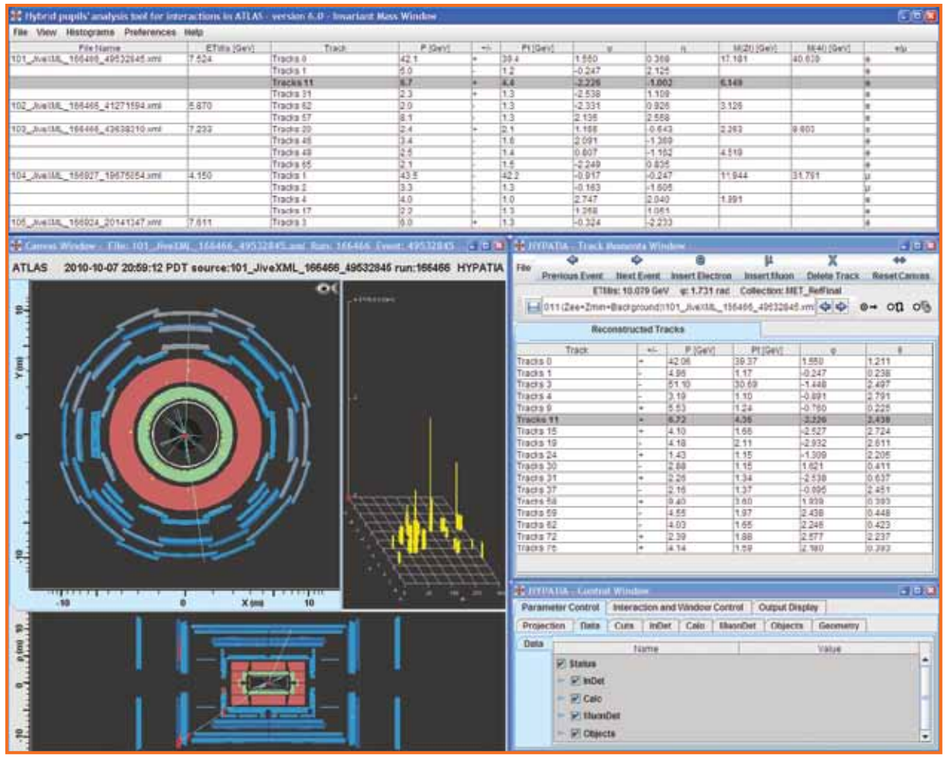
HYPATIA (Hybrid Pupil's Analysis Tool for Interactions in ATLAS)



Summary:

HYPATIA is an event analysis tool for data collected by the ATLAS experiment of the LHC at CERN.

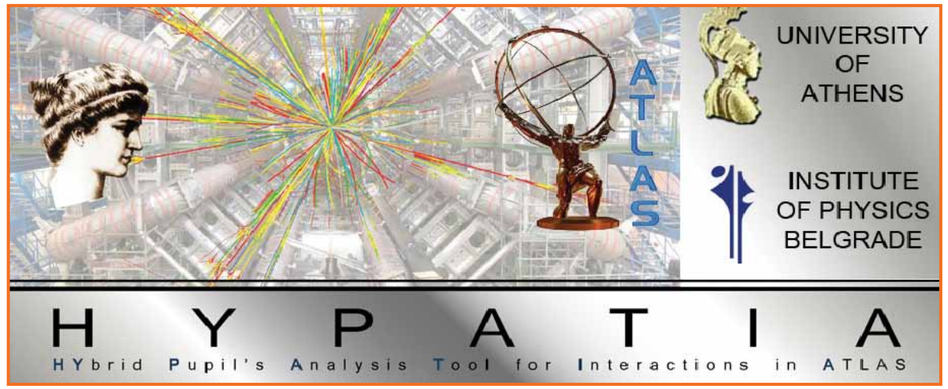
Aims:

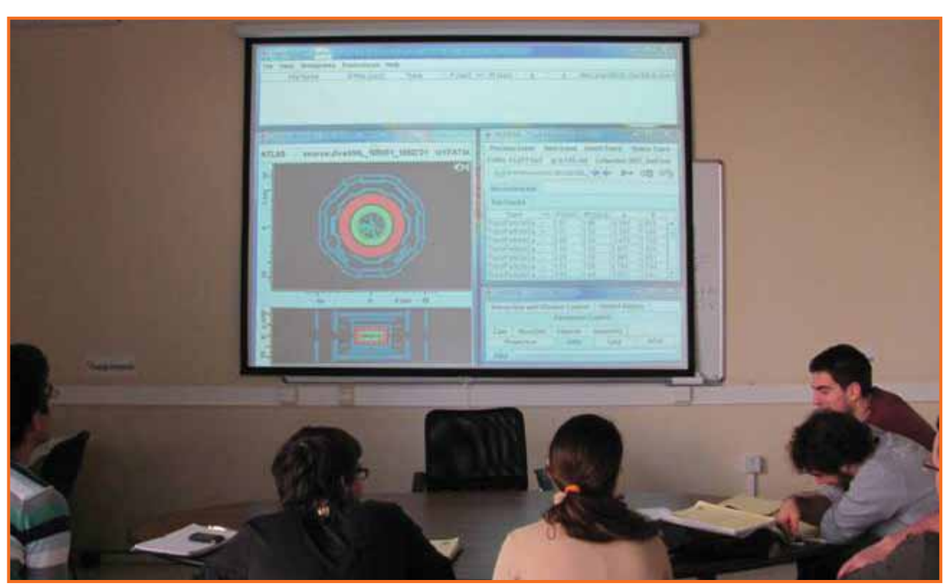
Its goal is to allow high school students to visualize the complexity of the hadron - hadron interactions through the graphical representation of ATLAS event data and interact with them in order to study different aspects of the fundamental building blocks of nature.

Main activities:

HYPATIA allows the use of events that have been collected by the ATLAS experiment or simulated using the Monte Carlo method. The usercan:

- Select the desired events from dedicated sets of selected events streams
- Browse the events with any order
- Study the particle tracks either through their graphical representation or through the tables
- Select from a variety of detector graphical representations
- Customize the display of information to his particular needs
- Combine multiple tracks to infer the existence of short lived particles "invisible" which decay very fast to a number of secondary particles.
- Collect interesting tracks and plot histograms of their properties
- Aggregate particles and study the distribution of their mass, momentum, angles, missing energy etc
- Use the techniques used by physicists in actual research
- Use HYPATIA to build teaching scenario (lesson plans) which fit to the IBSE





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

PATHWAY

Narrative:

HYPATIA is an event analysis tool for data collected by the ATLAS experiment of the LHC at CERN. Its goal is to allow high school and university students to visualize the complexity of the hadron - hadron interactions through the graphical representation of ATLAS event data and interact with them in order to study different aspects of the fundamental building blocks of nature.

HYPATIA allows the use of events that have been collected by the ATLAS experiment or simulated using the Monte Carlo method. The usercan:

- Select the desired events from dedicated sets of selected events streams
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- Combine multiple tracks to infer the existence of short lived particles "invisible" which decay very fast to a number of secondary particles.
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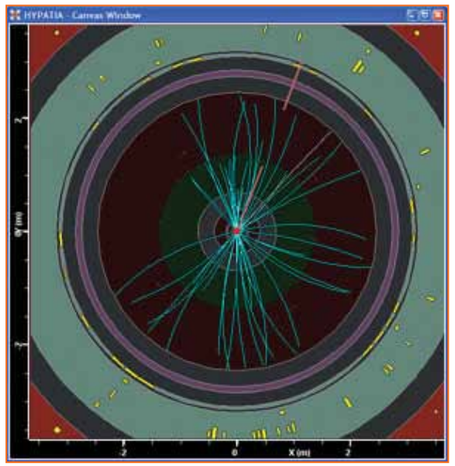

HYPATIA is based on the ATLANTIS event display. HYPATIA can be used on most modern operating systems such as Windows, Linux, Unix, Solaris, MacOS etc.
By using the ATLANTIS graphical representation (canvas) we ensure very accurate and detailed display of the event tracks. Also we ensure that the computing power required will be minimal and so HYPATIA will run on almost any computer regardless of memory or processor speed.The canvas allows even inexperienced users to interact with the events using simple point-and-click functionality. The multiple views of the ATLAS detector that are available ensure that the user will get an accurate view of all the particle tracks that make up an event.

End user:
HYPATIAcan be used by high school children with basic knowledge of the constituents of matter and electromagnetism. In Greece this means 15 to 18 year old students. It can also be used by university students studying physics and also by researchers for event analysis.

Involved actors:
HYPATIA can be used by high school teachers in their classes. Material is available that describes the use of the event display and the scenarios that can be implemented in the classroom depending on the available time and the level of the students. It is advisable for the teacher to have participated in a training program involving the use of HYPATIA, but this is not necessary.

Languages available:
The material is available in Greek and English

Where to find the application or case:
The homepage of HYPATIA is : http://hypatia.phys.uoa.gr/
Aditional material and scenarios involving HYPATIA can be downloaded from the LA@CERN portal : www.learningwithatlas-portal.eu/

Duration:
HYPATIA is a tool that can be used in scenarios with varying length. For example the scenario for teaching conservation of momentum to high school students takes one hour, and the International Masterclasses take a full day.

Evaluation parameters:
Questionnaires were distributed to the students who took part to the workshops.The results were described in the Guide for Best Practice of the Learning from ATLAS@CERN program (www.ea.gr/ea/myfiles/File/publications/CERN_GGP.pdf)

Connection with the curriculum:
Teaching conservation of momentum, magnetic fields etc

Teachers' Competencies

1	subject matter/content knowledge	x
2	nature of science	x
3	Multidisciplinary	x
4	knowledge of contemporary science	x
5	variety of (especially student-centred) instructional strategies	
6	lifelong learning	x
7	self-reflection	
8	teaching/ learning processes within the domain	
9	using laboratories, experiments, projects	x
10	common sense knowledge and learning difficulties	
11	use of ICTs	x
12	knowledge, planning and use of curricular materials	x
13	Information and Communication Technologies with Technological Pedagogical Content Knowledge	

Mapping best practices with main principles

1. Building interest in natural science phenomena and explanations:

HYPATIA allows high school and university students to visualize the complexity of the hadron - hadron interactions through the graphical representation of ATLAS event data and interact with them in order to study different aspects of the fundamental building blocks of nature.

2. Building up informed citizens: Students understanding the nature of Science & Science in society:

Using Hypatia is a powerful illustration of how an eScience experience can provide rich and meaningful opportunities for people to participate in and learn about science. With the appropriate guidance from the research teams, students can use tools of science as they learned the practices, goals, and habits of mind of the culture of science.

3. Develop multiple goals:

- **understanding big ideas in science including ideas of science, and ideas about science**
- **scientific capabilities concerned with gathering and using evidence**
- **scientific attitudes**

By engaging in scientific activities, students also develop greater facility with the language of scientists; terms like hypothesis, experiment, and control begin to appear naturally in their discussion of what they are learning. They think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science. When a transformation such as this one takes place, young people may begin to think seriously about a career in a research laboratory.

4. Understanding students' concepts and learning style about of science phenomena:

The HYPATIA learning environment allows students to work through material at their own pace, with different levels of support according to their own preferences. Inevitably, different students will embrace technology to greater or lesser extents and in different ways through the complementary interfaces the system offers.

5. Relevance of the content to daily life of students:

Today much of the ethical and political decision-making involves some understanding of the nature of science, its strengths and limits. To understand the role of science in deliberations about the projected outcomes of the experiments taking place in the LHC, their safety and value -given the immense investment involved- all students, including future scientists need to be critical consumers of scientific knowledge. The proposed practice improves students and teachers ability to engage in such debates, since they not only impart a knowledge of the content, but also a knowledge of 'how science works', "an element which should be an essential component of any school science curriculum".

6. Understanding science as a process not as stable facts. Using up-to-date information of science and education:

The proposed practice introduces students to concepts and ideas of science of a multidisciplinary nature spanning all science disciplines and engineering. As such it safeguards sustained intellectual engagement by the majority of students, while promoting the interest of the few who will choose to pursue careers in science. The students are asked to employ real-problem solving skills, to handle and study situations, and to engage in meaningful and motivating science inquiry activities.

7. Activities for gaining knowledge, not for entertainment, nor for simple imitating of results:

Through the use of HYPATIA students gain knowledge about the building blocks of matter and the interactions between particles.They also learnhowthescientificresearchprocessworks.

8. Doing science: experimenting, analyzing, interpreting, redefining explanations:

Students can do real event analysis in the same way that researchers are doing.

9. Assessment: formative ~ of students' learning and the summative ~ of their progress:

The use of HYPATIA has been evaluated in the framework of the Learning with ATLAS project (www.learningwithatlas.eu). The evaluation design and the analysis of the results were made by the research team of the University of Bayreuth and it is presented in the Guide of Good Parctice of the project. The results demonstrate the efficiency of the HYPATIA tool to promote the introduction of IBSE in the school environment.

10. Cooperation among teachers and with experts:

The proposed practice asks for cooperation between teachers and scientists and empowers teachers not only to change their teaching practice and introduce contemporary scientific issues in their lessons, but also to propose and initiate the necessary changes in their schools, to allow for a more seamless introduction of ICT innovations.