Online learning by experimenting

An example activity:
How long does a day last in Jupiter?

How long does a day last in Jupiter?

- **Educational Scenario by means of**
  - Astronomical pictures
  - Geometry
  - The Salsaj (or ImageJ) software

- **Duration:** 2X45min

- **Age Range:** 12-15, 15-18

How long does a day last in Jupiter?

- **Educational Objectives:**

- Get **information and planetary pictures** from the Internet.

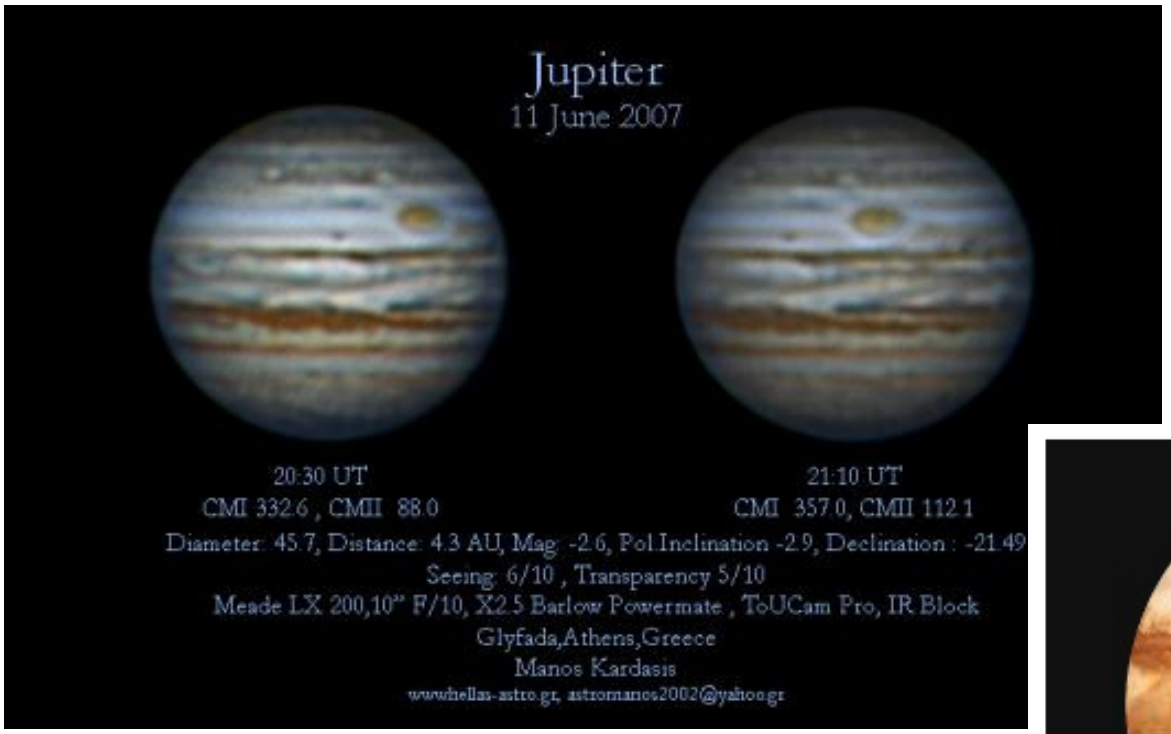
- Be aware of **model development importance** of a Physical system and the model verification (or not) through experiments and measurements.

- Use **simple actions of Salsaj software.**

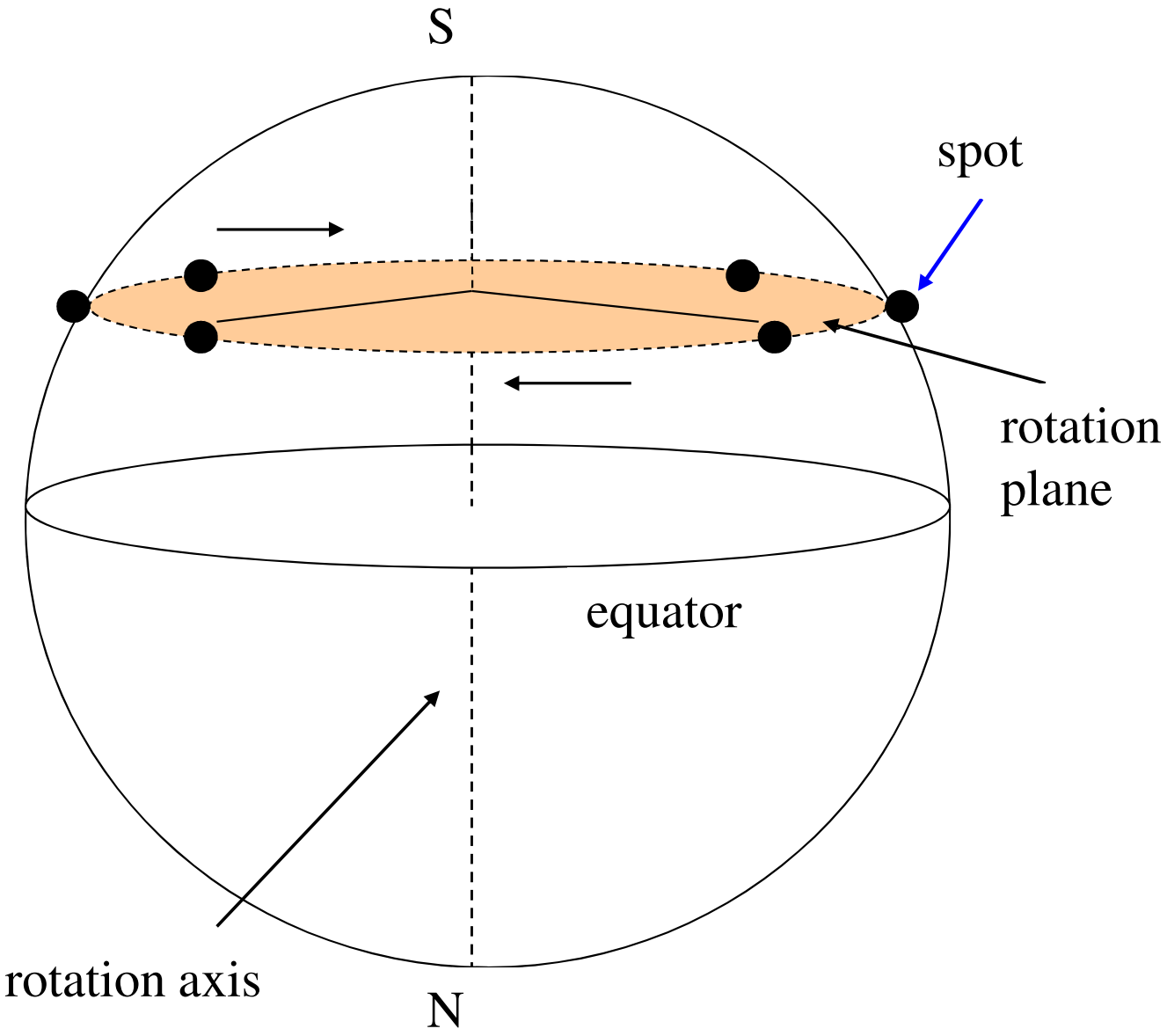
- Use the **normal round equations for statistics calculations** of a Physical system.

- Develop **actions, motivation and attitude** for Astronomy.

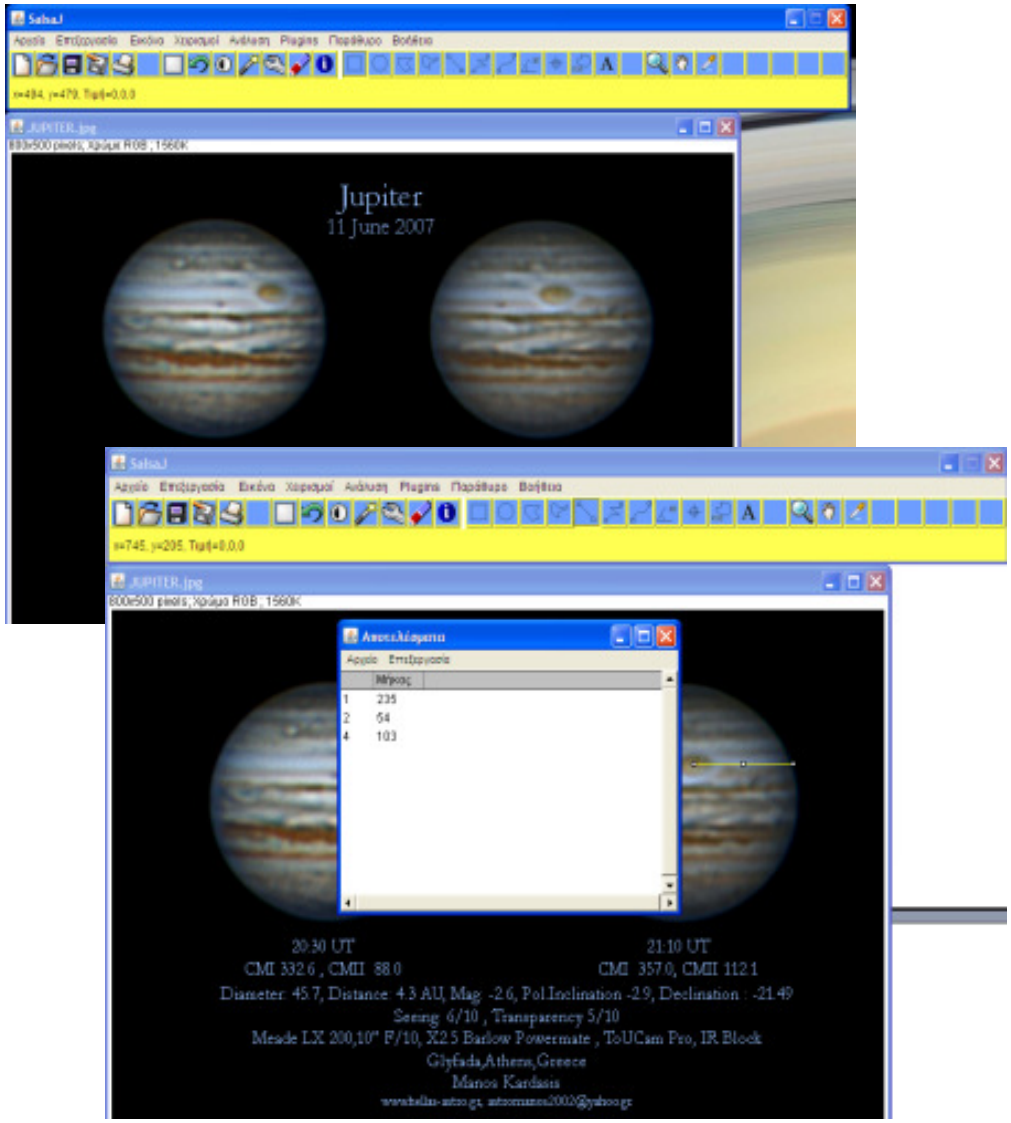
Using a remote robotic telescope to capture images of Jupiter

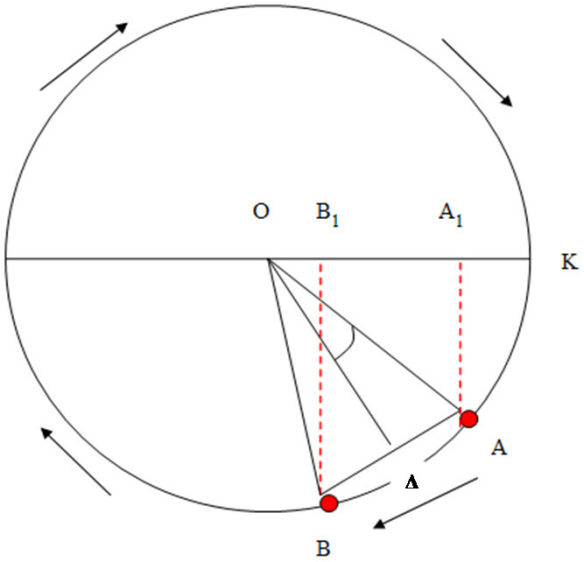


Working on the theoretical background

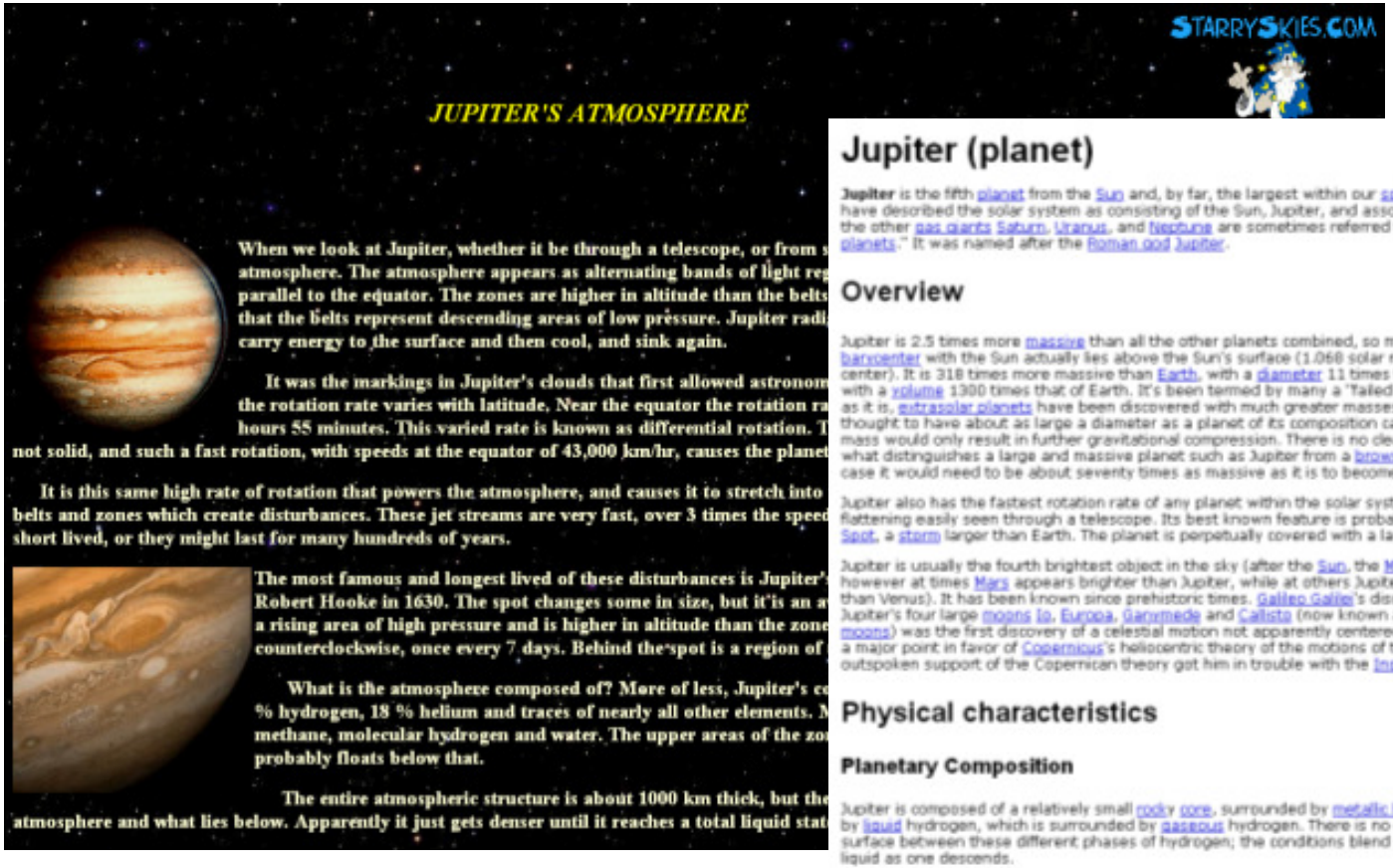


Using SalsaJ to collect and analyze data





Supporting the activity with digital educational resources



Jupiter (planet)

Jupiter is the fifth planet from the Sun and, by far, the largest within our solar system; some have described the solar system as consisting of the Sun, Jupiter, and assorted debris. It and the other gas giants Saturn, Uranus, and Neptune are sometimes referred to as "Jovian planets." It was named after the Roman god Jupiter.

Overview

Jupiter is 2.5 times more massive than all the other planets combined, so massive that its barycenter with the Sun actually lies above the Sun's surface (1.068 solar radii from the Sun's center). It is 318 times more massive than Earth, with a diameter 11 times that of Earth, and with a volume 1300 times that of Earth. It's been termed by many a "failed star." As impresssive as it is, extrasolar planets have been discovered with much greater masses. However, it is thought to have about as large a diameter as a planet of its composition can, as adding extra mass would only result in further gravitational compression. There is no clear-cut definition of what distinguishes a large and massive planet such as Jupiter from a brown dwarf but in any case it would need to be about seventy times as massive as it is to become a star.

Jupiter also has the fastest rotation rate of any planet within the solar system resulting in a flattening easily seen through a telescope. Its best known feature is probably the Great Red Spot, a storm larger than Earth. The planet is perpetually covered with a layer of clouds.

Jupiter is usually the fourth brightest object in the sky (after the Sun, the Moon and Venus; however at times Mars appears brighter than Jupiter, while at others Jupiter appears brighter than Venus). It has been known since prehistoric times. Galileo Galilei's discovery, in 1610, of Jupiter's four large moons Io, Europa, Ganymede and Callisto (now known as the Galilean moons) was the first discovery of a celestial motion not apparently centered on the Earth. It was a major point in favor of Copernicus's heliocentric theory of the motions of the planets; Galileo's outspoken support of the Copernican theory got him in trouble with the Inquisition.

Physical characteristics

Planetary Composition

Jupiter is composed of a relatively small rocky core, surrounded by metallic hydrogen, surrounded by liquid hydrogen, which is surrounded by gaseous hydrogen. There is no clear boundary or surface between these different phases of hydrogen; the conditions blend smoothly from gas to liquid as one descends.

Atmosphere

Jupiter's atmosphere is composed of ~86% hydrogen and ~14% helium (by number of atoms, the atmosphere is ~75%/24% by mass; with ~1% of the mass accounted for by other substances - the interior contains denser materials such that the distribution is ~71%/24%/5%). The atmosphere contains trace amounts of methane, water vapour, ammonia, and "rock". There are also negligible amounts of carbon, ethane, hydrogen sulfide, neon, oxygen, phosphine, and sulfur. This atmospheric composition is very close to the composition of the solar nebula. Saturn has a similar composition, but Uranus and Neptune have much less hydrogen and helium.

Jupiter's upper atmosphere undergoes differential rotation, an effect first noticed by Cassini

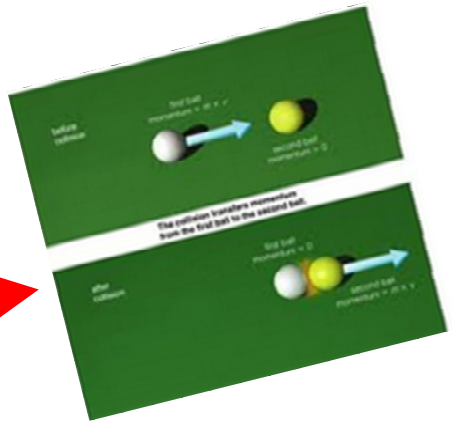
Jupiter

Orbital characteristics	
Avg Dist from Sol	5.20336301 AU
Mean radius	778,412,010 km
Eccentricity	0.04839266
Revolution period	11y 315d 1.1h
Synodic period	398.9 days
Avg. Orbital Speed	13.0697 km/s
Inclination	1.30530°
Number of satellites	61
Physical characteristics	
Equatorial diameter	142,984 km
Surface area	6.41×10^{10} km²
Mass	1.899×10^{27} kg
Mean density	1.33 g/cm³
Surface gravity	23.12 m/s²
Rotation period	9h 55.5m
Axial tilt	3.12°
Albedo	0.52
Escape Speed	59.54 km/s
Surface temp.	min mean max 110 K 152 K N/A K
Atmospheric characteristics	
Atmospheric pressure	70 kPa
Hydrogen	>81%
Helium	>17%
Methane	0.1%
Water vapor	0.1%

The need for a federation of online labs

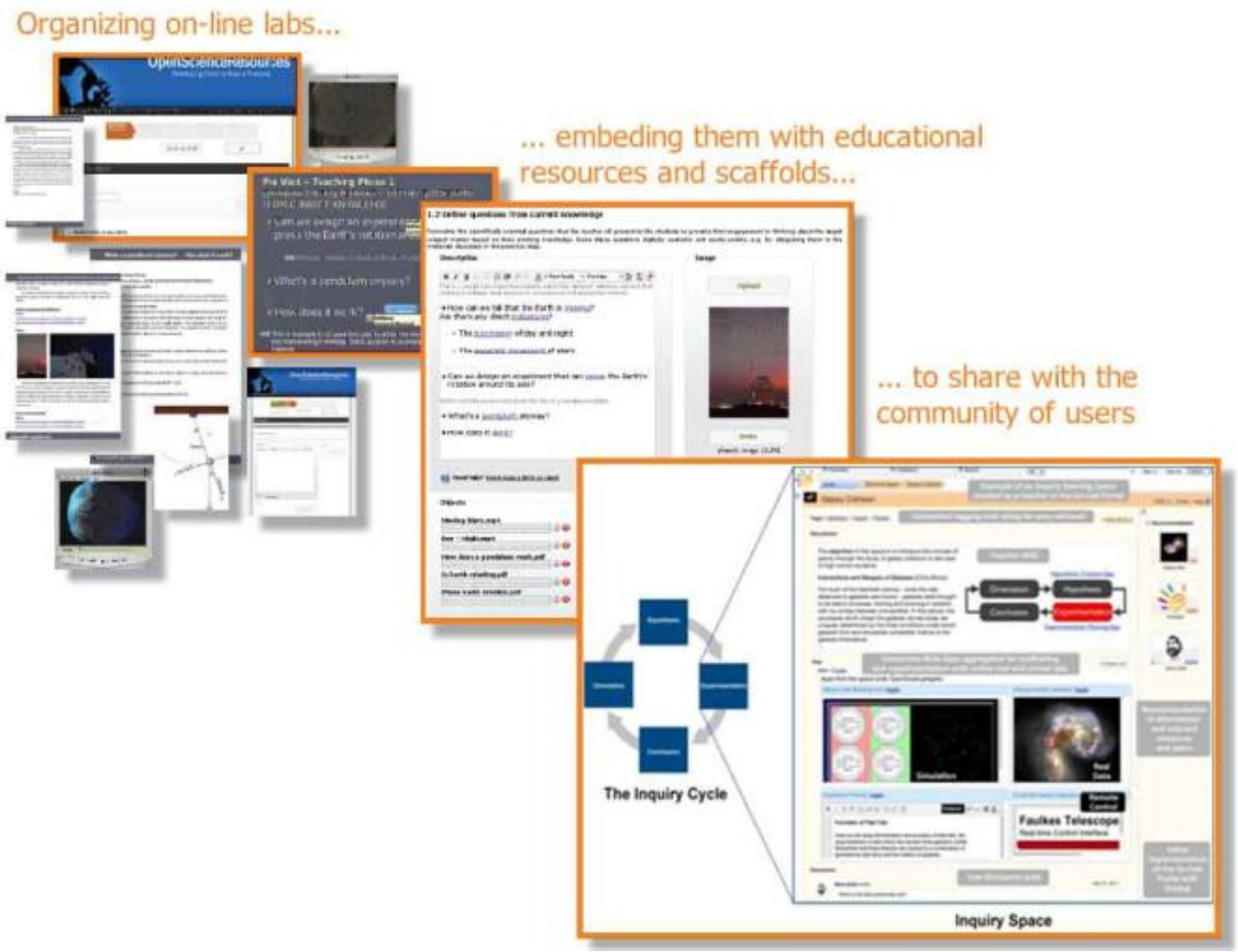
Searching for educational materials and tools

Searching for educational materials and tools

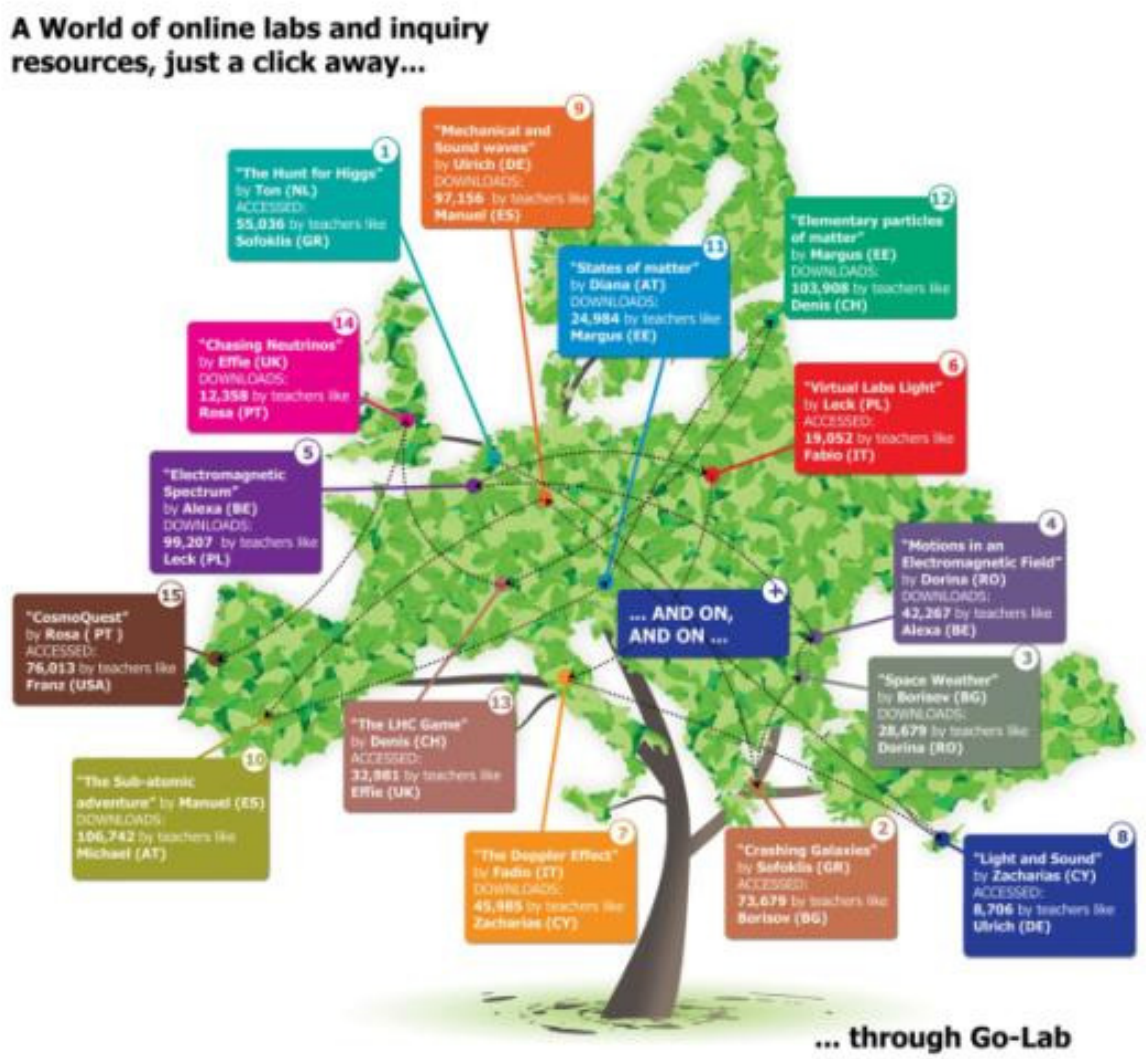


A search on Google for “conservation of momentum lab” retrieves 2.000.000 resources!

Necessity for a federation of on-line labs

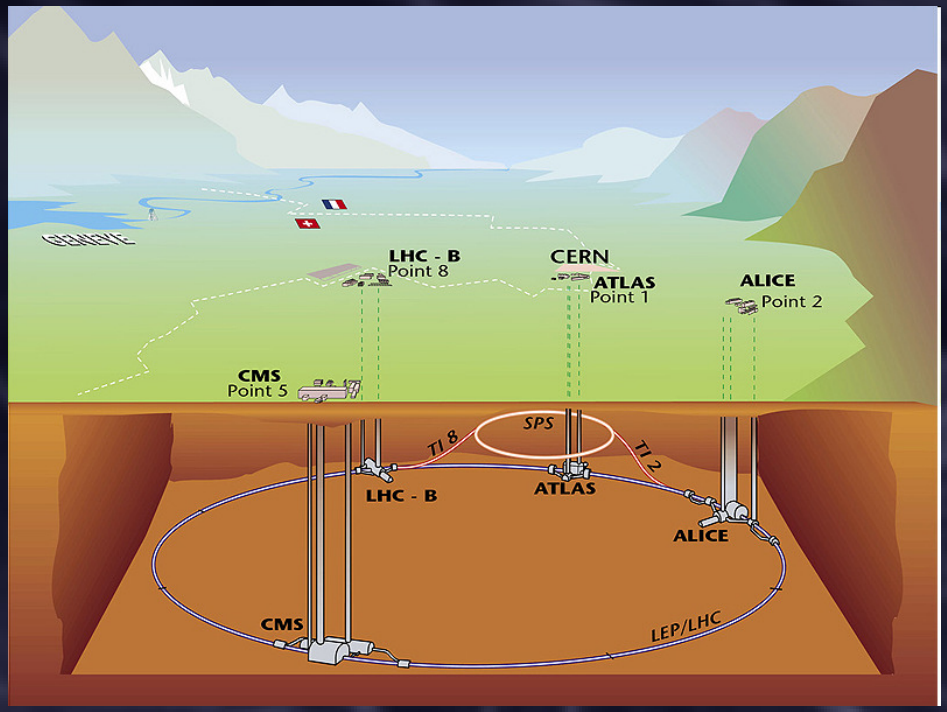


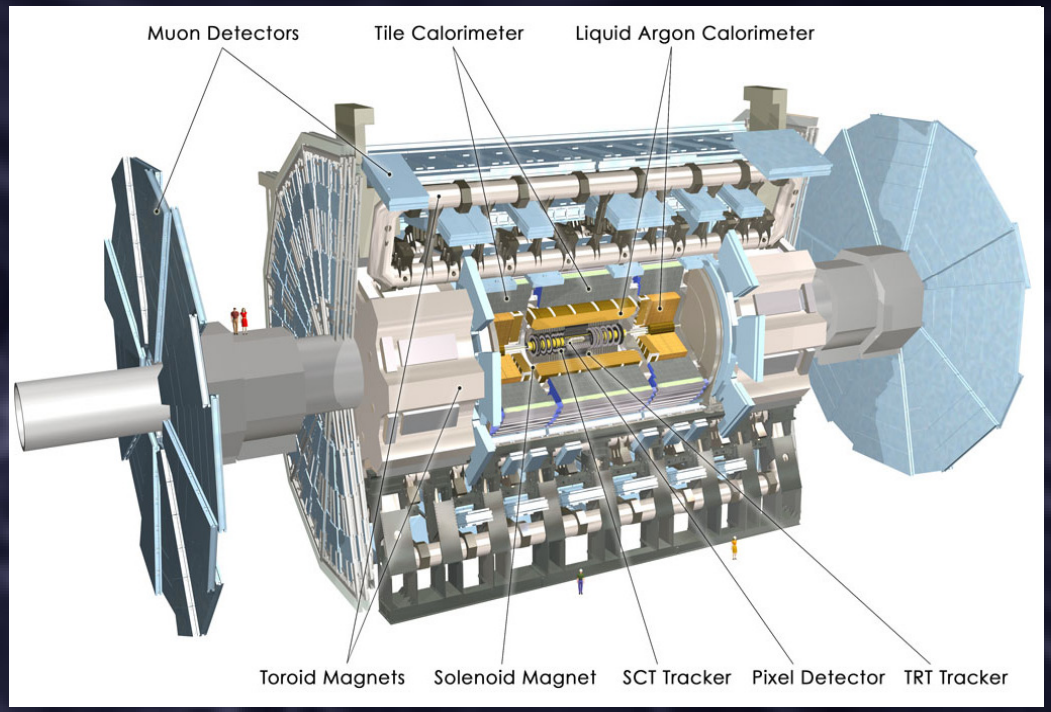
An ecosystem of users, online labs and educational resources

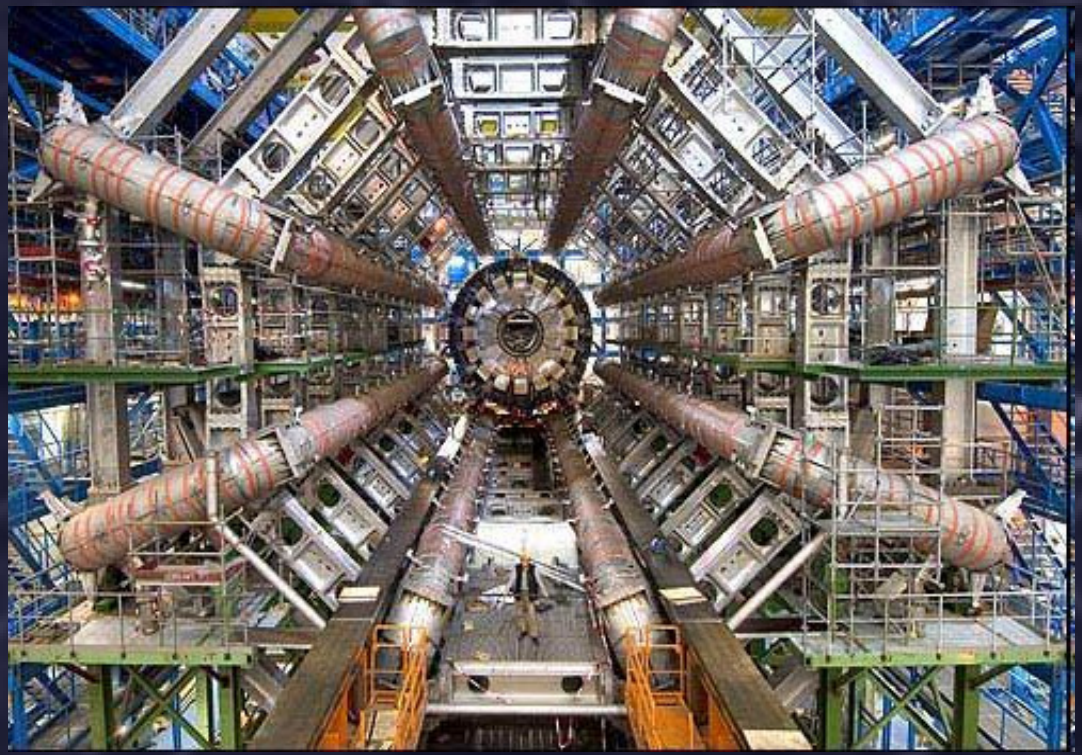


Sharing the vision of Go-Lab

Searching using Big Ideas of Science

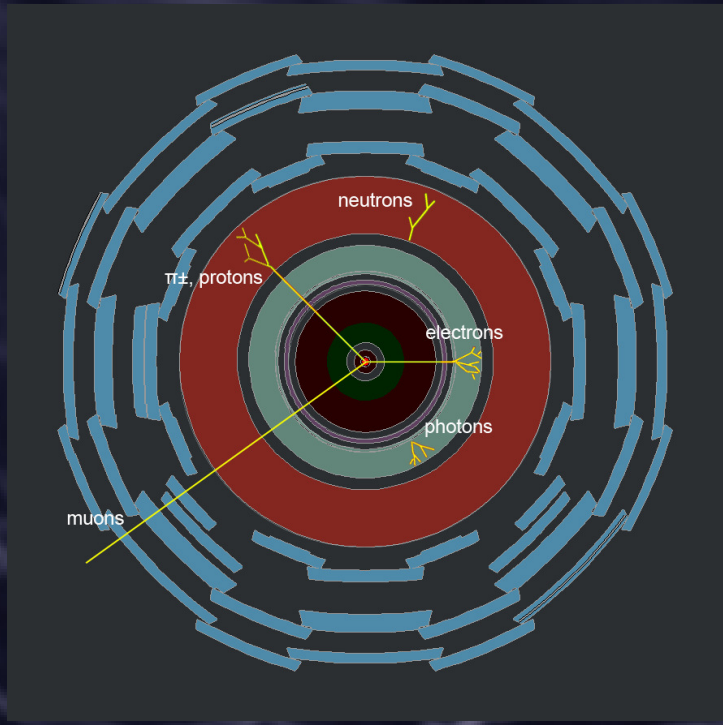

LHC - B
Point 8
CERN
ATLAS
Point 1
ALICE
Point 2
CMS
Point 5
SPS
TI 8
TI 2
LHC - B
ATLAS
ALICE
CMS
LEP/LHC

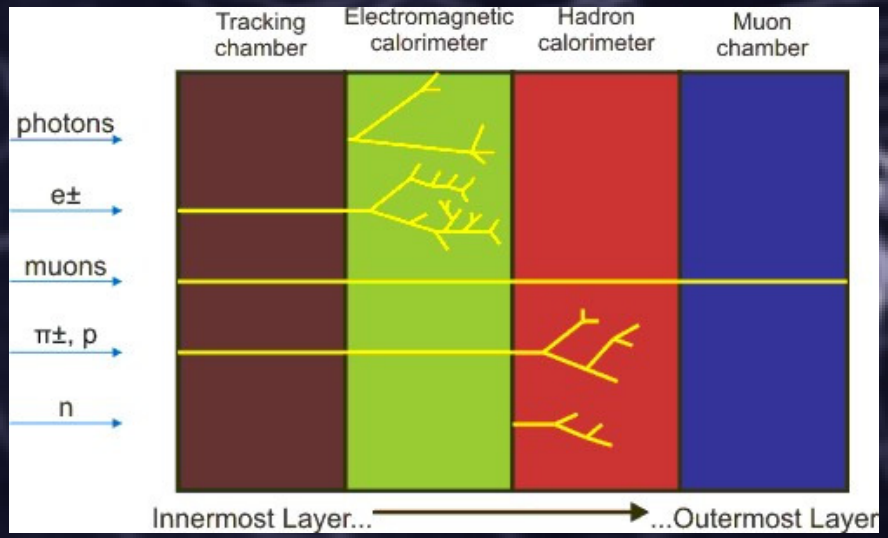

Muon Detectors
Tile Calorimeter
Liquid Argon Calorimeter
Toroid Magnets
Solenoid Magnet
SCT Tracker
Pixel Detector
TRT Tracker

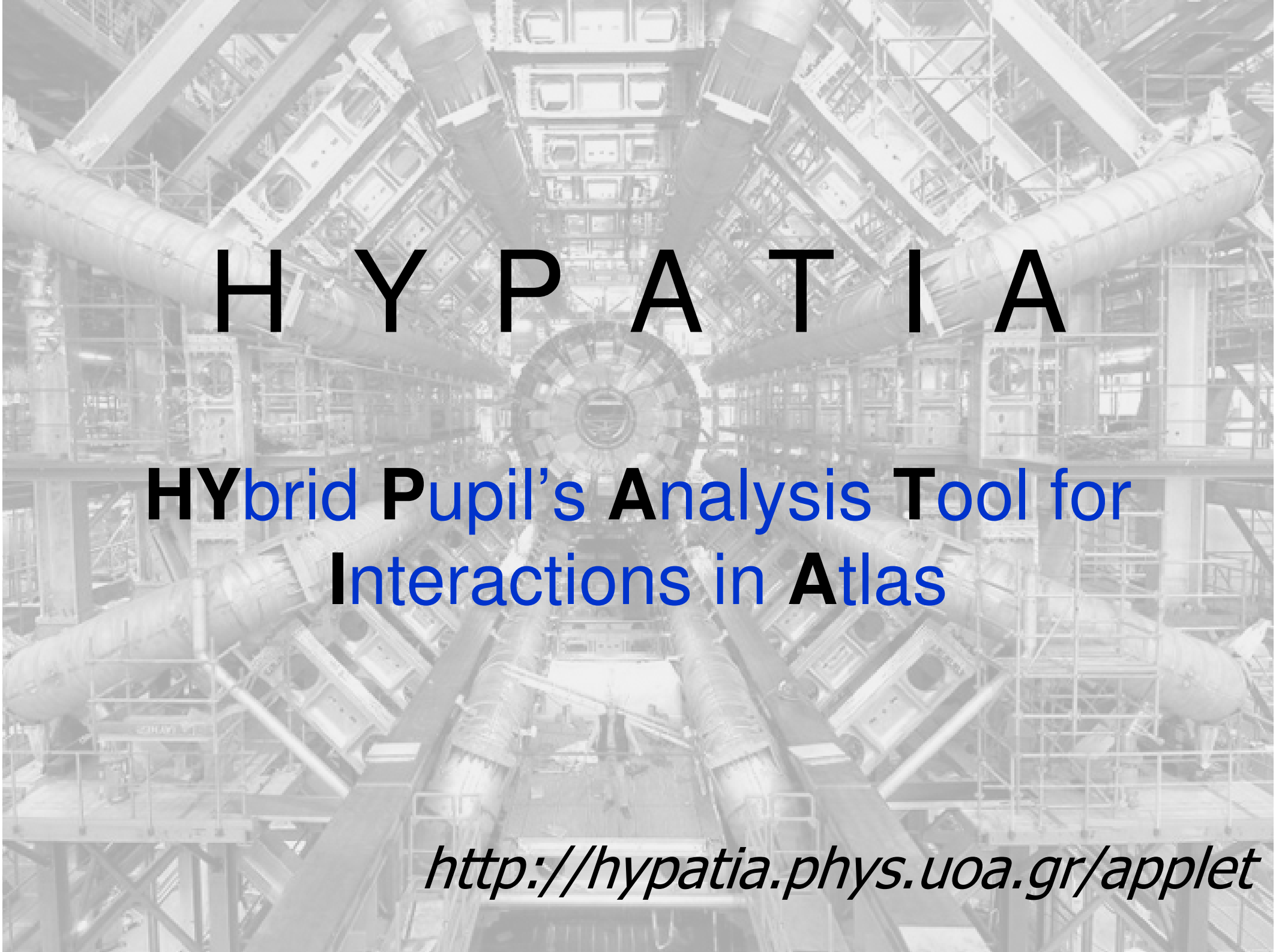


ATLAS

- 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





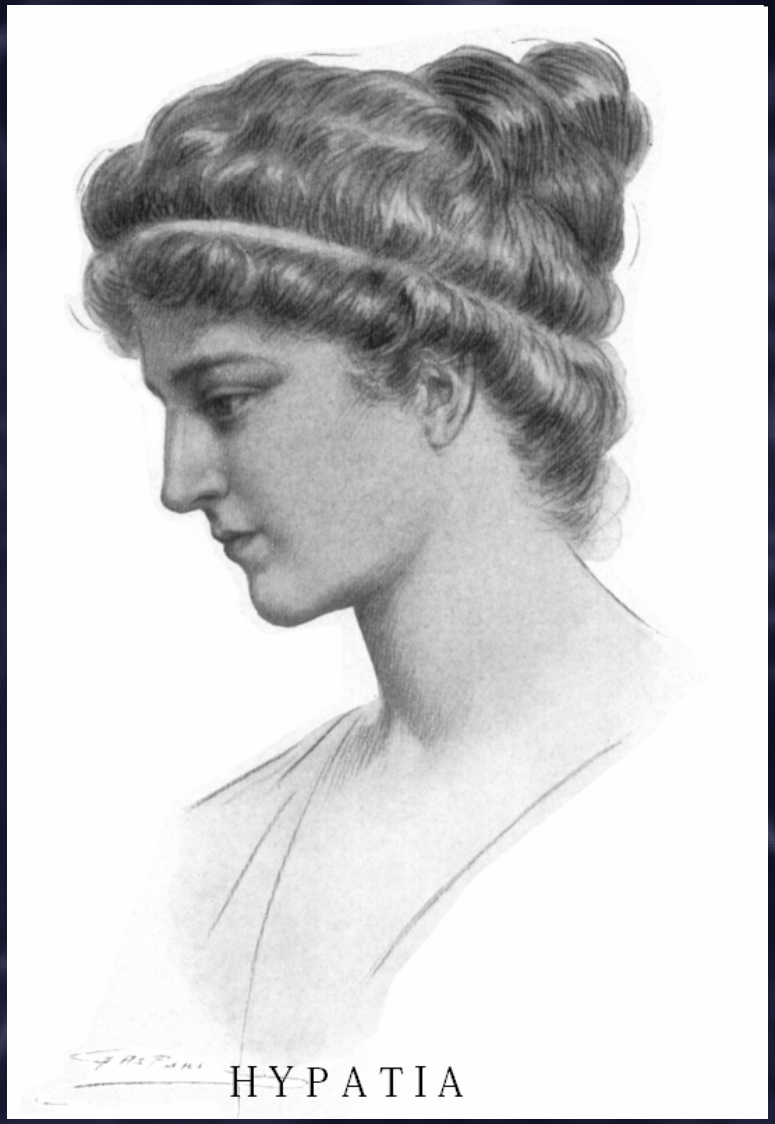


H Y P A T I A

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

http://hypatia.phys.uoa.gr/applet

HYPATIA of Alexandria



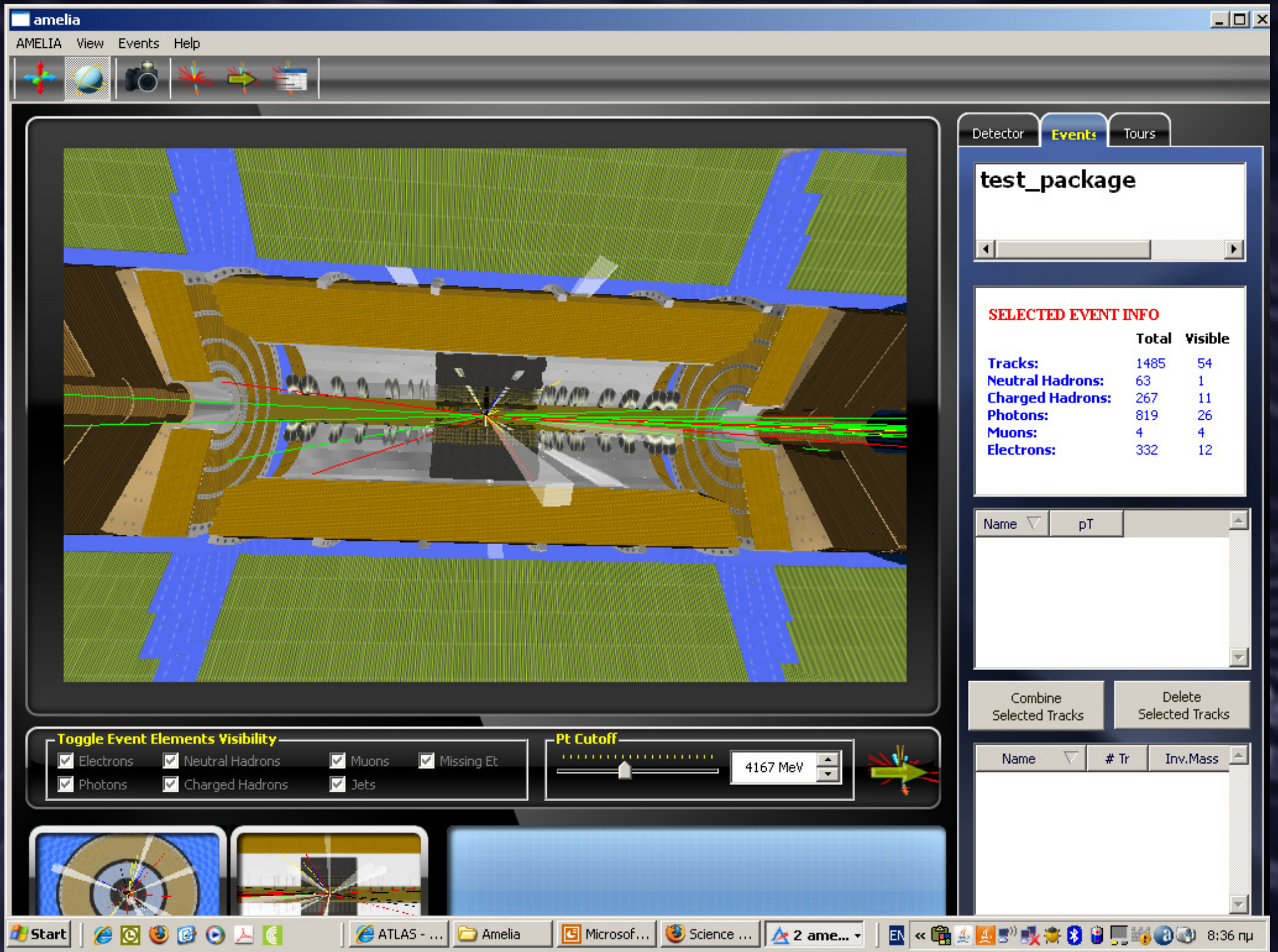
- First woman mathematician
- Alexandria, Egypt (370-418 A.D.)

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

- Developed as part of Learning with ATLAS@CERN, an educational program on modern particle physics
- Currently part of The Pathway to Inquiry Based Science Teaching and Discover the Cosmos
- 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 scientific and educational use

Conservation of momentum

- Take the example of a proton-proton collision in LHC
- Collisions and conservation of momentum is part os the 1st and 2nd class of Lyceum (16-17 years old) in Greece but also in most EU curruicula
- The momentum before and after the collision have to be the same


amelia
AMELIA View Events Help
Detector
Events
Tours
test_package
SELECTED EVENT INFO
Total Visible
Tracks: 1485 54
Neutral Hadrons: 63 1
Charged Hadrons: 267 11
Photons: 819 26
Muons: 4 4
Electrons: 332 12
Name pT
Combine Selected Tracks
Delete Selected Tracks
Name # Tr Inv.Mass
Toggle Event Elements Visibility
Electrons Neutral Hadrons Muons Missing Et
Photons Charged Hadrons Jets
Pt Cutoff
4167 MeV
Start
ATLAS - ...
Amelia
Microsof...
Science ...
2 ame...
8:36 πμ

http://hypatia.phys.uoa.gr/applet/

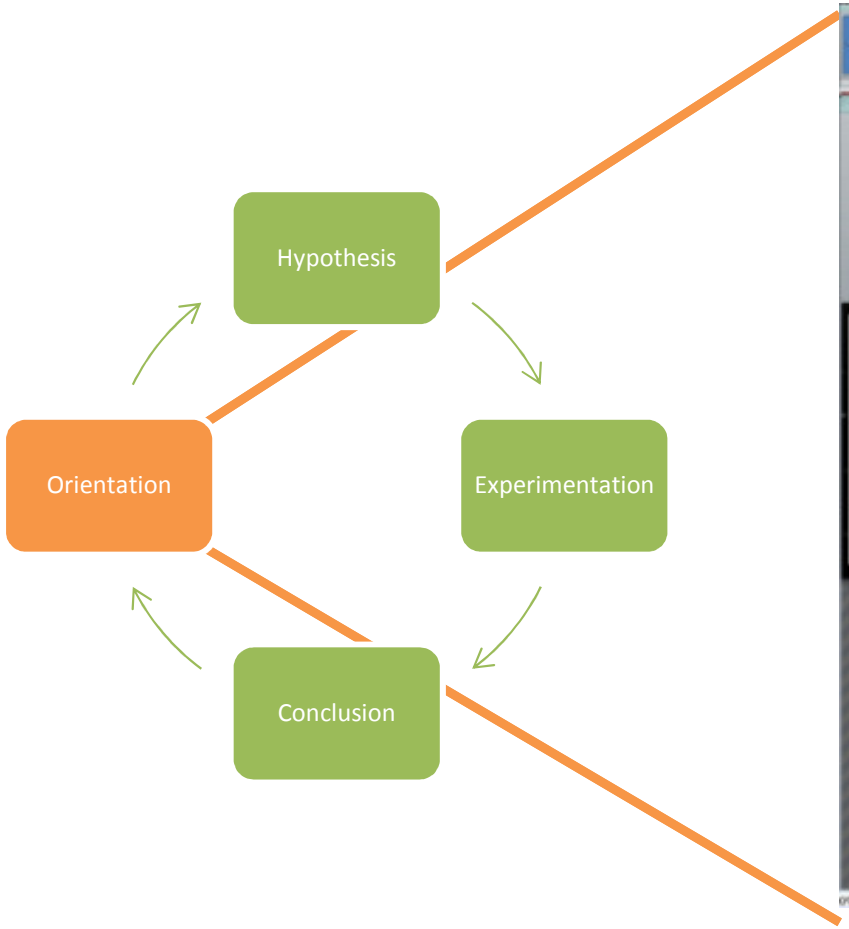
- General information about CERN, LHC, ATLAS, ATLANTIS
- Basic physics knowledge about the ATLAS experiment
- Instructions for the use of HYPATIA – full and simplified versions
- Relative links for further information

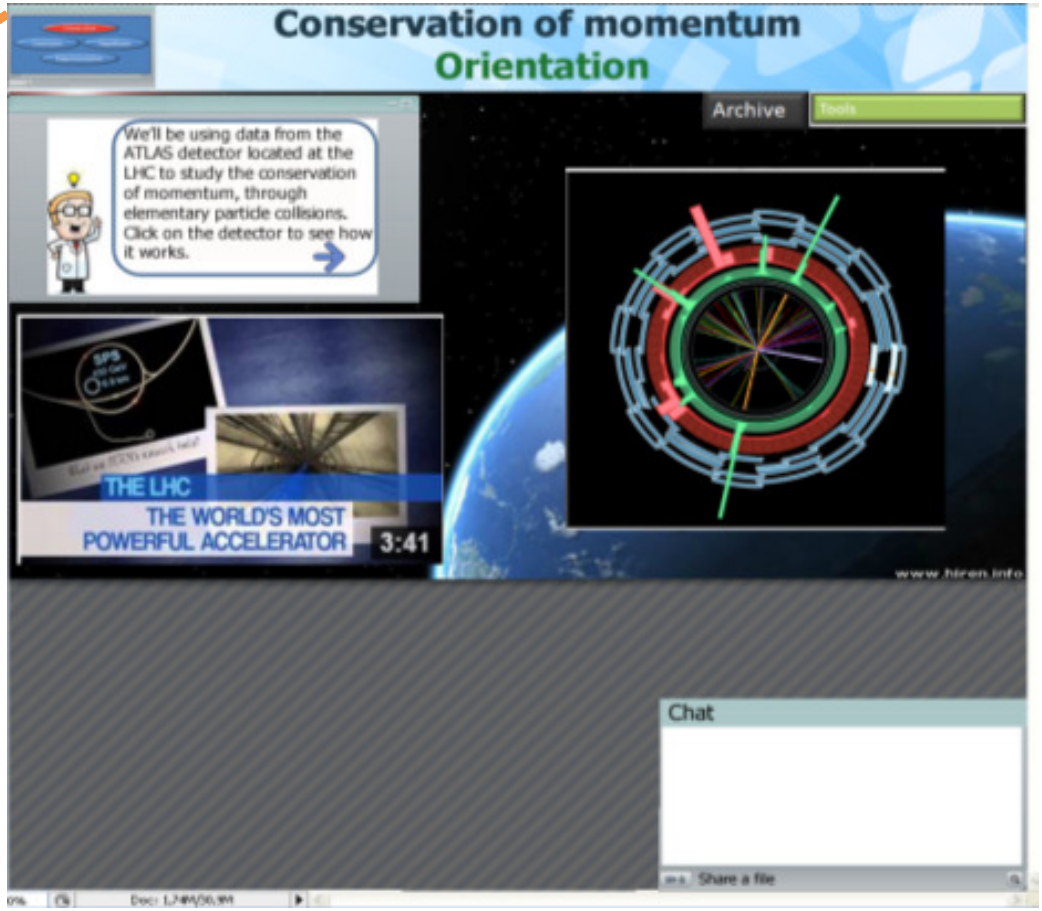
In Go-Lab


GO-LAB
Global Online Science Labs for Inquiry Learning at School
Search the Go-Lab library

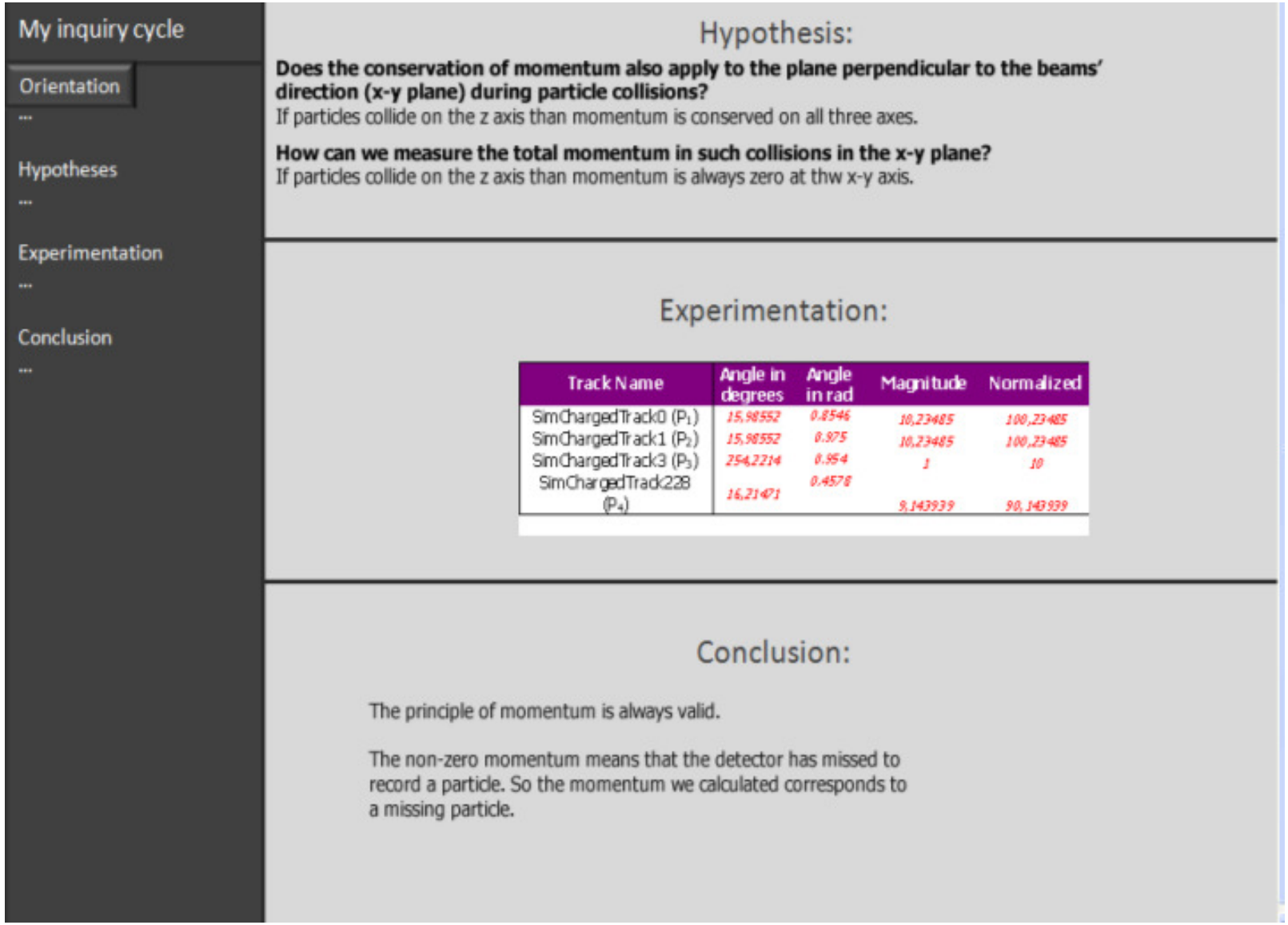

GO-LAB
Global Online Science Labs for Inquiry Learning at School
Conservation of momentum
Short Description
Students are introduced to the online lab HYPATIA, that display real data from the ATLAS experiment. Moreover, they understand vectors, how they are added in two dimensions and how conservation of physical quantities represented by vectors (momentum) allows us to infer information about invisible components of an experiment.
Subject Domain
Particle accelerators (CERN etc), LHC - Large Hadron Collider, LHC - Large Hadron Collider, LHC - Large Hadron Collider, Elementary particles, Quarks and leptons, Fermions and Bosons
Educational Objectives
The scenario helps students understand vectors, how they are added in two dimensions and how conservation of physical quantities represented by vectors (momentum) allows us to infer information about invisible components of an experiment.
View Go-Lab environment
View relative on-line labs
More Information
Classifications: Detectors, Calorimeters, Conservation of momentum, Collision
Age Range: 15-18
Aggregation Level: Go-Lab environment
Level of Difficulty: Medium
Educational Asset Type: Exercise - Experiment
Interactivity Level: High
Language: english
Learning Time: 2 didactic hours
Structure: Linear
Add to favorites

Following the Inquiry cycle Orientation





Following the Inquiry cycle Overview



Escoles pilot

- 1,000 escoles participant en el projecte (2016)
- **Estiu 2013**:
  - **100 escoles pilot** (provar, avaluar, ajudar…)

Vosaltres?