

HYPATIA

OBRAZOVNI PROJEKAT IZ FIZIKE ELEMENTARNIH ČESTICA

DUŠAN VUDRAGVIĆ

LABORATORIJA ZA PRIMENU RAČUNARA U NAUCI
INSTITUT ZA FIZIKU U BEOGRADU

ELEARNING 2012, VISIONARY WORKSHOP
BELGRADE METROPOLITAN UNIVERSITY, BELGRADE, SERBIA
27-28 SEPTEMBAR 2012.



National and Kapodistrian
UNIVERSITY OF ATHENS

INSTITUTE OF PHYSICS
BELGRADE



- **CERN**

CENTAR ZA EVROPSKA NUKLEARNA ISTRAŽIVANJA

- **LHC EKSPERIMENT**

NAJVEĆI I NAJMOĆNIJI UBRZAVAČ ČESTICA
(AKCELERATOR) NA SVETU

- **ATLAS DETEKTOR**

DETEKTOR OPŠTE NAMENA NA LHC-JU

- **HYPATIA PROJEKAT**

OBRAZOVNI PROJEKAT IZ FIZIKE ČESTICA

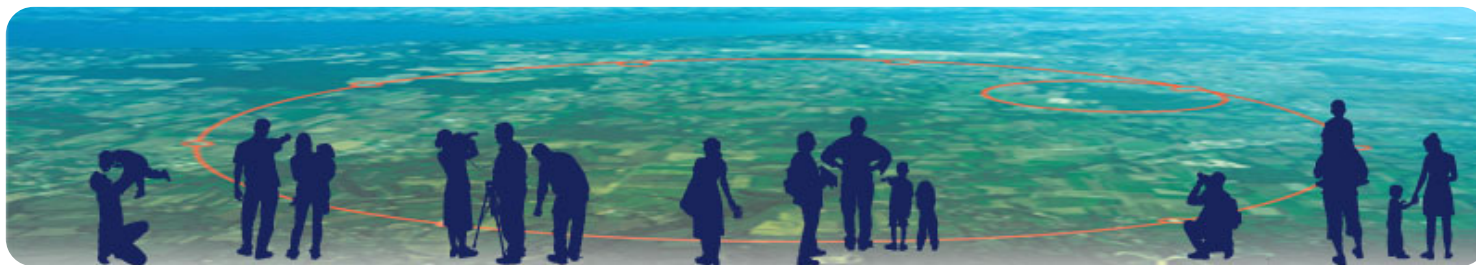
- **HYPATIA VEB SAJT**

OBRAZOVNI MATERIJAL IZ FIZIKE ČESTICA

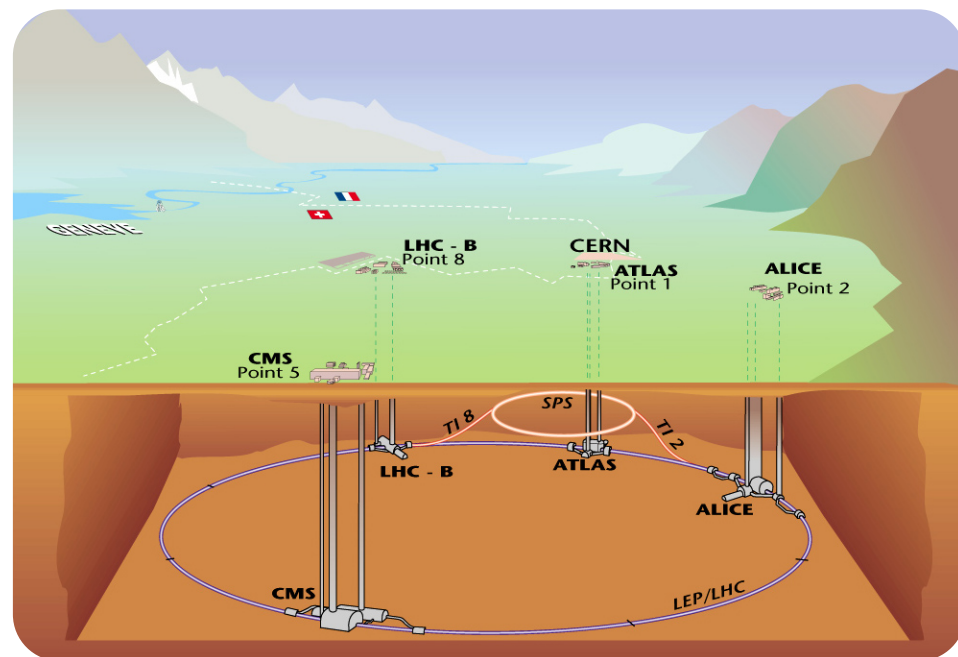
- **HYPATIA APLIKACIJA**

OBRAZOVNA RAČUNARSKA APLIKACIJA ZA ANALIZU
LHC DOGAĐAJA

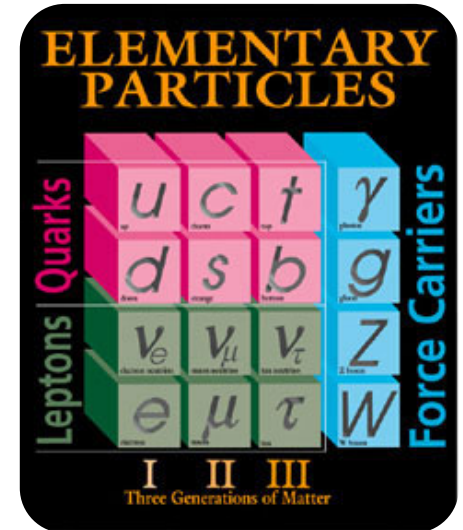
- **CENTAR ZA EVROPSKA NUKLEARNA ISTRAŽIVANJA
ŽENEVA, ŠVAJCARSKA**
- **NAJVEĆA LABORATORIJA ZA FIZIKU ČESTICA**
- **10,000 NAUČNIKA, 608 UNIVERZITETA, 113 ZEMALJA**
- **MISIJA CERN-A**
 - **ISTRAŽIVANJE – FUNDAMENTALNA FIZIKA**
 - **TEHNOLOGIJA – GRANICE TEHNOLOGIJE**
 - **SARADNJA**
 - **OBRAZOVANJE**



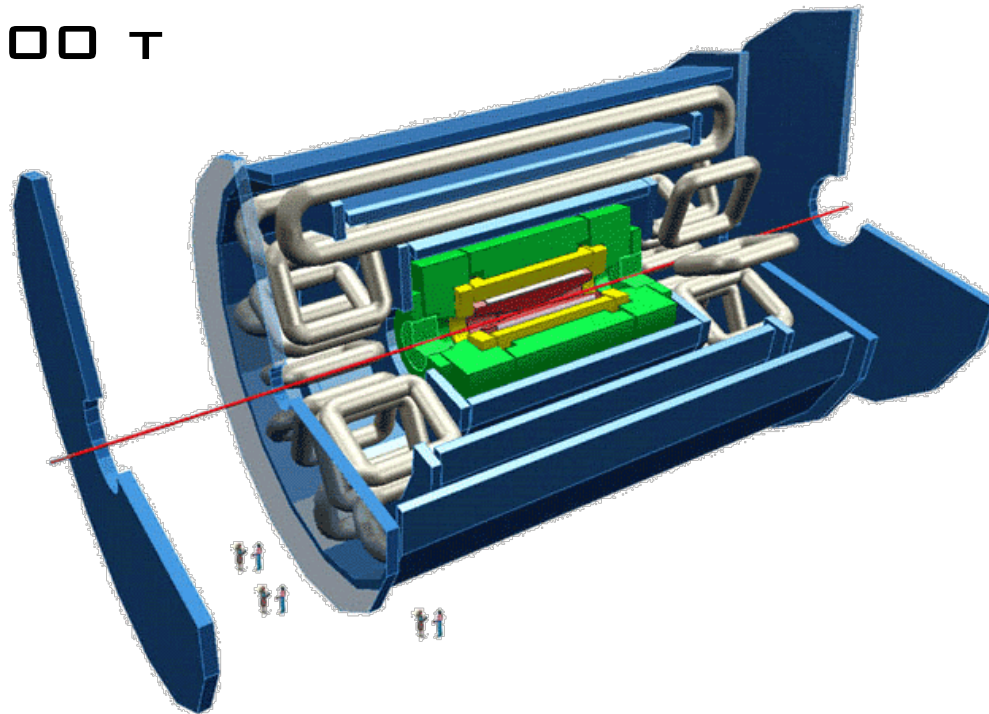
- **VELIKI HADRONSKI SUDARAČ**
NAJVEĆI I NAJMOĆNIJI UBRZAVAČ ČESTICA
(AKCELERATOR) NA SVETU
- **KARAKTERISTIKE: OBIM 27 KM, ULTRA-VISOKI VAKUUM,
SNAŽNA MAGNETNA POLJA, SUPERPROVODNI MAGNETI,
TEMPERATURA NIŽA OD TEMPERATURE SVEMIRA
- 271 °C**
- **LHC EKSPERIMETI**
 - ALICE
 - ATLAS
 - CMS
 - LHCb
 - TOTEM
 - LHCf



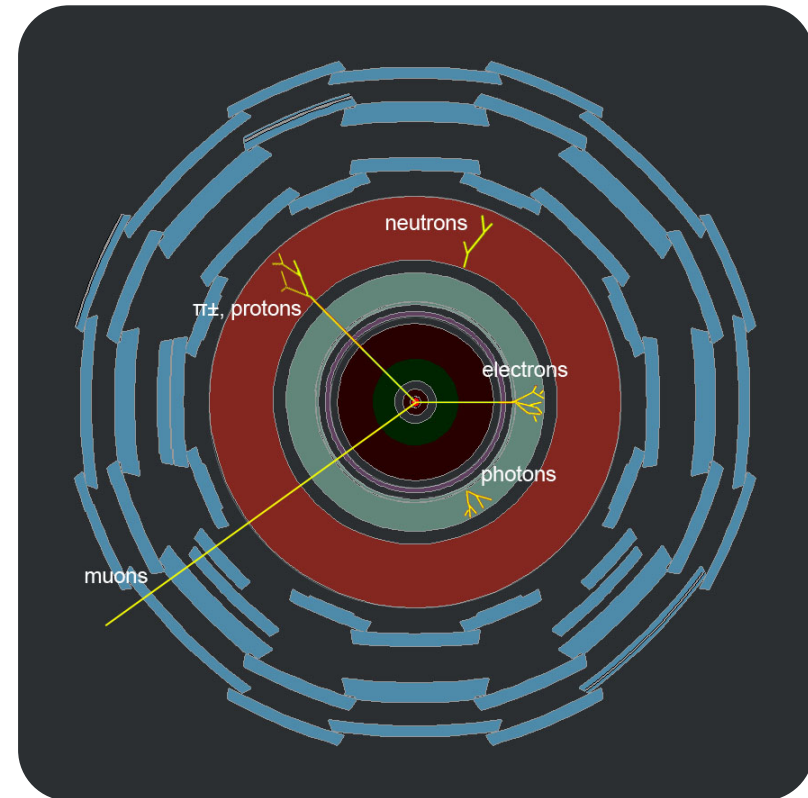
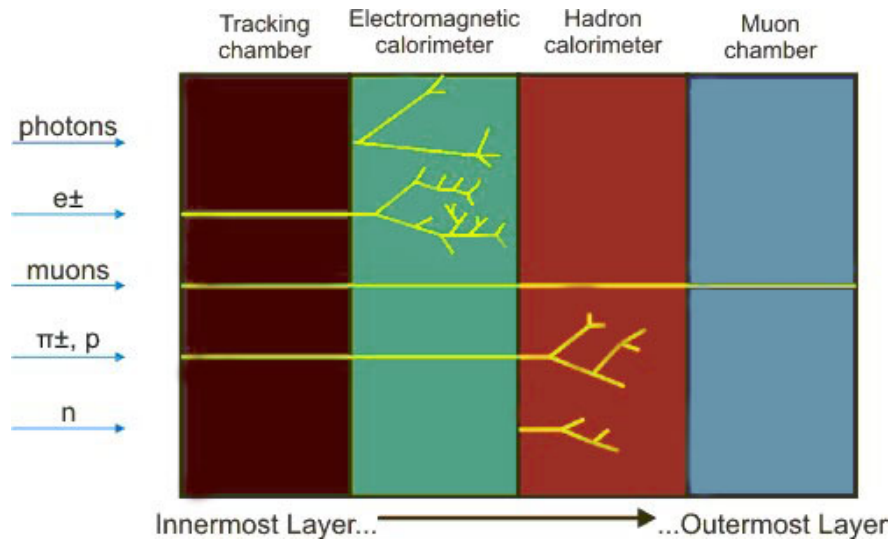
- KOJI JE CILJ LHC-JA? - NEDOSTACI STANDARDNOG MODELA
- ŠTA JE MASA?
 - HIGSOV BOZON
- ŠTA ČINI MASU 96% UNIVERZUMA?
 - POZNATE ČESTICE DAJU 4% MASE
 - TAMNA MATERIJIA 23% MASE
 - TAMNA ENERGIJA 73% MASE
- GDE JE ANTIMATERIJA?
 - U VELIKOM PRASKU STVORENE SU ISTE KOLIČINE
 - ODAKLE RAZLIKA U KOLIČINI MATERIJIE I ANTIMATERIJIE?
- KAKO JE IZGLEDAO UNIVERZUM U PRVIM SEKUNDAMA?
- DA LI POSTOJE DODATNE DIMENZIJE PROSTORA?
 - NOVIJE TEORIJE PRETPOSTAVLJAJU DODATNE PROSTORNE DIMENZIJE (TEORIJA STRUNA)



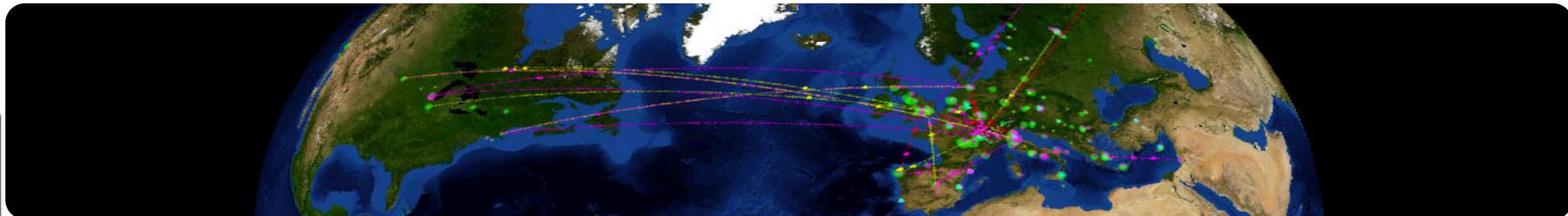
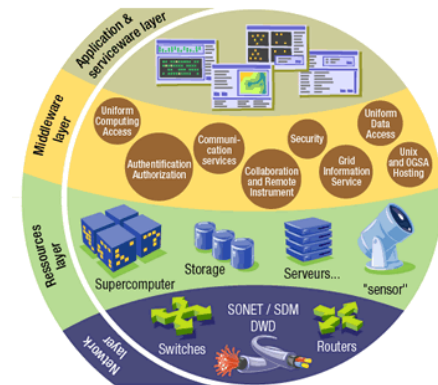
- **ATLAS - A TOROIDAL LHC APARATUS**
- **DETEKTOR OPŠTE NAMENE - OMOGUĆAVA ISTRAŽIVANJA POREKLA MASE, DODATNE DIMENZIJA, TAMNE MATERIJE**
- **KARAKTERISTIKE: DUŽINA 46 M, PREČNIK 25 M, TEŽINA 7000 T**



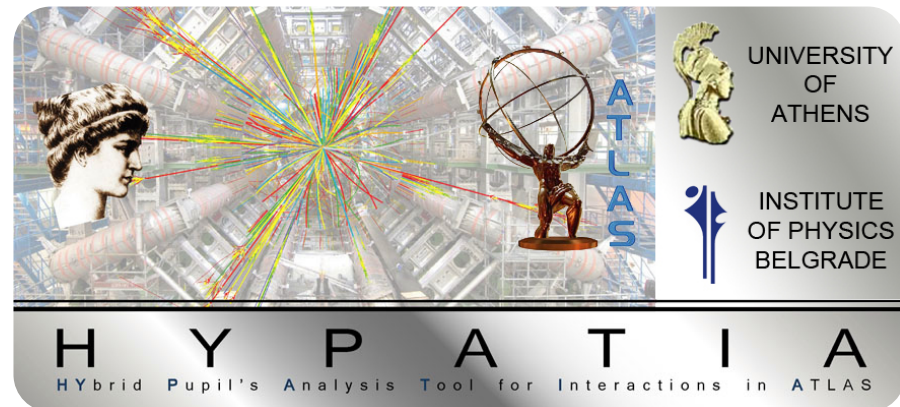
- STRUKTURA ATLAS DETEKTORA
 - SISTEM ZA PRAĆENJE TRAGOVA ČESTICA
 - ELEKTROMAGNETNI KALORIMETAR
 - HADRONSKI KALORIMETAR
 - MIONSKI DETEKTOR



- LHC PODACI: 10 PB/GOD
- LHC GENERISANJE, SIMULACIJE, REKONSTRUKCIJE I ANALIZA DOGAĐAJA U DETEKTORU
- LHC SIMULACIJA DOGAĐAJA
100,000 x 15 MIN = 3 GODINE CPU VREMENA
- DOSTUPNE TEHNOLOGIJE
WWW, LINUXS, SVIČ, KLASTER
- GRID TEHNOLOGIJA



- **HYPATIA OBUHVATA:**
 - **OBRAZOVNI VEB SAJT IZ FIZIKE ČESTICA KOJI JE NEOPHODAN ZA RAZUMEVANJE I KORIŠĆENJE HYPATIA APLIKACIJE**
 - **HYPATIA OBRAZOVNU RAČUNARSKU APLIKACIJU ZA PROUČAVANJE I ANALIZU DOGAĐAJA U ATLAS DETEKTORU**
 - **SKUPOVE PODATAKA O SUDARIMA ČESTICA IZ ATLAS DETEKTORA (SIMULIRANE I REALNE DOGAĐAJE)**
 - **DEMONSTRATIVNE VEŽBE I ZADATKE**



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

- NA ADRESI [HTTP://HYPATIA.PHYS.UOA.GR/](http://hypatia.phys.uoa.gr/)
 - FIZIKA ČESTICA KOJA JE NEOPHODNA ZA KORIŠĆENJE HYPATIA APLIKACIJE I SKUP KORISNIH LINKOVA SA VIŠE INFORMACIJA
 - PREUZIMANJE FAJLOVA DOGAĐAJA IZ ATLAS DETEKTORA
 - PREUZIMANJE HYPATIA OBRAZOVNE APLIKACIJE
 - VEŽBE I ZADACI ZA SAMOSTALAN RAD UČENIKA

Hypatia | Read About | Simplified Basics | Use Simplified Version | Basics | Use HYPATIA | Downloads | Useful Links | Contact Us

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Downloads

If you want to install the most recent version of the program then click on the upper right line of the first row. All versions contain a few example events. If you want more events then you can download them from the last row. Be careful to only use events that are compatible with the version you are using. Newer application versions are not compatible with old event files. You can save them on your PC and then load them by using the "File" item and then "Read Event" in the "Invariant Mass Window", or "Track Momenta Window" in the Simplified Version.

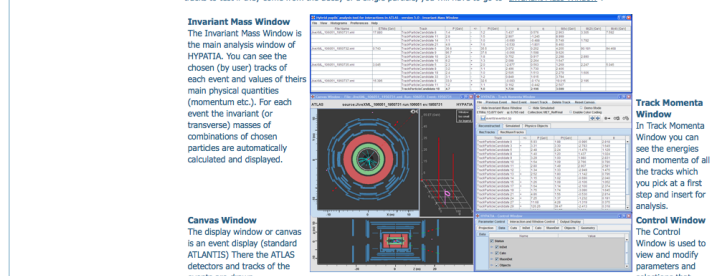
To run the program you need to have the [Java Runtime Environment](#) installed (version 1.5 or newer).

HYPATIA Latest version (7.2.1)	
	<p>HYPATIA-v7.2.1 download zip file</p> <p>Version: 7.2.1 download windows installer</p> <p>Date published: 9 December 2011</p> <p>Download size: 49,0 MB</p> <p>Compatible with: AtlantisJava-09-15-91</p> <p>download sample events (Z→e⁺ + e⁻ + Z→u⁺ + u⁻ + background)</p>
HYPATIA Latest version (7.2.1) for the 2012 Physics Masterclasses	
	<p>HYPATIA-v7.2.1 - 2012 Physics Masterclasses download zip file</p> <p>Version: 7.2.1 download windows installer</p> <p>Date published: 9 December 2011</p> <p>Download size: 10,0 MB</p> <p>Compatible with: AtlantisJava-09-15-91</p>

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Home :: Use HYPATIA

Use HYPATIA	
<ul style="list-style-type: none"> Invariant Mass Window Track Momenta Window Canvas Window Control Window Part I – Single Tracks Part II – Combinations of Tracks Part III – Discover the Higgs particle Exercises 	<p>In HYPATIA you have four different windows which provide you all the info needed. There are:</p> <ul style="list-style-type: none"> • Invariant Mass Window • Canvas Window • Track Momenta Window • Parameters Window <p>Start with the "Canvas Window". There you see either a graphical representation of the front-view (or the end-view) of the detector surrounding the collision point. As already discussed in the "Basics" page, the produced particles interact with different parts of the detector shown in different colours and leave traces which are shown as lines called tracks. In order to learn more about these tracks you have to go to the "Track Momenta Window", which shows the energy of the selected tracks. If you want to go further and combine several tracks to test if they come from the decay of a single particle, you will have to go to "Invariant Mass Window".</p> <p>Invariant Mass Window The Invariant Mass Window is the main analysis window of HYPATIA. You can see the chosen (by user) tracks of each event and values of their main physical quantities (momentum etc.). For each event the invariant (or transverse) masses of combinations of chosen particles are automatically calculated and displayed.</p> <p>Canvas Window The display window or canvas is an event display (standard ATLAS) There the ATLAS detectors and tracks of the events are drawn.</p> <p>Track Momenta Window In Track Momenta Window you can see the energies and momenta of all the tracks which you pick at a first step and insert for analysis.</p> <p>Control Window The Control Window is used to view and modify parameters and selections that</p>



HYPATIA OBRAZOVNA APLIKACIJA [1/5]

- ČETIRI PROZORA SA SVIM INFORMACIJAMA RELEVANTNIM ZA ANALIZU DOGAĐAJA

The screenshot displays the HYPATIA software interface with four main windows:

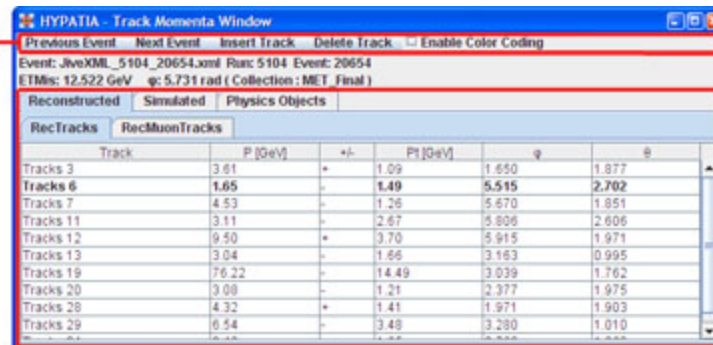
- Invariant Mass Window:** A table showing invariant mass analysis results for various tracks. The text "INVARIJANTNE MASE" is overlaid on this window.
- ATLAS Visualization:** A 3D visualization of the ATLAS detector showing particle tracks. The text "VIZUELIZACIJA DOGAĐAJA" is overlaid on this window.
- Track Moments Window:** A table showing track moments for reconstructed tracks. The text "TRAGOVI ČESTICA" is overlaid on this window.
- Control Window:** A window for parameter control and interaction settings. The text "KONTROLNI PROZOR" is overlaid on this window.

File Name	ETBts [GeV]	Track	P [GeV]	+	Pt [GeV]	φ	η	Wbts [GeV]	Wzts [GeV]	Mbts [GeV]
./src/XML_106051_1950731.xml	17.880	TrackParticleCandidate 8	1.4	-	1.2	1.437	0.178	2.963	3.306	7.552
		TrackParticleCandidate 11	2.8	-	1.5	2.907	-1.245	8.999		
		TrackParticleCandidate 14	5.1	-	1.0	-0.590	-0.488	5.749	1.792	
		TrackParticleCandidate 21	4.9	+	1.6	-0.530	-1.801	6.480		
./src/XML_106051_1950732.xml	8.743	TrackParticleCandidate 5	36.5	-	36.5	3.072	0.252	4.256	50.181	54.458
		TrackParticleCandidate 9	36.7	-	36.5	1.488	0.198	9.426		
		TrackParticleCandidate 13	36.7	-	36.5	1.488	0.198	2.298	2.890	
		TrackParticleCandidate 17	36.7	-	36.5	1.488	0.198	1.647		
./src/XML_106051_1950735.xml	3.045	TrackParticleCandidate 8	2.3	+	2.0	2.377	0.563	1.218	2.247	3.045
		TrackParticleCandidate 9	3.2	+	1.1	2.495	1.730	2.406		
		TrackParticleCandidate 19	3.4	-	1.0	2.505	1.613	2.279	1.606	
		TrackParticleCandidate 22	3.1	-	1.2	0.848	1.616	3.794		
./src/XML_106051_1950737.xml	15.395	TrackParticleCandidate 8	33.9	+	32.5	-0.593	-0.174	19.915	2.195	
		TrackParticleCandidate 15	1.2	-	1.1	0.162	-0.442	2.607		
		TrackParticleCandidate 18	4.7	-	1.8	1.726	2.198	3.989		

Track	η	P [GeV]	Pt [GeV]	φ	η
TrackParticleCandidate 0	0.33	1.86	-1.395	2.818	
TrackParticleCandidate 3	0.33	0.30	-0.783	1.649	
TrackParticleCandidate 5	0.48	0.24	-1.475	1.129	
TrackParticleCandidate 8	1.40	1.20	1.437	1.004	
TrackParticleCandidate 9	0.29	1.00	1.880	2.831	
TrackParticleCandidate 11	0.33	1.33	0.848	1.470	
TrackParticleCandidate 13	0.52	1.80	-1.142	0.795	
TrackParticleCandidate 14	0.15	1.02	-0.590	2.040	
TrackParticleCandidate 15	1.25	1.09	-0.106	1.052	
TrackParticleCandidate 17	1.64	1.14	-0.500	2.374	
TrackParticleCandidate 19	1.75	1.74	-3.080	1.645	
TrackParticleCandidate 21	4.85	1.55	-0.530	2.814	
TrackParticleCandidate 24	7.25	1.37	-1.232	0.181	
TrackParticleCandidate 27	11.88	4.25	-1.519	0.315	
TrackParticleCandidate 28	12.29	3.47	-2.413	0.319	

HYPATIA – SREDSTVO ZA ANALIZU [2/5]

- PROZOR SA PODACIMA O TRAGOVIMA ČESTICA
 - SVI TRAGOVI ČESTICA IZ JEDNOG DOGAĐAJA (SUDARA)
 - RAZVRSTAVANJE TRAGOVA PO DELOVIMA DETEKTORA
 - RAZVRSTAVANJE TRAGOVA PO TIPU
 - FILTRIRANJE TRAGOVA (IMPULS, ENERGIJA...)
 - OBELEŽAVANJE TRAGOVA BOJAMA
 - VIZUELNA IDENTIFIKACIJA TRAGA
 - TABELARNI PRIKAZ ENERGIJA I IMPULSA ČESTICA
- KRETANJE KROZ DOGAĐAJE
- BIRANJE TRAGOVA
- OBELEŽAVANJE BOJAMA
- DOGAĐAJI IZ SIMULACIJA
- REKONSTRUISANI DOGAĐAJI
- OBJEKTI (MLAZOVI ČESTICA)

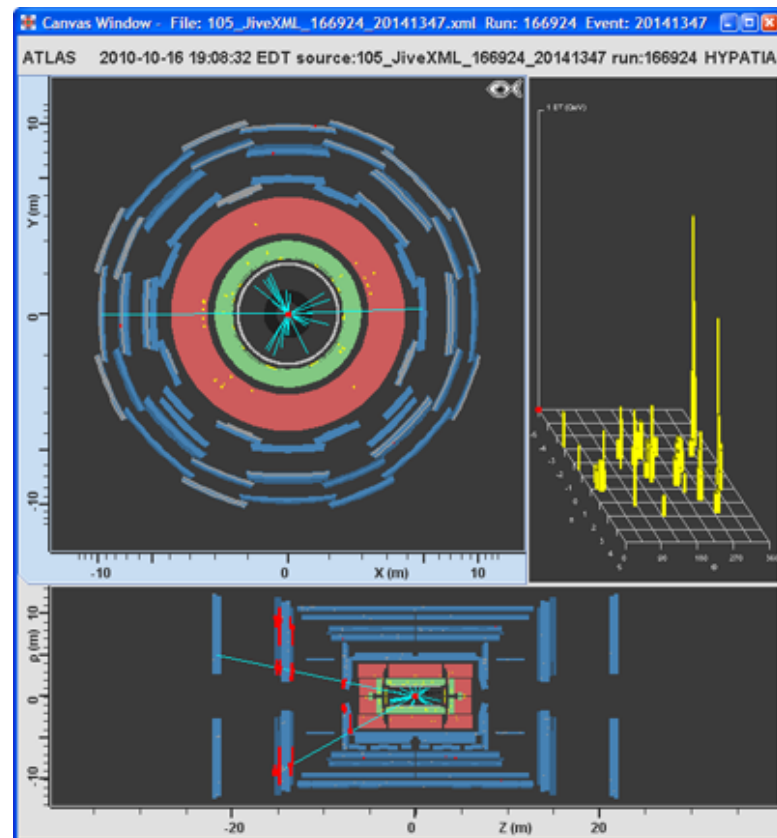


The screenshot shows the 'HYPATIA - Track Momenta Window' with a table of track data. The table has columns for Track, P [GeV], +/-, P1 [GeV], phi, and theta. The data is as follows:

Track	P [GeV]	+/-	P1 [GeV]	phi	theta
Tracks 3	3.61	*	1.09	1.650	1.877
Tracks 6	1.65	-	1.49	5.515	2.702
Tracks 7	4.53	-	1.26	5.670	1.851
Tracks 11	3.11	-	2.67	5.806	2.606
Tracks 12	9.50	*	3.70	5.915	1.971
Tracks 13	3.04	-	1.66	3.163	0.995
Tracks 19	76.22	-	14.49	3.039	1.762
Tracks 20	3.08	-	1.21	2.377	1.975
Tracks 28	4.32	*	1.41	1.971	1.903
Tracks 29	6.54	-	3.48	3.280	1.010

HYPATIA – SREDSTVO ZA ANALIZU [3/5]

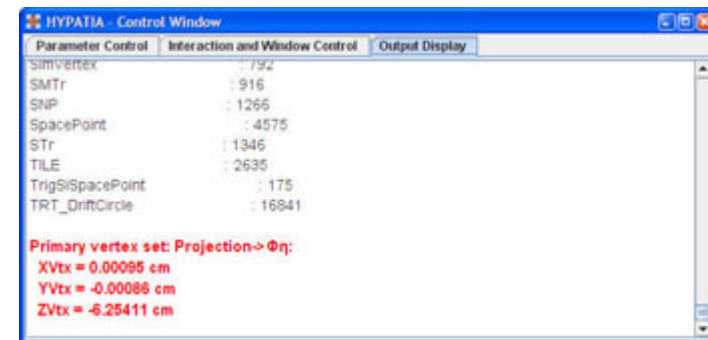
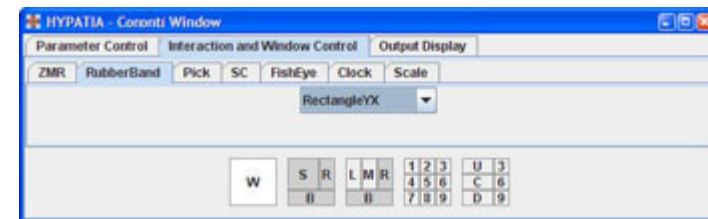
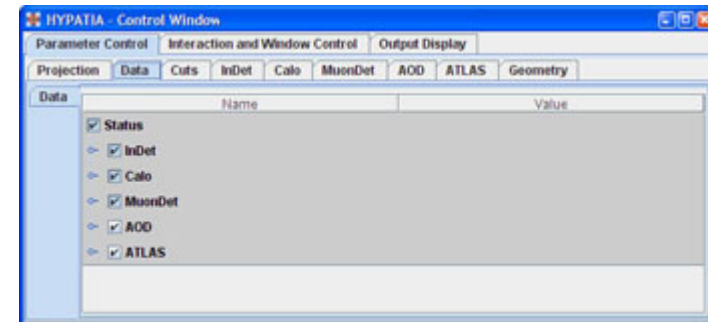
- PROZOR VIZUELIZACIJE DOGAĐAJA
 - PRIKAZ TRAGOVA ČESTICA U DETEKTORU
 - VIŠE PARALELNIH PRIKAZA (LAYOUT)
 - OZNAČAVANJE TRAGOVA
 - IDENTIFIKACIJA TRAGA
 - POVEZIVANJE VIZUELIZACIJE SA TRAGOVIMA U TABELI
 - UVELIČAVANJE ODREĐENIH DELOVA DETEKTORA
 - “FISHEYE” TRANSFORM.
 - RAZLIČITE PROJEKCIJE DETEKTORA



HYPATIA – SREDSTVO ZA ANALIZU [4/5]

■ KONTROLNI PROZOR

- KONTROLA PARAMETARA RAZLIČITIH DELOVA DETEKTORA
- KONTROLA FILTRIRANJA
- KONTROLA INTERAKCIJA
- KONTROLA PARALELNIH PRIKAZA
- VIZUELNA PODEŠAVANJA IZGLEDA APLIKACIJE
- INFORMACIJE O ODABRANOM TRAGU



- PROZOR INVARIJANTNIH MASA
 - CENTRALNI PROZOR APLIKACIJE
 - UČITAVANJE DOGAĐAJA I SKUPOVA DOGAĐAJA
 - TRAGOVI ČESTICA INTERESANTNIH ZA DALJU ANALIZU SE OVDE GRUPIŠU
 - AUTOMATSKO IZRAČUNAVANJE INVARIJANTNIH MASA, NEDOSTAJUĆIH ENERGIJA
 - ISCRTAVANJE HISTOGRAMA (IMPULSA, INVARIJANTNIH MASA, NEDOSTAJUĆIH ENERGIJA...)

Hybrid puppi's analysis tool for interactions in ATLAS - version 1.00 - Invariant Mass Window

File Name	ETMis [GeV]	Track	P [GeV]	±	Pt [GeV]	η	η	M(lv) [GeV]	M(20) [GeV]	M(40) [GeV]
csc11_005145.PythiaZmumu_5145_0012...	44.712	ConvertedPatTracks 2	32.9	+	32.0	0.829	-0.226	14.195	5.166	22.271
		ConvertedPatTracks 5	4.5	+	3.6	0.808	-0.704	4.994		
		ConvertedPatTracks 7	3.0	-	2.7	4.856	0.404	21.867	5.455	
		ConvertedPatTracks 18	2.8	-	1.7	0.926	-1.086	2.449		
csc11_005145.PythiaZmumu_5145_0012...	5.414	ConvertedPatTracks 0	20.4	+	7.2	3.238	-1.701	12.451	6.353	29.819
		STr 135	1.4	+	1.4	3.852	0.002	5.343		
		STr 183	9.3	+	1.2	2.649	2.719	4.796	7.732	
		STr 288	1.8	+	1.1	0.212	-1.001	0.117		
csc11_005145.PythiaZmumu_5145_0012...	74.376	ConvertedPatTracks 2	2.9	+	2.8	2.859	-0.270	15.522	6.105	85.494
		ConvertedPatTracks 5	11.0	+	1.8	2.924	-2.483	11.844		
		ConvertedPatTracks 10	1.6	+	1.4	3.309	0.419	6.946	12.372	
		STr 2	151.8	-	68.2	3.966	1.439	1.762		
csc11_005145.PythiaZmumu_5145_0012...	61.195	ConvertedPatTracks 1	48.4	+	25.1	4.445	1.273	75.943	0.003	157.620
		STr 1	47.9	+	24.9	4.445	1.273	75.556		
		STr 7	16.7	-	1.1	6.178	-3.417	13.366	5.616	
		STr 14	55.9	-	11.3	5.073	-2.279	52.553		

- **LA@CERN: LEARNING WITH ATLAS@CERN**
EUROPEAN COMMISSION
LIFELONG LEARNING PROGRAMME
2008-2010
[HTTP://WWW.EA.GR/EP/LACERN](http://www.ea.gr/ep/lacern)
- **ATLAS STUDENT EVENT CHALLENGE**
ZA OBRAZOVNE SVRHE U CERN-U
- **INTERNATIONAL MASTERCLASSES, ŠIROM SVETA**
[HTTP://WWW.PHYSICSMASTERCLASSES.ORG/](http://www.physicsmasterclasses.org/)
- **UNIVERSITY OF ATHENS**
- ...



National and Kapodistrian
UNIVERSITY OF ATHENS

■ UNIVERSITY OF ATHENS

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- ZACHARIAS ROUPAS
DEVELOPMENT (UP TO SUMMER 2007)

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CURRENT DEVELOPMENT, WEBPAGE

INSTITUTE OF PHYSICS
BELGRADE

