

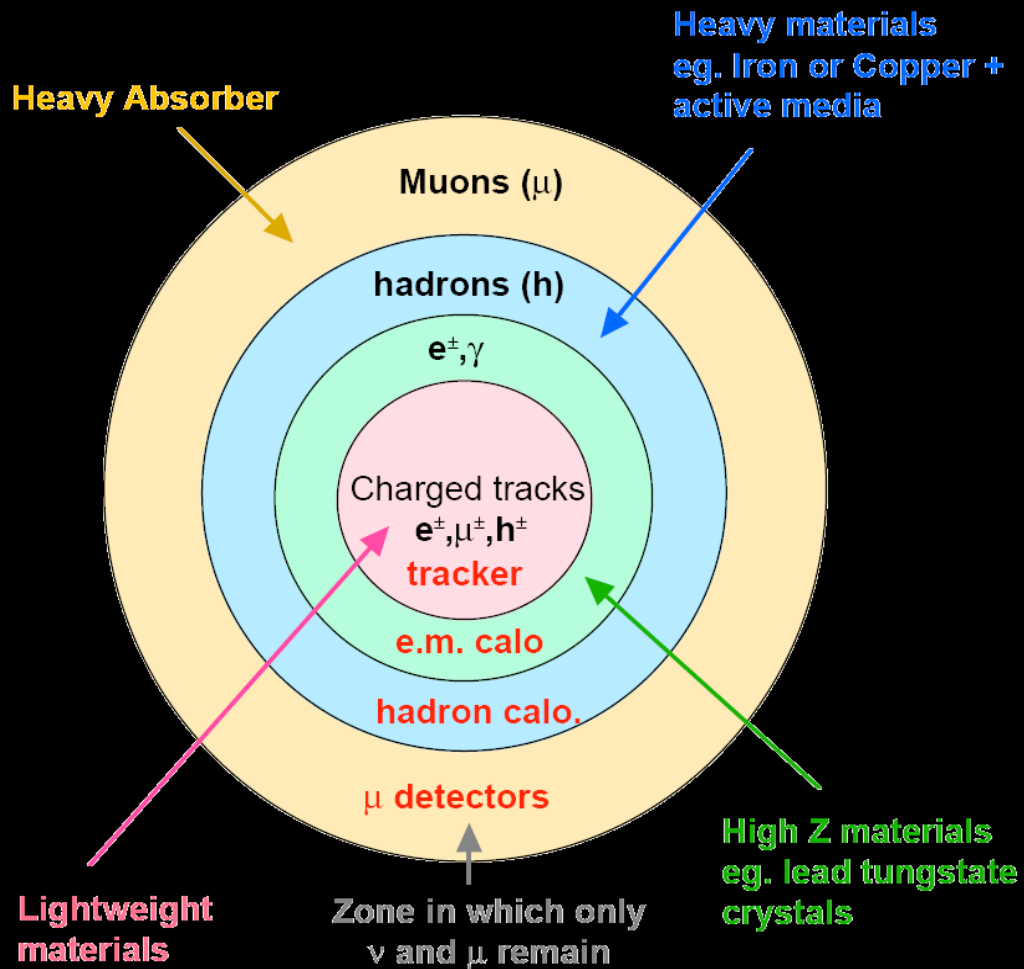
DETEKCIJA ELEMENTARNIH ČESTICA I ANALIZA DOGAĐAJA

Itana Bujanja

Prirodno-matematički fakultet, Podgorica

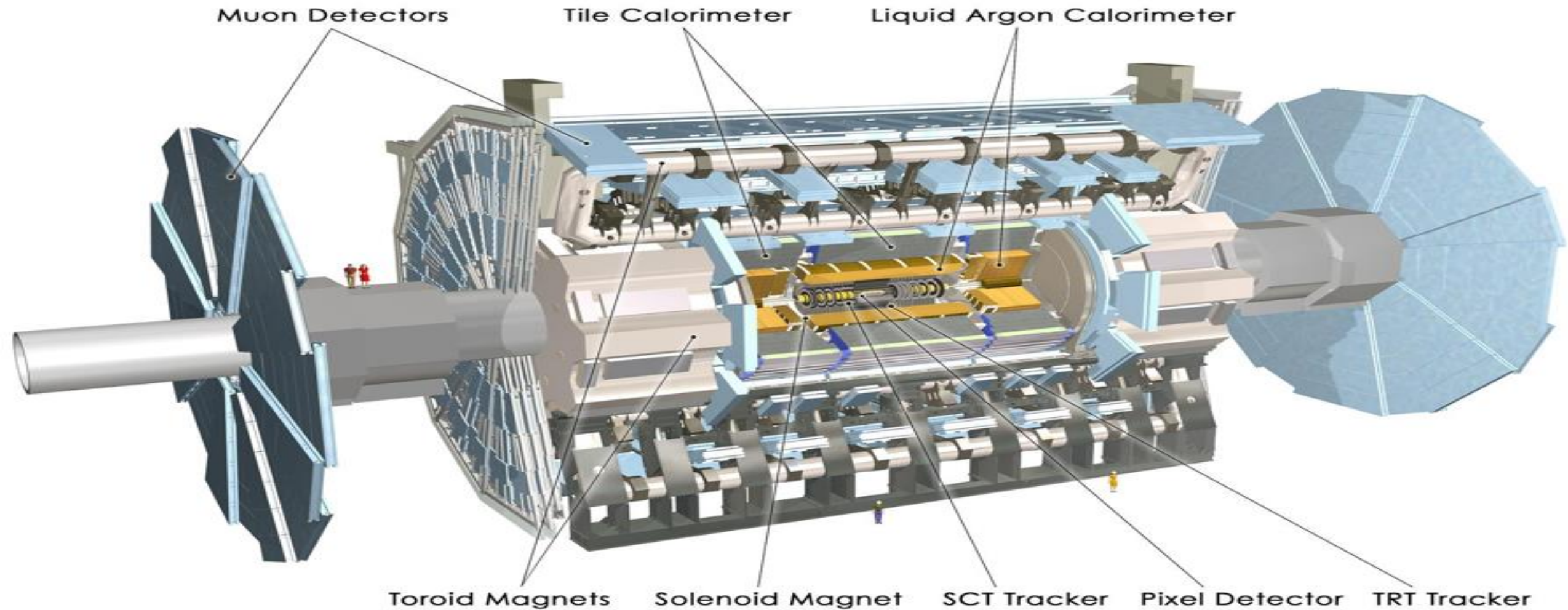
2018.

STRUKTURA DETEKTORA



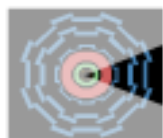
- Detekcija se bazira na analizi interakcije čestica sa materijom
- Ne postoji sloj/detektor koji bi mogao da izmjeri energiju/impuls svih čestica nastalih u sudaru

ATLAS DETEKTOR



ATLAS

animation



display instantly



Electron



Proton



Neutrino



Photon



Positron



Anti-proton



Jets



Muon

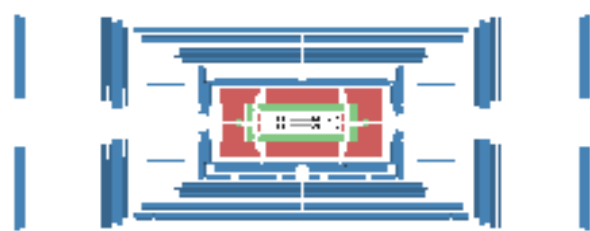
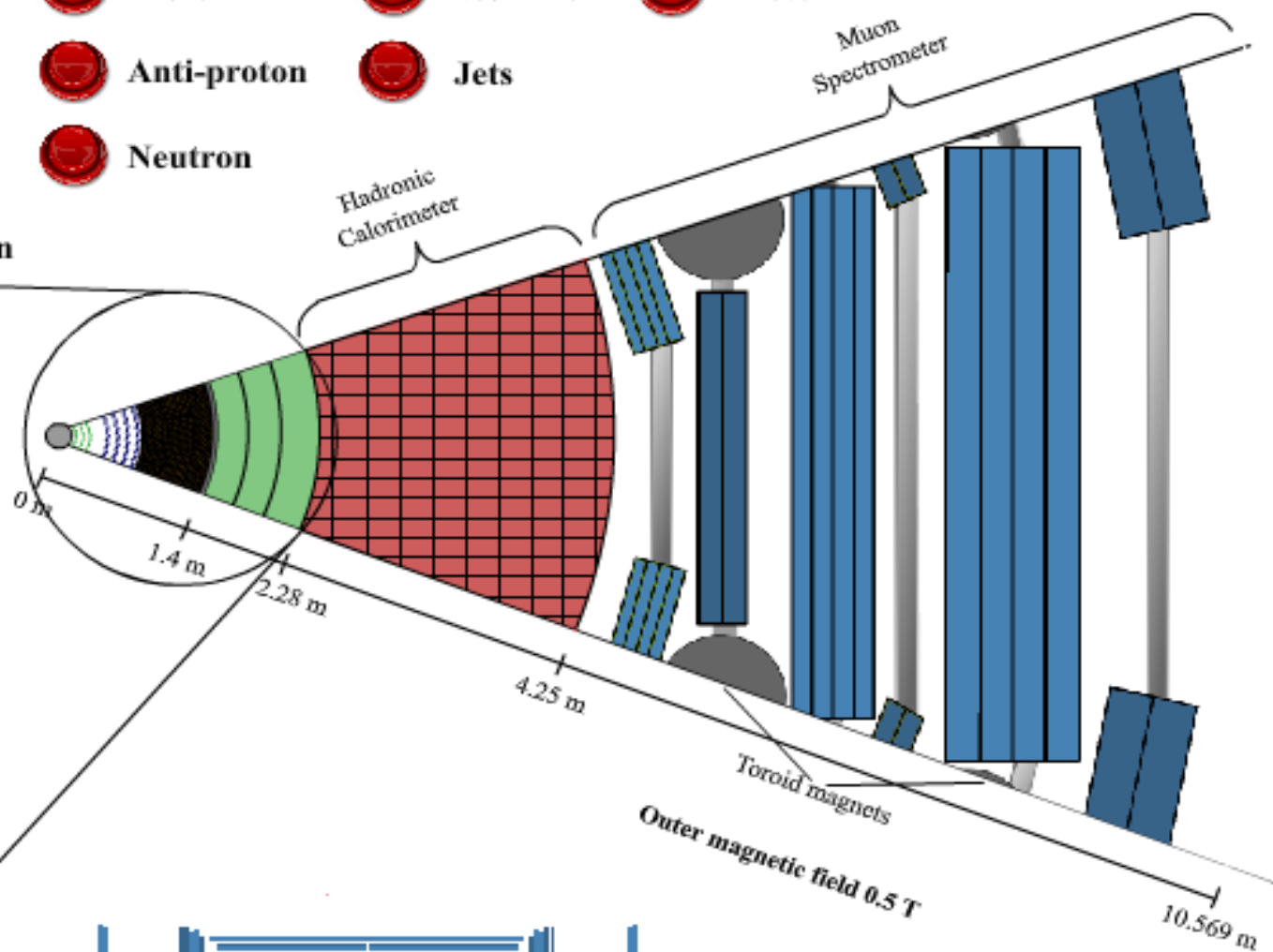
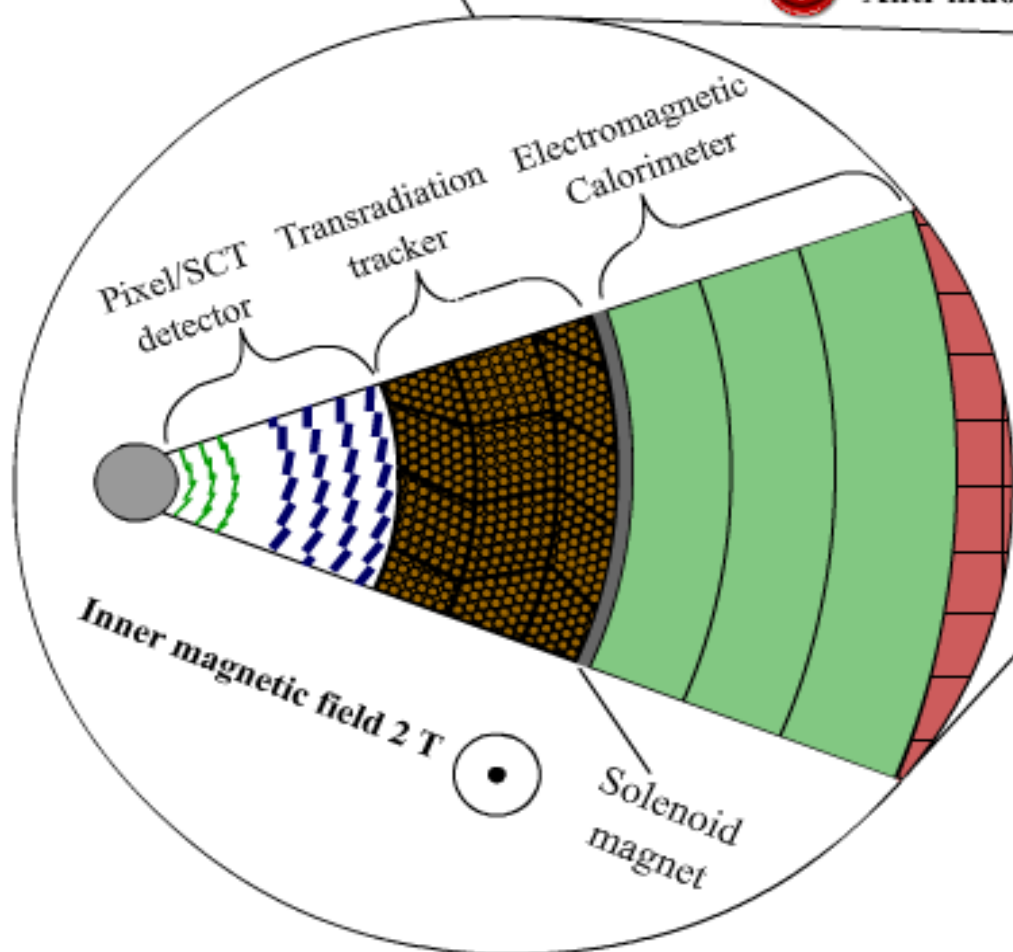


Neutron



Anti-muon

Magnification 3x



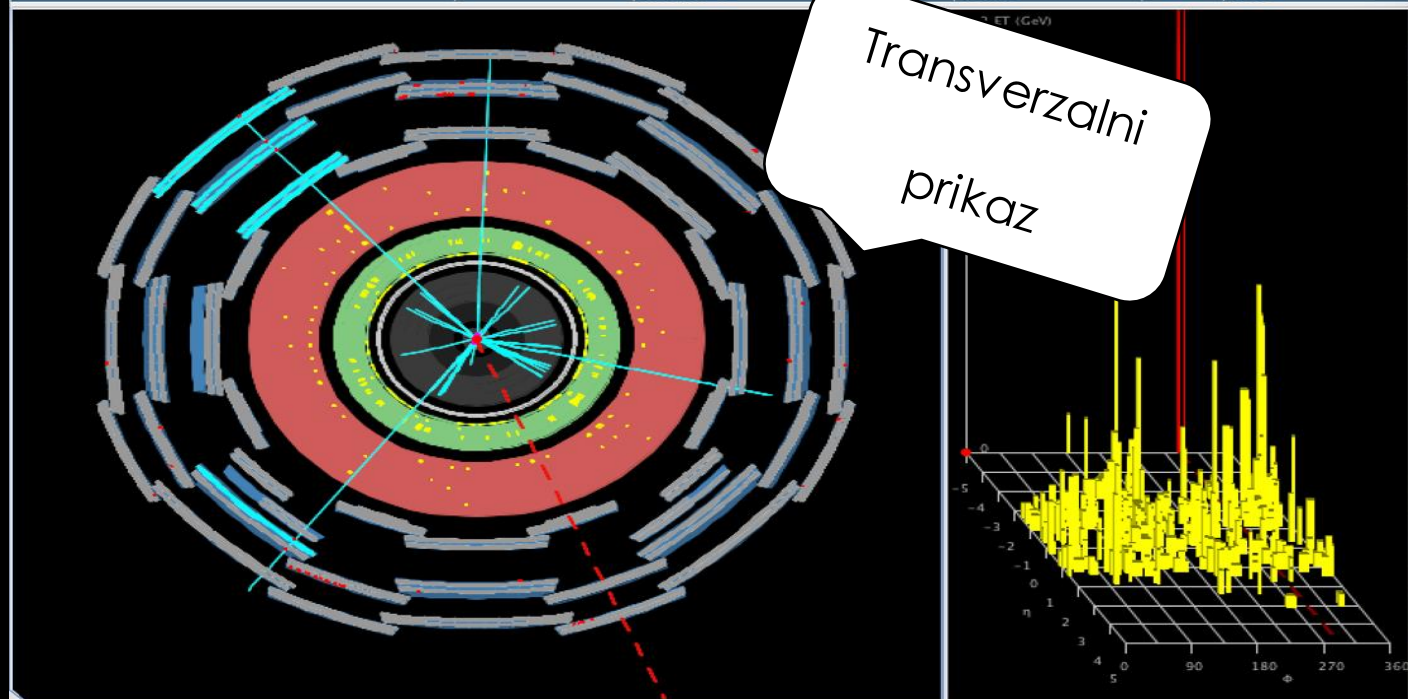
MC 2018 – ANALIZA DOGAĐAJA

- **Podaci:** proton-proton sudari (energija 8 TeV)
- **Alat:** Edukativni program za vizualizaciju događaja HYPATIA
- **Zadatak 1:** Rekonstrukcija događaja i potraga za:
 - Raspadima neutralnih čestica na par elektrona ili miona
 - Raspadima Higgs bozona na par fotona ili par Z bozona
- **Zadatak 2:** Snimanje masenog spektra za događaje sa parom leptona, ili parom fotona, ili parom Z bozona. Upoređivanje rezultata sa vrednostima izmerenim na eksperimentima ATLAS i CMS.
- **Zadatak 3:** Upoređivanje i kombinovanje rezultata sa rezultatima studenata ostalih instituta koji učestvuju u ovom programu

HYPATIA

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

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
JiveXML_106051_1950731.xml	13.877	Tracks 1	126.1	+	39.4	-2.413	1.830	91.054				e
		Tracks 3	167.9	-	53.0	0.906	1.820					e

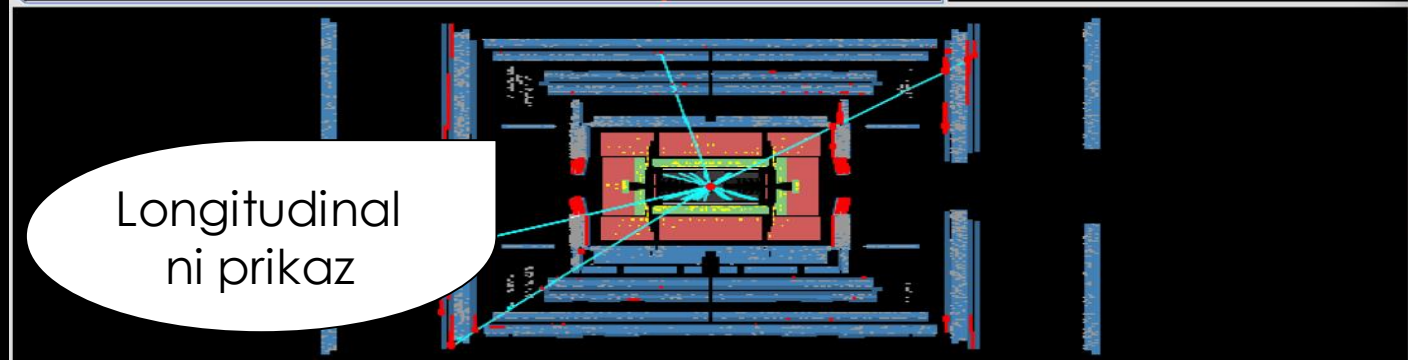


HYPATIA - Track Momenta Window

ETMis: 37.975 GeV ϕ : -1.183 rad Collection: MET_RefFinal

Track	+/-	P [GeV]	Pt [GeV]	ϕ	θ
Tracks 2	-	108.74	57.99	1.525	0.562
Tracks 4	+	98.79	61.23	-2.171	2.473
Tracks 10	-	136.93	39.24	-0.248	2.851
Tracks 21	+	43.41	41.65	2.277	1.856
Tracks 410	-	14.96	7.48	-0.701	2.618
Tracks 579	-	179.71	116.20	-1.751	2.438
Tracks 626	+	103.61	70.80	-0.444	0.752
Tracks 627	+	172.28	163.14	-0.125	1.898
Tracks 629	+	44.54	42.15	0.908	1.900
Tracks 631	-	81.25	55.61	1.015	0.754
Tracks 632	+	97.55	33.18	-2.863	0.347
Tracks 664	+	10.52	7.64	-2.010	0.813
Tracks 667	-	7.87	5.66	-2.214	2.339
Tracks 669	+	22.48	8.68	-0.465	0.396
Tracks 673	+	9.86	6.47	0.339	0.715
Tracks 675	-	9.28	7.38	-2.051	2.223

Prozor za biranje događaja i selekciju objekata



HYPATIA - Control Window

Parameter Control Interaction and Window Control Output Display

Name	Value
<input checked="" type="checkbox"/> Pt	> 5.0 GeV
<input type="checkbox"/> Pt2	< 700
<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

Prozor za kontrolu prikaza detektora i objekata

HYPATIA - KONTROLA PRIKAZA

The screenshot shows the 'HYPATIA - Control Window' with three tabs: 'Parameter Control', 'Interaction and Window Control', and 'Output Display'. The 'Interaction and Window Control' tab is active, displaying a toolbar with icons for Zoom, Pick, and other functions. Callouts identify the Zoom and Pick icons, and a larger callout points to the entire toolbar area.

Zoom

Pick

Interakcija sa prikazom detektora i objekta

W	S	X	L	M	R	1	2	3	U	3
	B			B		4	5	6	C	6
						7	8	9	D	9

The screenshot shows the 'HYPATIA - Control Window' with the 'Parameter Control' tab active. It displays a list of parameters for the 'InDet' detector, including energy, dimensions, and hit counts. A callout points to the parameter list.

Kontrola parametara

Name	Value
<input checked="" type="checkbox"/> Pt	> 1.5 GeV
<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 type="checkbox"/> Number Pixel Hits	> = 2
<input type="checkbox"/> Number SCT Hits	> = 7

HYPATIA - Track Momenta Window

File Previous Event Next Event Electron Muon Photon Delete Track Reset Canvas

ETMis: 33.441 GeV φ : 0.18 rad Collection: MET_RefFinal

/Users/predragm/Downloads/groupA/ent021... ← → 🔍 🔄 🌐

Tracks Physics Objects

Track	Charge	P [GeV]	Pt [GeV]	φ	θ
Tracks 0	-			3.017	0.219
Tracks 7	-			3.088	0.736
Tracks 8	+			0.972	2.967
Tracks 9	+			2.753	1.442
Tracks 10	+	6.28	1.34	-0.133	2.927
Tracks 11	-	5.93	1.04	-0.829	2.966
Tracks 12	+	4.59	1.35	1.769	0.298
Tracks 13	+	6.48	2.11	0.257	0.332
Tracks 15	+	6.50	1.16	2.404	0.179
Tracks 17	+	6.19	2.52	0.122	2.722
Tracks 18	-	4.68	1.07	2.430	2.912
Tracks 19	+	3.53	1.26	1.626	2.777
Tracks 20	+	6.55	1.43	-1.504	0.219
Tracks 22	-	7.52	1.54	2.978	0.206
Tracks 24	+	2.28	2.28	-2.111	1.657
Tracks 26	+	12.72	2.55	-1.088	2.940
Tracks 27	-	6.60	1.50	1.665	2.912
Tracks 29	+	2.35	2.16	-2.994	1.163
Tracks 30	+	3.95	1.09	-0.813	2.863
Tracks 32	+	28.89	16.72	-3.081	0.617
Tracks 34	-	3.73	1.86	1.054	2.620
Tracks 35	+	4.01	1.30	2.397	2.813

Selekcija
rekonstruisanih
elektrona i miona

HYPATIA - Track Momenta Window

File Previous Event Next Event Electron Photon Delete Track Reset Canvas

ETMis: 33.441 GeV φ : 0.518 ... MET_RefFinal

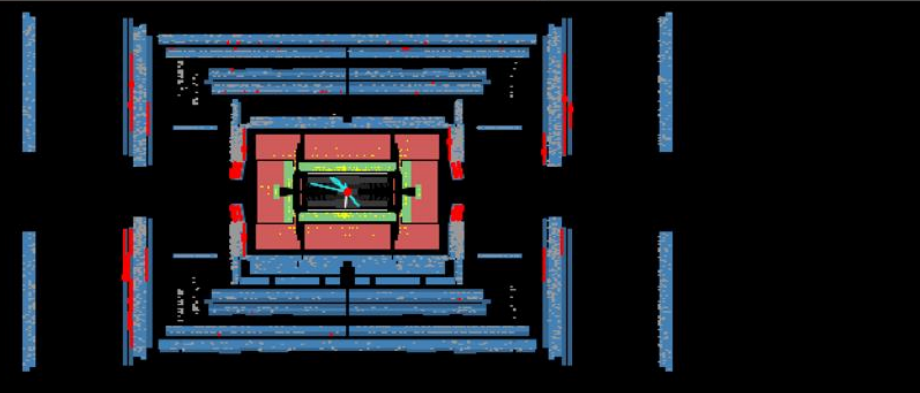
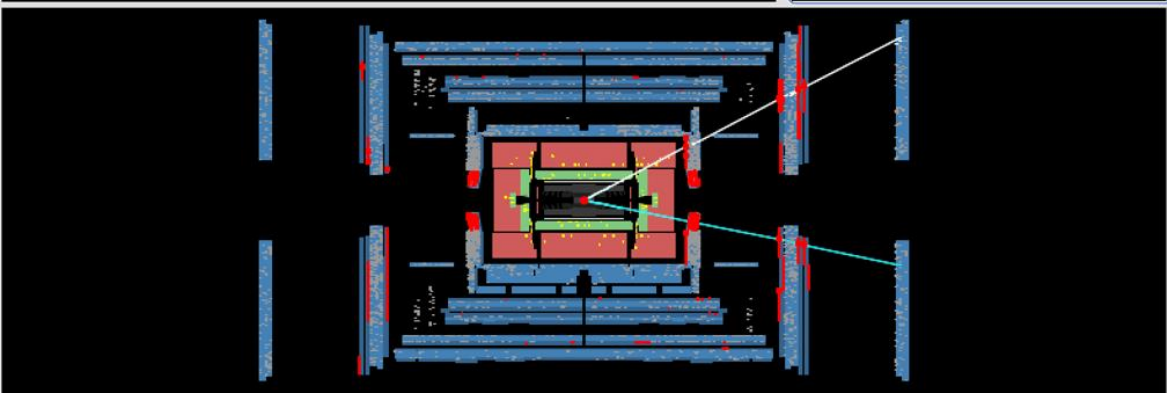
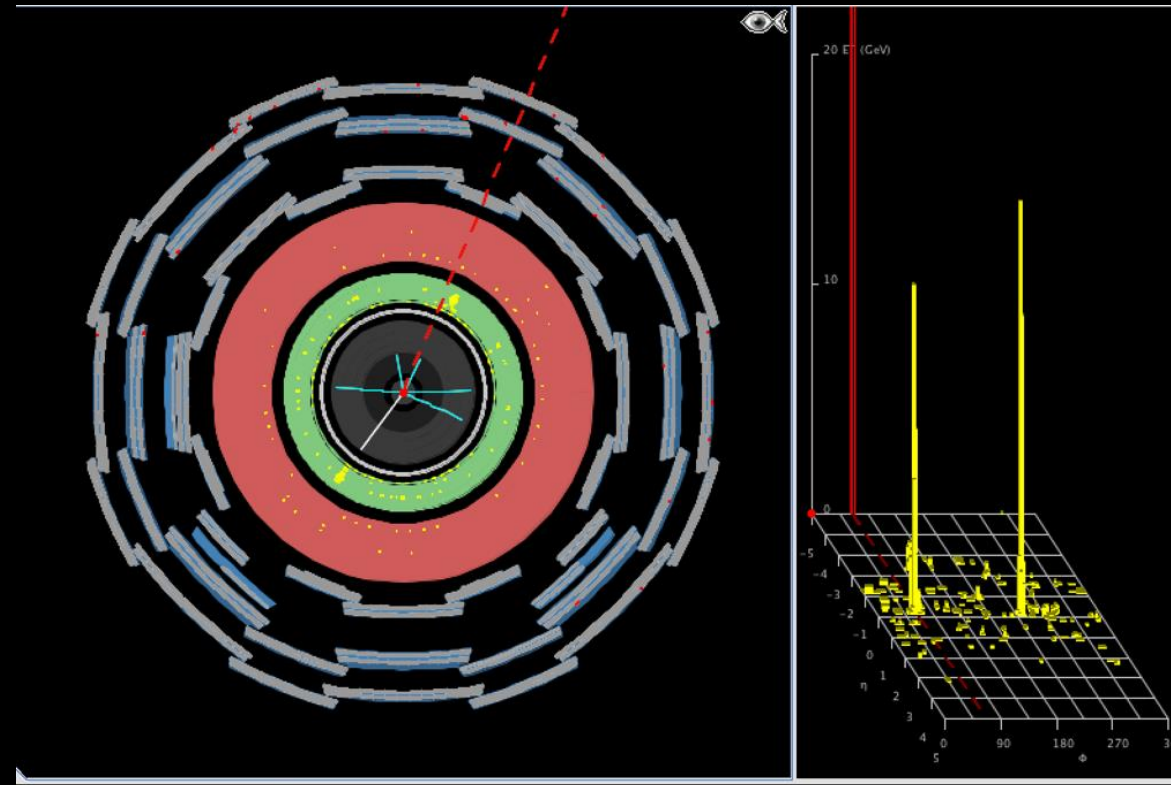
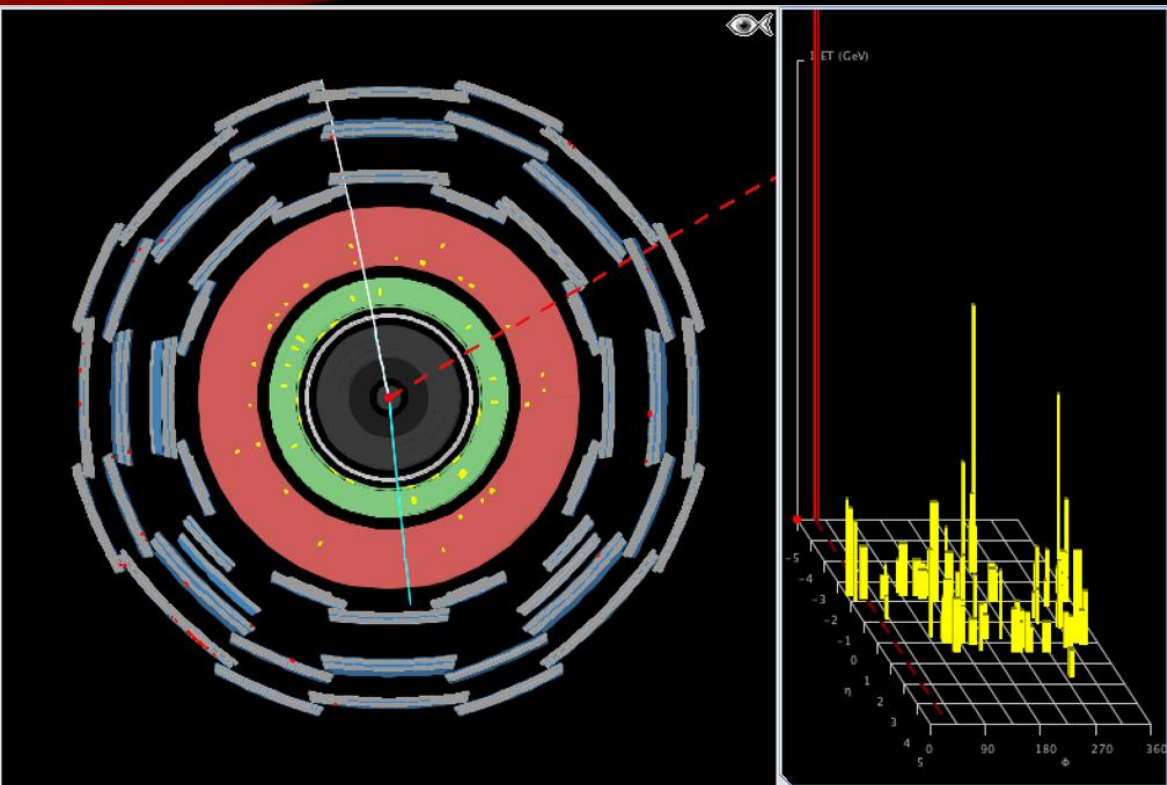
/Users/predragm/Downloads/groupA/ev... ← → ⌂ → ○ □ ○ ○

Selekcija
rekonstrui
sanih
fotona

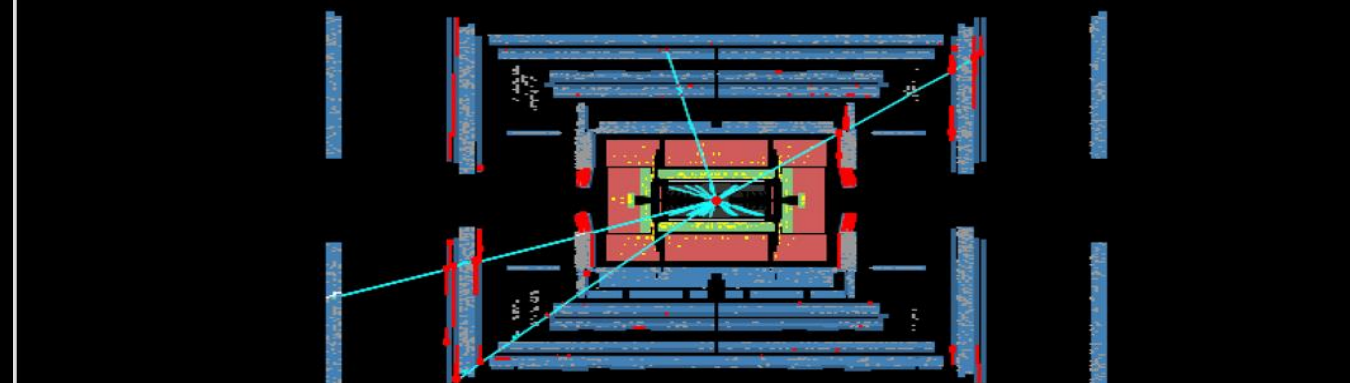
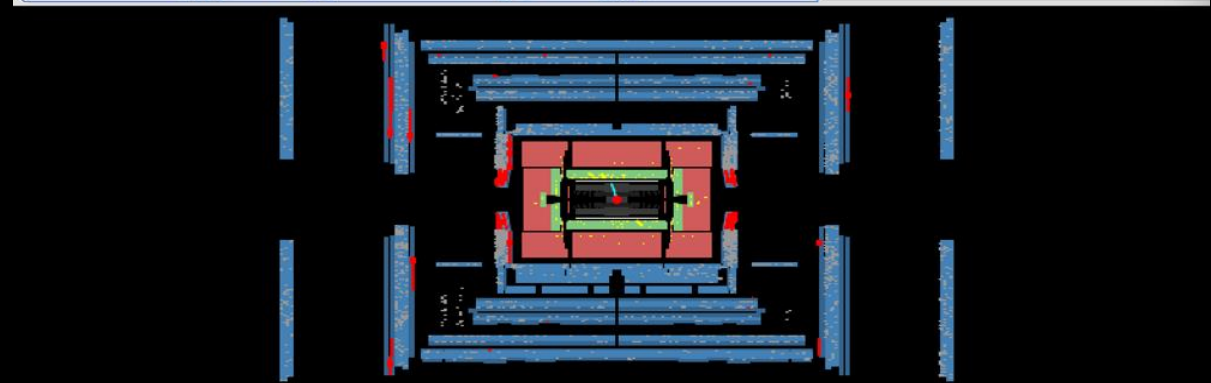
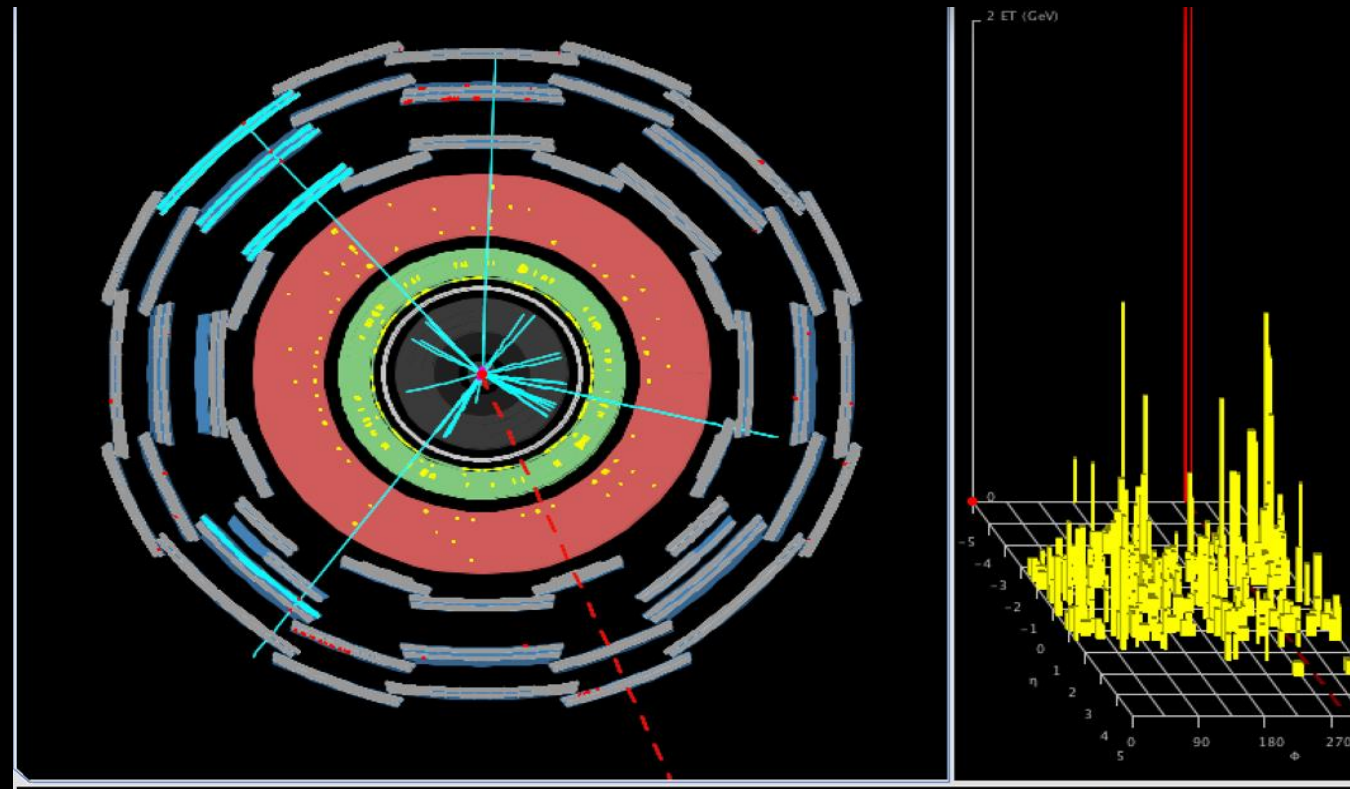
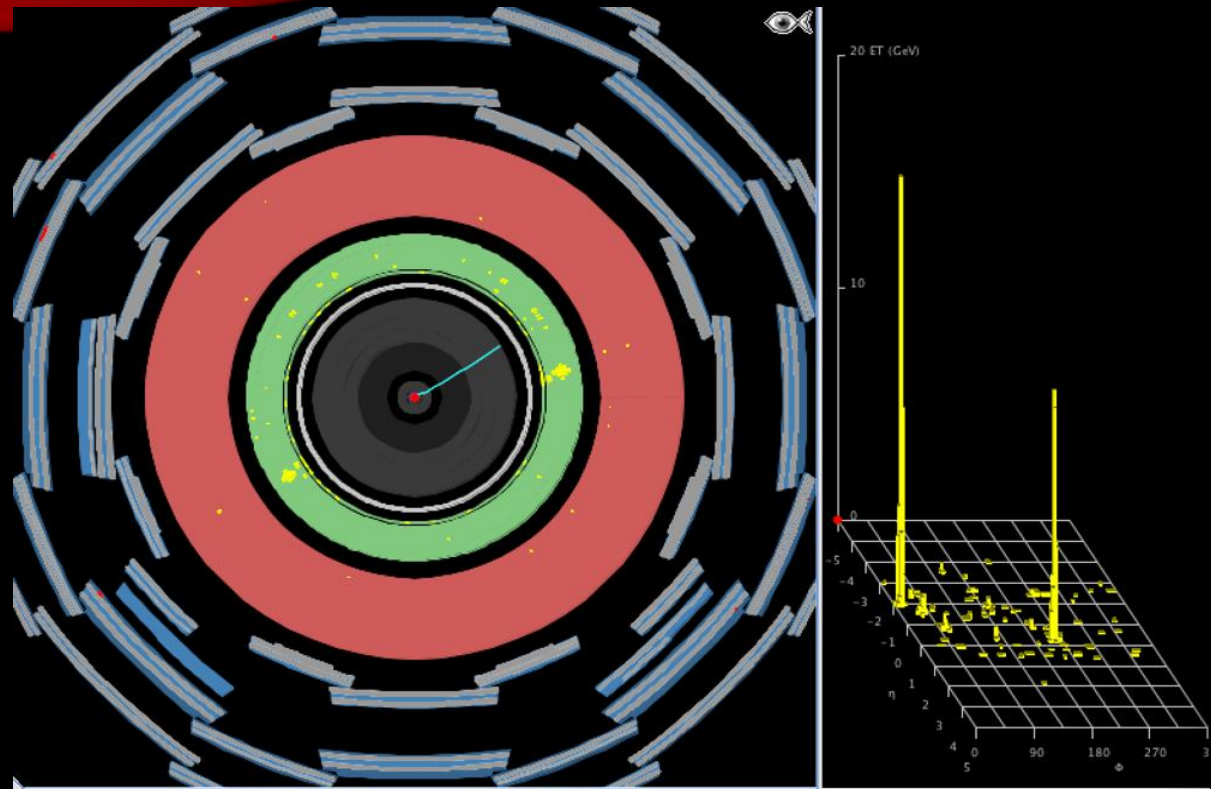
Tracks Physics Objects

Track	P [GeV]	... [GeV]	φ	θ
Object 0	191.71	50.84	0.372	0.268
Object 1	32.13	31.64	-1.763	1.745

DETEKCIJA Z BOZONA



DETEKCIJA HIGSOVOG BOZONA



ČUVANJE REZULTATA INVARIJANTNE MASE

Hybrid pupils' analysis tool for interactions in ATLAS – version 7.2.1 – Invariant Mass Window

File View Histograms Preferences Help

	ETMis [GeV]	Track	P [GeV]	+/-	Pt [GeV]	ϕ	η	M(2l) [GeV]	M(4l) [GeV]	e/ μ
Read Event Locally	9.980	Tracks 2	6.9	+	2.5	1.917	1.662	13.167		e
Read Event From URL (live)		Tracks 5	6.7	-	1.2	3.127	-2.391			e
Clear Hypatia Project	8.901	Tracks 4	5.8	+	1.0	-2.037	2.401	6.195		μ
Load Hypatia Project		Tracks 8	1.9	-	1.1	-2.995	-1.136			μ
Save Hypatia Project	28.772	Tracks 6	3.9	+	3.8	-2.674	0.147	8.274		e
Export Invariant Masses (MII)		Tracks 10	7.5	+	2.4	1.902	-1.796			e

Loop over events
Save Image of Canvas
Animated Event
Event Properties
Read Geometry
Read G4Steps
Exit

Previous Event Next Event Insert Electron Insert Muon Delete Track Reset Canvas
ETMis: 23.276 GeV ϕ : -2.006 rad Collection: MET_RefFinal
/Users/nenadv/Downloads/groupA-1/event006.xml

Reconstructed Tracks

Track	+/-	P [GeV]	Pt [GeV]	ϕ	θ
s 1	+	117.38	42.10	1.169	2.775
s 2	+	12.75	2.50	-0.965	2.944
s 3	+	4.28	1.25	-2.531	2.846
s 4	-	17.94	6.68	1.240	2.760
s 5	+	3.35	1.19	1.057	2.777
s 6	+	3.87	3.83	-2.674	1.425
s 8	-	7.01	6.92	-2.596	1.414
s 9	+	8.62	3.61	-1.861	0.431
s 10	+	7.48	2.42	1.902	2.813
s 11	+	3.03	2.10	-0.237	0.763
s 13	-	1.69	1.23	-1.888	2.327
s 14	-	5.29	2.45	-1.734	0.482
s 15	-	3.90	1.80	-1.566	0.480
s 17	+	3.54	1.30	-1.211	2.766
s 18	-	9.05	2.99	2.147	2.805
s 20	-	6.17	1.06	-1.262	0.173
s 23	-	1.07	1.06	-2.187	1.419
s 24	-	11.34	11.20	-2.706	1.415
s 25	-	5.19	1.33	1.715	2.882
s 29	+	9.95	1.75	0.060	0.176
s 31	+	3.40	1.60	-0.837	0.489
s 34	+	1.34	1.32	2.876	1.416
s 36	+	8.72	3.71	0.804	0.439
s 39	-	24.27	8.30	1.160	2.793
s 41	+	2.17	2.17	-2.828	1.623
s 44	+	1.80	1.77	2.560	1.384
s 46	-	3.64	2.05	0.331	2.543

HYPATIA – Control Window
meter Control Interaction and Window Control Output Display
Event Data

W S X L M R 1 2 3 U 3
E 4 5 6 C 6
7 8 9 D 9

OPIoT – MasterClass – Student page

[Start](#) [Student](#) [Moderator](#) [Tutor](#) [Administrator](#)

Student Tasks

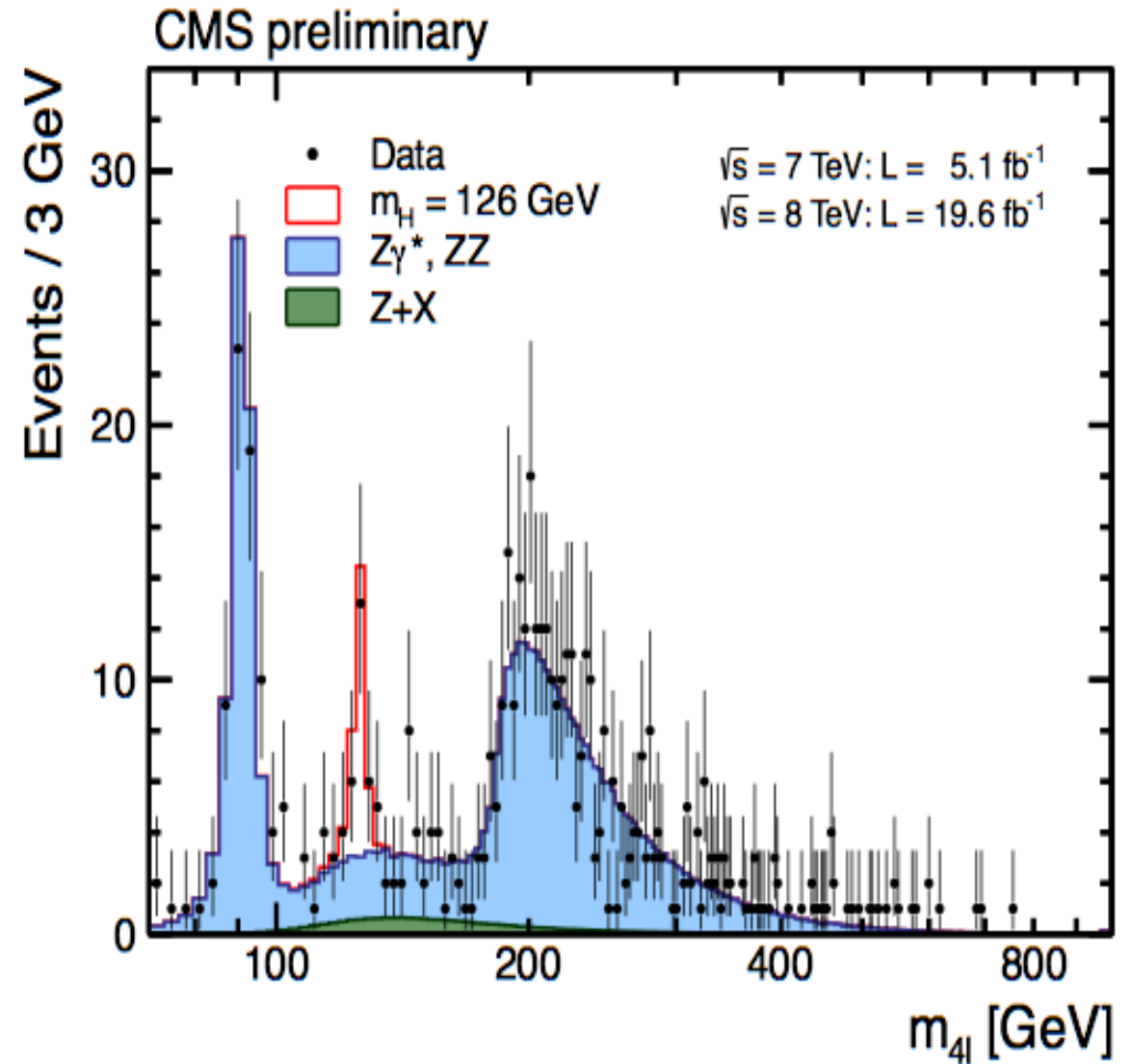
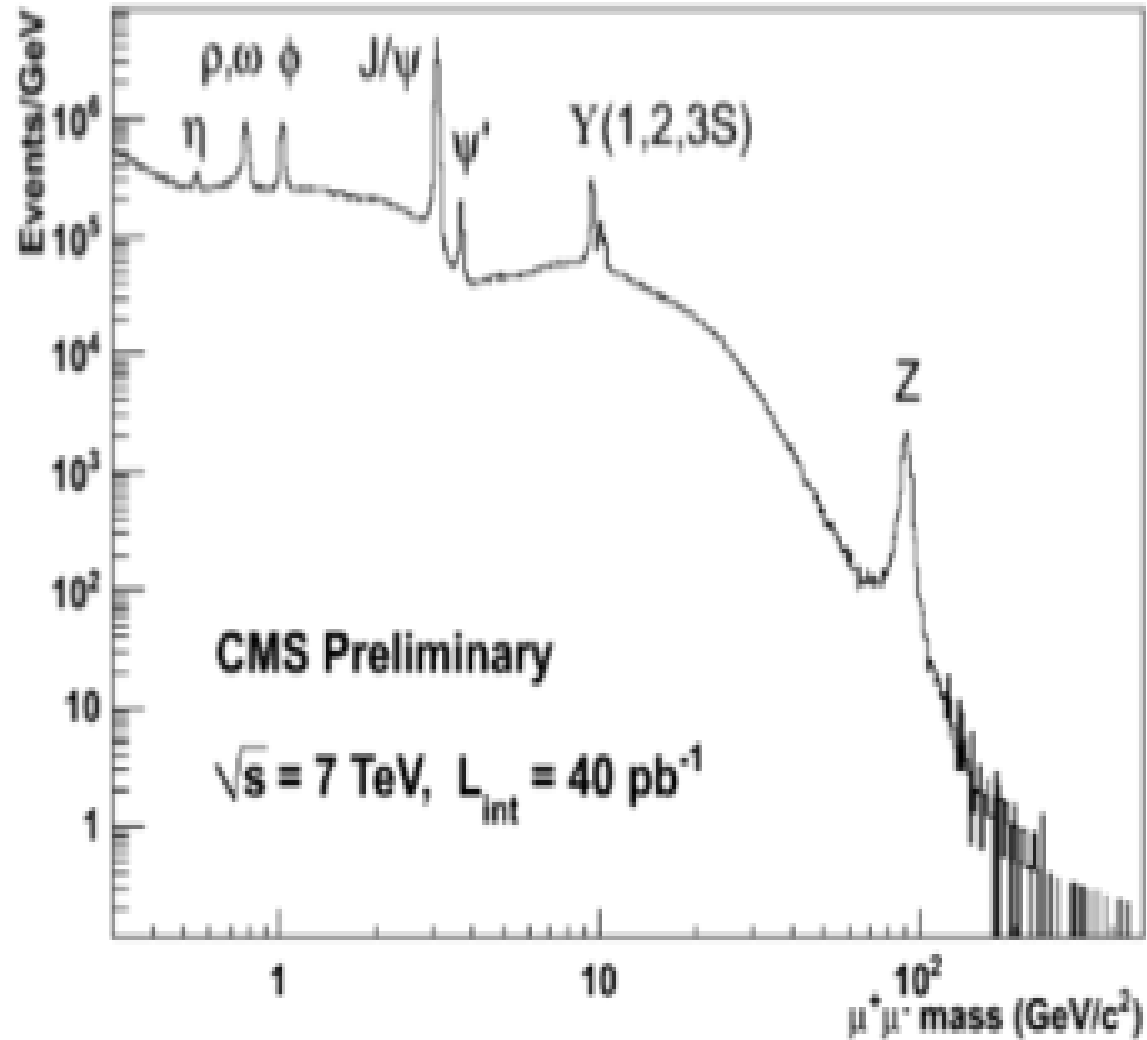
Please select items from the drop-down boxes to submit your results!

2016 ▾ March ▾ 23 ▾ Nis ▾ 1 ▾

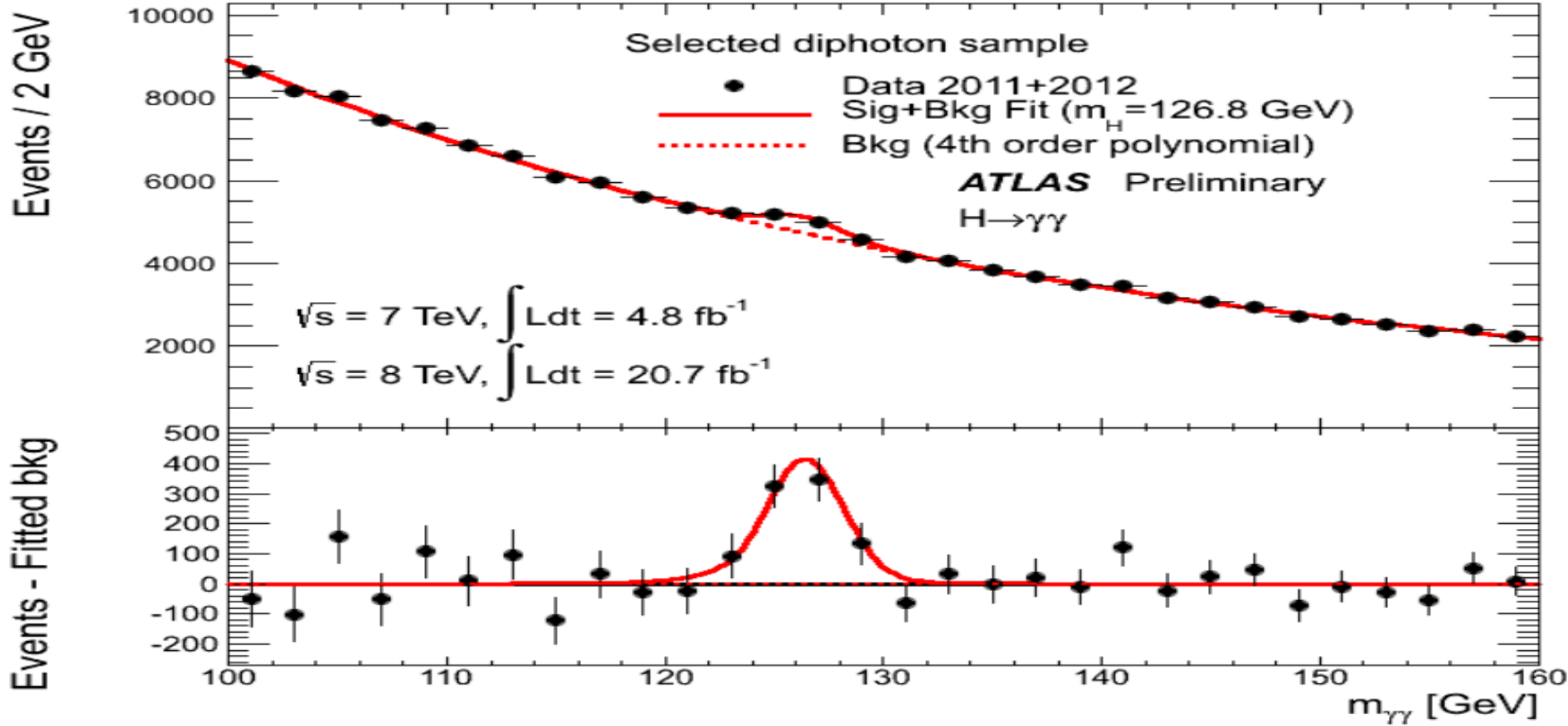
✓ Group letter
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T

Sačuvajte podatke pod imenom svoje grupe (A, B, C...), i submit-ujte ih na:
<http://cernmasterclass.uio.no/OPIoT/>

MASENI SPEKTAR ZA Z ILI ZZ



MASENI SPEKTAR DVA FOTONA





SREĆNO!