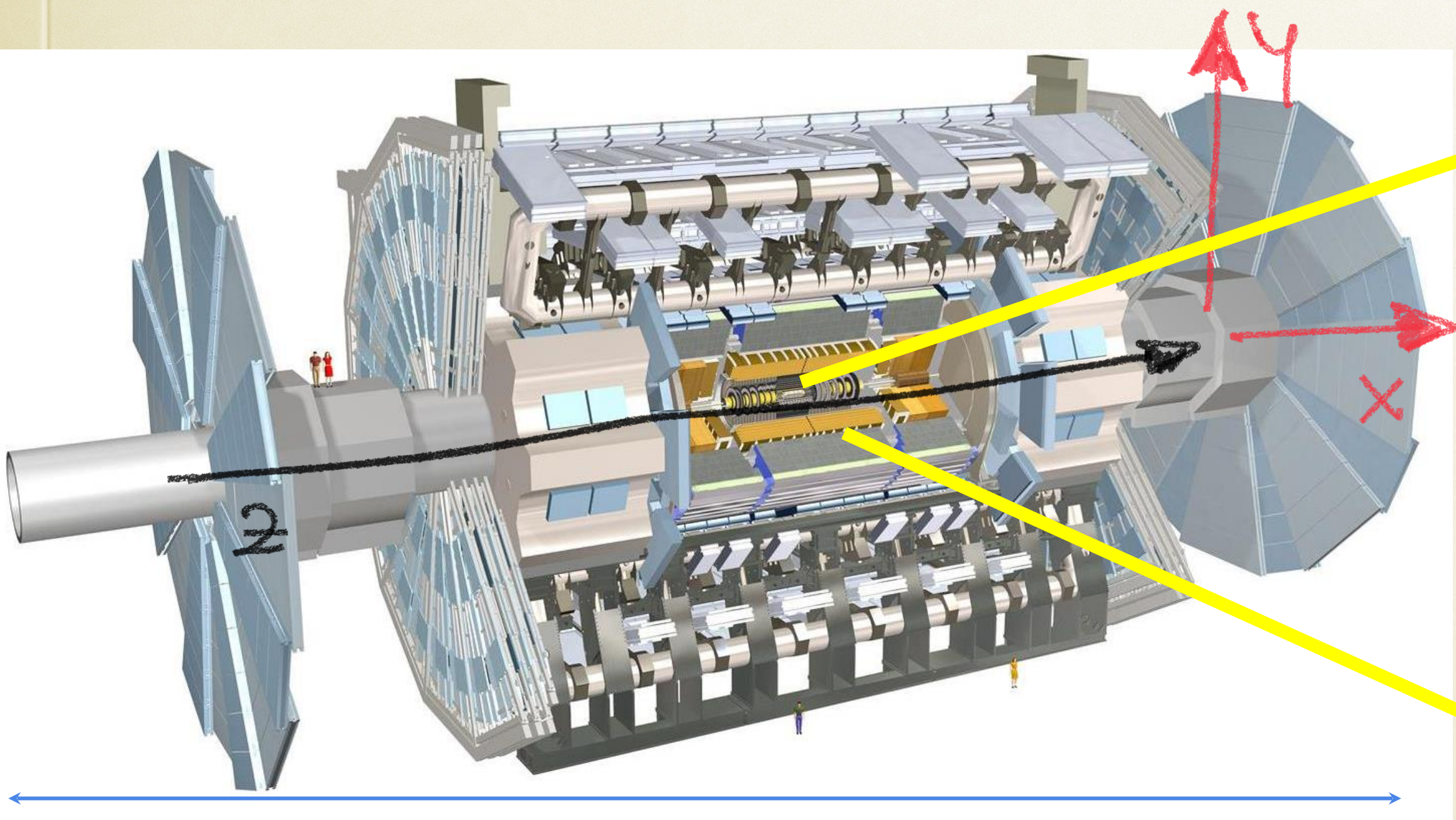
Strategia di rivelazione



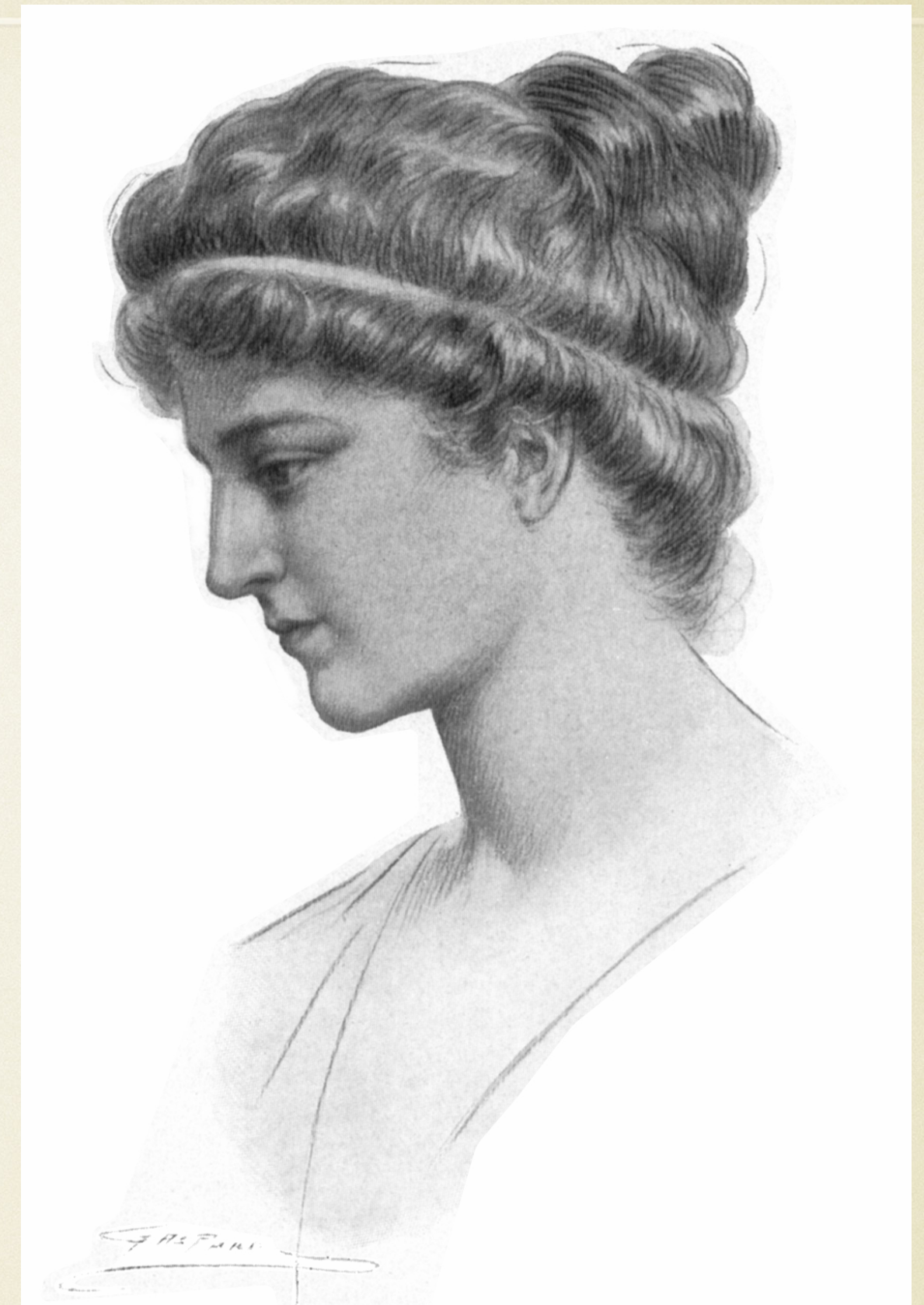
Il neutrone (n) e il protone (p) sono particelle formate da quarks up e down



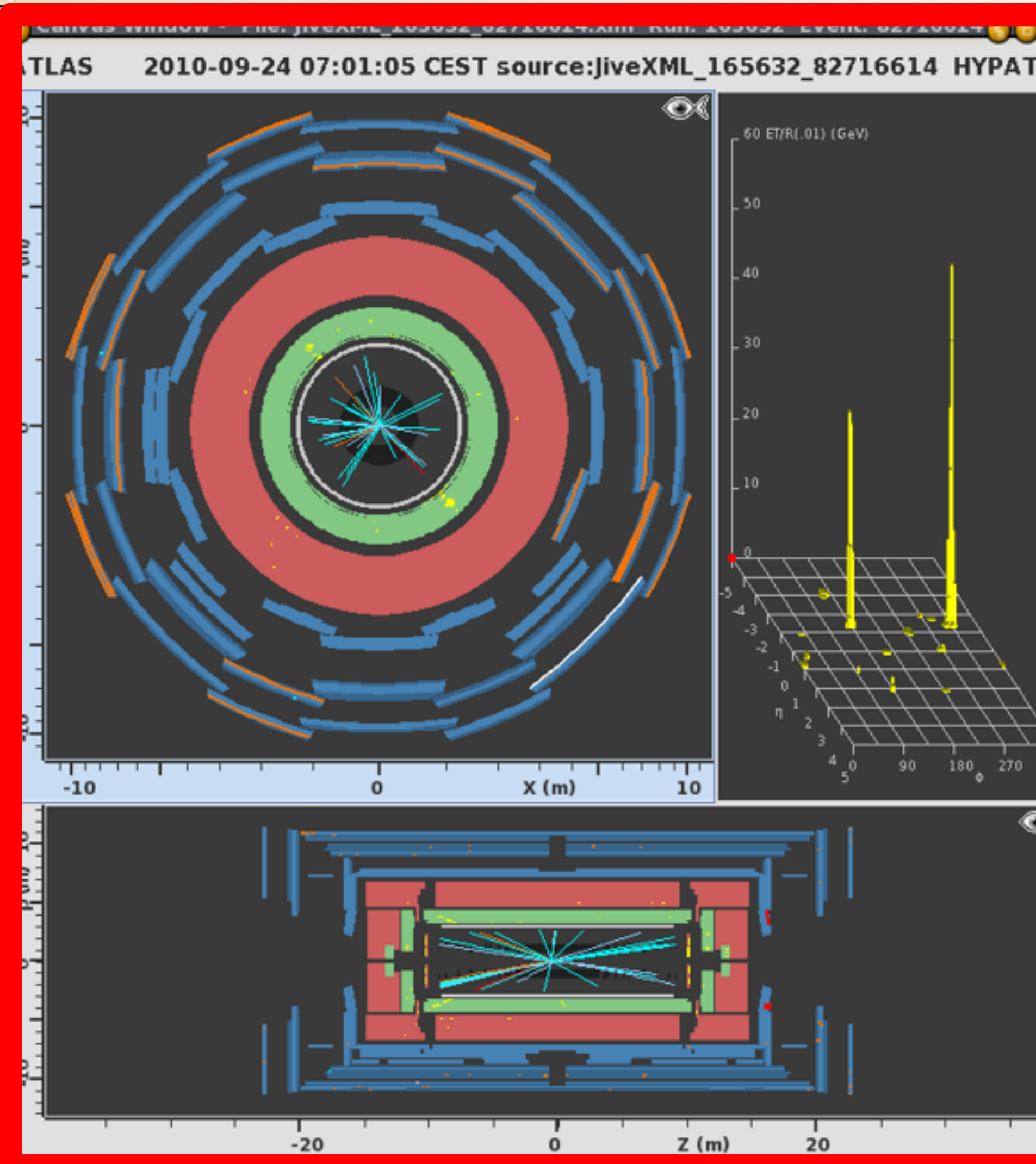
Come osserviamo le particelle in ATLAS



HYPATIA (Hybrid Pupil's Analysis Tool for Interactions in Atlas)



Ἰπάτια
 (Ἰπάτια, [Alessandria d'Egitto](#),
[355/370](#) - [415](#))



Previous Event Next Event Insert Electron Insert Muon Dele
 ETMis: 7.384 GeV ϕ : 2.227 rad Collection: MET RefFinal
 masterClass/zpath/Els/jiveXML_165632_82716614.xml

Reconstructed Tracks					
Track	+/-	P [GeV]	Pt [GeV]	ϕ	θ
Tracks 15	+	1.32	1.19	0.728	1.126
Tracks 23	+	1.81	1.81	-3.046	1.513
Tracks 24	+	1.64	1.63	-1.903	1.695
Tracks 26	+	5.08	1.53	-0.616	2.835
Tracks 30	+	2.19	1.27	-2.001	2.526
Tracks 31	+	6.86	1.21	2.569	0.177
Tracks 32	+	1.58	1.55	1.978	1.766
Tracks 34	-	5.41	1.81	-3.037	2.801
Tracks 36	-	10.23	2.05	1.480	2.940
Tracks 40	+	4.73	1.45	-2.665	2.830
Tracks 54	-	60.96	33.55	2.296	2.559

HYPATIA - Control Window

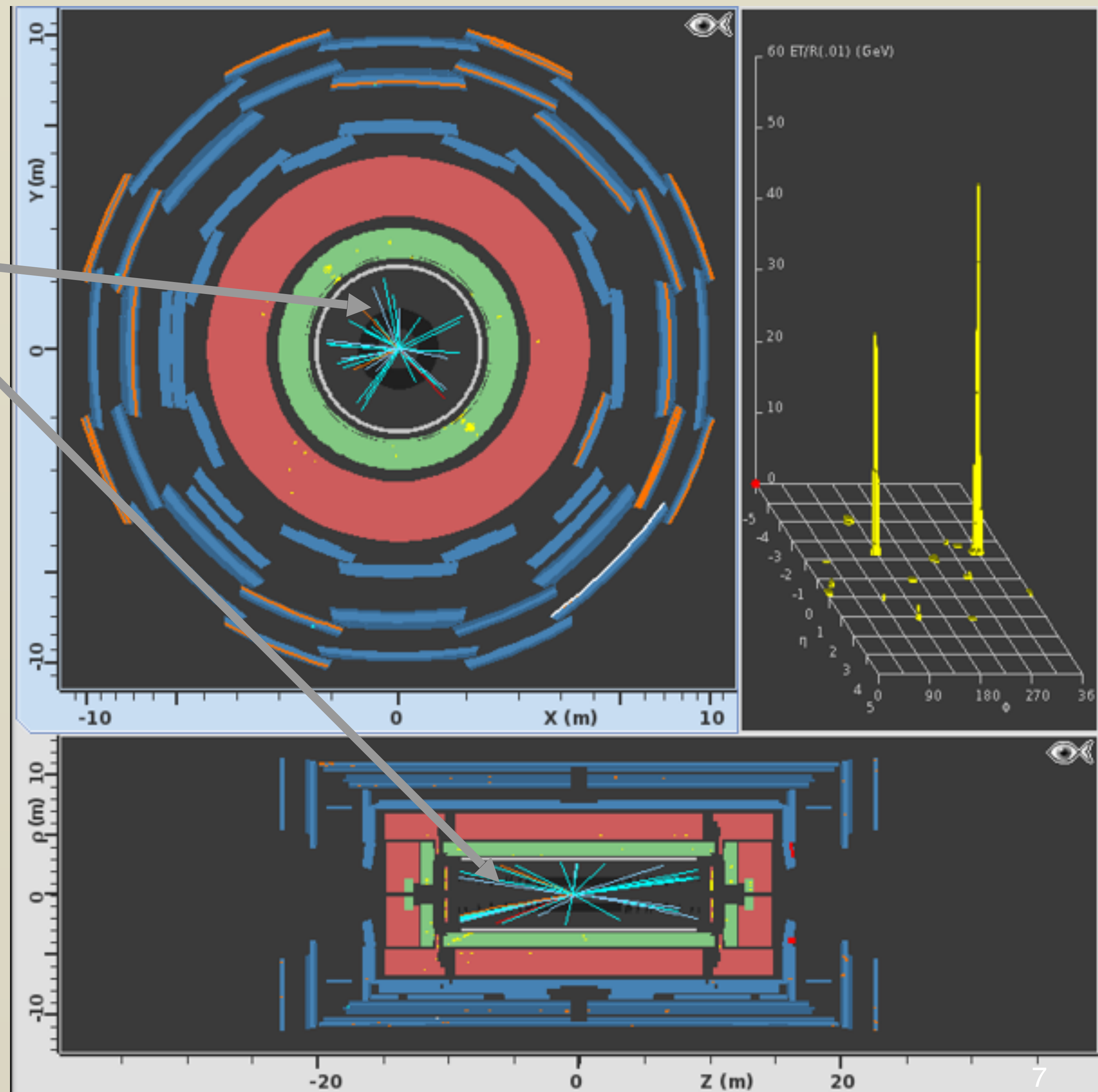
Interaction and Window Control Output Display

Parameter Control

InDet	Calo	MuonDet	Objects	Geometry	Cuts
Projection		Data			Cuts
InDet	Name	Value			
Calo	<input checked="" type="checkbox"/> Pt	> 1.0 GeV			
MuonDet	<input checked="" type="checkbox"/> d0	< 6.5 mm			
Objects	<input checked="" type="checkbox"/> z0	< 25.0 cm			
ATLAS	<input type="checkbox"/> d0 Loose	< 2.0 cm			
	<input type="checkbox"/> z0-zVtx	< 2.5 mm			
	<input type="checkbox"/> Layer	> 0			
	<input type="checkbox"/> Number Pixel Hits	>= 2			
	<input type="checkbox"/> Number SCT Hits	>= 7			
	<input type="checkbox"/> Number TRT Hits	>= 30			
	<input type="checkbox"/> Sim. Particle PDG-ID	< 40			
	<input type="checkbox"/> Sim. Particle Barcode	= 0			
	<input type="checkbox"/> Sim. Particle Type	charged hadron			

Event display

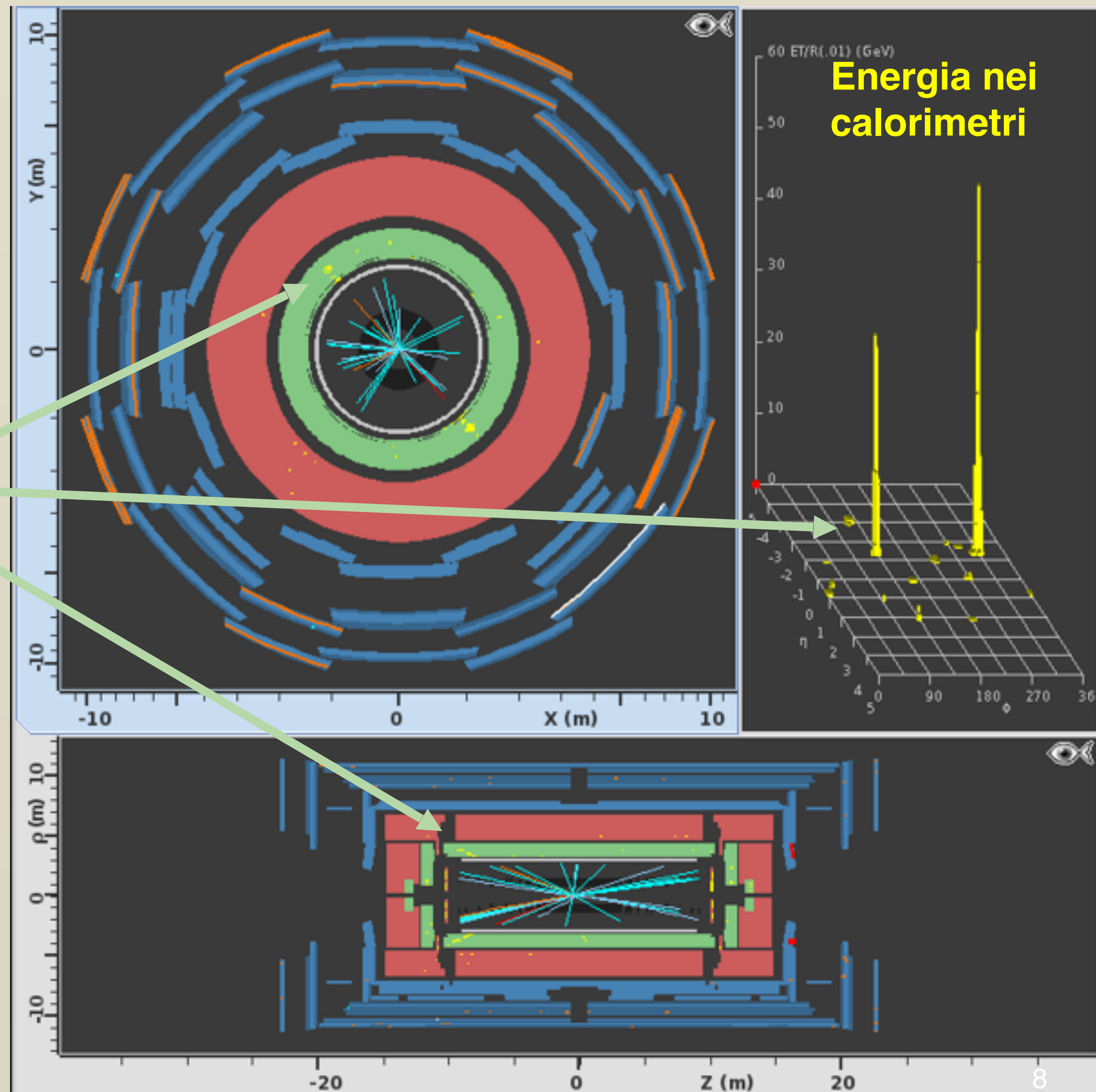
Tracciatore:
particelle cariche



Event display

Tracciatore:
particelle cariche

Calorimetro elettromagnetico:
elettroni (e^-), positroni (e^+) e
fotoni.

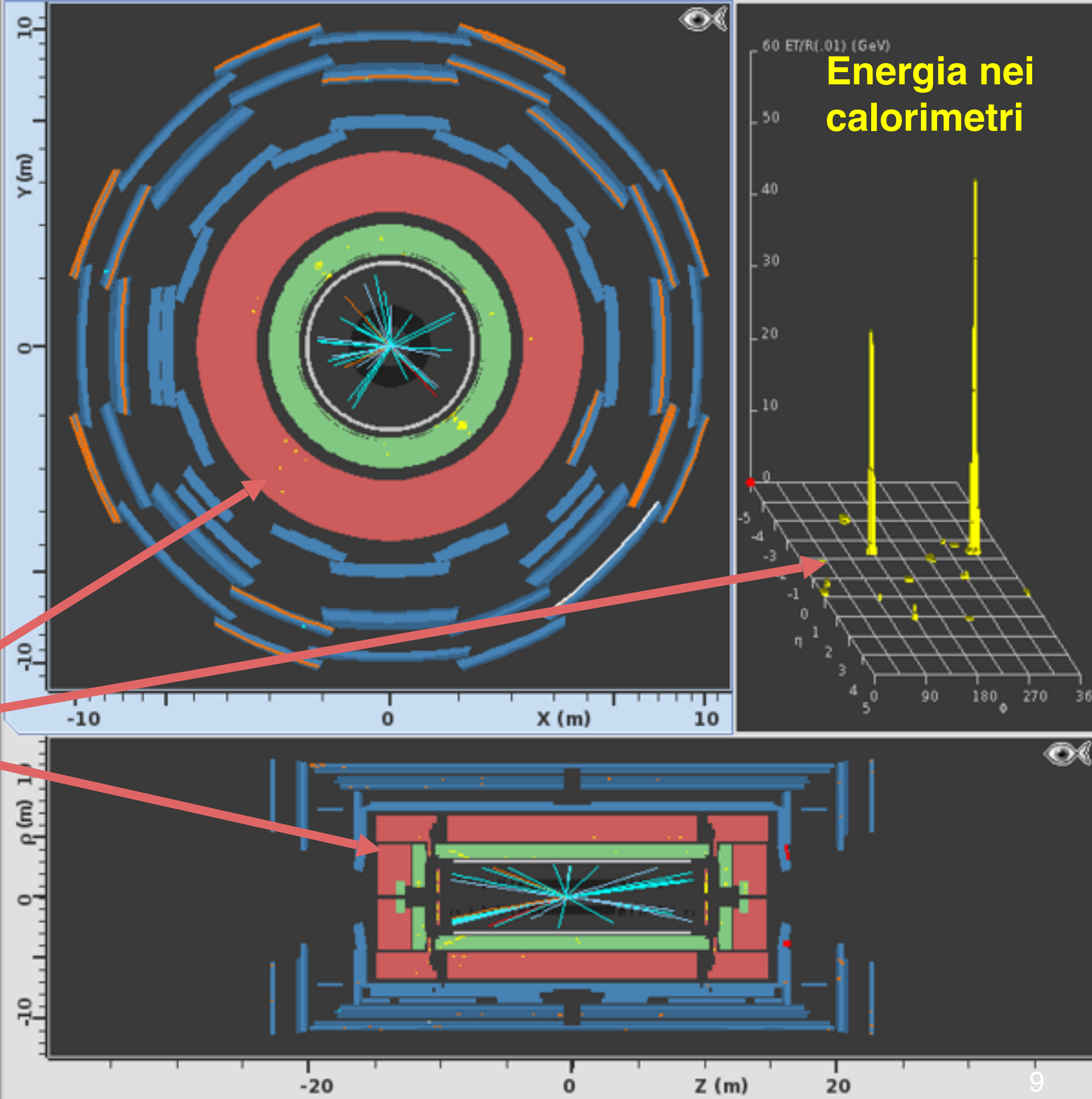


Event display

Tracciatore:
particelle cariche

Calorimetro elettromagnetico:
elettroni (e^-), positroni (e^+) e
fotoni.

Calorimetro adronico: adroni
(es: protoni, neutroni)



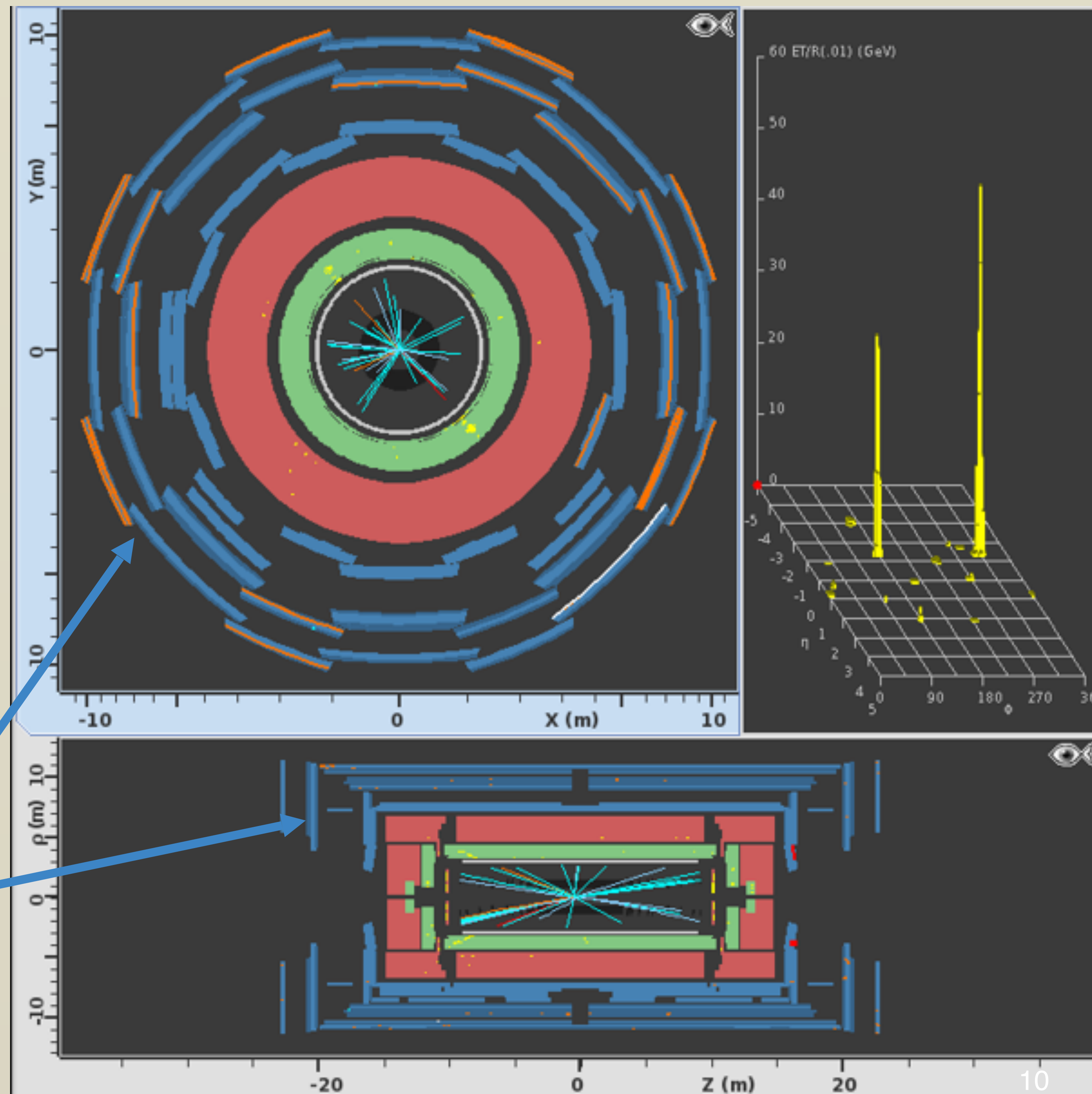
Event display

Tracciatore:
particelle cariche

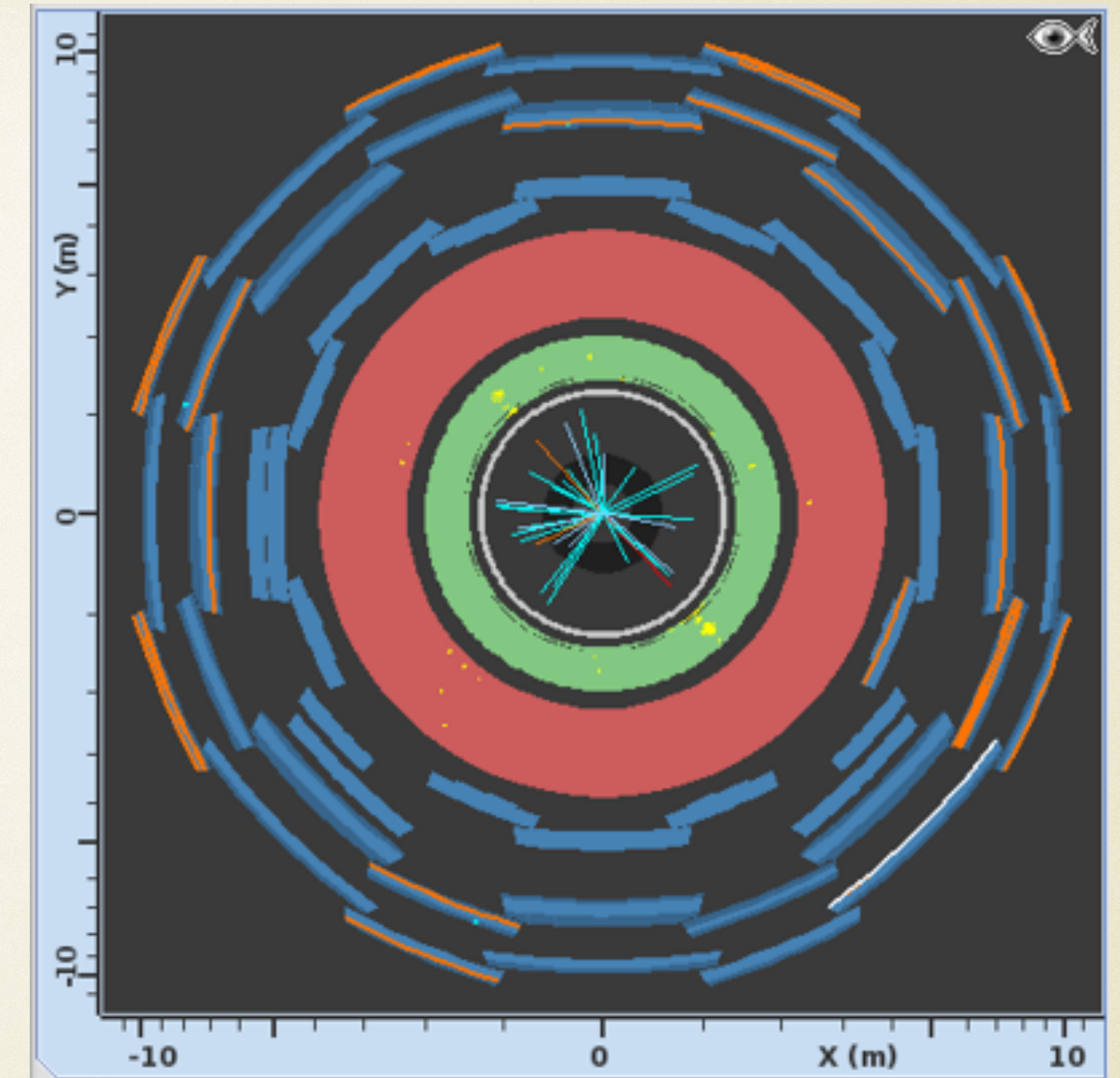
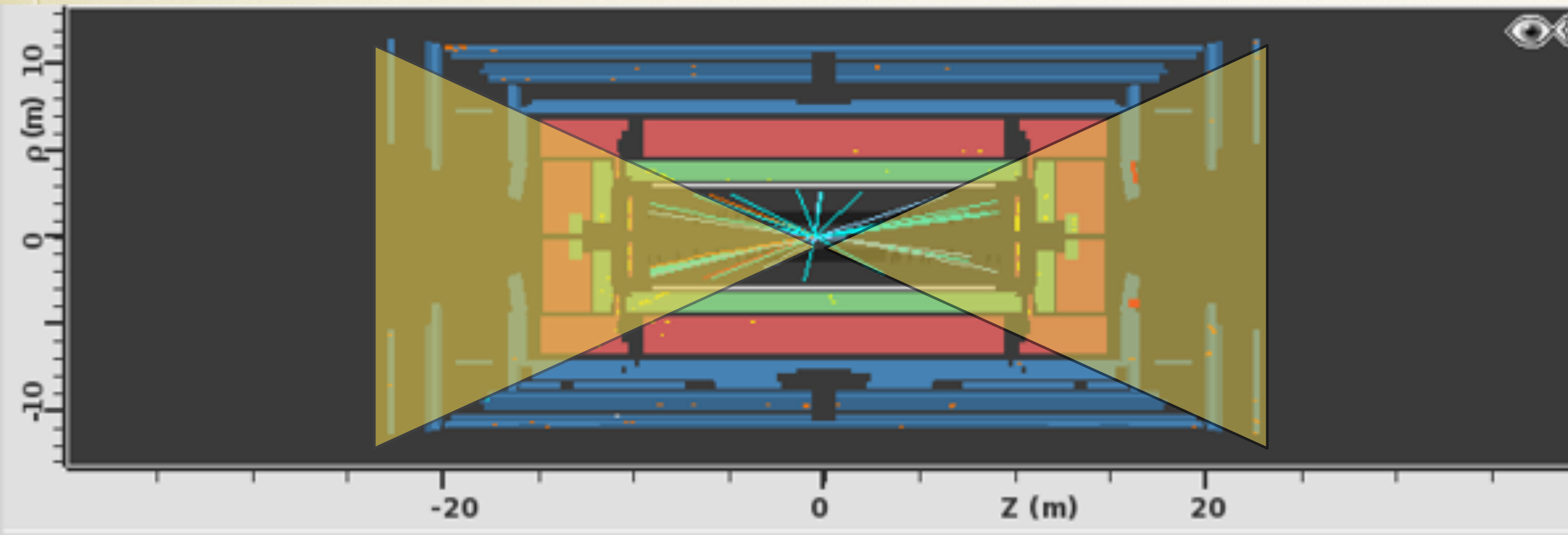
Calorimetro elettromagnetico:
elettroni (e^-), positroni (e^+) e
fotoni.

Calorimetro adronico: adroni
(es: protoni, neutroni)

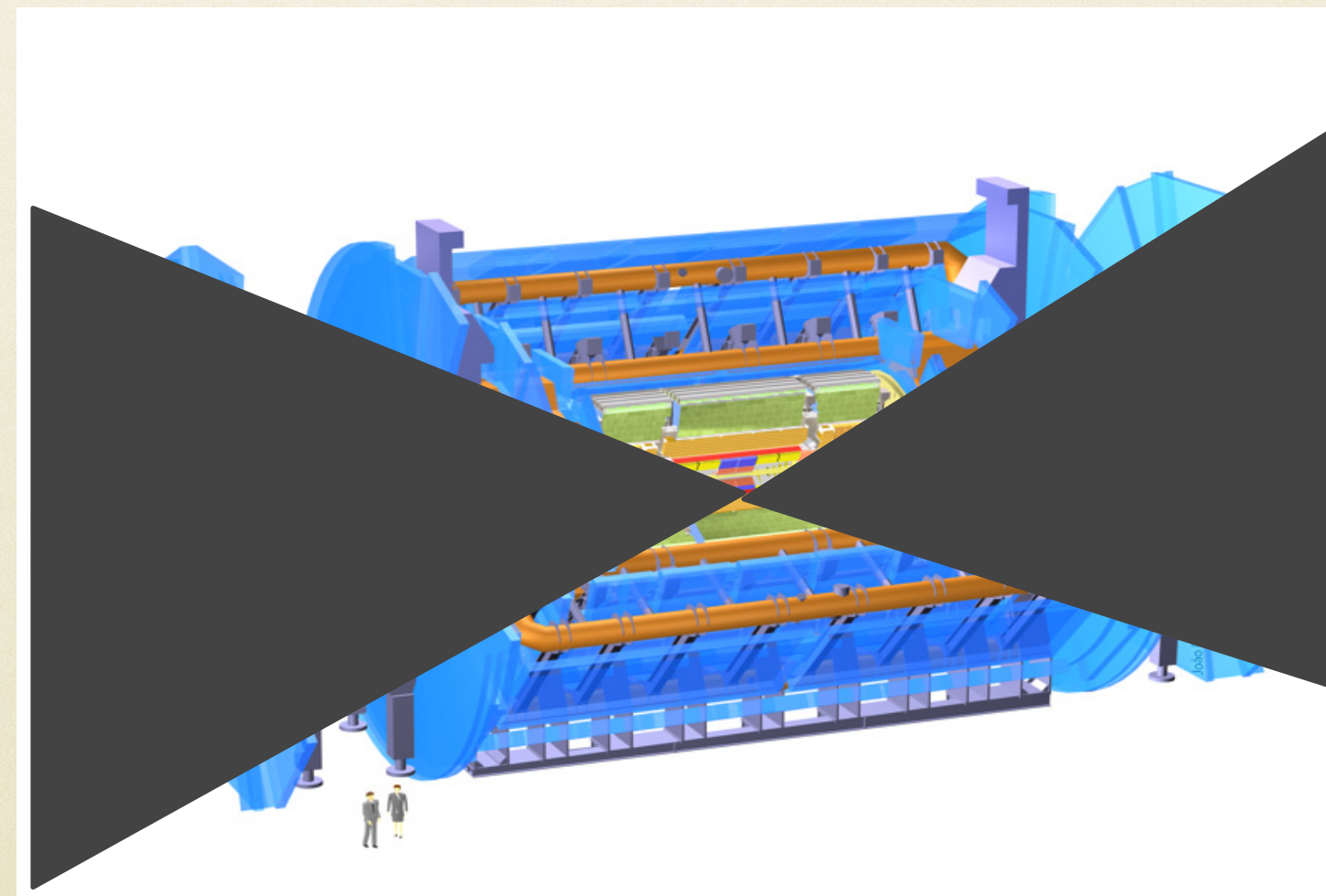
Rivelatori muoni



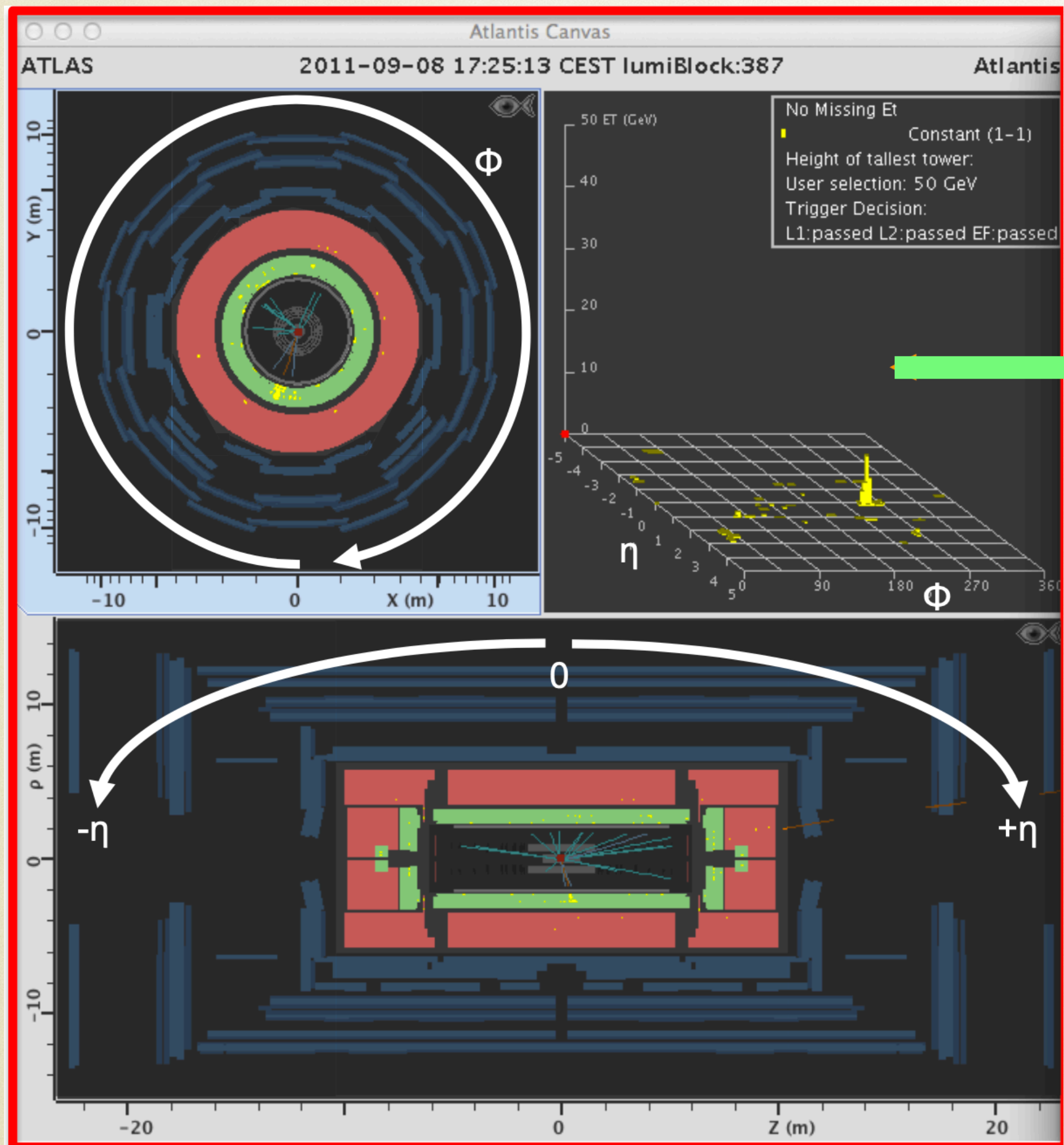
Event display



Solo le particelle ricostruite
nella regione centrale sono
visibili nella visione
trasversale



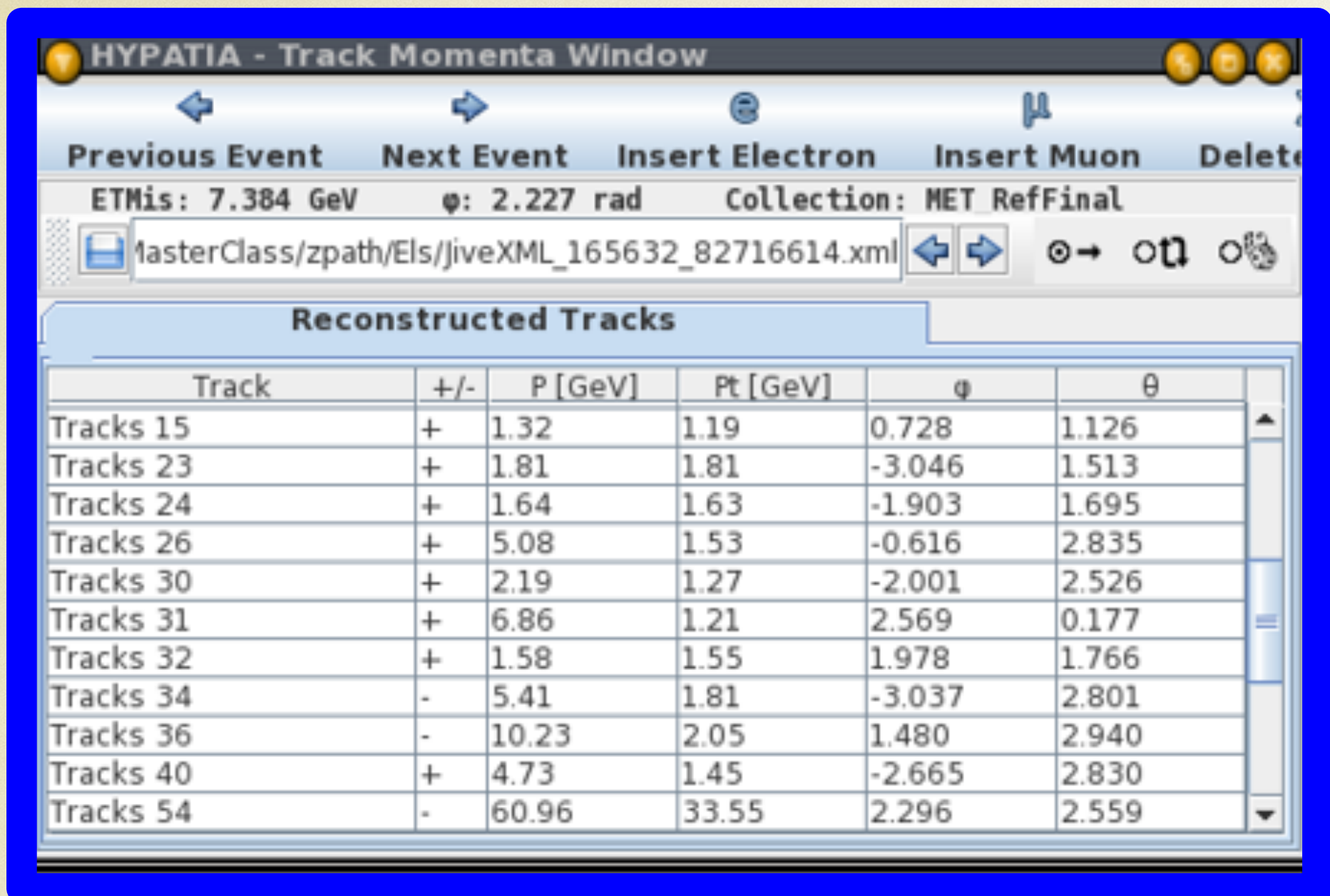
Event display



Lego plot : Mostra l'entità dei depositi di energia visti da tutte le regioni dei calorimetri elettromagnetico ed adronico in **eta (η) e phi (Φ)**

Selezione degli eventi

Particelle selezionate



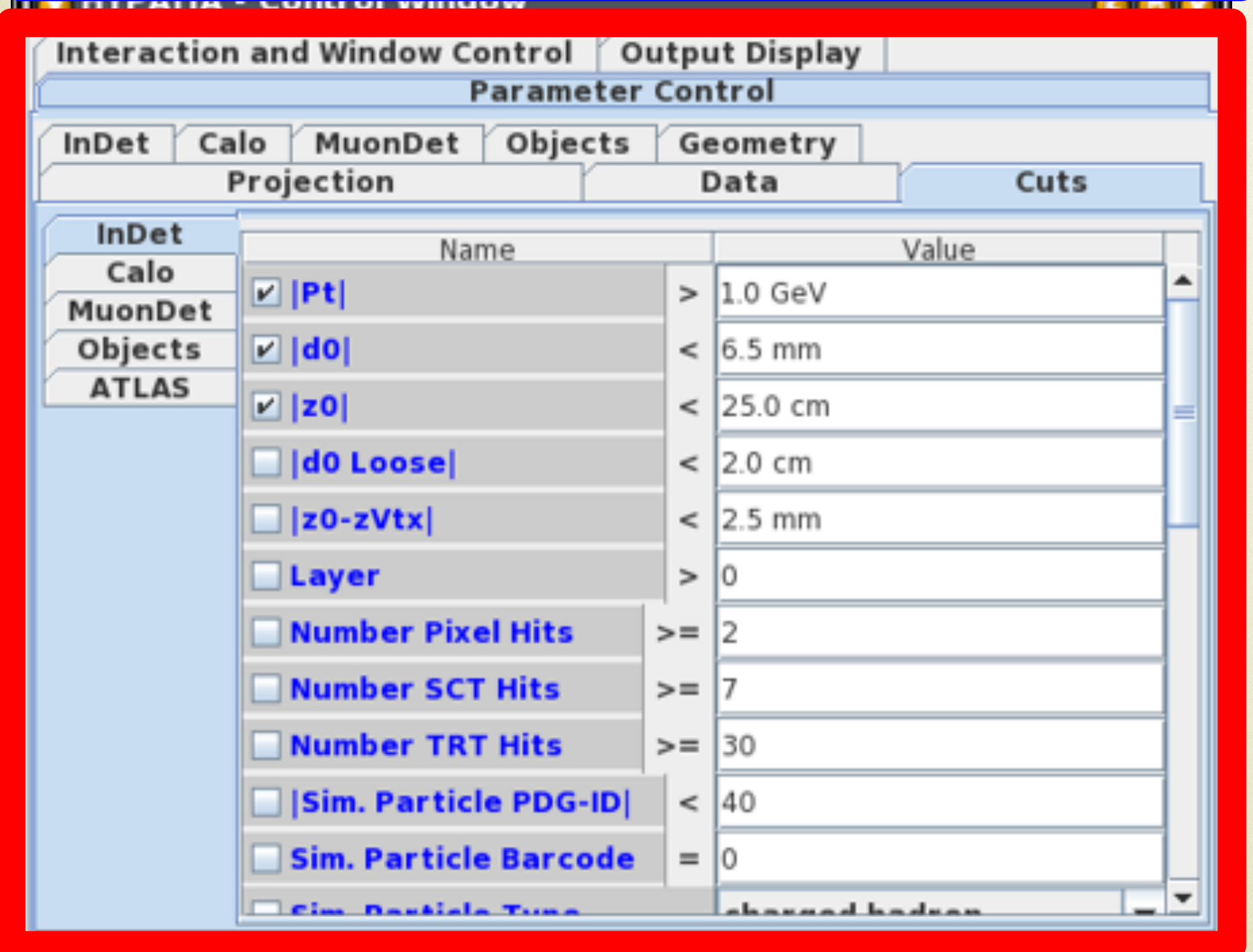
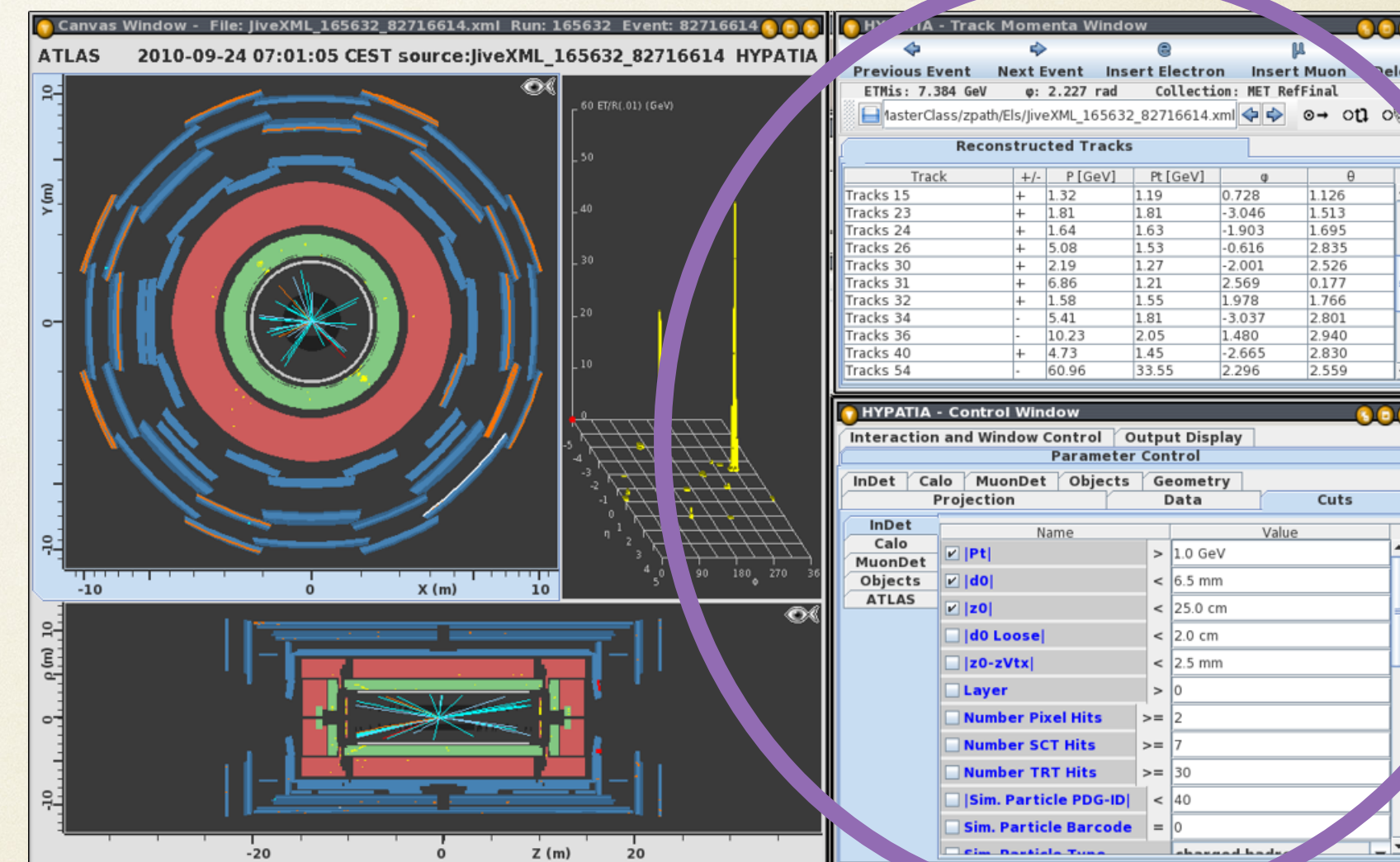
HYPATIA - Track Momenta Window

Previous Event Next Event Insert Electron Insert Muon Delete

ETMis: 7.384 GeV ϕ : 2.227 rad Collection: MET RefFinal

MasterClass/zpath/Els/jiveXML_165632_82716614.xml

Track	+/-	P [GeV]	Pt [GeV]	ϕ	θ
Tracks 15	+	1.32	1.19	0.728	1.126
Tracks 23	+	1.81	1.81	-3.046	1.513
Tracks 24	+	1.64	1.63	-1.903	1.695
Tracks 26	+	5.08	1.53	-0.616	2.835
Tracks 30	+	2.19	1.27	-2.001	2.526
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Tracks 32	+	1.58	1.55	1.978	1.766
Tracks 34	-	5.41	1.81	-3.037	2.801
Tracks 36	-	10.23	2.05	1.480	2.940
Tracks 40	+	4.73	1.45	-2.665	2.830
Tracks 54	-	60.96	33.55	2.296	2.559

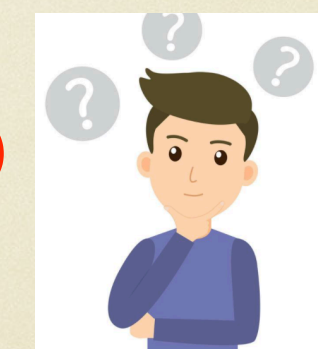


Interaction and Window Control Output Display

Parameter Control

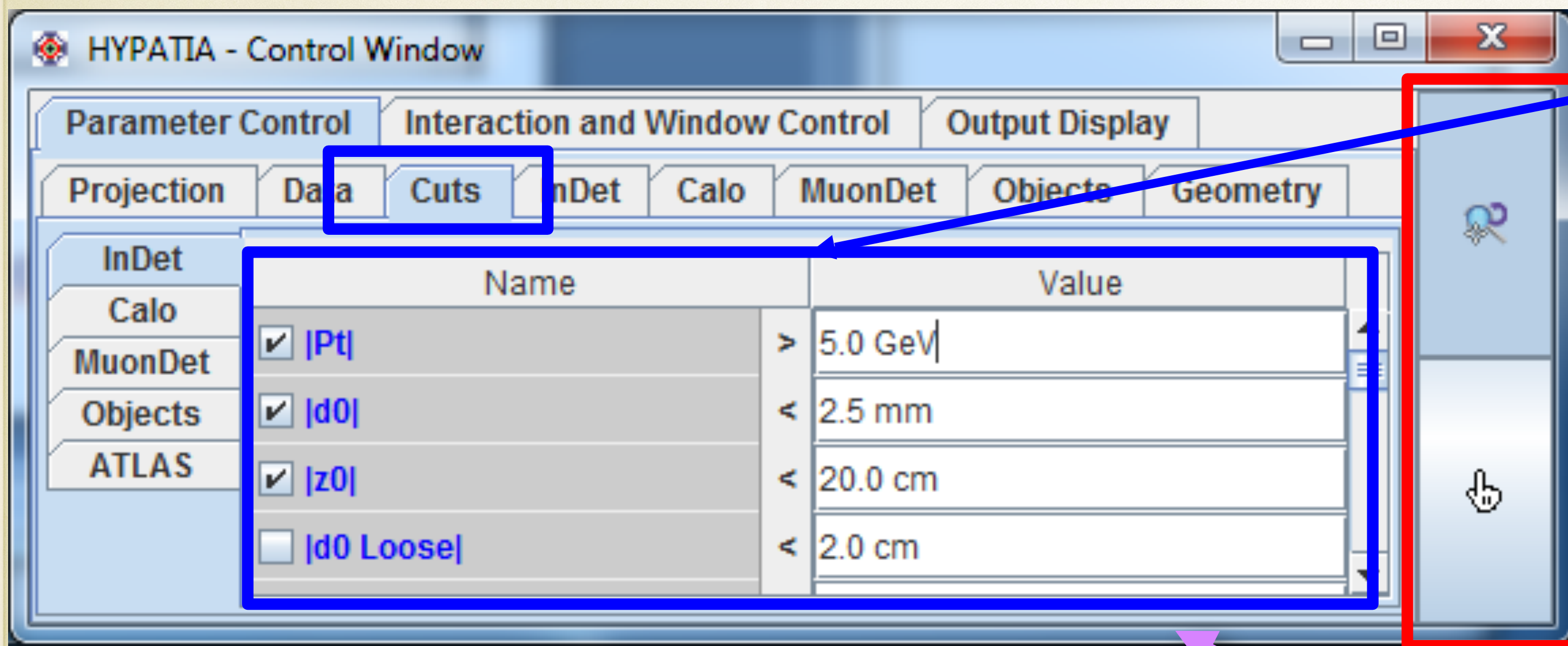
InDet	Calo	MuonDet	Objects	Geometry	Cuts
InDet					
Calo					
MuonDet					
Objects					
ATLAS					

Tagli sull'impulso



impulso P = massa x velocità [vettore]
impulso trasverso P_t = proiezione nel piano xy dell'impulso p

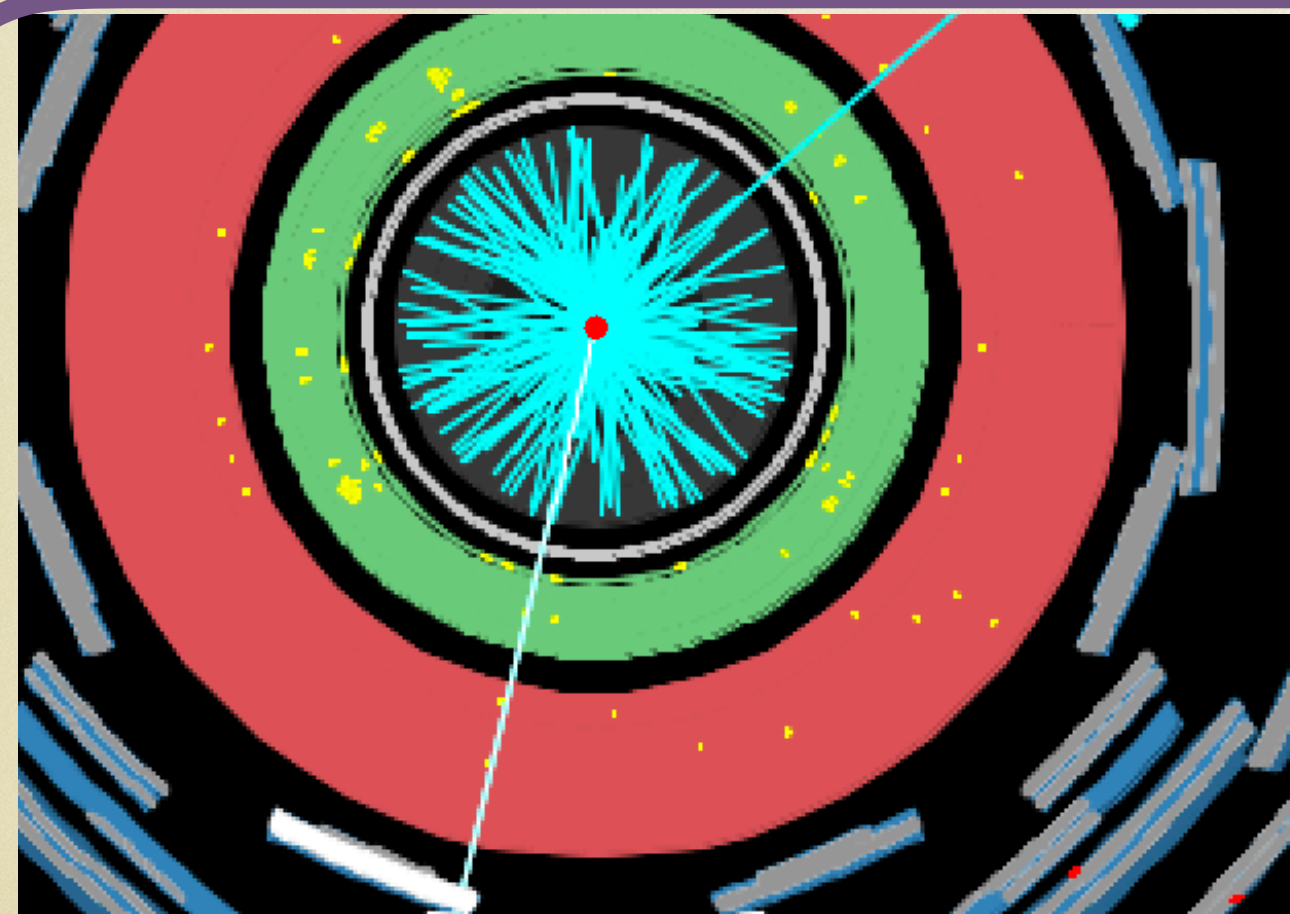
Selezione degli eventi



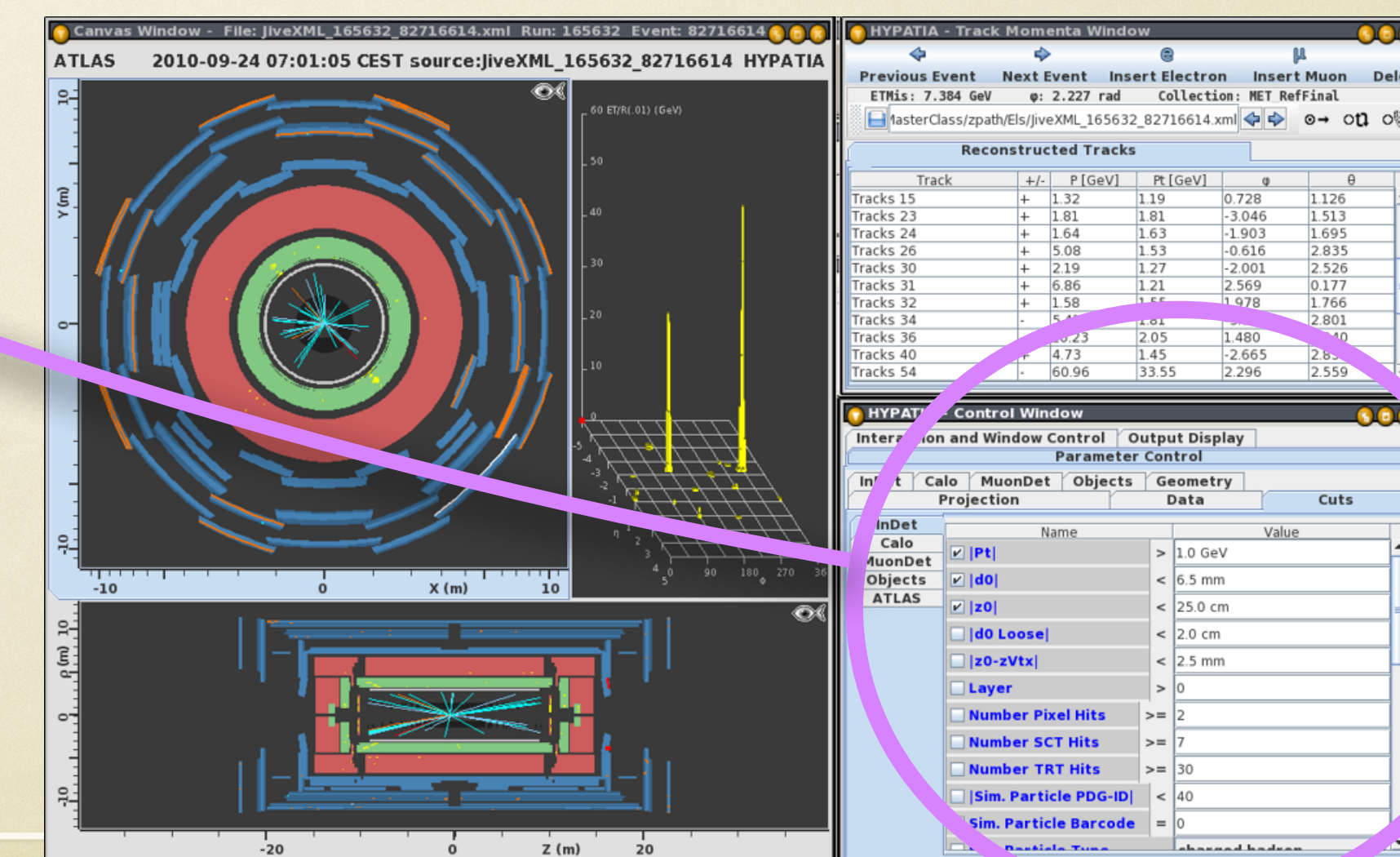
Tagli: criteri di selezione degli eventi

Zoom/Move/Rotate

Mostra informazioni per l'oggetto selezionato



Evento senza tagli in Pt !!!



Selezione degli eventi

HYPATIA - Control Window

Parameter Control | Interaction and Window Control | Output Display

Projection | Data | Cuts | InDet | Calo | MuonDet | Objects | Geometry

InDet
Calo
MuonDet
Objects
ATLAS

Name	Value
<input checked="" type="checkbox"/> Pt	> 5.0 GeV
<input type="checkbox"/> Pt2	< 700.0 MeV
<input checked="" type="checkbox"/> d0	< 2.5 mm
<input checked="" type="checkbox"/> z0	< 20.0 cm
<input type="checkbox"/> d0 Loose	< 2.0 cm
<input type="checkbox"/> z0-zVtx	< 2.5 mm
<input type="checkbox"/> Layer	> 0
<input checked="" type="checkbox"/> Number Pixel Hits	>= 2
<input checked="" type="checkbox"/> Number SCT Hits	>= 7
<input type="checkbox"/> Number TRT Hits	>= 15
<input type="checkbox"/> Sim. Particle PDG-ID	< 40

Click sul:
Number of Pixel Hits
Number of SCT Hits

In questo modo
eliminiamo le tracce
non perfettamente
ricostruite

Selezione degli eventi

Click CALO (diventa celeste come nella figura)


Mettere
LAr ET 2000
Tile Energy Bottom 2500
HEC ET 2500
HEC Energy 2500

In questo modo eliminiamo depositi di energia non perfettamente ricostruiti

The screenshot shows the ATLAS control window with the 'Calo' tab selected. The 'Data' sub-tab is active, displaying a table of event selection parameters. The 'Calo' section is highlighted in blue. The table lists various energy thresholds for different detector regions.

Name	Value
<input checked="" type="checkbox"/> LAr ET	> 2.0 GeV
<input type="checkbox"/> LAr Energy	> 200.0 MeV
<input type="checkbox"/> LAr Energy Layer 0	> 500.0 MeV
<input type="checkbox"/> LAr Energy Layer 1	> 60.0 MeV
<input type="checkbox"/> LAr Energy Layer 2	> 155.0 MeV
<input type="checkbox"/> LAr Energy Layer 3	> 125.0 MeV
<input type="checkbox"/> Tile ET	> 100.0 MeV
<input checked="" type="checkbox"/> Tile Energy Bottom	> 2.5 GeV
<input type="checkbox"/> Tile Energy Up	< 100.0 GeV
<input type="checkbox"/> Tile PMT ADC	< 1
<input checked="" type="checkbox"/> FCAL ET	> 500.0 MeV
<input type="checkbox"/> FCAL Energy	> 2.0 GeV
<input checked="" type="checkbox"/> HEC ET	> 2.5 GeV
<input checked="" type="checkbox"/> HEC Energy	> 2.5 GeV
<input checked="" type="checkbox"/> MBTS Energy	> 10.0 KeV
LAr region	All
FCAL region	All
HEC region	All

Carta di Identita' del FOTONE


REPUBBLICA ITALIANA
 MINISTERO DELL'INTERNO
 CARTA DI IDENTITÀ / IDENTITY CARD
 COMUNE / MUNICIPALITY

CA00000XX

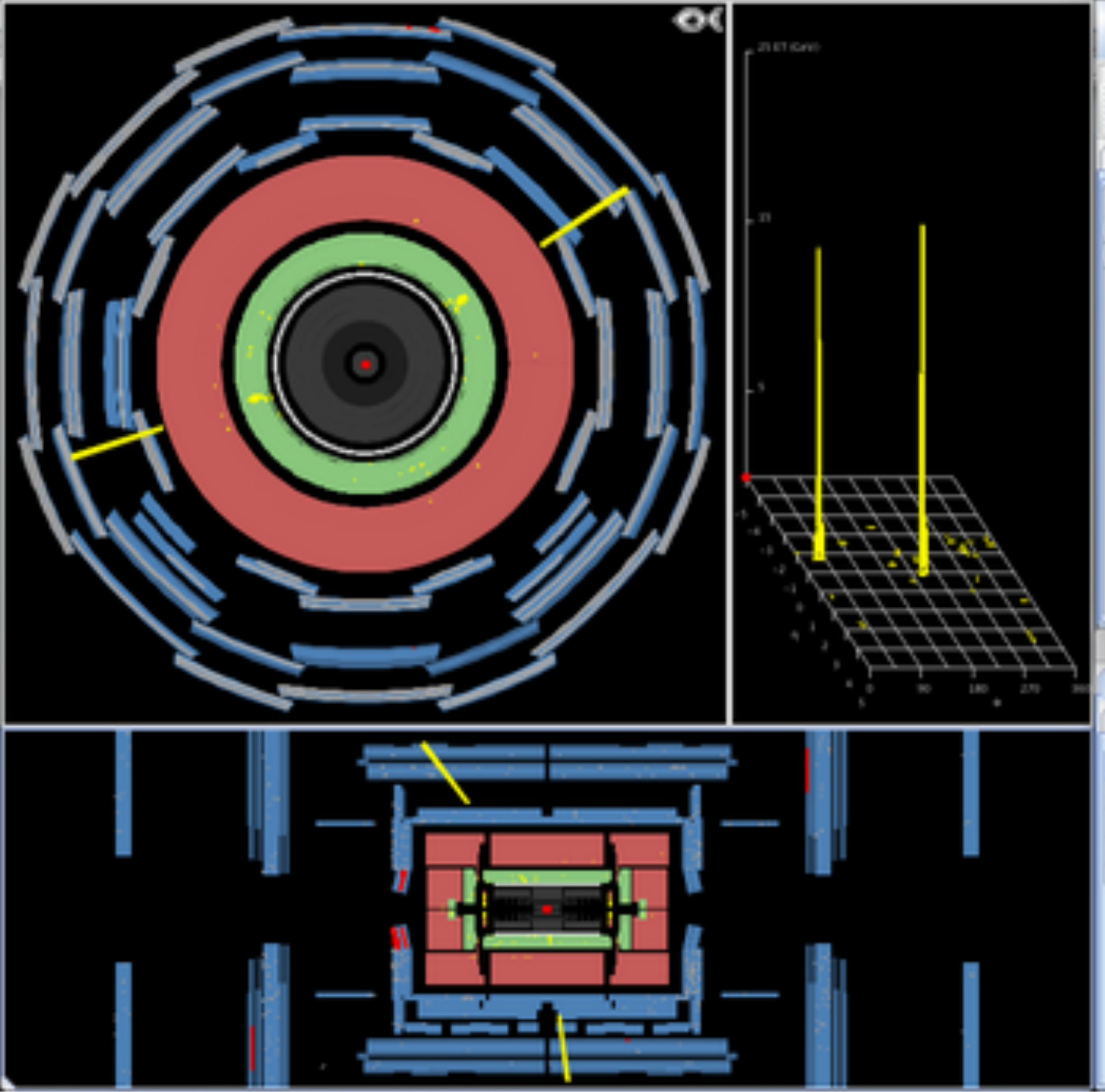
COGNOME / SURNAME

Fotone

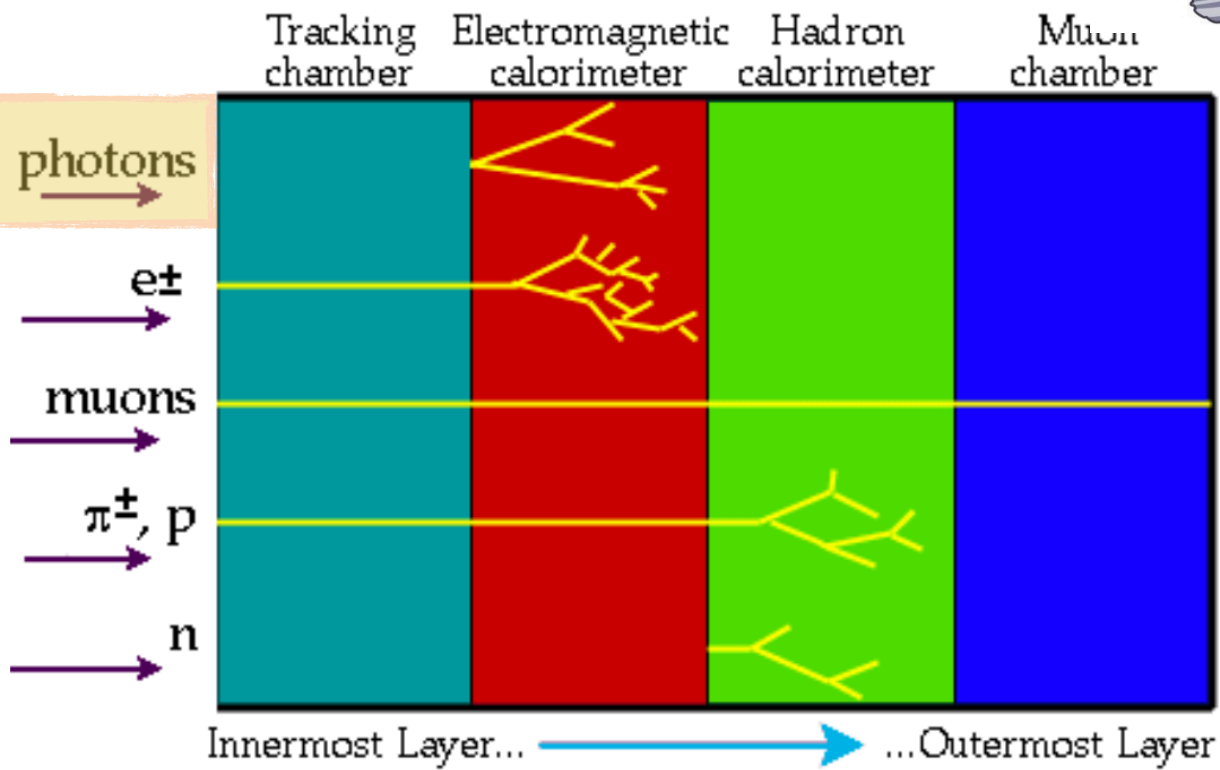
Mass 0 MeV/c²
 Charge 0
 Spin 1

CITTADINANZA
 NATIONALITY
 SCADENZA / EXPIRY
 00000
 NON VALIDA PER L'ESPATRIO

Photon



- Non lascia traccia nel rivelatore interno
- Deposita tutta la sua energia nel Calorimetro Elettromagnetico



Carta di Identita' dell' ELETTRONE



REPUBBLICA ITALIANA
MINISTERO DELL'INTERNO
CARTA DI IDENTITÀ / IDENTITY CARD
COMUNE / MUNICIPALITY

CA00000XX



Electron

COGNOME / SURNAME

Electrone

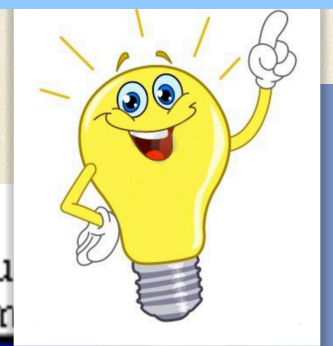
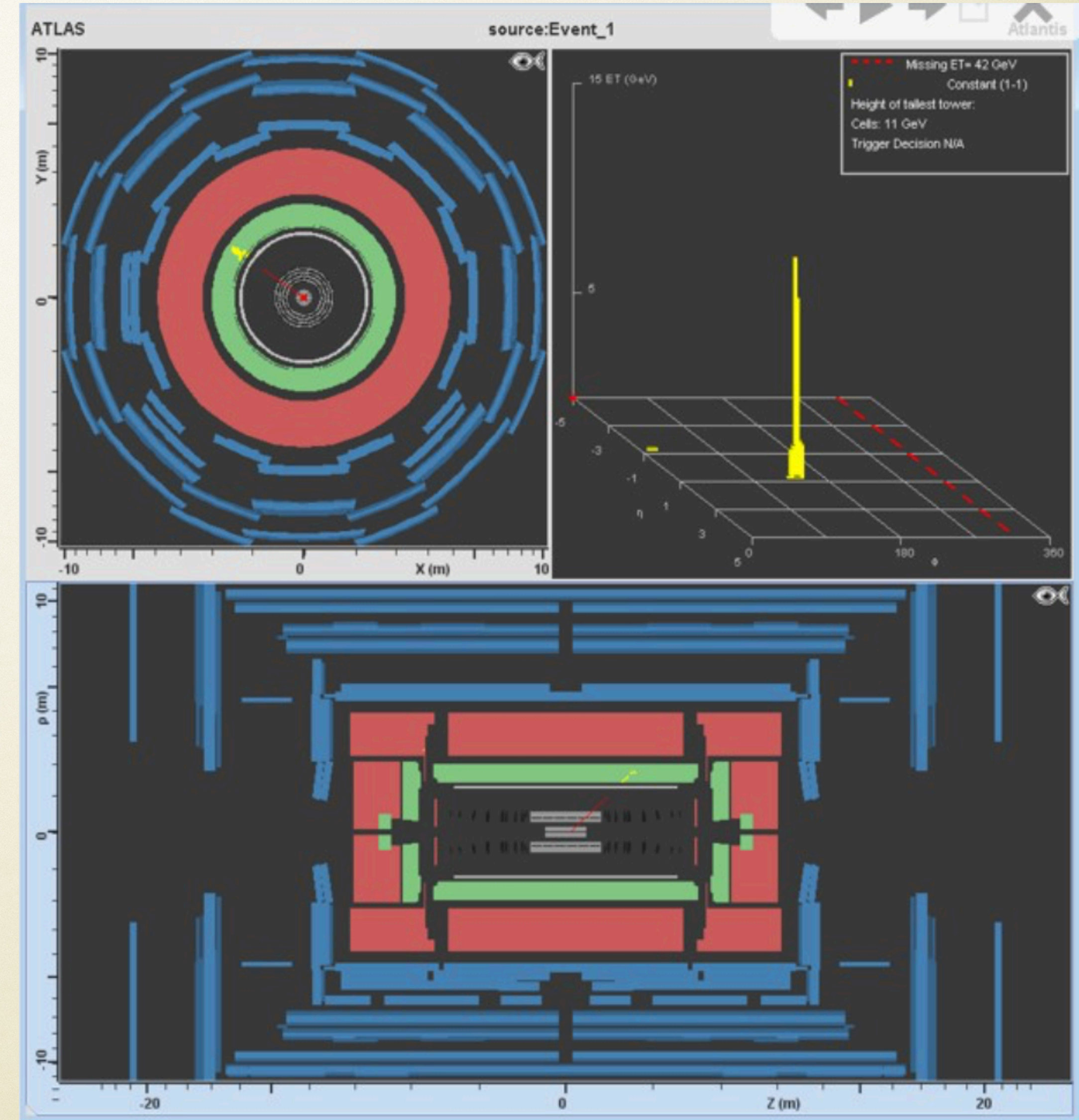
CITTADINANZA
NATIONALITY

SCADENZA / EXPIRY

00000

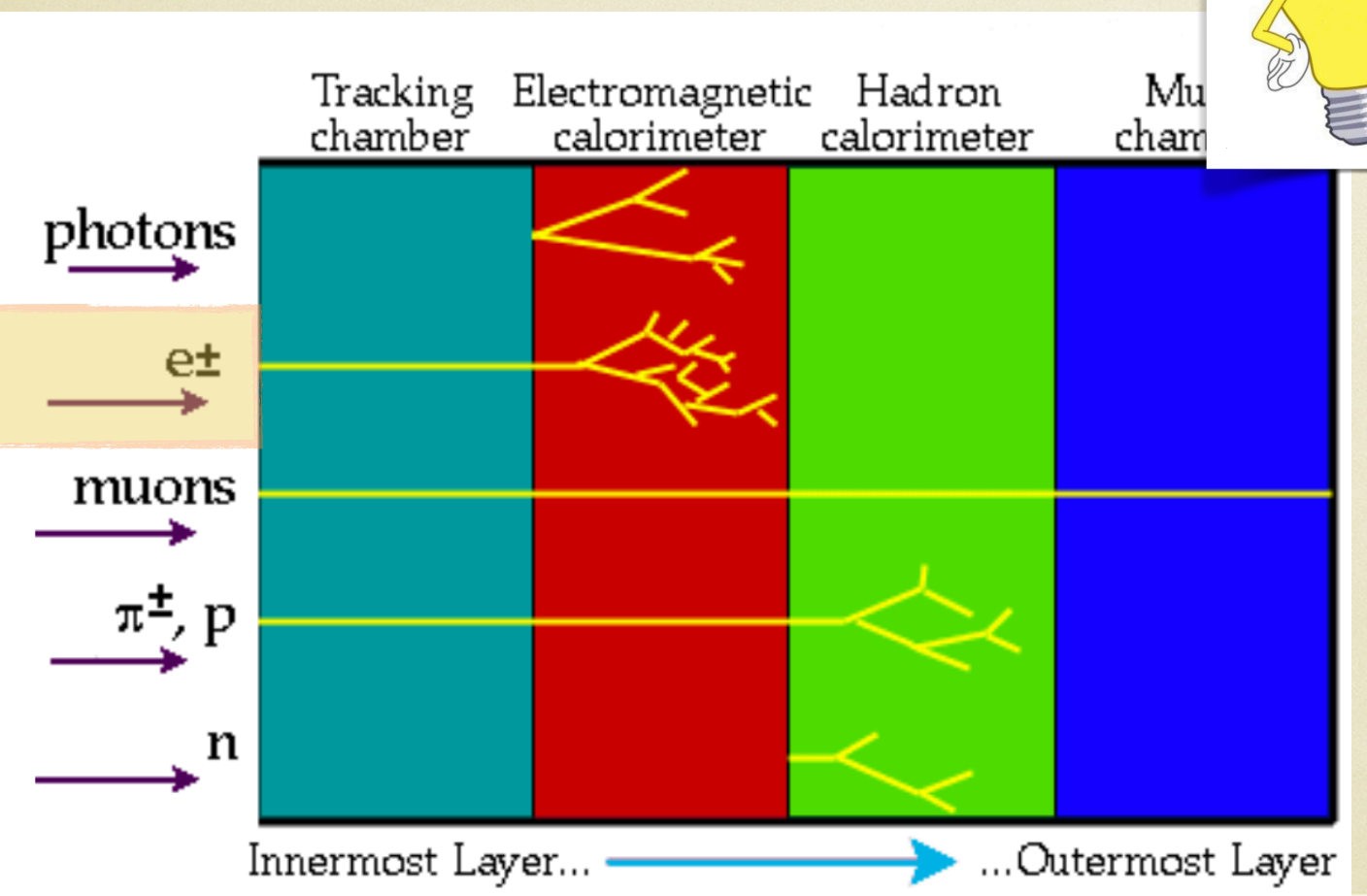
NON VALIDA PER L'ESPATRIO

Mass 0,5 MeV/c²
Charge -
Spin 1/2

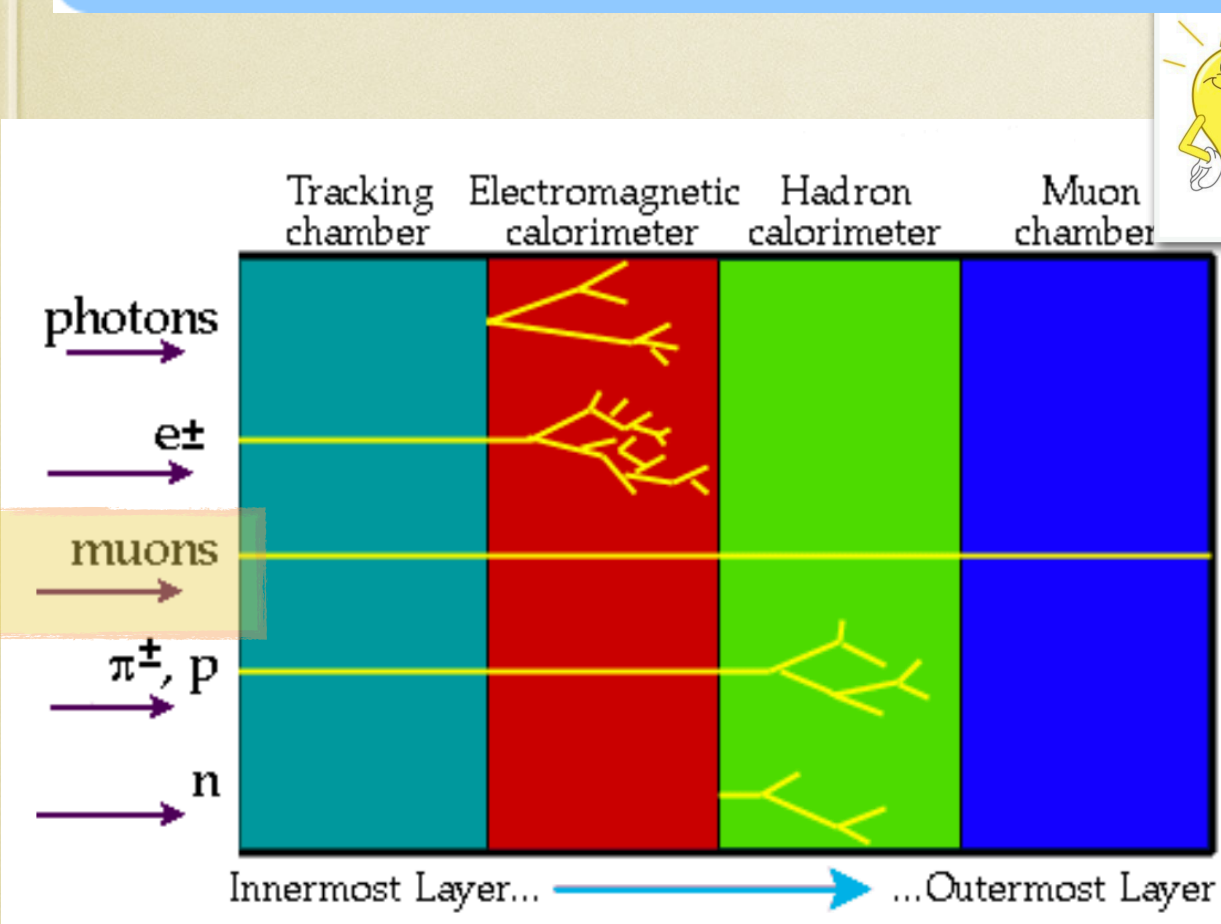
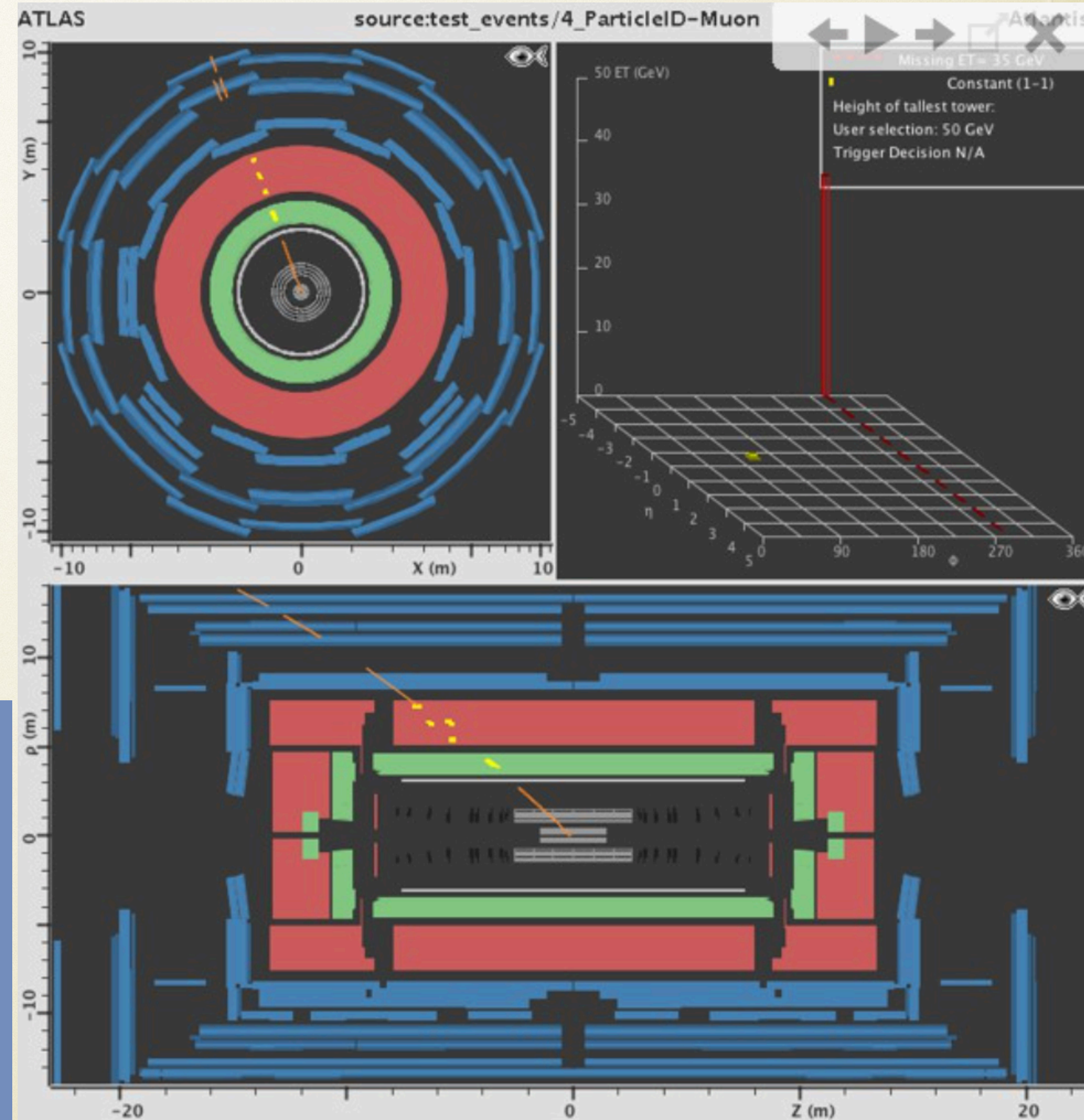


Lascia una traccia nel rivelatore interno

- Deposita tutta la sua energia nel Calorimetro Elettromagnetico



Carta di Identita' del MUONE



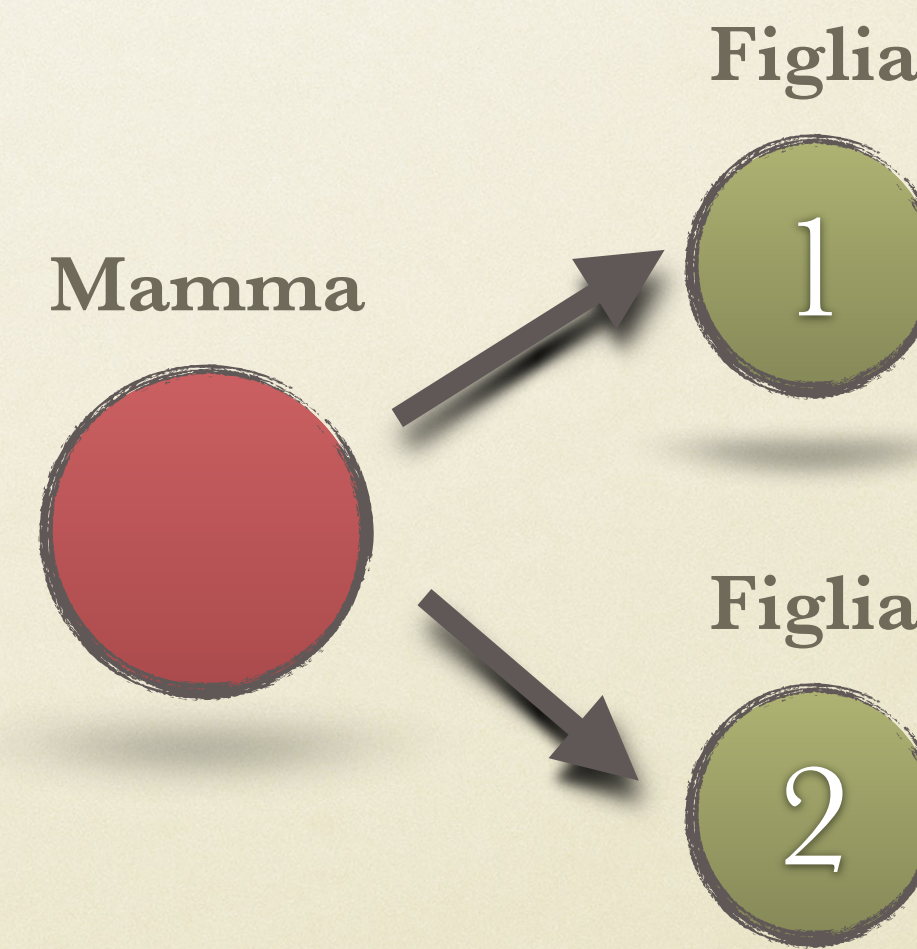
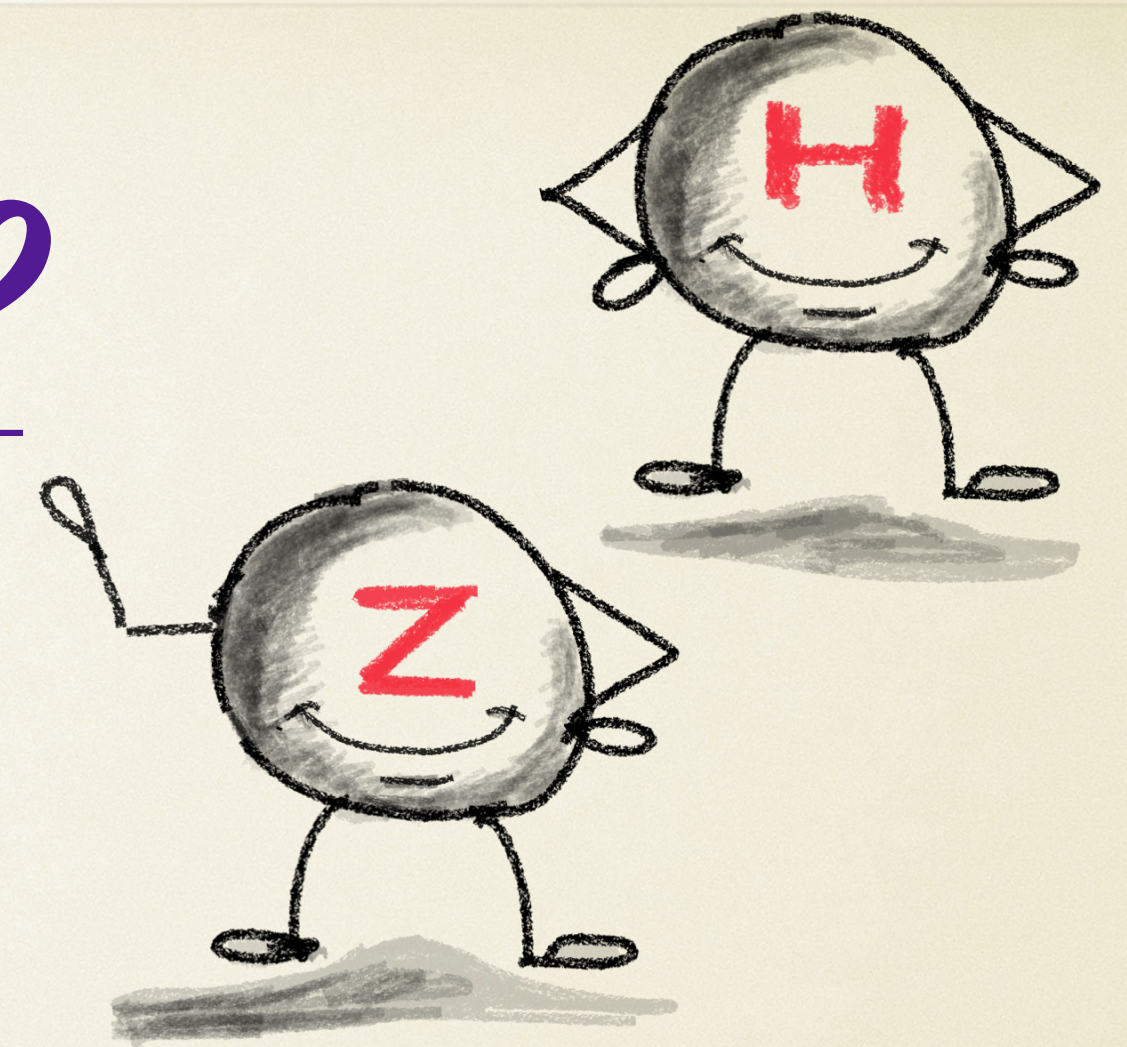
Lascia traccia nel rivelatore interno

- Deposita pochissima energia nei Calorimetri
- Raggiunge il rivelatore più esterno dove lascia un'altra traccia

... ma il Bosone Z e il Bosone H?!?

Come identifico il Bosone Z e il Bosone Higgs?

- **Queste particelle decadono** (ovvero creano altre particelle disintegrandosi) in altre particelle, rispettando tutte le leggi di conservazione (carica elettrica, energia, momento angolare...).
- Quando **questo decadimento e' molto probabile avviene su tempi brevissimi** per cui **non riusciamo a "vedere direttamente"** mai il Bosone Z o il Bosone Higgs.
- **I rivelatori registrano solo i prodotti finali (le particelle prodotte dal decadimento - figlie del decadimento)**
 - **"Sommando" tutte le masse delle particelle finali e le loro energie si trova la massa (massa invariante) della particella iniziale (particella mamma)**

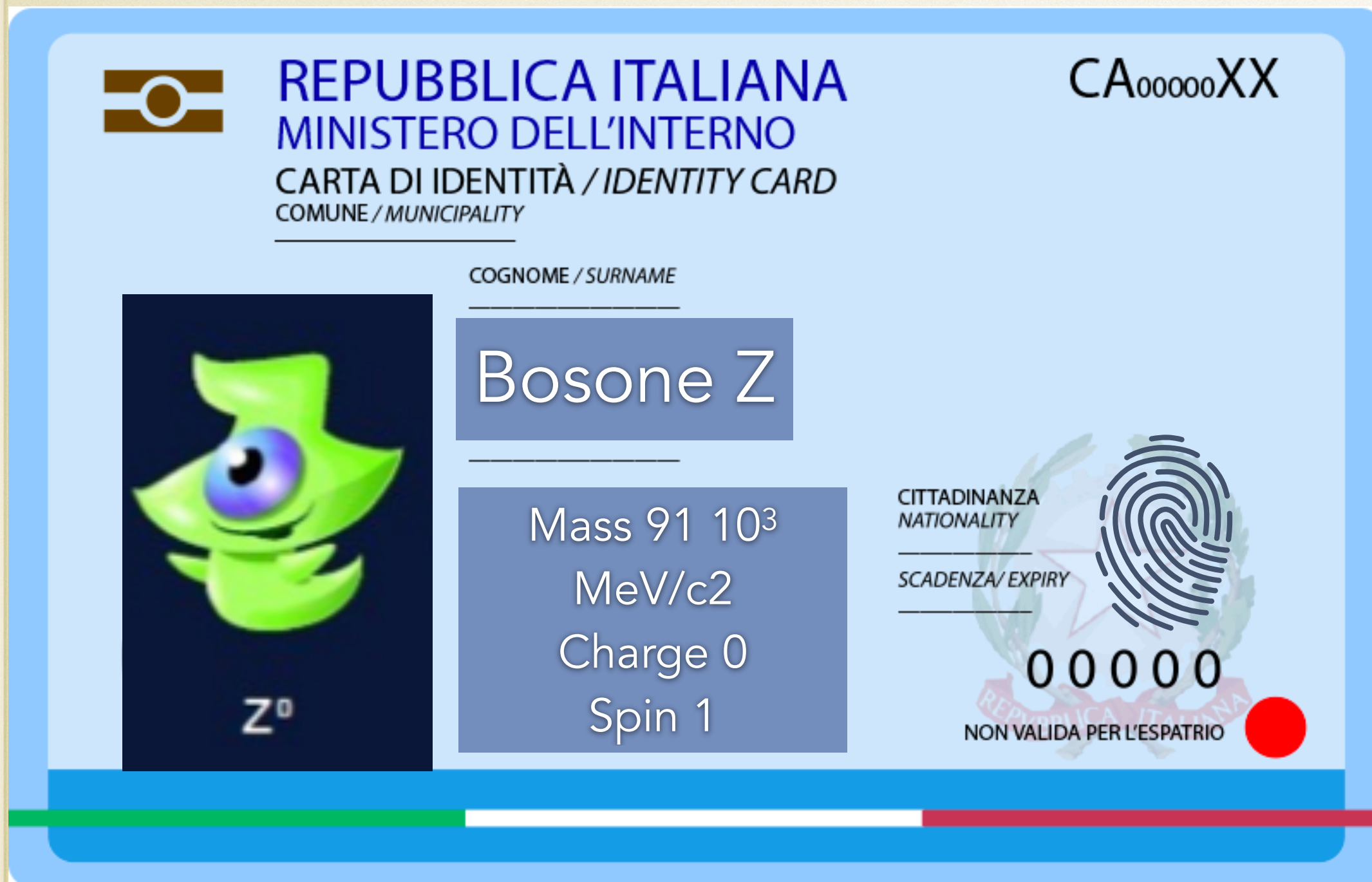


Distribuzione della massa della particella mamma



$$m_0^{(Z)} = \sqrt{\left(\frac{E_{e^-} + E_{e^+}}{c^2}\right)^2 - \left(\frac{\vec{p}_{e^-} + \vec{p}_{e^+}}{c}\right)^2}$$

Il Bosone Z

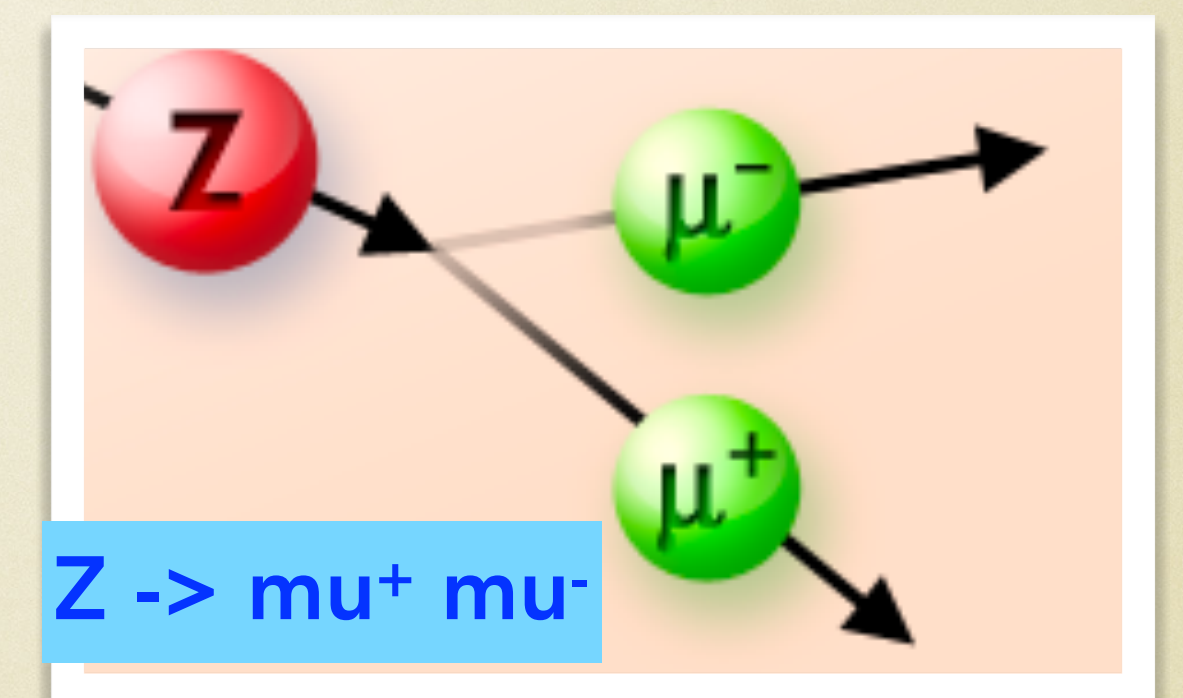
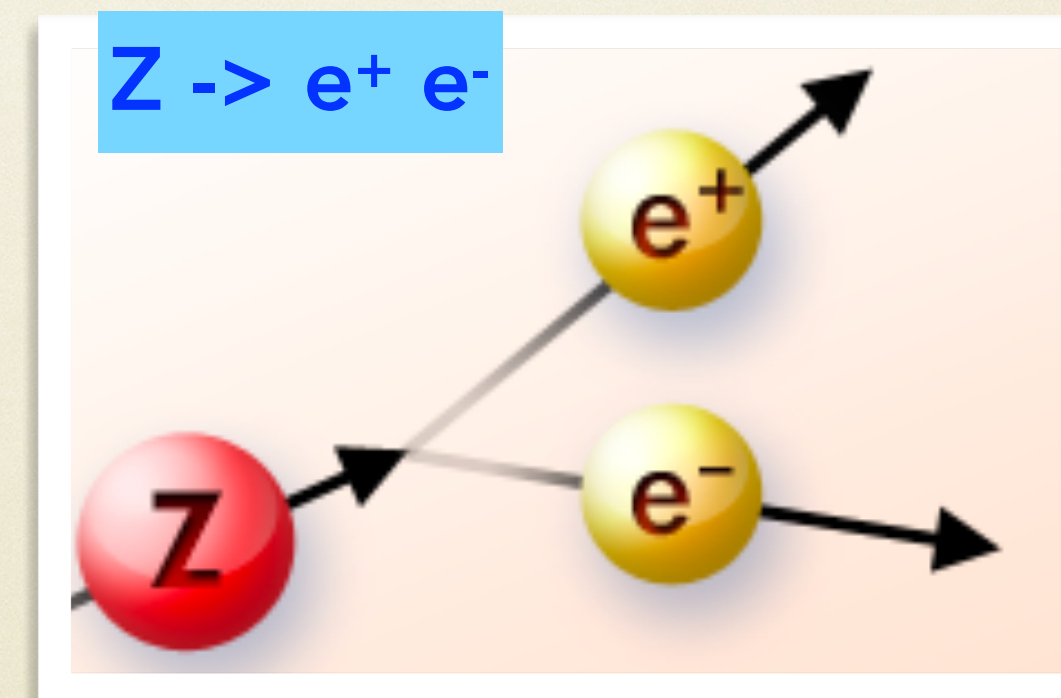


NB: Z e' neutro!
Le due particelle figlie devono avere carica opposta

Il Bosone Z e' molto pesante e decade in coppie di fermione-antifermione:

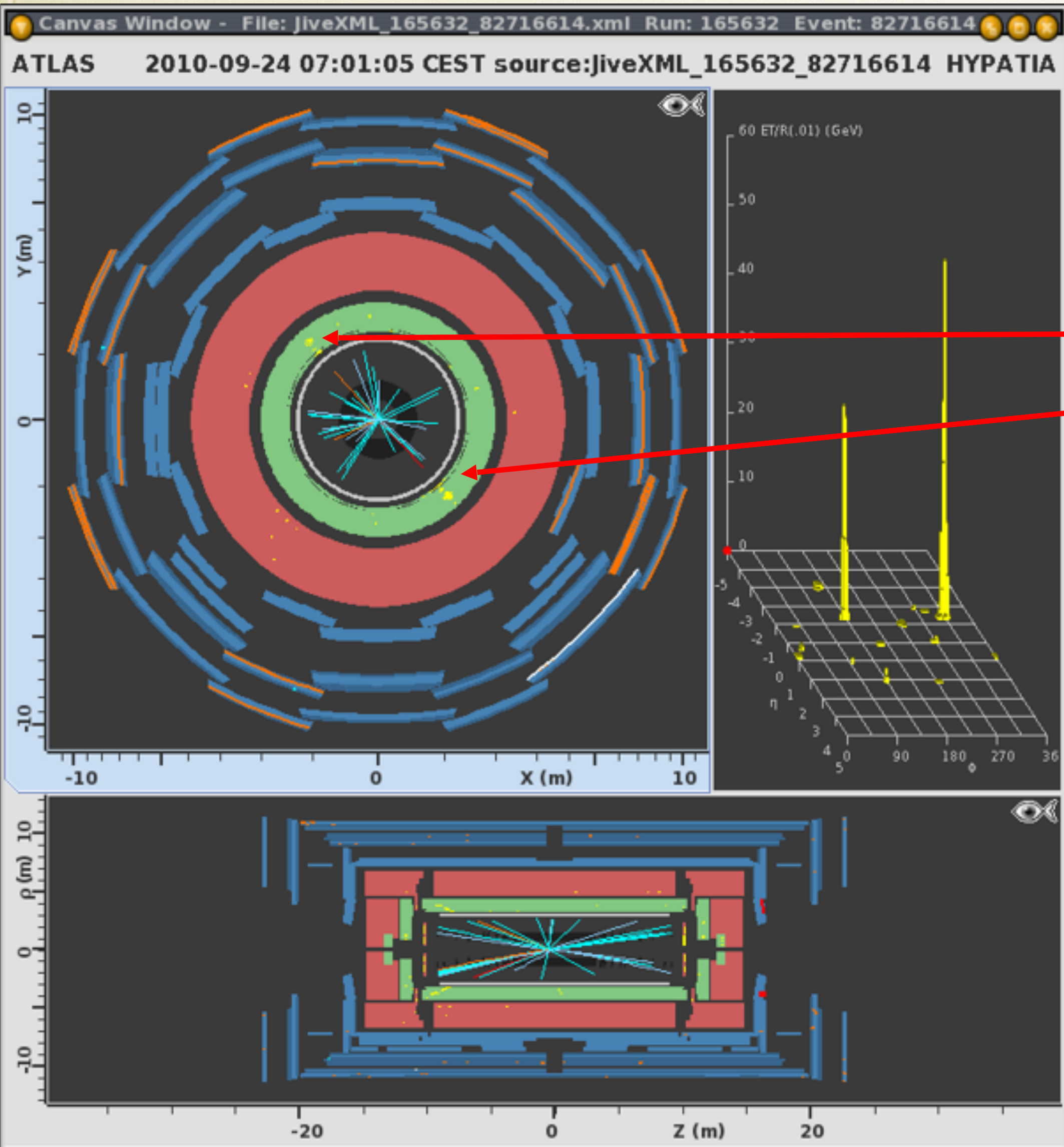
Nel nostro esercizio ci aspettiamo di "vedere":

- $e^+ e^-$ (positrone ed elettrone)
- $\mu^+ \mu^-$ (muone positivo e muone negativo)



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

Il bosone Z è neutro.



HYPATIA - Track Momenta Window

Previous Event Next Event Insert Electron Insert Muon Delete

ETMis: 7.384 GeV ϕ : 2.227 rad Collection: MET RefFinal

masterClass/zpath/Els/jiveXML_165632_82716614.xml

Reconstructed Tracks

Track	+/-	P [GeV]	Pt [GeV]	ϕ	θ
Tracks 15	+	1.82	1.19	0.728	1.126
Tracks 23	-	2.87	1.81	-3.046	1.513
Tracks 24	+	1.64	1.63	-1.903	1.695
Tracks 26	+	5.08	5.3	-0.616	2.835
Tracks 30	+	2.19	1.27	-2.001	2.526
Tracks 31	+	6.86	1.21	2.569	0.177
Tracks 32	+	1.58	1.55	1.948	1.766
Tracks 34	-	5.41	1.81	-3.037	2.801
Tracks 36	-	10.23	2.05	1.480	2.940
Tracks 40	+	4.73	1.45	-2.665	2.830
Tracks 54	-	60.96	33.55	2.296	2.559

Elettrone e positrone

HYPATIA - Control Window

Interaction and Window Control Output Display

Parameter Control

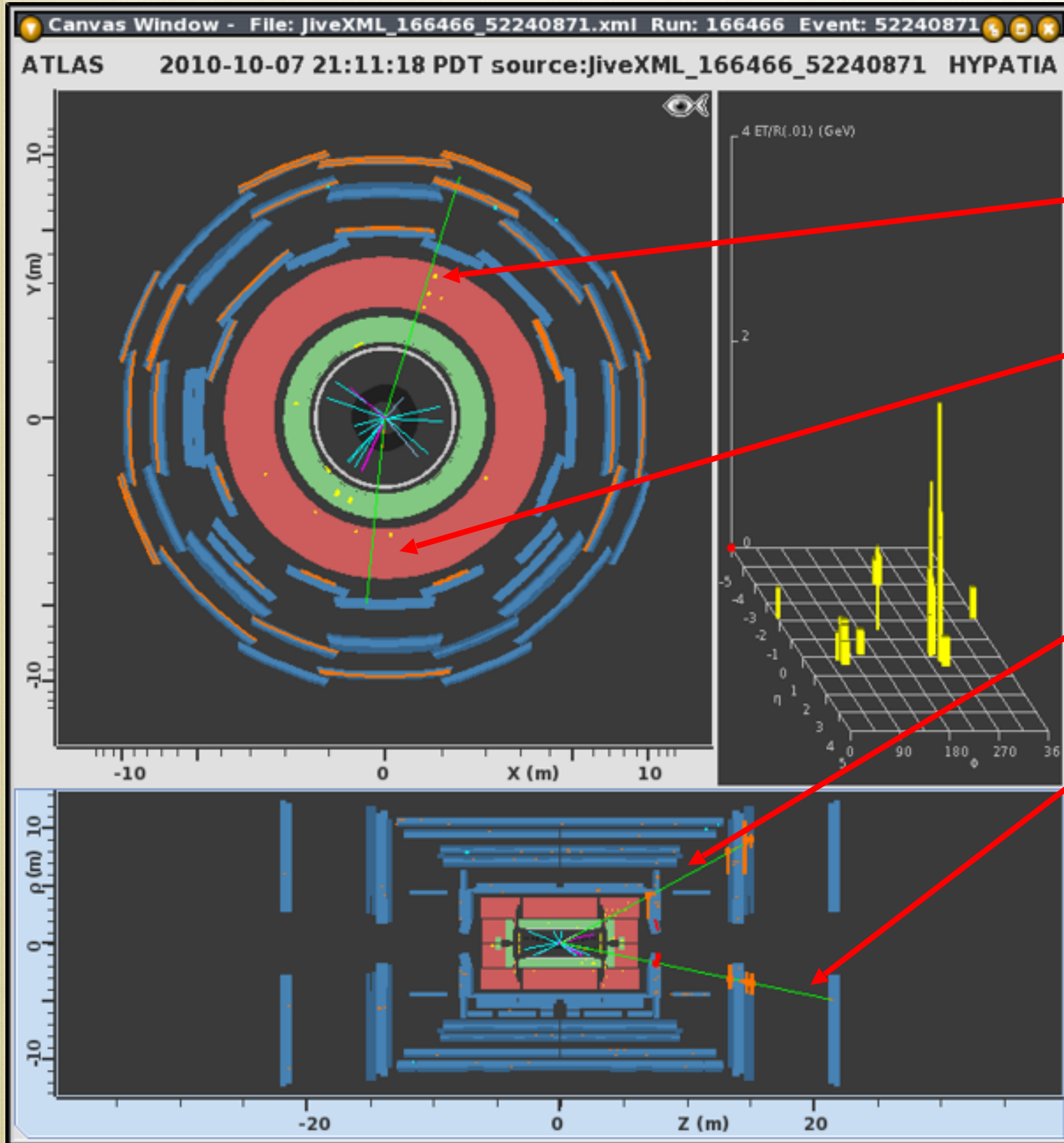
InDet Calo MuonDet Objects Geometry

Projection Data Cuts

InDet	Name	Value
Calo	<input checked="" type="checkbox"/> Pt	> 1.0 GeV
Calo	<input checked="" type="checkbox"/> d0	< 6.5 mm
Calo	<input checked="" type="checkbox"/> z0	< 25.0 cm
Calo	<input type="checkbox"/> d0 Loose	< 2.0 cm
Calo	<input type="checkbox"/> z0-zVtx	< 2.5 mm
Calo	<input type="checkbox"/> Layer	> 0
Calo	<input type="checkbox"/> Number Pixel Hits	>= 2
Calo	<input type="checkbox"/> Number SCT Hits	>= 7
Calo	<input type="checkbox"/> Number TRT Hits	>= 30
Calo	<input type="checkbox"/> Sim. Particle PDG-ID	< 40
Calo	<input type="checkbox"/> Sim. Particle Barcode	= 0
Calo	<input type="checkbox"/> Sim. Particle Type	charged hadron

I segni delle due particelle devono essere opposti

$$Z \rightarrow \mu^- \mu^+$$



HYPATIA - Track Momenta Window

Previous Event Next Event Insert Electron Insert Muon Delete

ETMis: 0.568 GeV ϕ : -0.573 rad Collection: MET RefFinal

Reconstructed Tracks

Track	+/-	P [GeV]	Pt [GeV]	ϕ	θ
Tracks 0	+	26.71	29.23	-1.659	0.233
Tracks 3	+	4.78	4.24	-1.928	0.577
Tracks 5	-	120.75	61.66	1.257	0.536
Tracks 6	+	2.97	1.31	-0.477	2.686
Tracks 7	-	2.83	1.25	-0.062	2.757
Tracks 9	-	2.99	1.20	2.356	0.415
Tracks 10	+	8.03	1.47	-2.472	2.958
Tracks 11	+	5.87	1.19	-2.757	0.204
Tracks 15	+	6.05	2.69	-0.771	2.681
Tracks 17	-	8.08	4.16	-2.043	0.410
Tracks 24	-	1.50	1.36	2.582	2.002
Tracks 25	+	1.57	1.00	-1.943	0.689
Tracks 26	-	2.69	1.16	-0.327	2.697
Tracks 57	-	2.42	2.15	0.765	0.679
Tracks 58	-	1.09	1.09	2.206	1.510
Tracks 65	+	1.97	1.34	-2.065	0.745
Tracks 72	+	28.08	7.80	2.460	0.281

HYPATIA - Control Window

Interaction and Window Control Output Display

Parameter Control

	Projection	Data	Cuts
InDet			
Calo			
MuonDet			
Objects			
ATLAS			
	<input checked="" type="checkbox"/> Pt	>	1.0 GeV
	<input checked="" type="checkbox"/> d0	<	6.5 mm
	<input checked="" type="checkbox"/> z0	<	25.0 cm
	<input type="checkbox"/> d0 Loose	<	2.0 cm
	<input type="checkbox"/> z0-zVtx	<	2.5 mm
	<input type="checkbox"/> Layer	>	0
	<input type="checkbox"/> Number Pixel Hits	>=	2

Muone e anti-muone

I segni delle due particelle devono essere opposti

Il Bosone H

NB: H e' neutro!

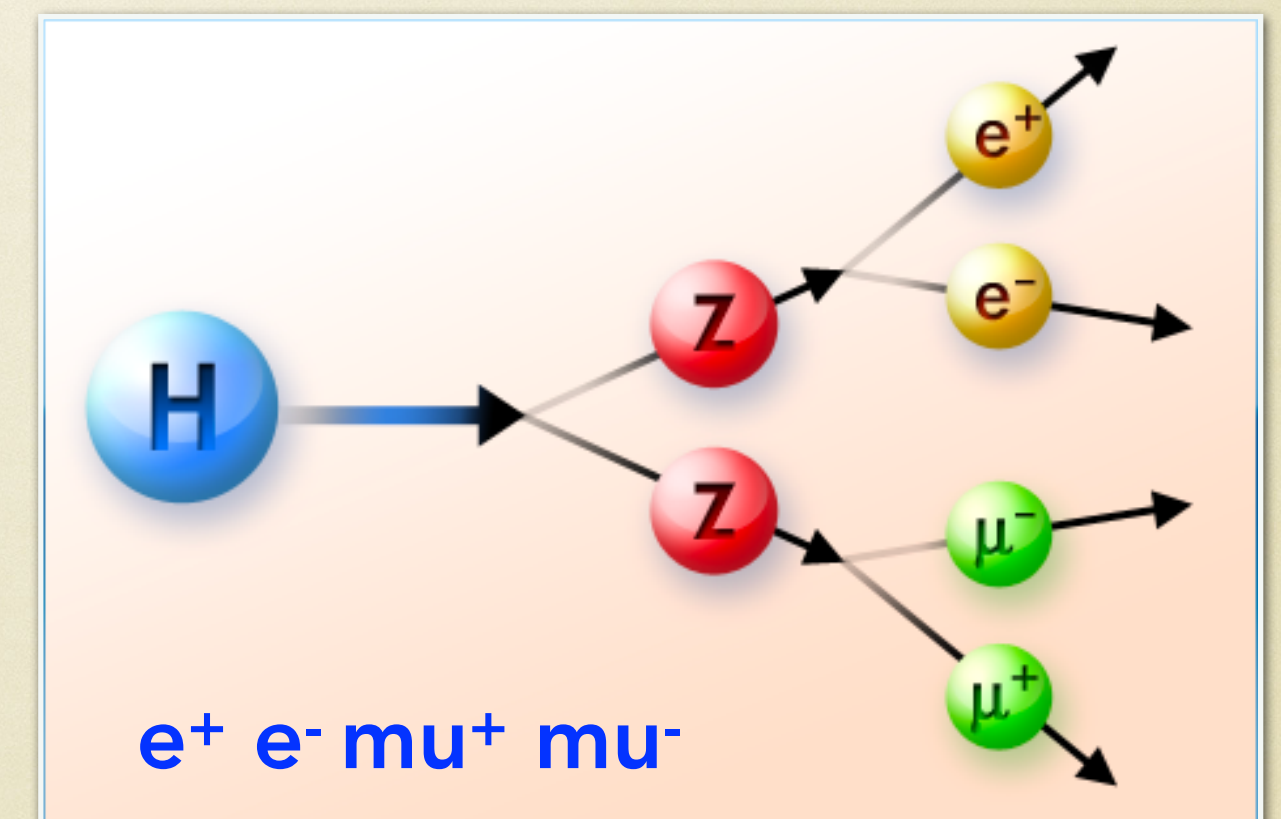
Le quattro particelle figlie devono avere carica totale zero!!!



Il Bosone Higgs e' anche lui molto pesante e decade in coppie di fermione-antifermione e coppie di bosoni:

Nel nostro esercizio ci aspettiamo di "vedere":

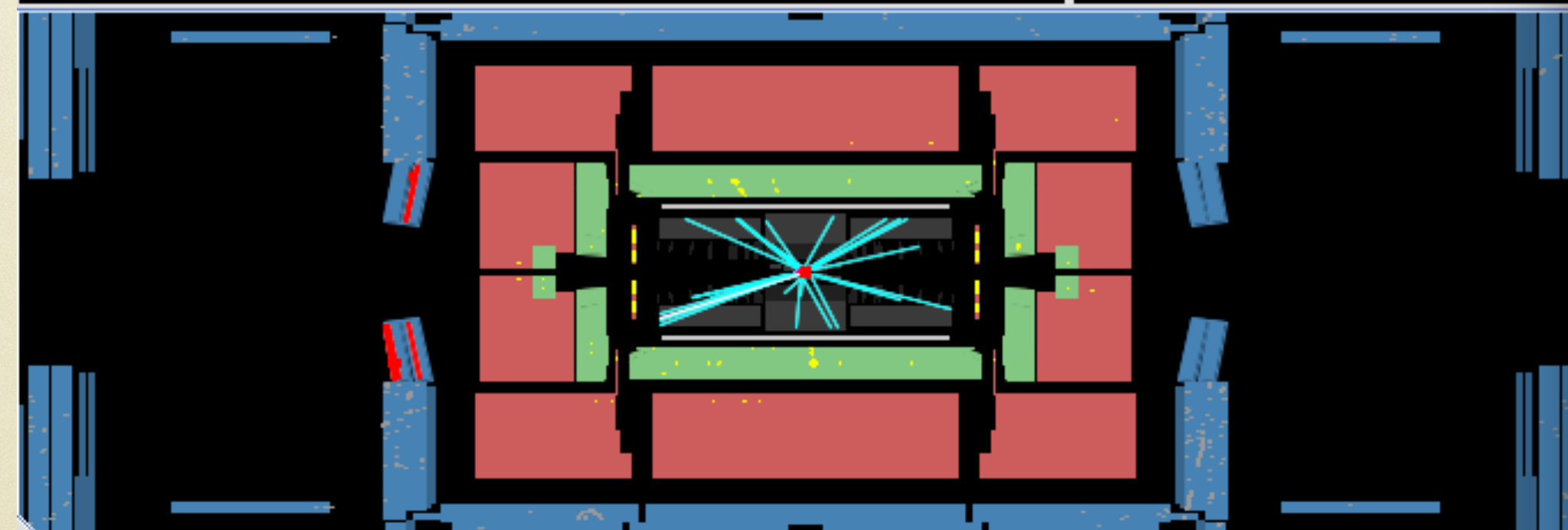
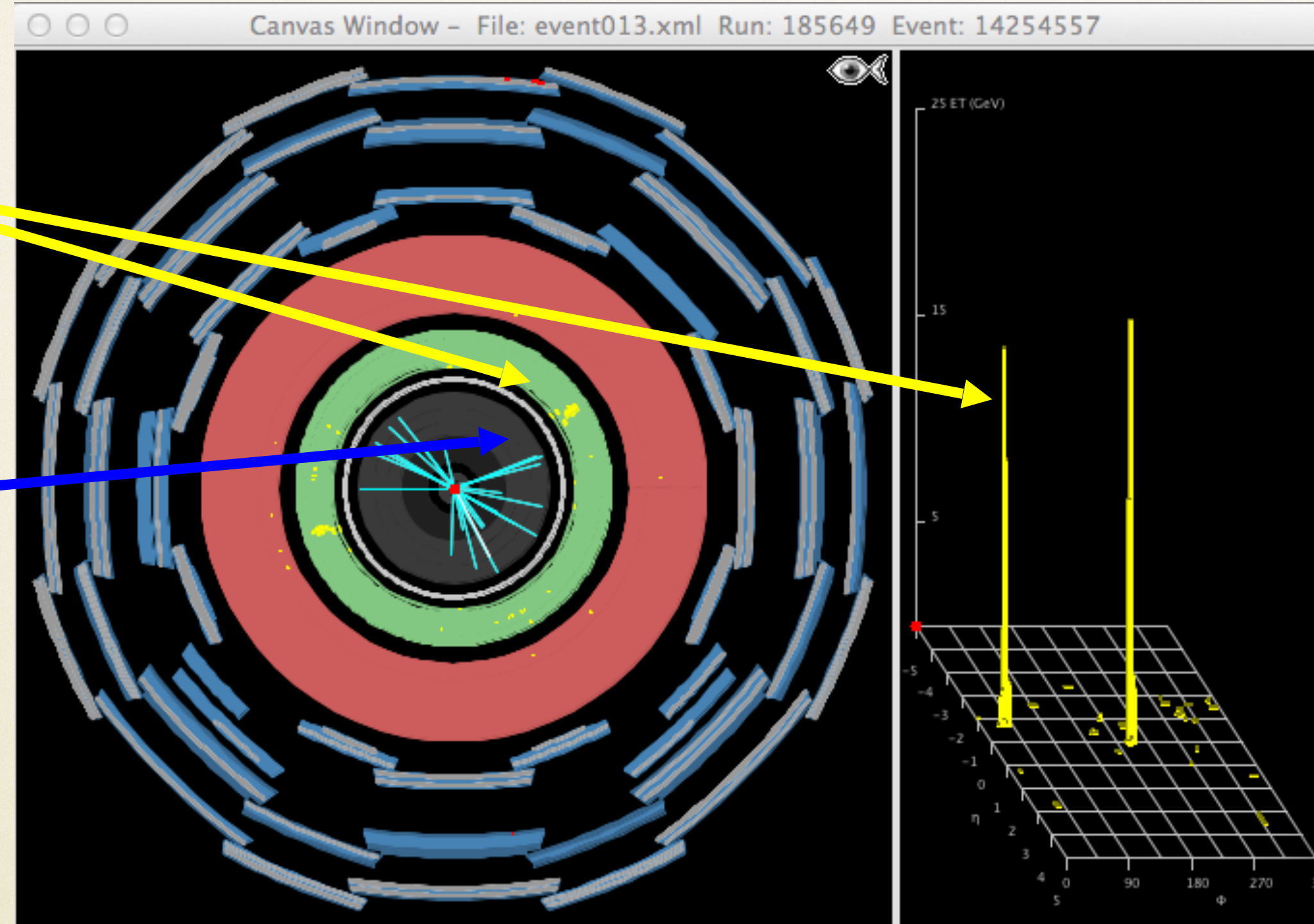
- **Z Z (coppie di Z)**
 - Ricordiamoci che la Z a sua volta decade per cui questo decadimento dell'Higgs in coppie di Z può essere "visto" trovando:
 - $e^+ e^- e^+ e^-$
 - $e^+ e^- \mu^+ \mu^-$
 - $\mu^+ \mu^- \mu^+ \mu^-$
- **$\gamma\gamma$ (Coppie di fotoni)**



Higgs → fotone - fotone

Energia nel
**calorimetro
elettromagnetico**

No tracce vicino ai
depositi → non
sono elettroni



HYPATIA - Track Momenta Window

ETMis: 13.073 GeV ϕ : 3.120 rad Collection: MET_RefFinal

events/group04.zip/event013.xml

Track	+/-	P [GeV]	Pt [GeV]	ϕ	θ
Tracks 0	+	5.23	1.28	-0.782	2.895
Tracks 4	+	3.70	1.09	-0.886	2.841
Tracks 5	-	4.98	1.26	-1.768	0.256
Tracks 6	+	5.02	2.43	0.400	0.506
Tracks 7	+	5.52	1.24	-0.000	2.915
Tracks 10	-	3.93	1.06	-0.737	2.869
Tracks 11	+	3.03	1.44	2.820	0.495
Tracks 15	-	2.35	1.51	2.260	2.445
Tracks 21	-	2.03	1.78	0.170	1.065
Tracks 26	+	1.41	1.24	-2.876	1.068
Tracks 29	-	2.08	1.34	0.148	2.439
Tracks 36	-	1.36	1.36	-1.320	1.665
Tracks 37	-	1.25	1.10	-0.811	1.076
Tracks 38	-	4.73	1.05	1.665	0.223
Tracks 39	-	5.60	1.61	-1.044	2.849
Tracks 52	+	2.16	1.78	2.824	2.170

HYPATIA - Control Window

Parameter Control Interaction and Window Control Output Display

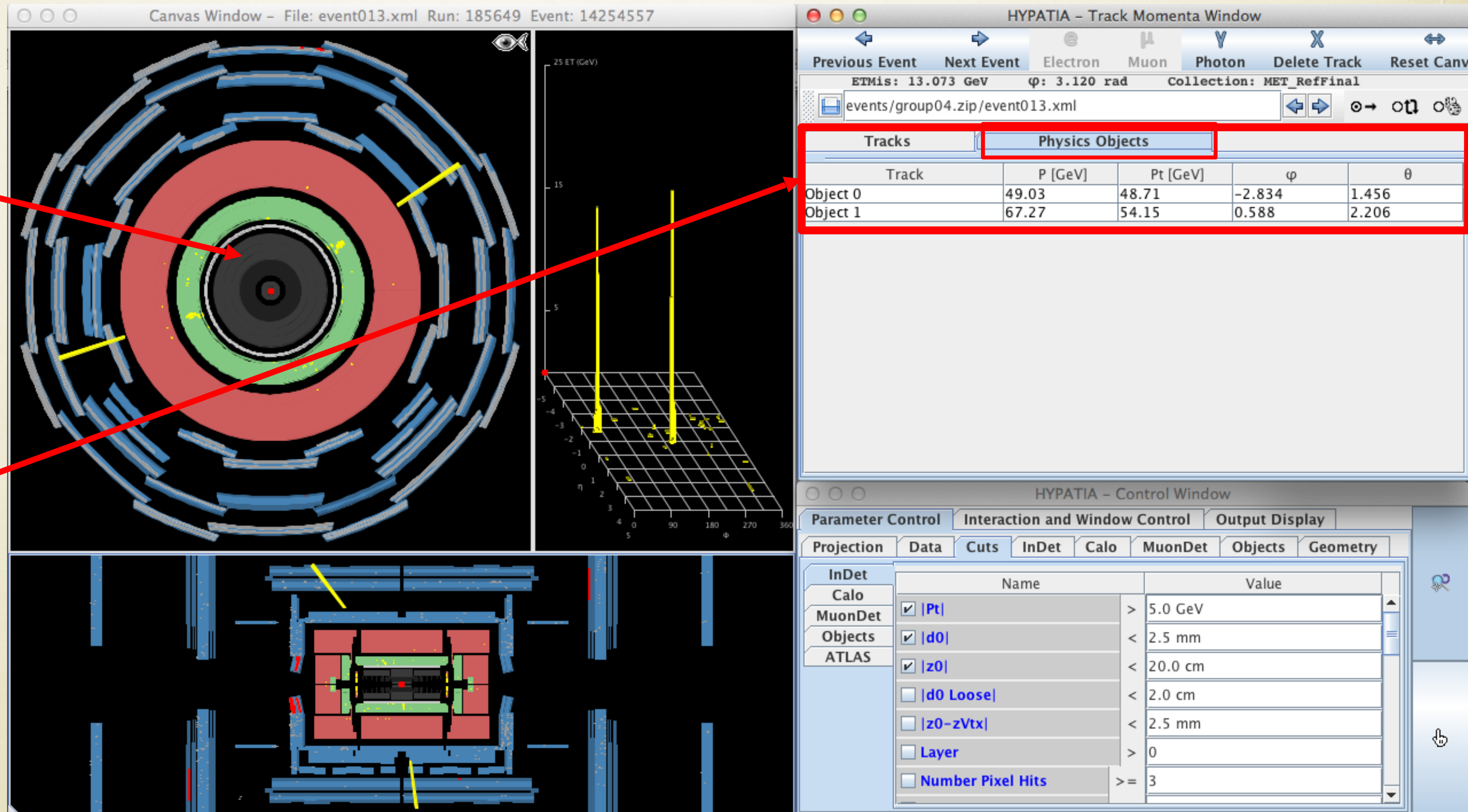
Projection Data Cuts InDet Calo MuonDet Objects Geometry

InDet	Name	Value
Calo	<input checked="" type="checkbox"/> Pt	> 1.0 GeV
Calo	<input checked="" type="checkbox"/> d0	< 2.5 mm
Calo	<input checked="" type="checkbox"/> z0	< 20.0 cm
Calo	<input type="checkbox"/> d0 Loose	< 2.0 cm
Calo	<input type="checkbox"/> z0-zVtx	< 2.5 mm
Calo	<input type="checkbox"/> Layer	> 0
Calo	<input type="checkbox"/> Number Pixel Hits	>= 3

Higgs → fotone - fotone

Applicando un taglio $p_T > 5$ GeV non vedo più le tracce nel tracciatore

I fotoni sono fra i "Physics Objects"

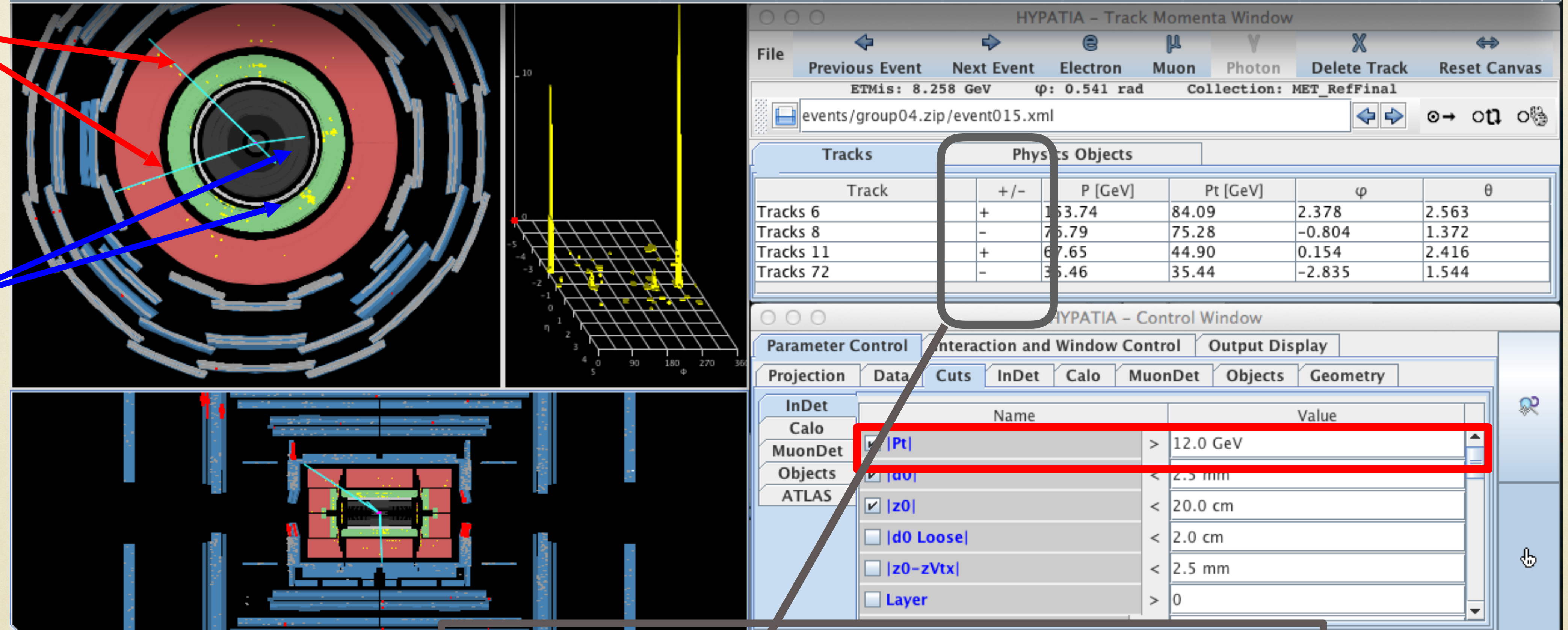


Higgs → 4 particelle cariche

(es: $H \rightarrow e^+e^-\mu^+\mu^-$)

Il bosone H è neutro.

File Name	ETMis [GeV]	Track	P [GeV]	+/-	Pt [GeV]	φ	η	M(2) [GeV]	M(4) [GeV]	e/m/g
event015.xml	8.258	Tracks 6	153.7	+	84.1	2.378	-1.212	91.056	291.010	m
		Tracks 72	35.5	-	35.4	-2.835	0.027			m
		Tracks 8	76.8	-	75.3	-0.804	0.200	89.645		e
		Tracks 11	67.6	+	44.9	0.154	-0.968			e

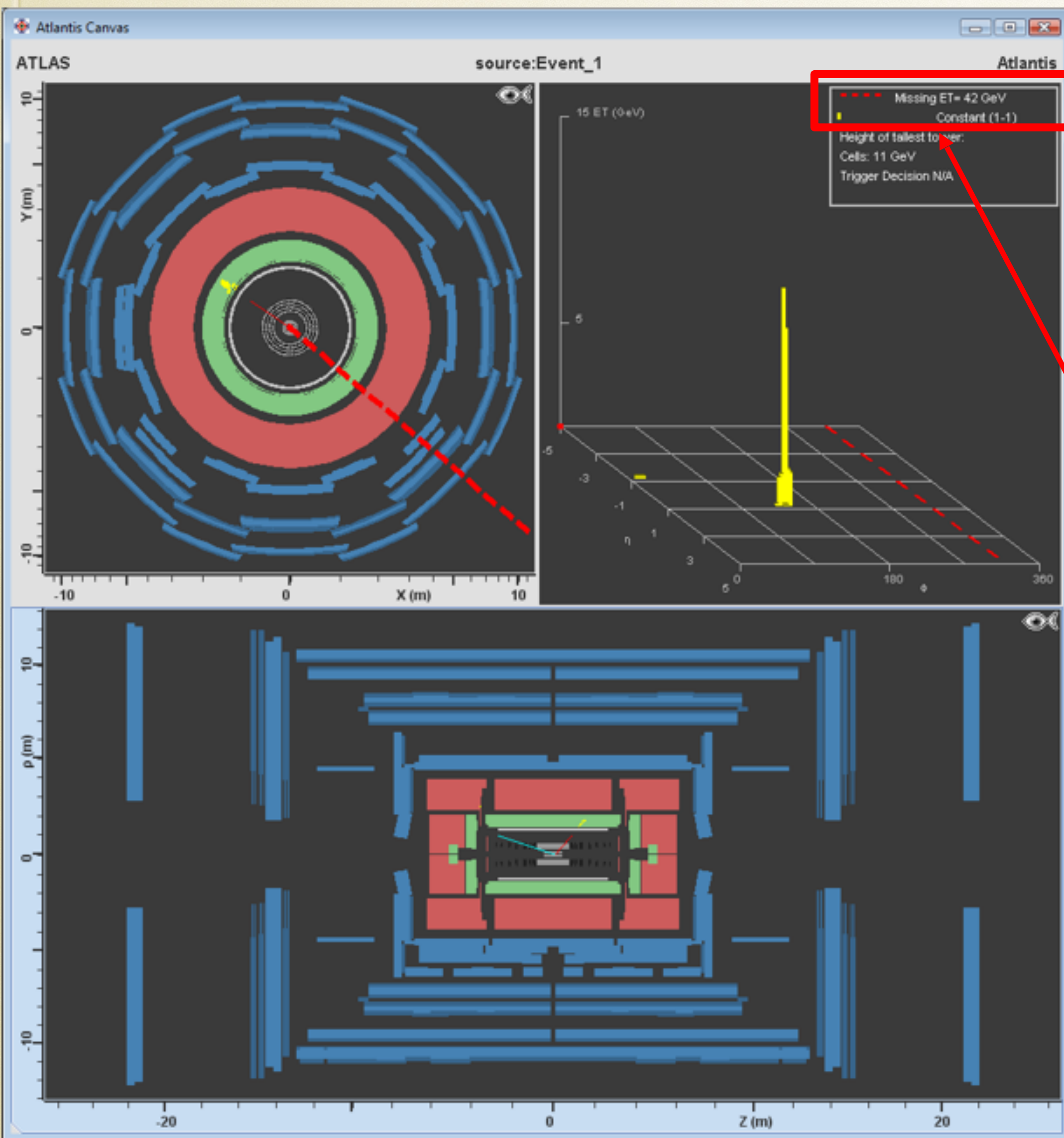


$\mu^+\mu^-$

e^+e^-

due particelle positive e due negative!

Eventi da scartare



Identificazione dei Neutrini

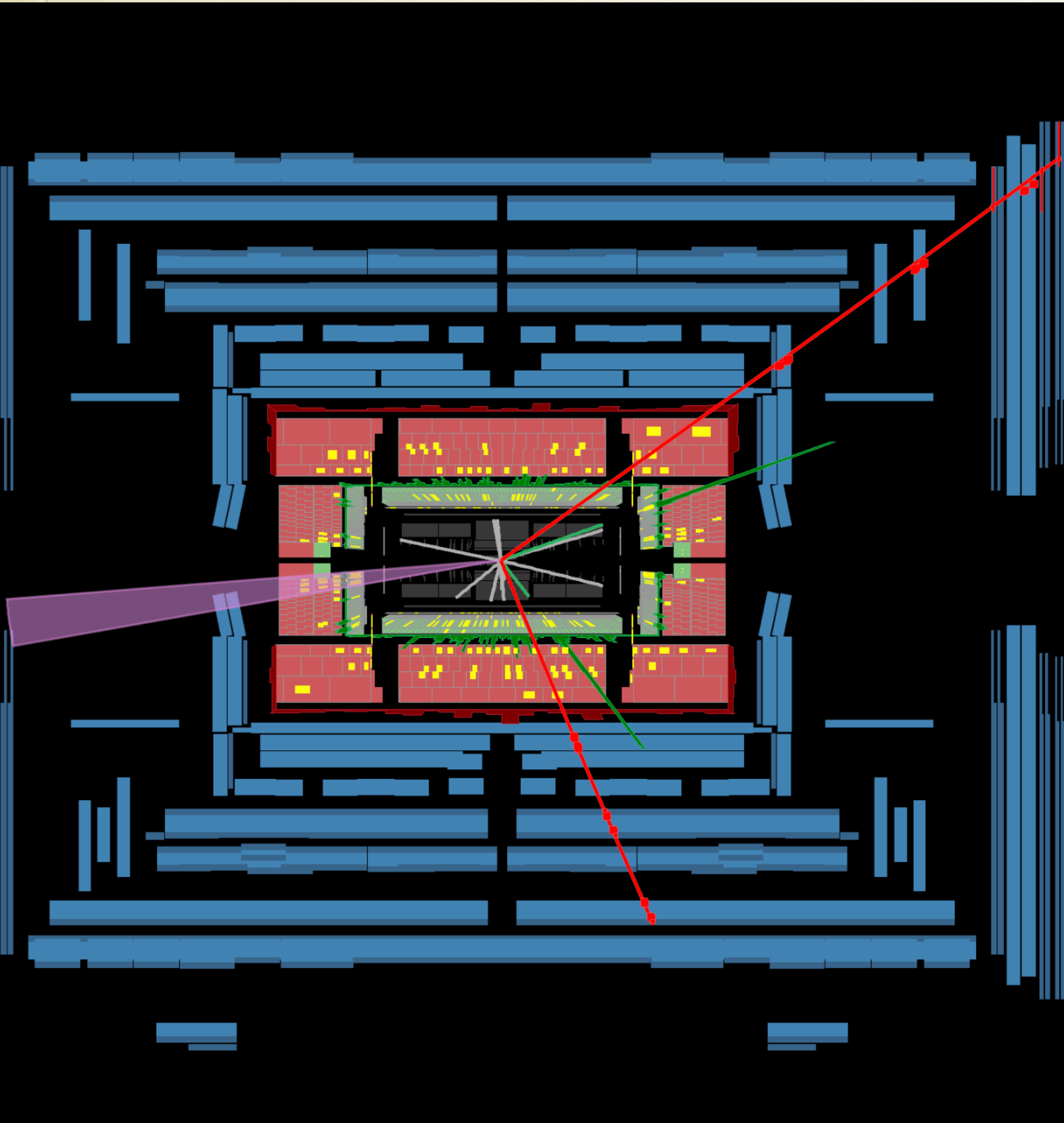
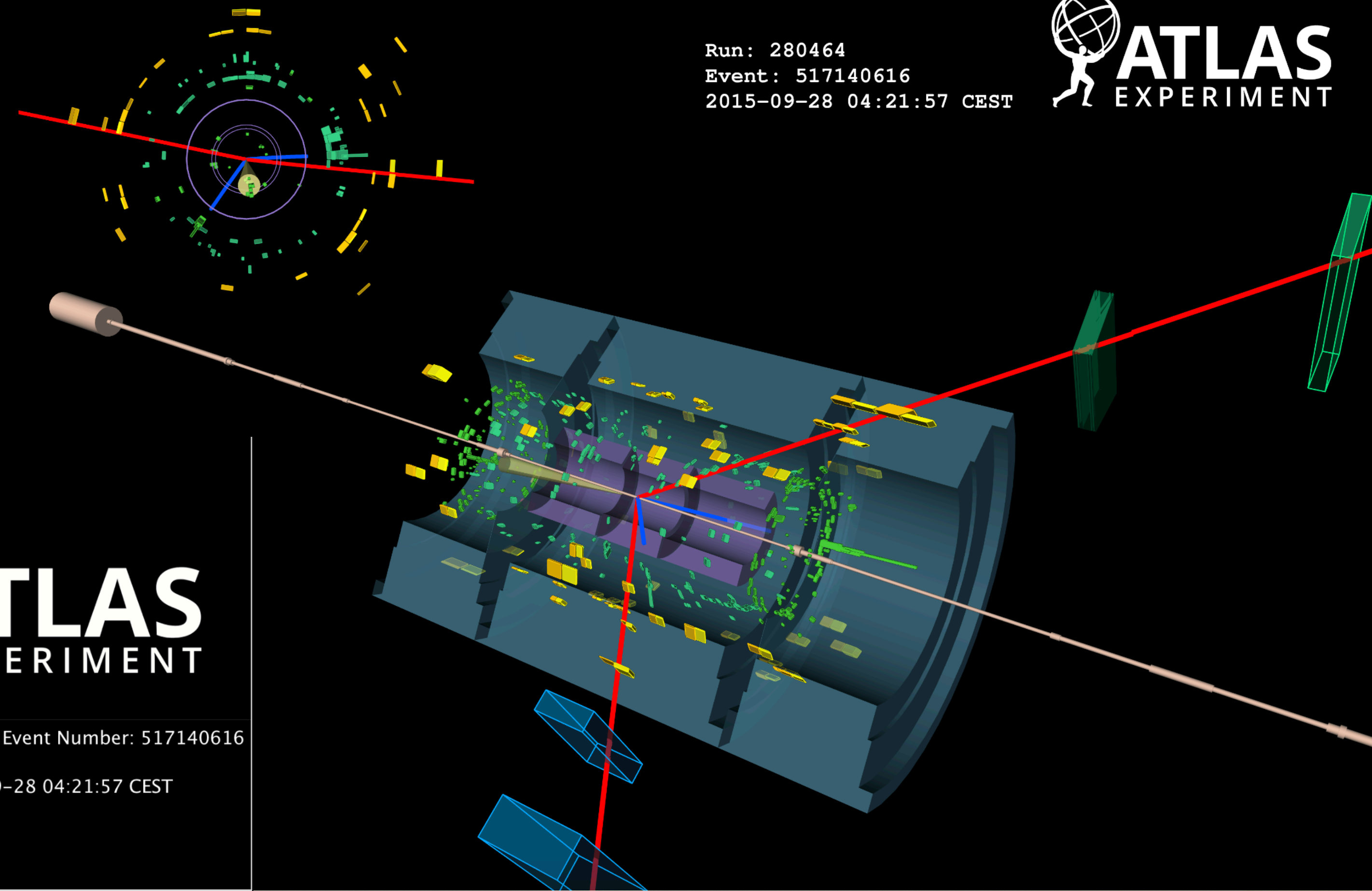
Trovati dal calcolo dell' "impulso mancante"
sul piano trasverso

Valore dell'impulso del neutrino (Missing ET)

Eventi con la presenza di
linea rossa tratteggiata
(Missing ET) vanno scartati!

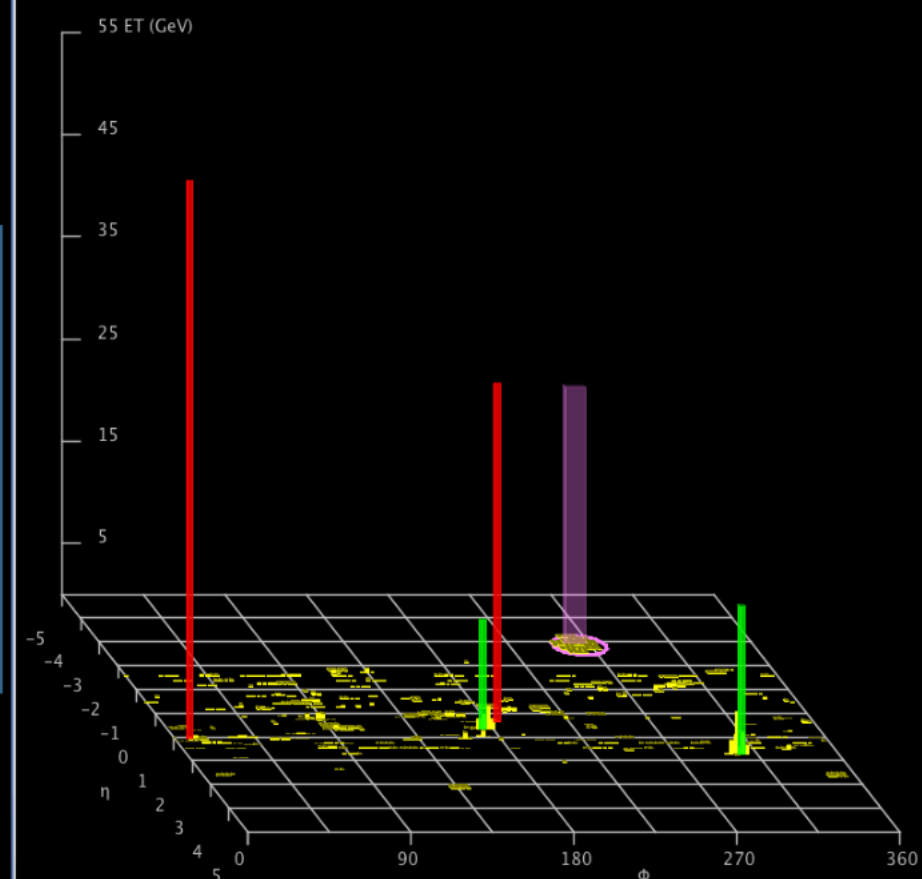
Higgs $\rightarrow \mu\mu ee$

Run: 280464
Event: 517140616
2015-09-28 04:21:57 CEST

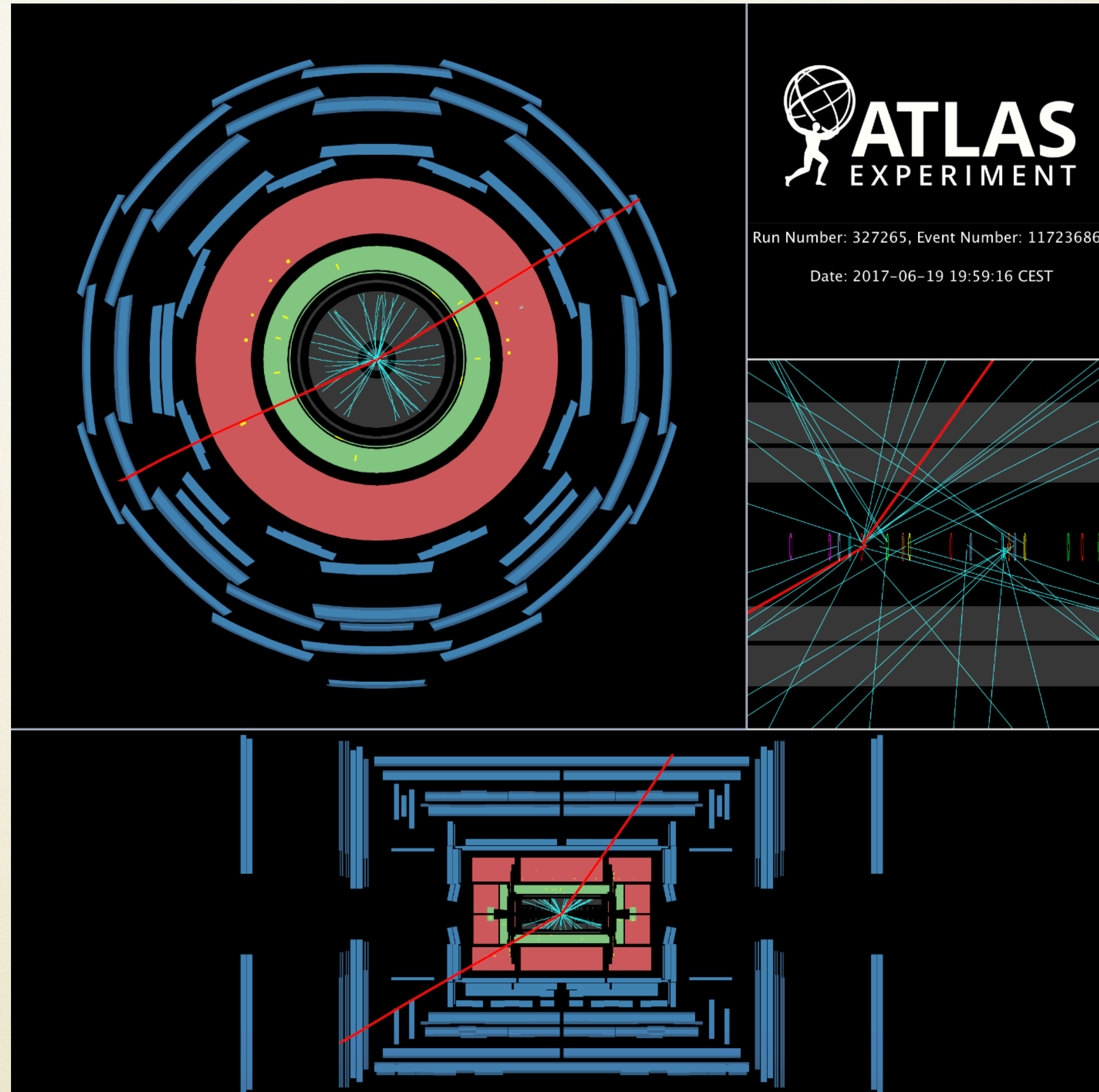


Run Number: 280464, Event Number: 517140616

Date: 2015-09-28 04:21:57 CEST



$Z \rightarrow \mu\mu$



Cominciamo...

Obiettivo: Misurare la massa del bosone Z e di eventuali altre particelle presenti nel campione di dati (compreso il bosone di Higgs).

1. Identificare eventi con Z (da salvare) nei decadimenti:
 - A. Elettrone (e^-) -positrone (e^+)
 - B. Muone (μ^-)-antimuone (μ^+)
2. Identificare eventi con Higgs (da salvare) nei decadimenti:
 - A. Due coppie di particelle cariche ($e^+e^- e^+e^-$, $e^+e^- \mu^+\mu^-$, $\mu^+\mu^- \mu^+\mu^-$)
 - B. fotone - fotone

Apriamo Hypathia e carichiamo i file di eventi

1. Apriamo Hypathia e carichiamo il file scelto per gli eventi

The screenshot shows the Hypathia software interface. The main window displays a detector simulation with tracks. An 'Open' dialog box is open, showing the file 'groupM.zip' selected. The 'HYPATIA - Track Momenta Window' is also open, displaying a table of track parameters. The 'HYPATIA - Control Window' is visible at the bottom right, showing various control options.

Track	+/-	P [GeV]	Pt [GeV]	φ	θ
Tracks 0	-	11.68	4.28	-1.319	0.375
Tracks 1	+	126.06	39.41	-2.413	0.318
Tracks 2	+	4.57	4.56	-2.783	1.649
Tracks 3	-	167.90	53.01	0.906	0.321
Tracks 4	-	1.34	1.33	-2.949	1.475
Tracks 5	-	1.75	1.74	-3.090	1.645
Tracks 6	+	18.61	3.94	-1.818	0.214

Come Selezioniamo le tracce?

File Name	ETMis [GeV]	Track	P [GeV]	+/-	Pt [GeV]	ϕ	η	M(2) [GeV]	M(eeee) [GeV]	M(eemm) [GeV]	M(mmmm) [GeV]	e/m/g
event003.xml	26.783	Tracks 3	58.2	-	37.7	0.707	-1.001					m

Track	+/-	P [GeV]	Pt [GeV]	ϕ	θ
Tracks 3	-	58.21	37.68	0.707	2.438
Tracks 4	+	79.66	57.03	-1.794	2.344
Tracks 13	+	14.52	11.66	-2.513	2.209
Tracks 118	-	28.78	15.80	2.114	2.561
Tracks 180	-	9.84	9.27	-0.295	1.912

2. Analizzo gli eventi

1. Mi sembra un muon

2. Click sulla traccia quindi su "Muon"

3. La traccia mi appare sopra

4. Vedo un altro muone, lo aggiungo click su "muon" e mi appare la **massa invariante** dei due.

File Name	ETMis [GeV]	Track	P [GeV]	+/-	Pt [GeV]	ϕ	η	M(2) [GeV]	M(eeee) [GeV]	M(eemm) [GeV]	M(mmmm) [GeV]	e/m/g
event003.xml	26.783	Tracks 3	58.2	-	37.7	0.707	-1.001	88.235				m
		Tracks 4	79.7	+	57.0	-1.794	-0.864					m

Esportare i dati

1

HYbrid Pupils' Analysis Tool for Interactions in ATLAS - version 7.4 - Invariant Mass Window

ETMis [GeV]	Track	P [GeV]	+/-	Pt [GeV]	ϕ	η	M(2) [GeV]	M(e)	M(eemm) [GeV]	M(mmmm) [GeV]	e/m/g
21.013	Object 0	58.2		42.5	2.252	0.837	145.215				g
	Object 1	98.9		35.2	-0.143	-1.692					g

HYPATIA - Track Momenta Window

Track	P [GeV]	Pt [GeV]	ϕ	θ
Object 0	58.25	42.49	2.252	0.817
Object 1	98.92	35.22	-0.143	2.778

Parameter Control

Name	Value
[d0 Loose]	< 2.0 cm
[z0-zVtx]	< 2.5 mm
Layer	> 0
Number Pixel Hits	>= 2
Number SCT Hits	>= 7
Number TRT Hits	>= 15

2

HYbrid Pupils' Analysis Tool for Interactions in ATLAS

File View Histograms Preferences Help

- Read Event Locally
- Read Event From URL (live)
- Clear Hypatia Project
- Load Hypatia Project
- Save Hypatia Project
- Export Invariant Masses**
- Loop over events
- Save Image of Canvas
- Animated Event
- Event Properties
- Read Geometry
- Read G4Steps
- Exit

3

HYbrid Pupils' Analysis Tool for Interactions in ATLAS

File View Histograms Preferences Help

File Name	ETMis [GeV]	Track	P [GeV]	+/-	Ge
event050.xml	21.013	Object 0	58.2		
		Object 1	98.9		

Save

Save In: MasterClass2021

- configuration
- events
- geometry
- help
- img
- lib

File Name: Invariant_Masses.txt

Files of Type: Text files

Save Cancel

1. Al passo 3 avete ora salvato il file Invariant_Mass.txt
2. Inseriamo questo file su OPLOT dalla pagina web per fare un grafico e confrontarci con gli altri gruppi
3. <https://cernmasterclass.uio.no/OPLOT/index.php>

Carichiamo i risultati

Selezionate "Student" dal menu-item

* username: ippog

* password: imc

2. Selezionate la data e l'istituto (PISA) dal menu

3. Selezionate il groupX del file di dati usato dal menu

4. Caricate quindi il vostro file "Invariant_Masses.txt".

OPIoT - MasterClass - Student page

Start Student Moderator Tutor Administrator

Student Tasks

Please select items from the drop-down boxes to submit your results!

2012 January 01 Test-Oslo Group

Choose year, month, day, institution and group from dropdown menus

OPIoT - MasterClass - Group 2M

Start Student Moderator Tutor Administrator

Change institute
Change date
Change group

Upload a file

Filename: Browse...

Submit

		Electrons			
Region		R1	R2	R3	R4
Events		0	0	0	0
Mean		0.00	0.00	0.00	0.00
Width		0.00	0.00	0.00	0.00

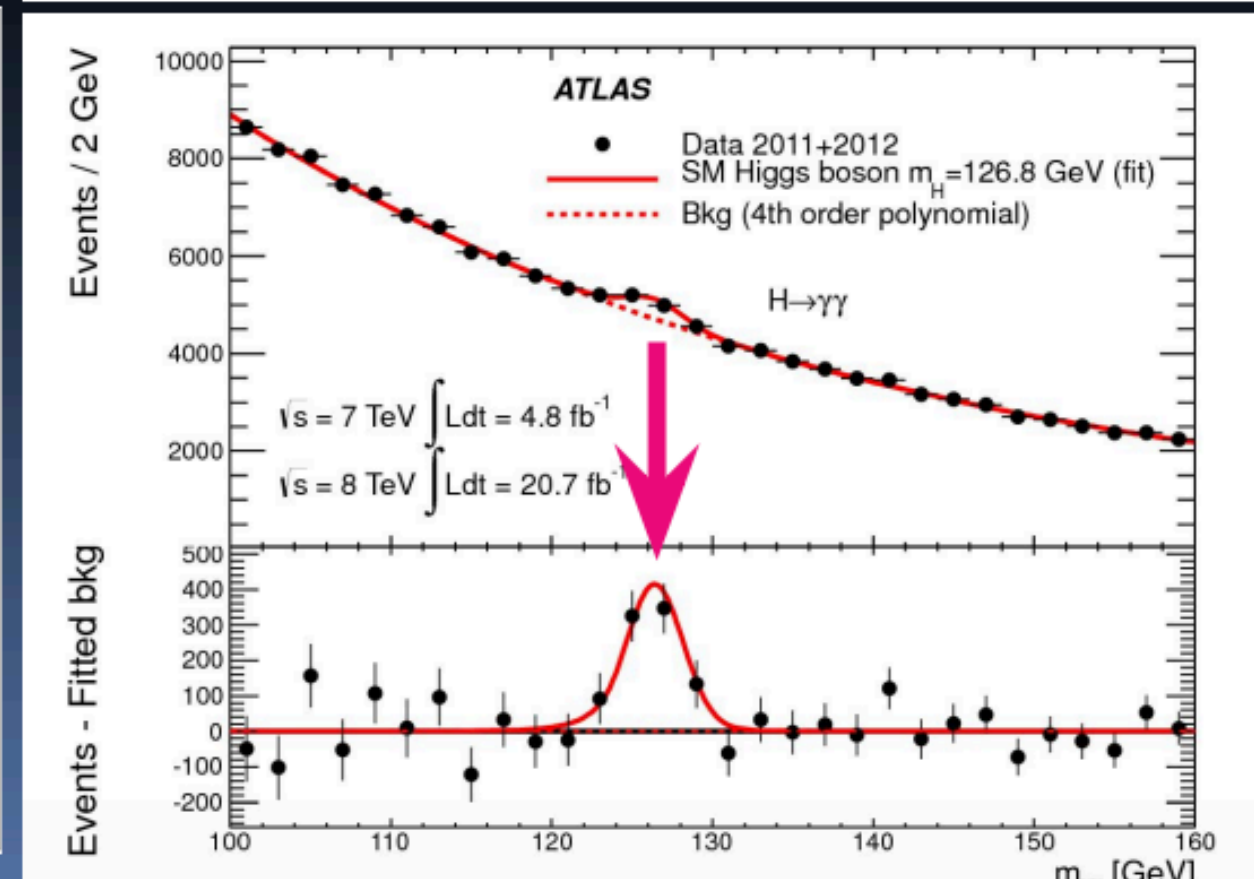
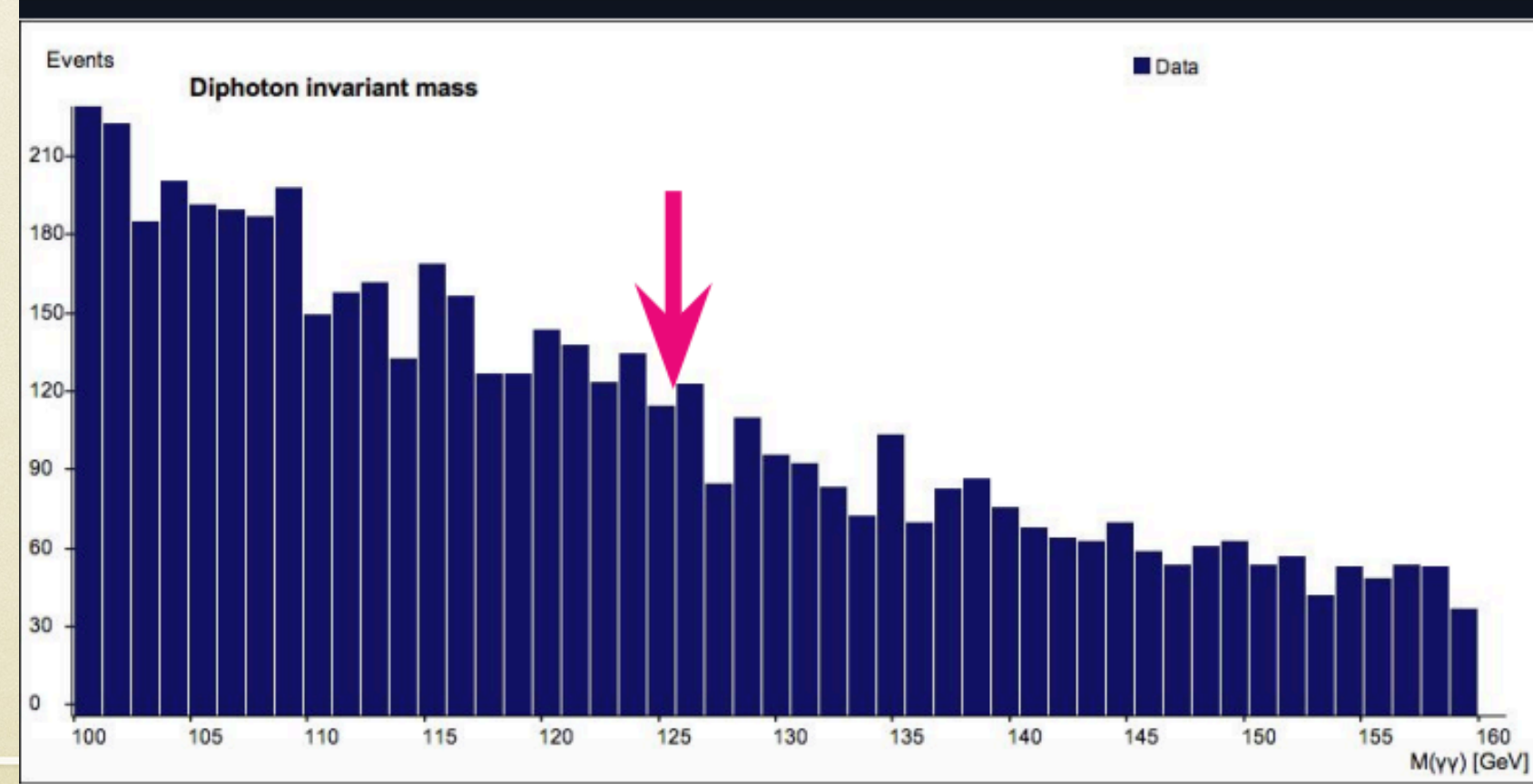
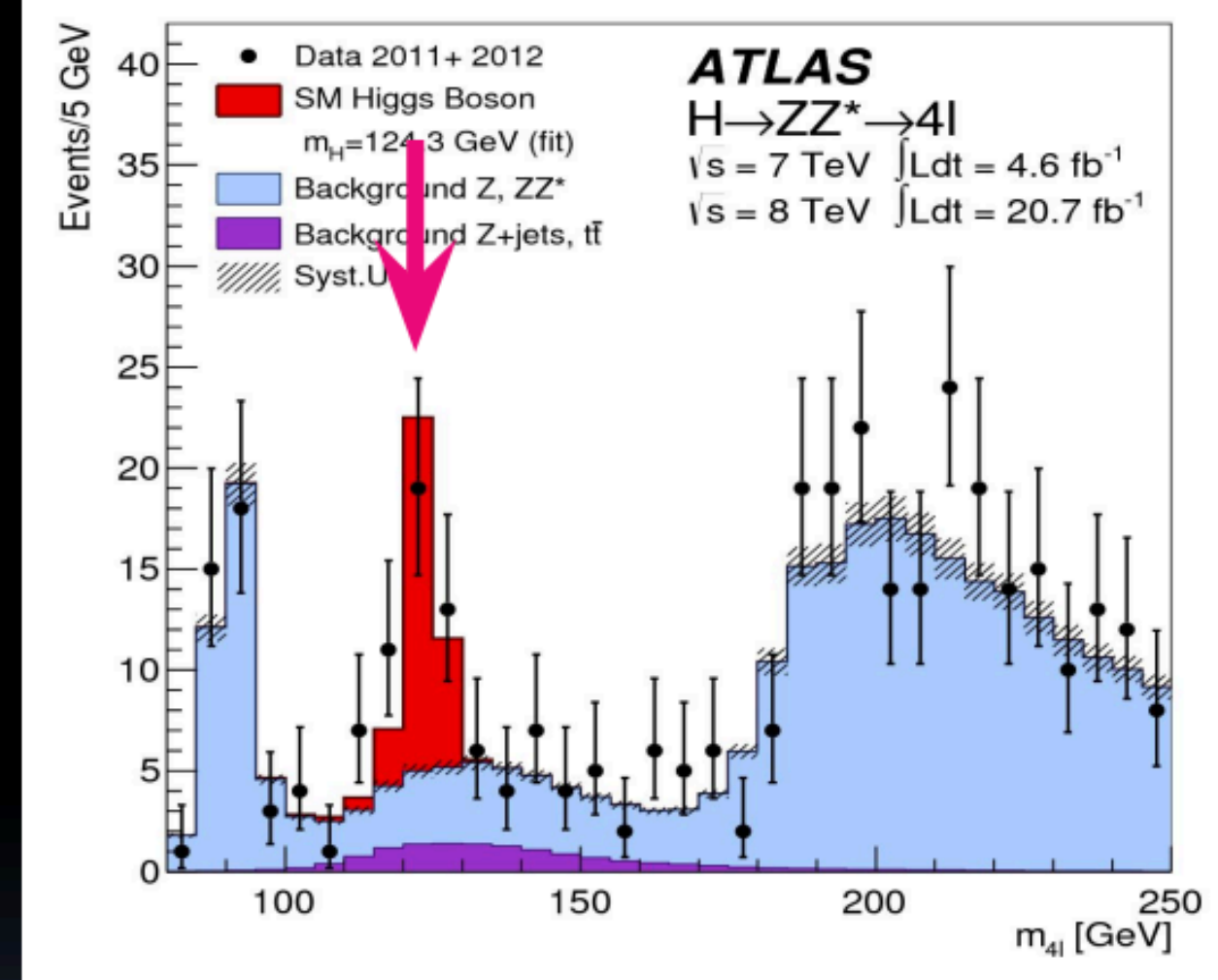
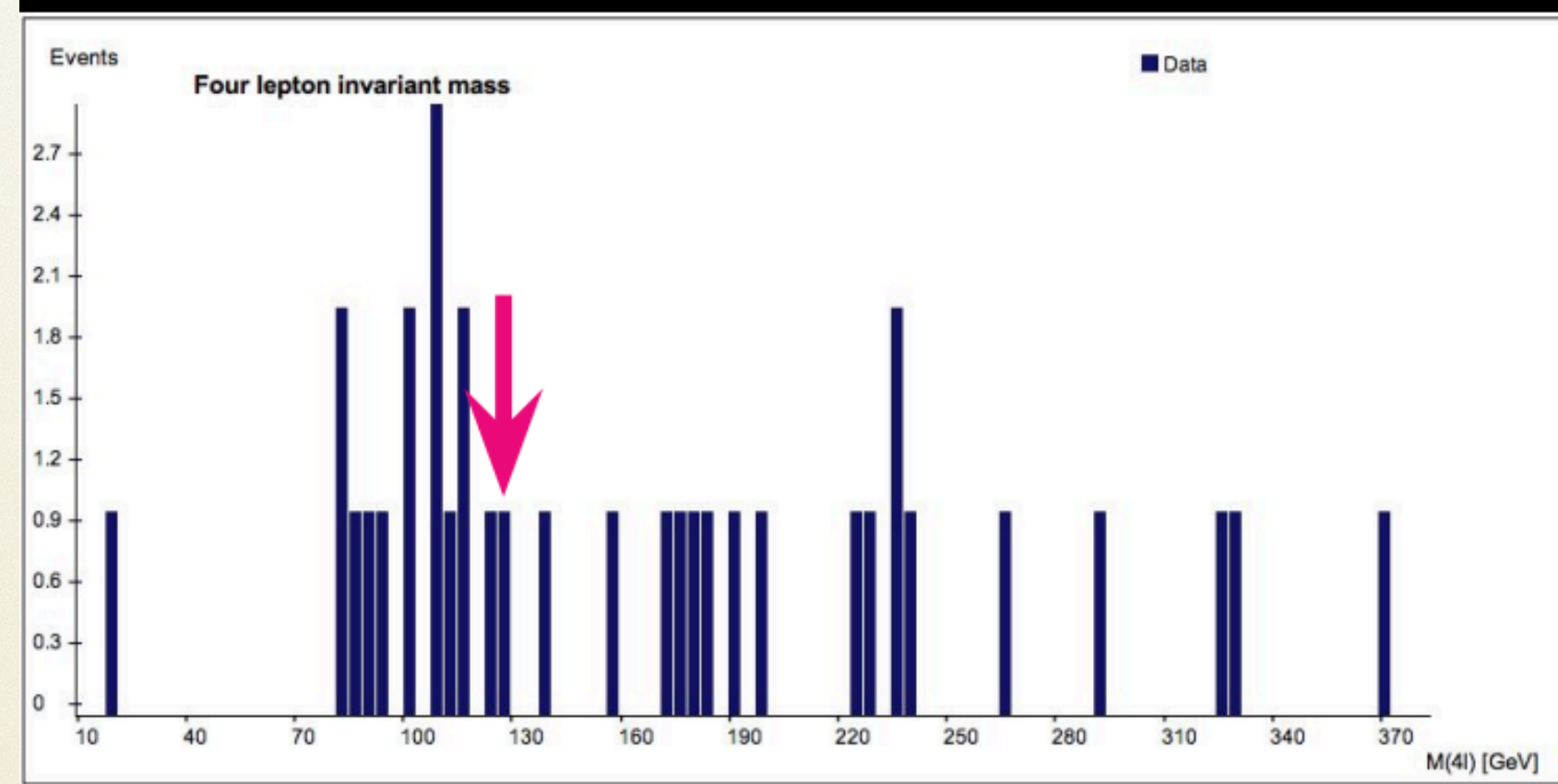
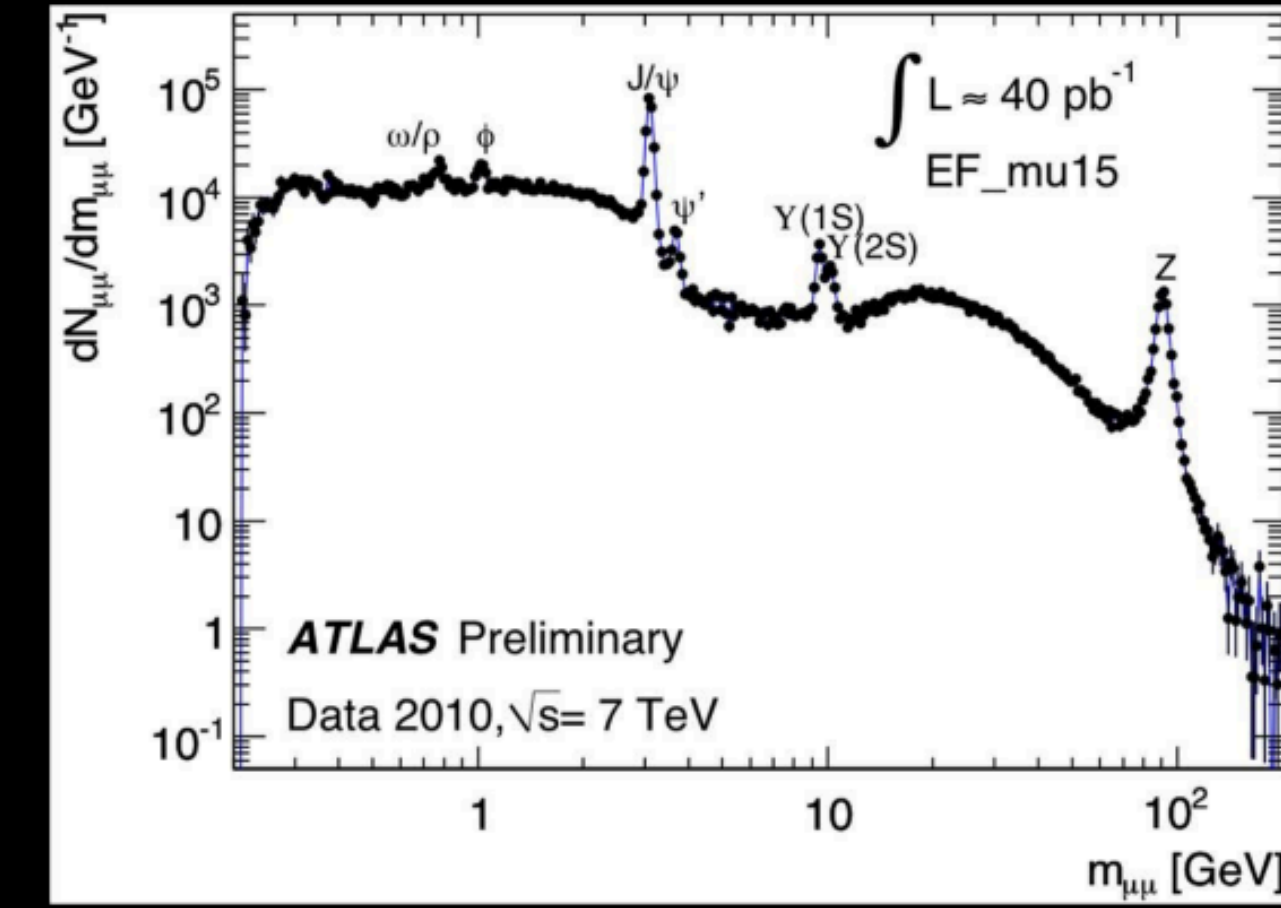
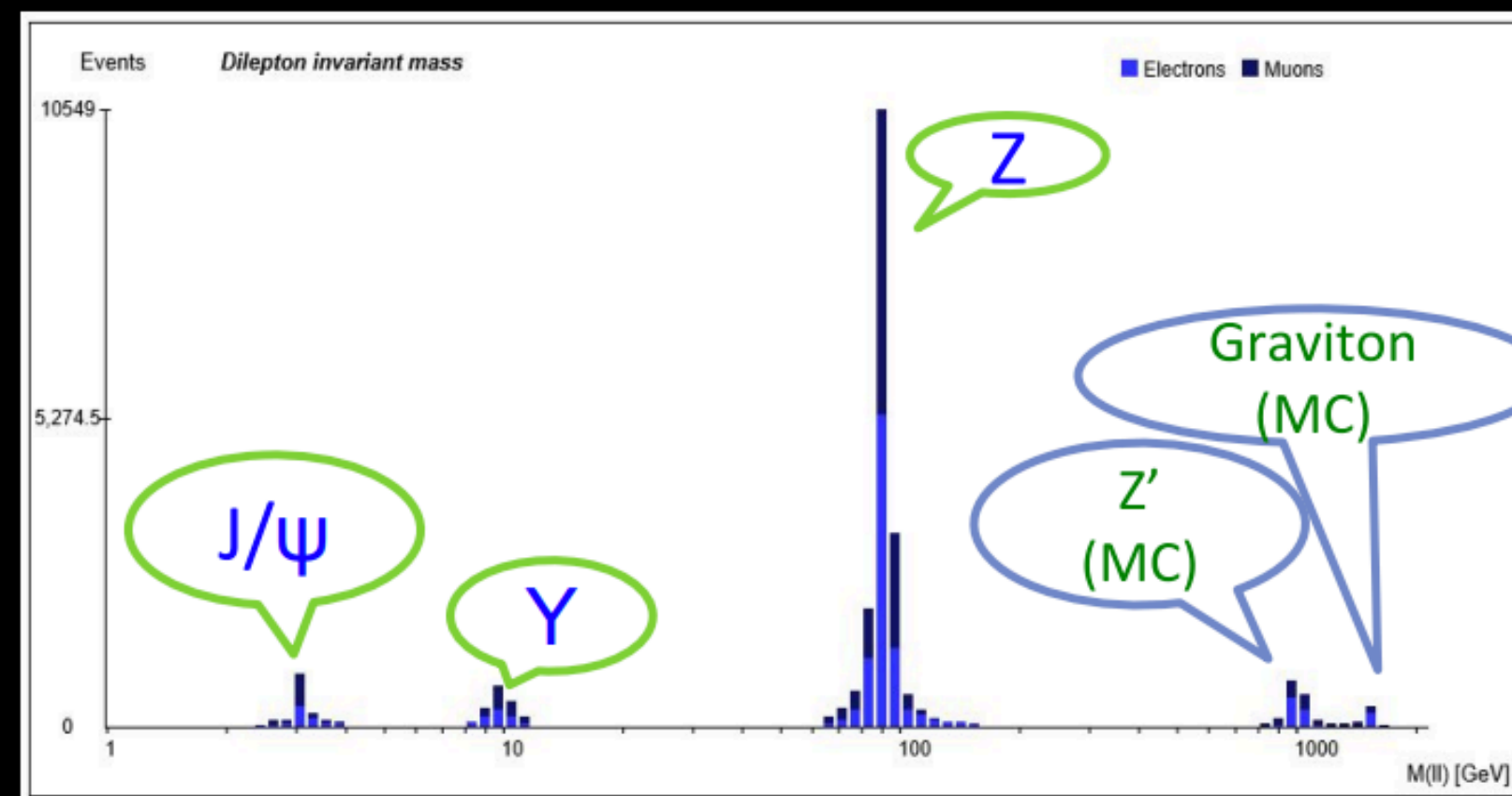
		Muons			
Region		R1	R2	R3	R4
Events		0	0	0	0
Mean		0.00	0.00	0.00	0.00
Width		0.00	0.00	0.00	0.00

Bins: 50 X-Axis: Linear Lower: 0 Upper: 2000

R1 Min: 2.0 R2 Min: 7.0 R3 Min: 80.0 R4 Min: 900.0
R1 Max: 4.0 R2 Max: 13.0 R3 Max: 100.0 R4 Max: 1100.0

Reset

Commentiamo i Risultati



XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Masterclass 01 is inviting you to a scheduled Zoom meeting.

Topic: ATLAS International Masterclass

Time: Feb 28, 2025 15:30 Zurich

Join Zoom Meeting

<https://cern.zoom.us/j/67339850490?pwd=WusneBsMfBvKWyEQmmn77nucm8QISK.1>

Meeting ID: 673 3985 0490

Passcode: 430371

BACK UP