

HYPATIA

HYbrid **P**upil's **A**nalysis **T**ool for
Interactions in **A**tlas

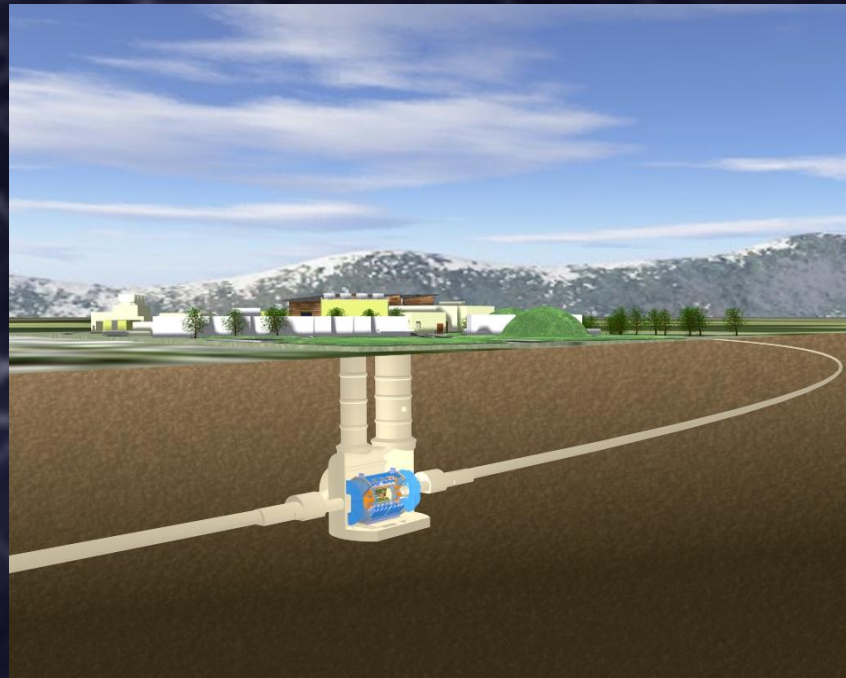
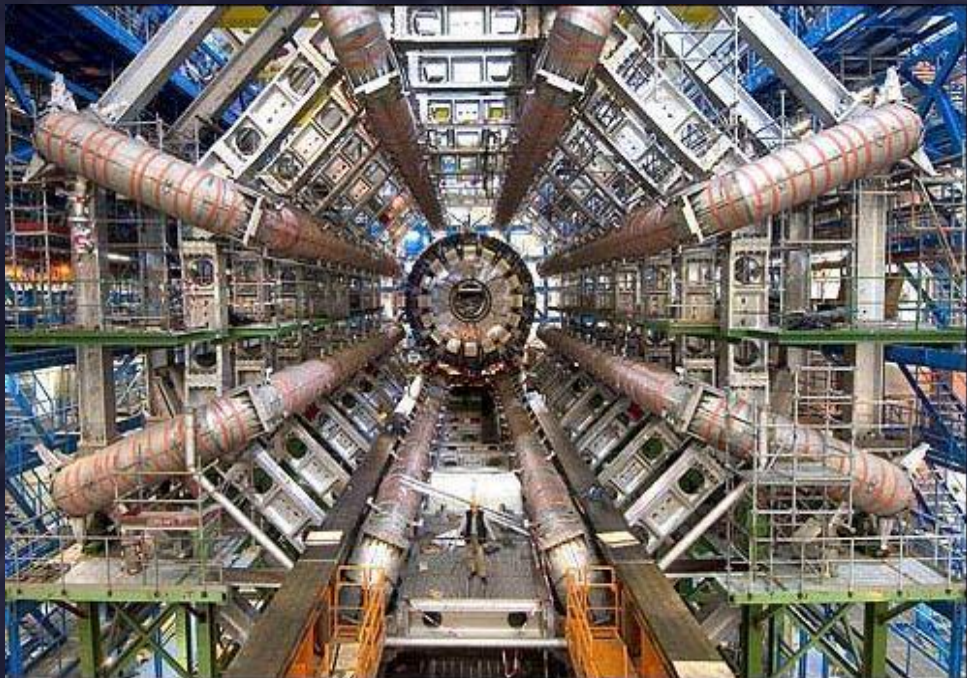
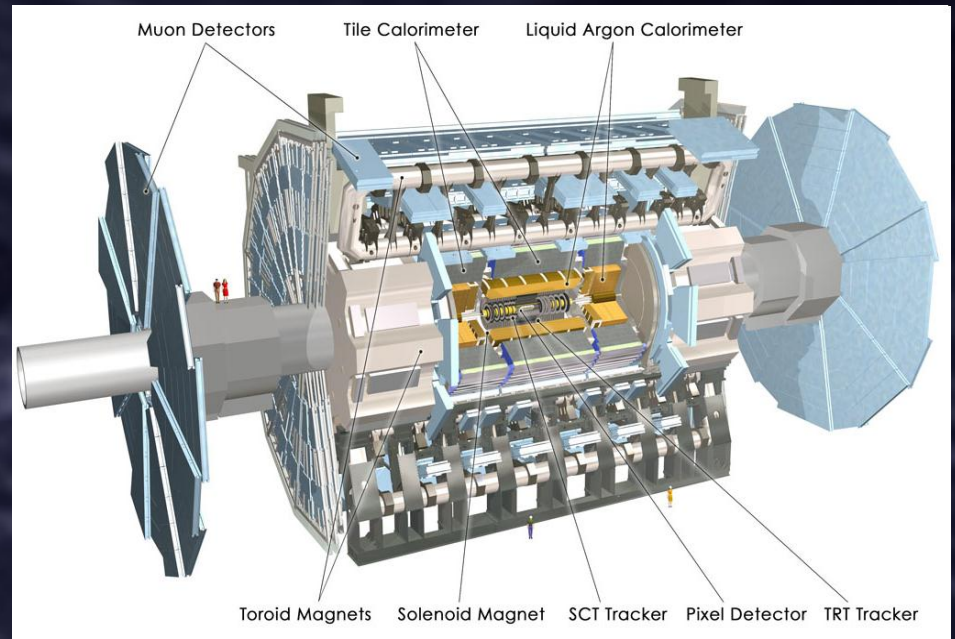
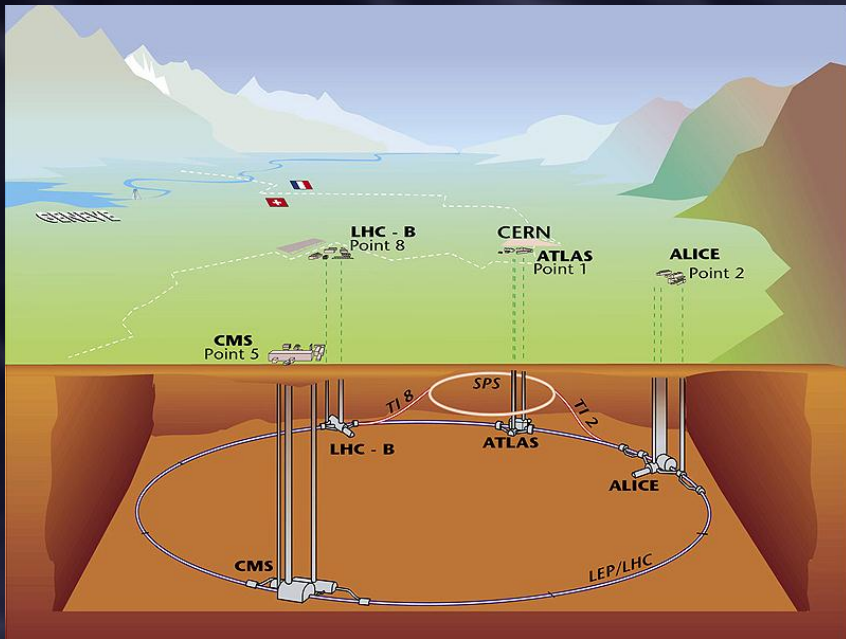
<http://hypatia.phys.uoa.gr>

HYPATIA of Alexandria

- First woman mathematician
- Alexandria, Egypt (370-418 A.D.)
- Daughter of the mathematician and astronomer Theon
- Supported science over religion
- Murdered by fanatics
- Her death signaled the end of the Hellenistic era

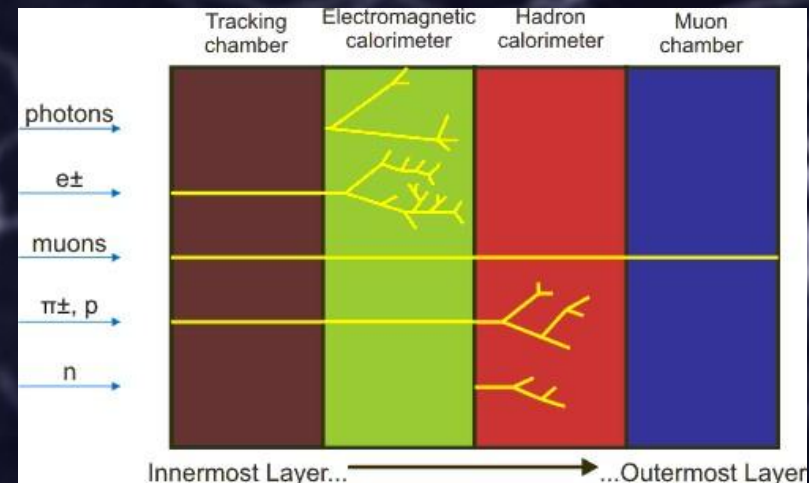
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- Developed as part of **Learning with ATLAS@CERN**, an educational program on modern particle physics
- Allows high school students and their teachers to study the elementary particles and their interactions
- Uses real “events” from the **ATLAS** experiment at **CERN**
- Suitable for **educational** and **scientific** use

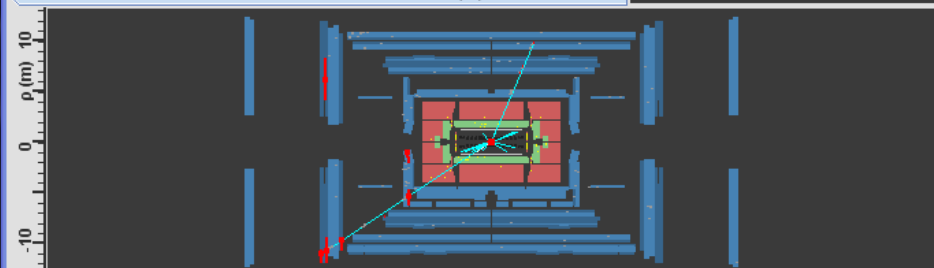
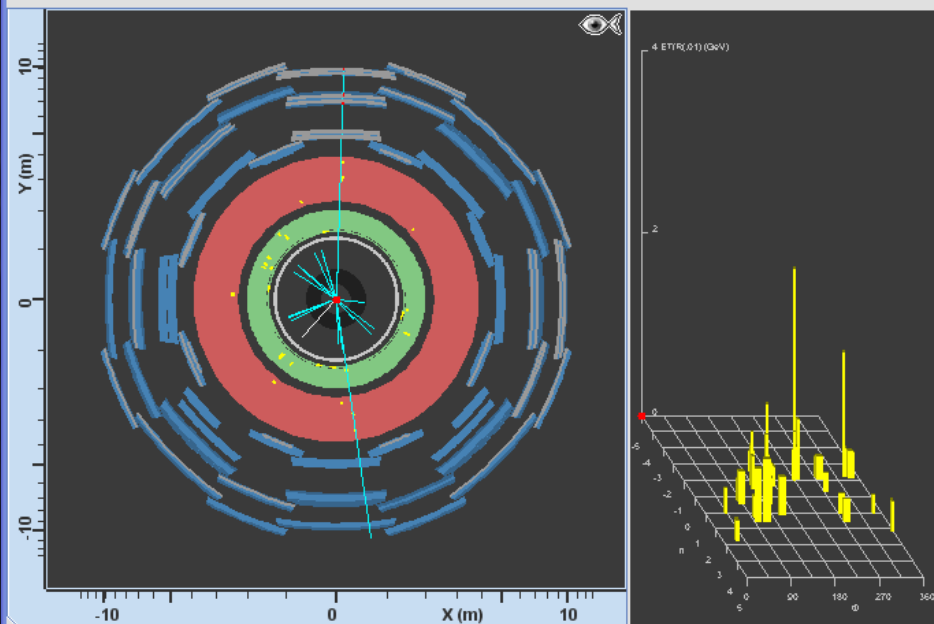


ATLAS

- Particle **tracks** appear as lines on the detectors
- The **length** of each track is determined by particle type
- Each particle leaves a **trace** only on specific detectors according to its type



File Name	ETMis [GeV]	Track	P [GeV]	+/-	Pt [GeV]	ϕ	η	M(2l) [GeV]	M(4l) [GeV]	e/ μ
101_JiveXML_166466_49532845.xml	7.524	Tracks 0	42.1	+	39.4	1.550	0.368	17.181	40.639	e
		Tracks 1	5.0	-	1.2	-0.247	2.125			e
		Tracks 11	6.7	+	4.4	-2.226	-1.002	6.149		
102_JiveXML_166466_41271594.xml	5.870	Tracks 31	2.3	+	1.3	-2.538	1.109			e
		Tracks 62	2.0	-	1.3	-2.331	0.926	3.126		e
103_JiveXML_166466_43638310.xml	7.233	Tracks 57	8.1	-	1.3	2.135	2.558			e
		Tracks 20	2.4	+	2.1	1.155	-0.543	2.263	8.603	e
		Tracks 46	3.4	-	1.6	2.091	-1.369			e
		Tracks 49	2.5	-	1.4	0.807	-1.162	4.519		e
		Tracks 65	2.1	-	1.5	-2.249	0.835			e
104_JiveXML_166927_19675054.xml	4.150	Tracks 1	43.5	-	42.2	-0.917	-0.247	11.944	31.791	μ
		Tracks 2	3.3	-	1.3	-0.163	-1.605			μ
		Tracks 4	4.0	-	1.0	2.747	2.040	1.991		e
		Tracks 17	2.2	-	1.3	1.258	1.051			e
105_JiveXML_166924_20141347.xml	7.611	Tracks 3	6.0	+	1.3	-0.324	-2.233			e



ETMis: 10.079 GeV ϕ : 1.731 rad Collection: MET_Reffinal

011 (Zee+Zmm+Background)\101_JiveXML_166466_49532845.xml

Reconstructed Tracks

Track	+/-	P [GeV]	Pt [GeV]	ϕ	θ
Tracks 0	+	42.06	39.37	1.550	1.211
Tracks 1	-	4.96	1.17	-0.247	0.238
Tracks 3	-	51.10	30.69	-1.448	2.497
Tracks 4	-	3.19	1.10	-0.891	2.791
Tracks 9	+	5.53	1.24	-0.760	0.225
Tracks 11	+	6.72	4.35	-2.226	2.438
Tracks 15	+	4.10	1.66	-2.527	2.724
Tracks 19	-	4.18	2.11	-2.932	2.611
Tracks 24	+	1.43	1.15	-1.309	2.205
Tracks 30	-	2.88	1.15	1.621	0.411
Tracks 31	+	2.26	1.34	-2.538	0.637
Tracks 37	-	2.16	1.37	-0.995	2.451
Tracks 58	+	9.40	3.60	1.939	0.393
Tracks 59	-	4.55	1.97	2.438	0.448
Tracks 62	-	4.03	1.65	2.246	0.423
Tracks 72	+	2.39	1.88	2.577	2.237
Tracks 75	+	4.14	1.59	2.180	0.393

Parameter Control Interaction and Window Control Output Display

Projection Data Cuts InDet Calo MuonDet Objects Geometry

Data

Name	Value
<input checked="" type="checkbox"/> Status	
<input checked="" type="checkbox"/> InDet	
<input checked="" type="checkbox"/> Calo	
<input checked="" type="checkbox"/> MuonDet	
<input checked="" type="checkbox"/> Objects	

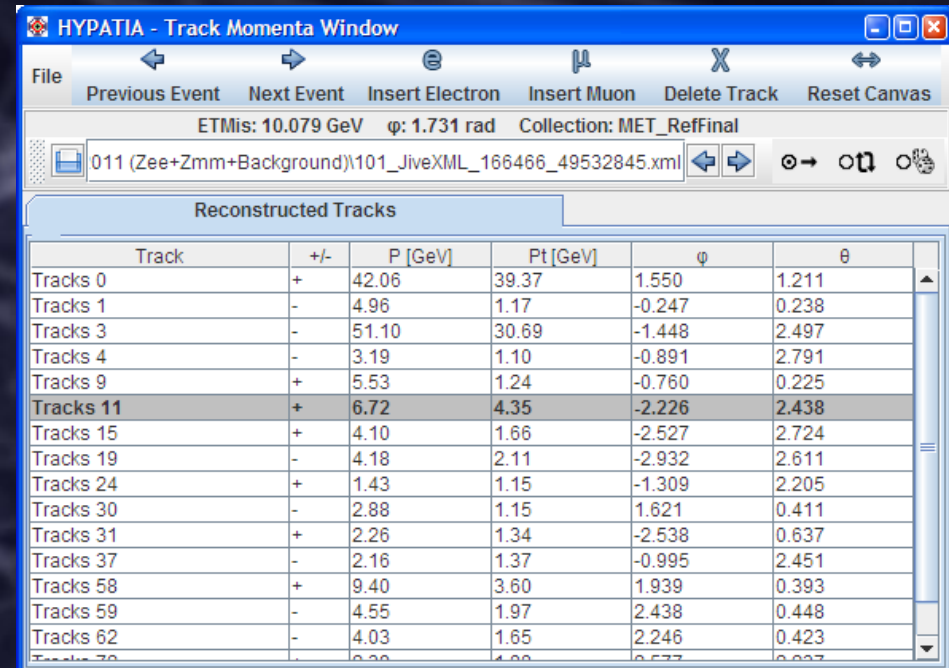
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Track Momenta

Displays the quantities that describe each track (type, momentum, charge, ϕ , θ)

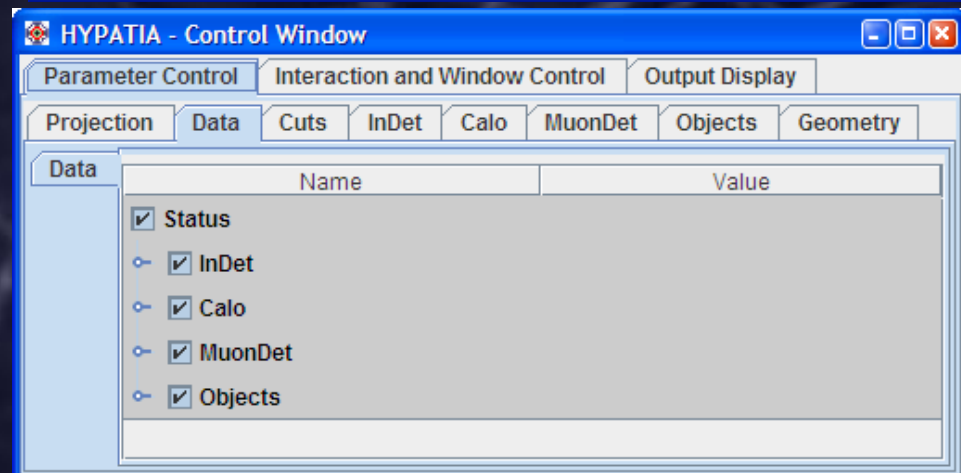
Control

Controls the parameters that define how events are displayed



The screenshot shows the 'HYPATIA - Track Momenta Window' interface. At the top, it displays event information: 'ETMis: 10.079 GeV', ' ϕ : 1.731 rad', and 'Collection: MET_RefFinal'. Below this is a file path: '011 (Zee+Zmm+Background)\101_JiveXML_166466_49532845.xml'. The main area is a table titled 'Reconstructed Tracks' with the following columns: Track, +/-, P [GeV], Pt [GeV], ϕ , and θ . The table lists tracks from 0 to 70, with Track 11 highlighted.

Track	+/-	P [GeV]	Pt [GeV]	ϕ	θ
Tracks 0	+	42.06	39.37	1.550	1.211
Tracks 1	-	4.96	1.17	-0.247	0.238
Tracks 3	-	51.10	30.69	-1.448	2.497
Tracks 4	-	3.19	1.10	-0.891	2.791
Tracks 9	+	5.53	1.24	-0.760	0.225
Tracks 11	+	6.72	4.35	-2.226	2.438
Tracks 15	+	4.10	1.66	-2.527	2.724
Tracks 19	-	4.18	2.11	-2.932	2.611
Tracks 24	+	1.43	1.15	-1.309	2.205
Tracks 30	-	2.88	1.15	1.621	0.411
Tracks 31	+	2.26	1.34	-2.538	0.637
Tracks 37	-	2.16	1.37	-0.995	2.451
Tracks 58	+	9.40	3.60	1.939	0.393
Tracks 59	-	4.55	1.97	2.438	0.448
Tracks 62	-	4.03	1.65	2.246	0.423
Tracks 70	-	0.00	0.00	0.000	0.000



The screenshot shows the 'HYPATIA - Control Window' interface. It has three tabs: 'Parameter Control', 'Interaction and Window Control', and 'Output Display'. The 'Data' sub-tab is active, showing a list of parameters to be displayed. The 'Data' section has a table with 'Name' and 'Value' columns. The parameters listed are Status, InDet, Calo, MuonDet, and Objects, all of which are checked.

Name	Value
<input checked="" type="checkbox"/> Status	
<input checked="" type="checkbox"/> InDet	
<input checked="" type="checkbox"/> Calo	
<input checked="" type="checkbox"/> MuonDet	
<input checked="" type="checkbox"/> Objects	

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Hybrid pupils' analysis tool for interactions in ATLAS - version 2.0.0-2 - Invariant Mass Window

File Name	ETMis [GeV]	Track	P [GeV]	+/-	Pt [GeV]	ψ	η	M(lv) [GeV]	M(2l) [GeV]	M(4l) [GeV]
Event01.xml	91.857	Tracks 0	44.8	+	13.6	3.989	1.860	67.270	198.839	249.756
		Tracks 2	223.7	+	96.3	0.295	-1.486	7.272		
		Tracks 5	81.7	-	45.2	1.245	-1.199	63.293	13.931	
Event02.xml	13.451	Tracks 6	13.6	+	10.0	1.796	-0.832	42.920		
		Tracks 8	58.1	-	41.8	4.611	0.858	42.456	50.698	62.175
		Tracks 10	25.8	-	22.2	0.249	0.564	30.327		
Event03.xml	11.598	Tracks 4	18.9	+	8.2	5.358	1.477	20.909	9.090	
		Tracks 15	3.5	+	2.5	1.587	0.862	4.560		
		Tracks 10	121.6	-	53.4	1.397	-1.464	48.967	15.333	
Event04.xml	9.136	Tracks 7	2.5	+	1.1	4.941	-1.408	2.711		
		Tracks 13	1.6	-	1.2	0.427	-0.890	6.988		
		Tracks 5	24.9	-	20.1	0.282	0.675	27.095	50.742	85.173
Event05.xml	15.681	Tracks 9	32.1	+	31.6	2.978	0.177	6.651		
		Tracks 13	2.0	-	2.0	4.294	0.020	3.843	8.251	
		Tracks 16	32.8	+	31.6	5.335	0.274	28.224		
		Tracks 3	10.8	+	3.7	3.491	1.738	5.333	27.460	93.411
		Tracks 6	33.8	+	32.5	4.276	-0.286	1.562		
		Tracks 10	41.2	-	39.0	1.182	0.331	49.400	28.925	
		Tracks 14	10.9	+	3.6	3.617	1.779	4.344		

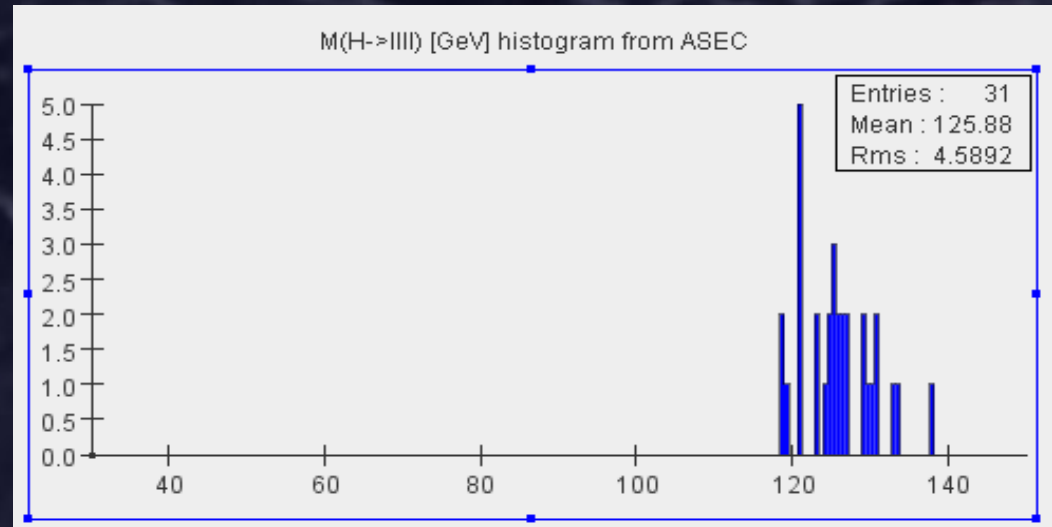
Invariant Mass

Main event analysis window.

Displays the user selected tracks from various events.
Calculates invariant masses.

Creates Histograms.

$$H \rightarrow 4\ell$$

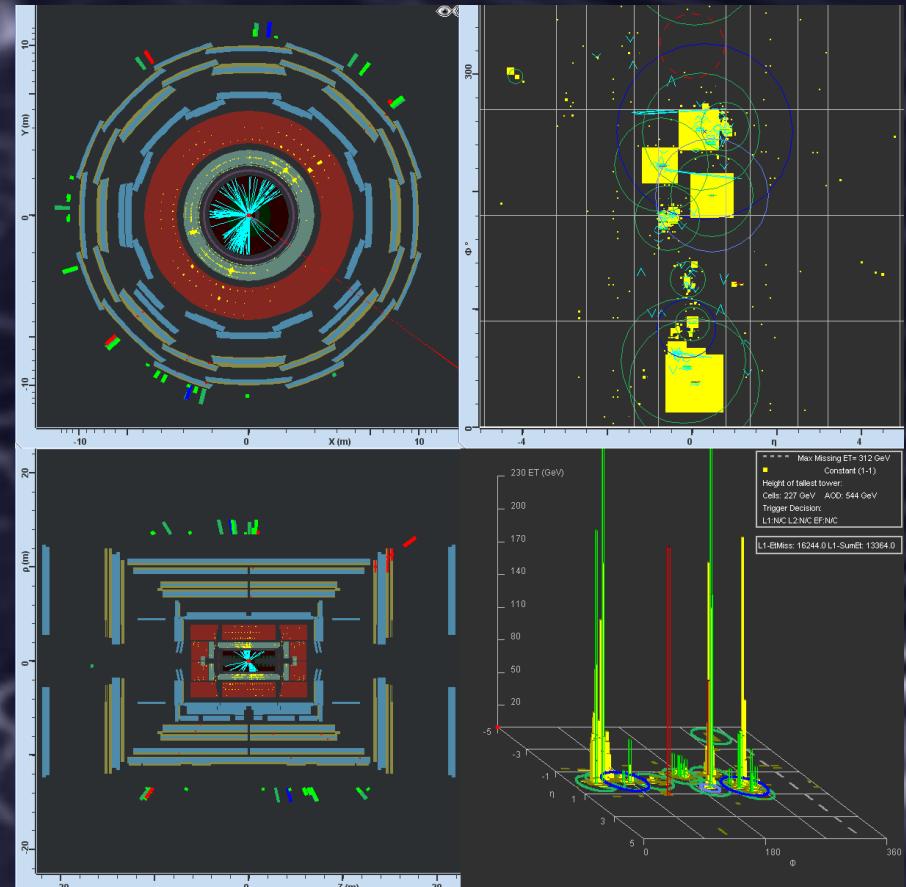


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Canvas

Displays events in various forms depending on particle type and user preference.

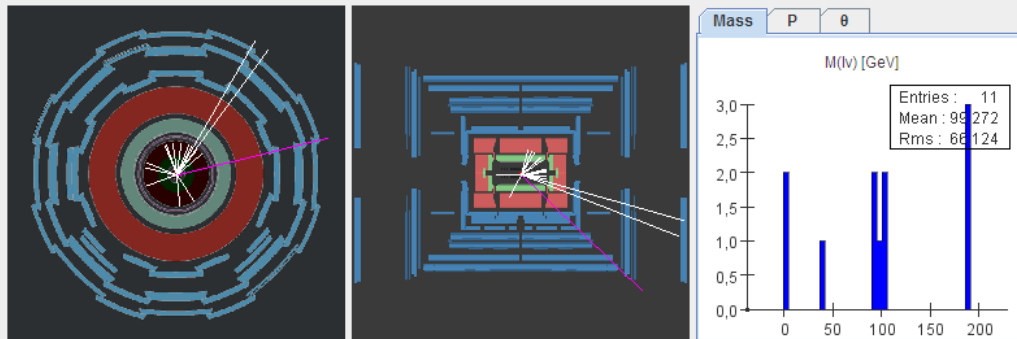
Can do zoom, pan, rotate, pick track etc



HY.P.A.T.I.A. applet

H Y P A T I A
 HYbrid Pupil's Analysis Tool for Interactions in ATLAS

File Name	ETMis [GeV]	Track	P [GeV]	...	Pt [GeV]	ϕ	θ	M(lv) [GeV]	M(2l) [GeV]	M(4l) [GeV]
event_1_20100822	100	track1_1	100	-	90	-0.985	1.28	90	150	461
event_1_20100822	100	track1_3	50	-	40	-1.476	0.24	40		
event_1_20100822	100	track1_5	111	-	55	1.98	1.02	101	311	
event_1_20100822	100	track1_7	200	-	10	2.907	0.12	190		
event_1_20100822	100	muon1_1	200	+	22	0.938	6.01	190	210	521
event_1_20100822	100	track1_4	10	-	37	1.437	6.2	0		
event_1_20100822	100	track1_7	200	-	10	2.907	0.12	190	311	
event_1_20100822	100	track1_5	111	-	55	1.98	1.02	101		
event_1_20100822	100	track1_4	10	-	37	1.437	6.2	0	110	
event_1_20100822	100	track1_1	100	-	90	-0.985	1.28	90		
event_1_20100822	100	track1_6	110	-	29	2.766	0.71	100		



Previous Event Next Event Insert Track Delete Track Zoom In Zoom Out

Event : 1 of 6 Run Number : 512 Pt > 1 GeV Event : event_1_20100822

Track	+/-	P [GeV]	Pt [GeV]	ϕ
track1_1	-	100	90	-0.985
track1_2	+	22	21	-2.783
track1_3	-	50	40	-1.476
track1_4	-	10	37	1.437
muon1_1	+	200	22	0.938
track1_5	-	111	55	1.98
track1_6	-	110	29	2.766
muon1_2	+	220	22	1.038
track1_7	-	200	10	2.907
muon1_3	+	10	22	0.238
track1_7	-	200	10	2.907

HY.P.A.T.I.A. applet

- Runs in browser
- Needs java installed
- No need to download or install applet
- No need to download events
- Intended functionality (events selection, detector views, pick, zoom, histograms, invariant mass, cuts etc)
- Doesn't include any Atlantis code

<http://hypatia.phys.uoa.gr>

- General **information** about CERN, LHC, ATLAS, ATLANTIS
- Basic physics knowledge about the ATLAS experiment
- **Instructions** for the use of HYPATIA – full and simplified versions
- **Download** the most recent version of HYPATIA
- **Events** (W, Z, Higgs, Black Holes, etc)
- Relative **links** for further information

Activities

- **Masterclass** 2008, 2009, 2010, 2011
- **ATLAS** Visitor Center
- **Nuclear Physics Lab** – University of Athens
- **Talks** in Greece and abroad
- Part of **Learning with Atlas @ CERN**
- Part of **The Pathway to Inquiry Based Science Teaching**
- **Scenarios for Universities and Schools**
<http://www.learningwithatlas-portal.eu/>

