



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?

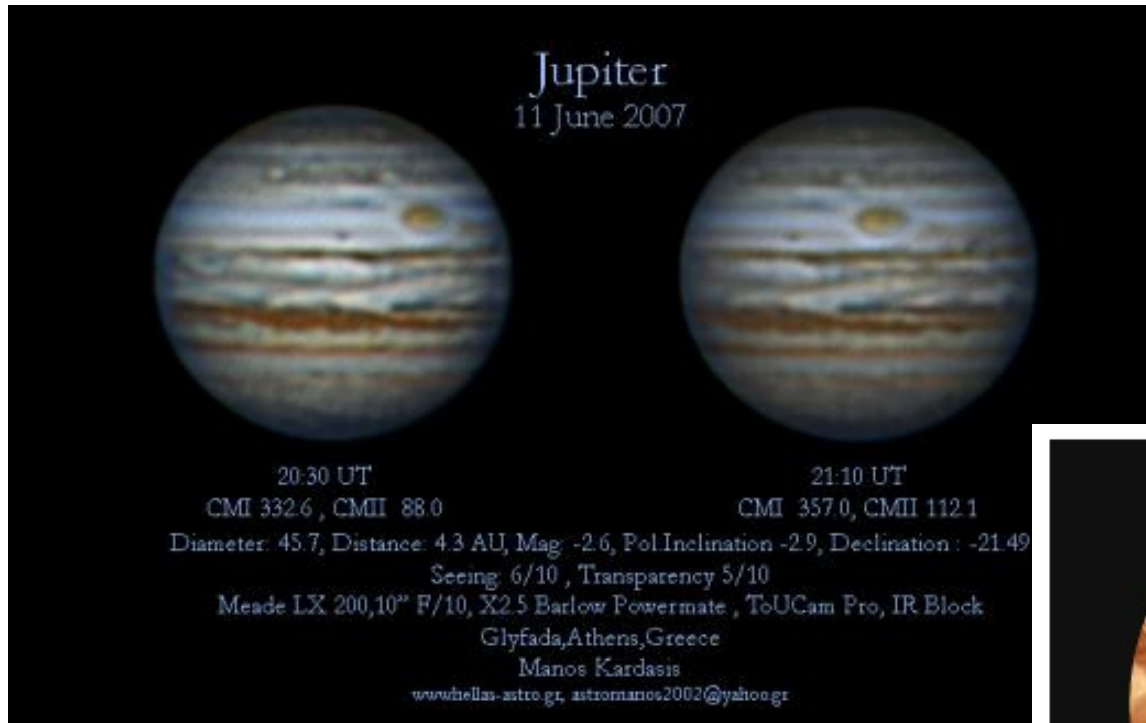


➤ Educational Objectives:

- 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.

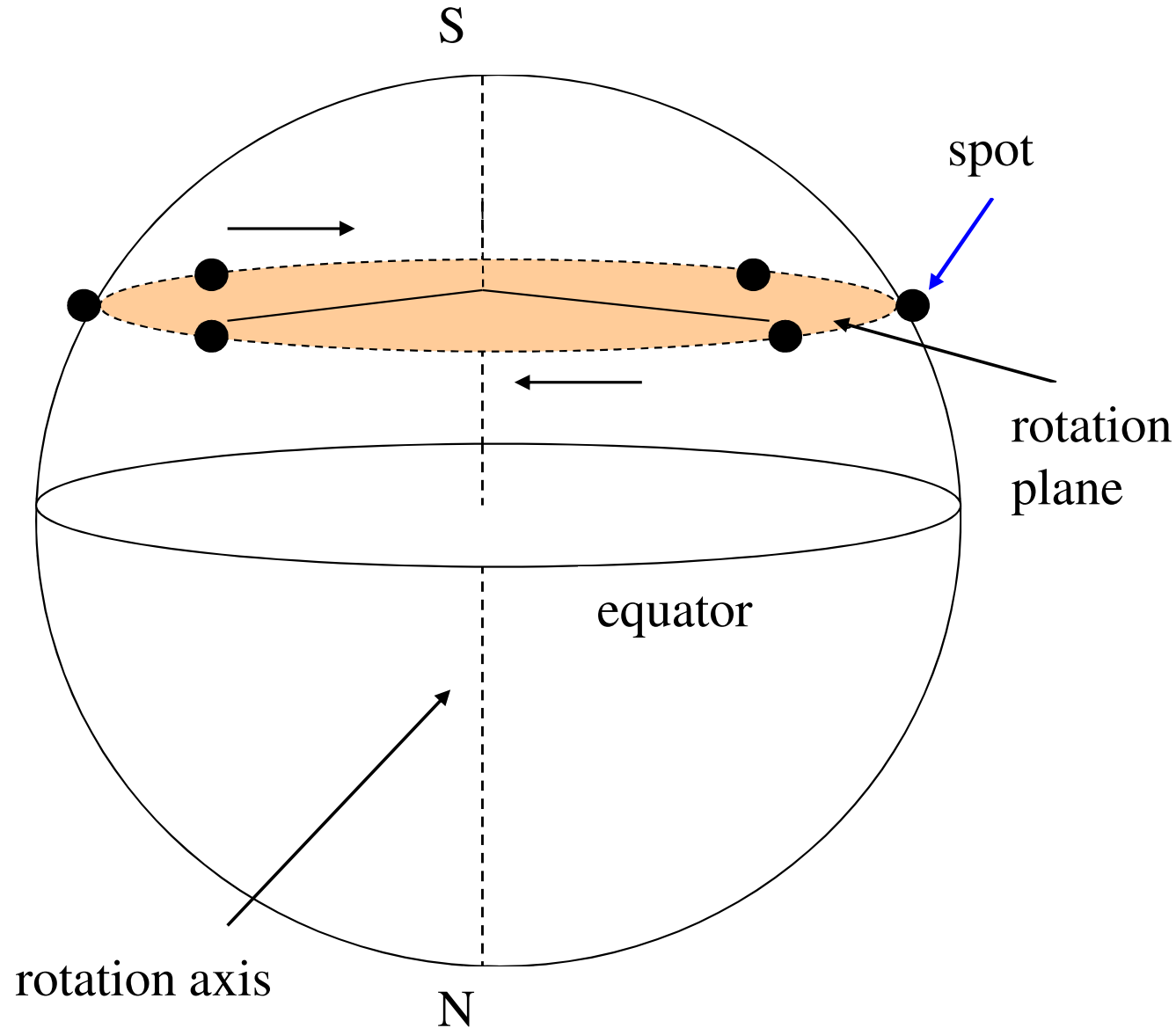


Using a remote robotic telescope to capture images of Jupiter



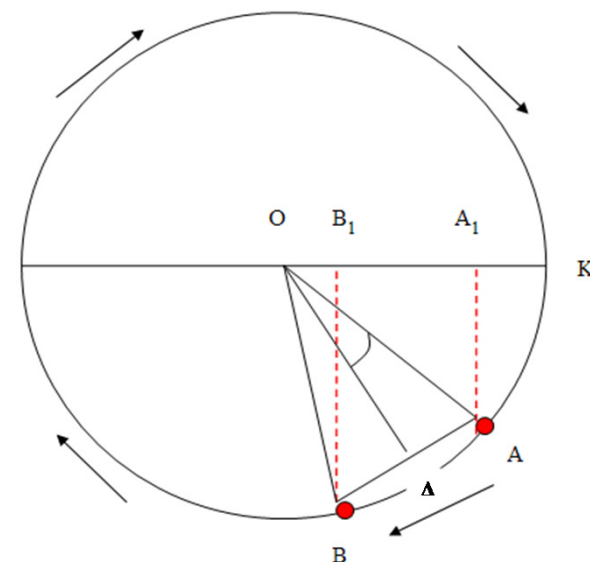
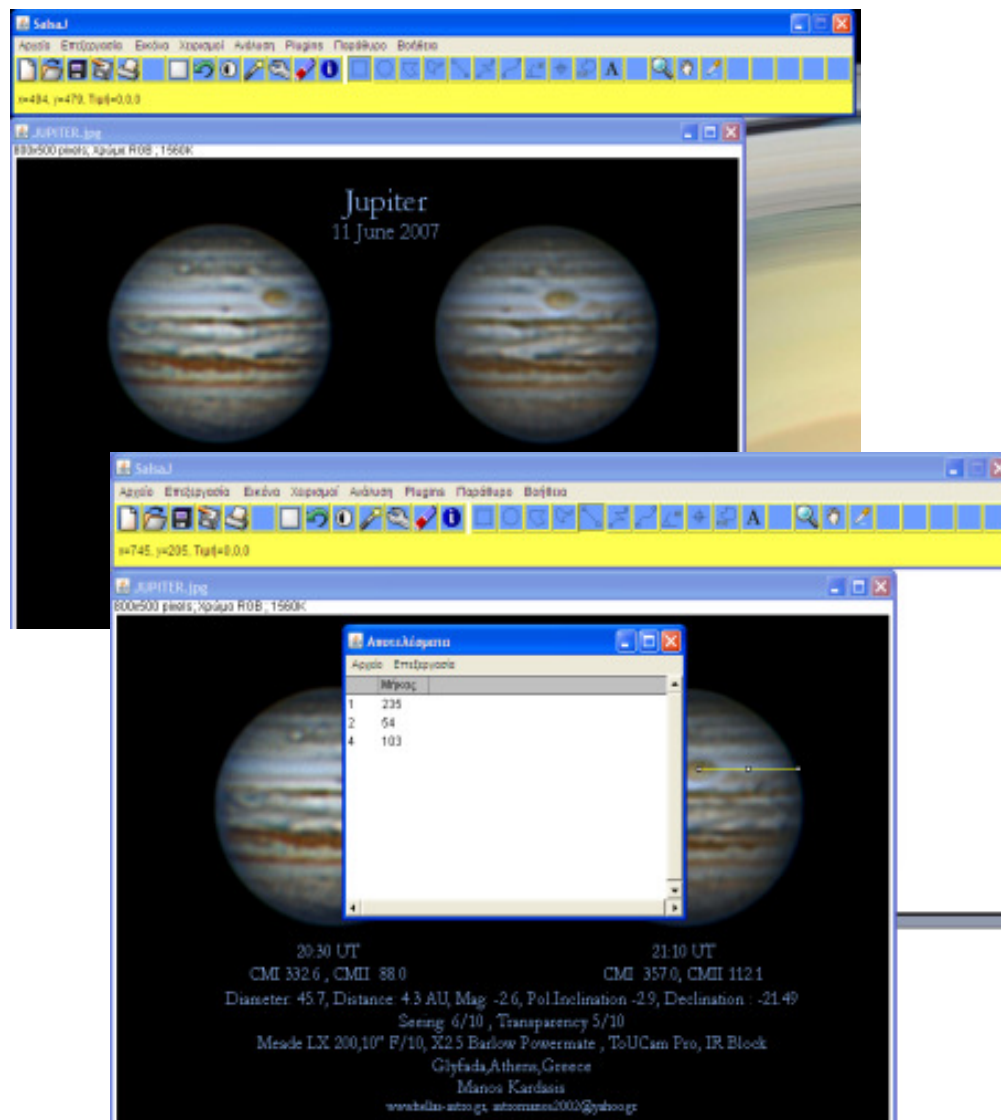


Working on the theoretical background





Using SalsaJ to collect and analyze data






Supporting the activity with digital educational resources



STARRY SKIES.COM


JUPITER'S ATMOSPHERE



When we look at Jupiter, whether it be through a telescope, or from space, the atmosphere appears as alternating bands of light and dark, parallel to the equator. The zones are higher in altitude than the belts that the belts represent descending areas of low pressure. Jupiter radiates energy to the surface and then cool, and sink again.

It was the markings in Jupiter's clouds that first allowed astronomers to determine the rotation rate varies with latitude. Near the equator the rotation rate is about 9 hours 55 minutes. This varied rate is known as differential rotation. The planet is not solid, and such a fast rotation, with speeds at the equator of 43,000 km/hr, causes the planet to flatten.

It is this same high rate of rotation that powers the atmosphere, and causes it to stretch into belts and zones which create disturbances. These jet streams are very fast, over 3 times the speed of sound, short lived, or they might last for many hundreds of years.



The most famous and longest lived of these disturbances is Jupiter's Great Red Spot. Robert Hooke in 1630. The spot changes some in size, but it's an area of a rising area of high pressure and is higher in altitude than the zone around it, counterclockwise, once every 7 days. Behind the spot is a region of low pressure.

What is the atmosphere composed of? More or less, Jupiter's atmosphere is composed of 86% hydrogen, 18% helium and traces of nearly all other elements. Methane, molecular hydrogen and water. The upper areas of the zone probably floats below that.

The entire atmospheric structure is about 1000 km thick, but the atmosphere and what lies below. Apparently it just gets denser until it reaches a total liquid state.

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 "faded star." As impressive 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 11h
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 km ²
Mass	1.899 × 10 ²⁷ kg
Mean density	1.33 g/cm ³
Surface gravity	23.12 m/s ²
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

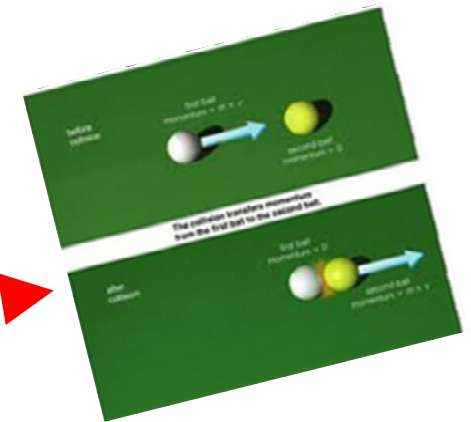


Searching for educational materials and tools





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



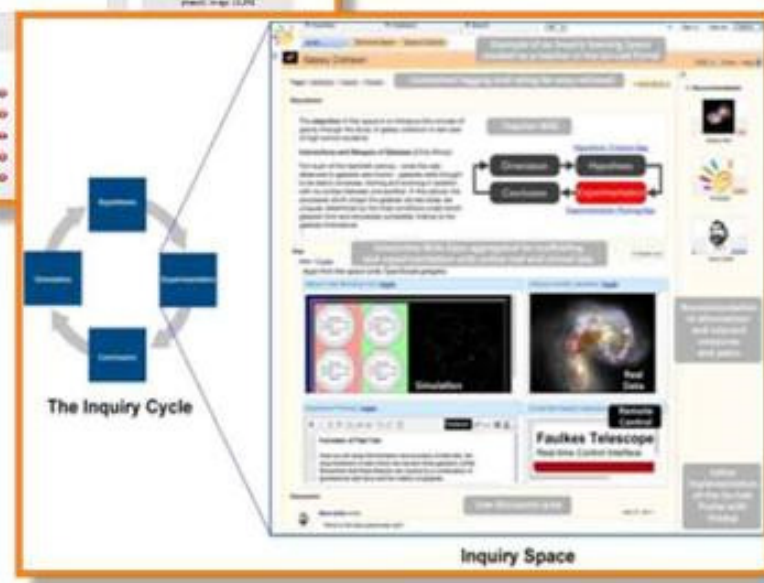
Organizing on-line labs...



... embedding them with educational
resources and scaffolds...



... to share with the
community of users

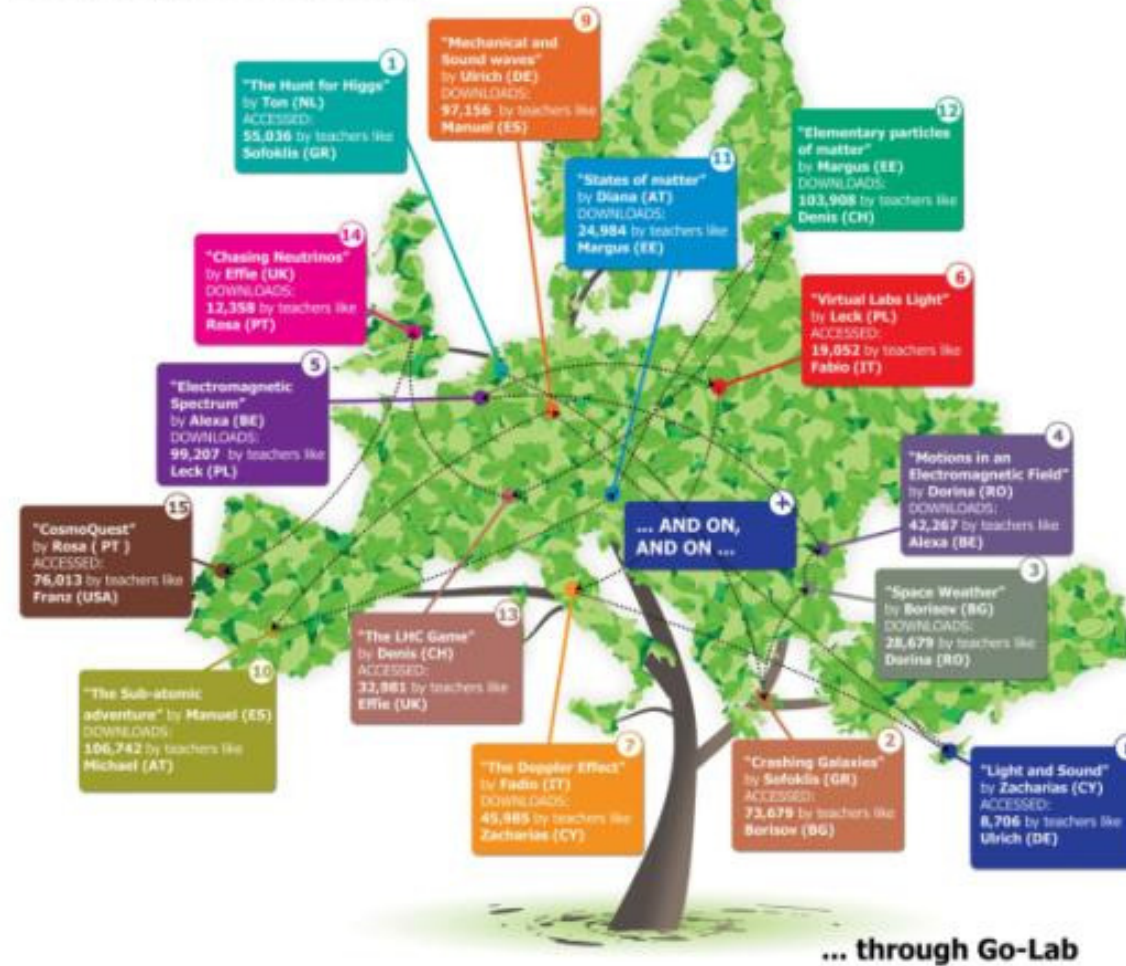




An ecosystem of users, online labs and educational resources



A World of online labs and inquiry resources, just a click away...



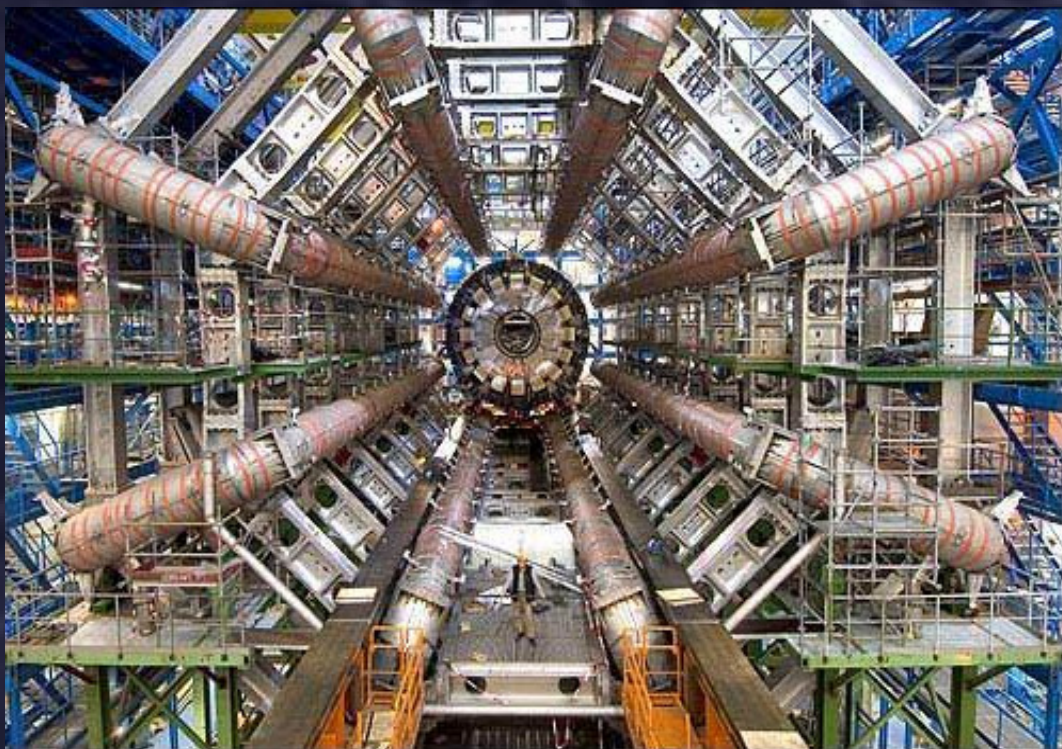
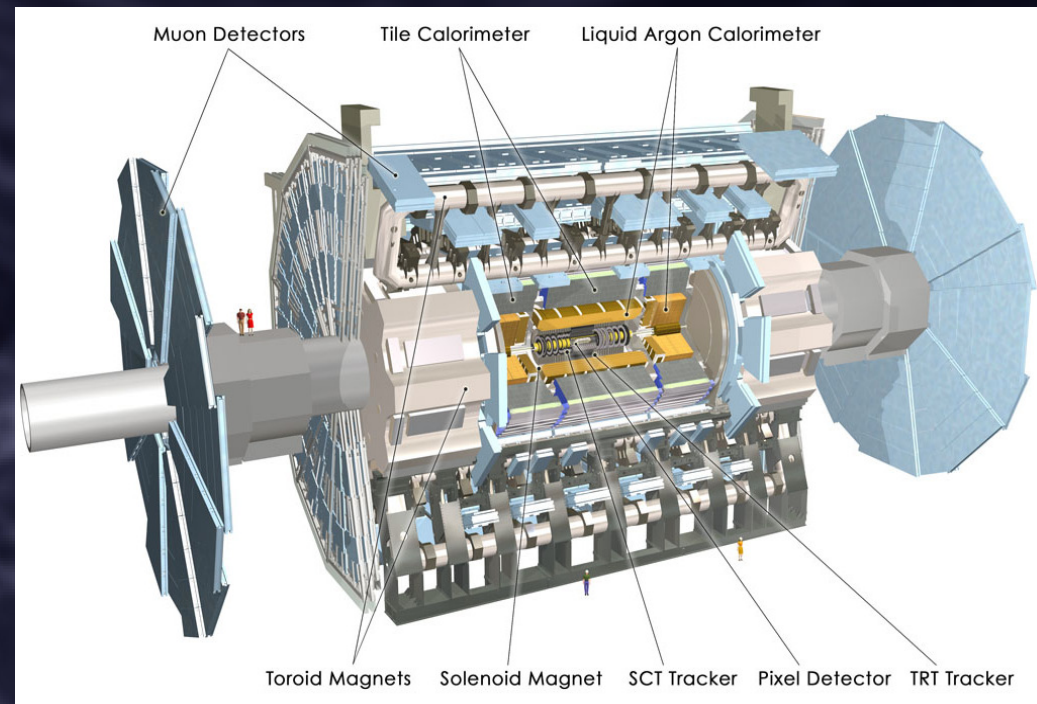
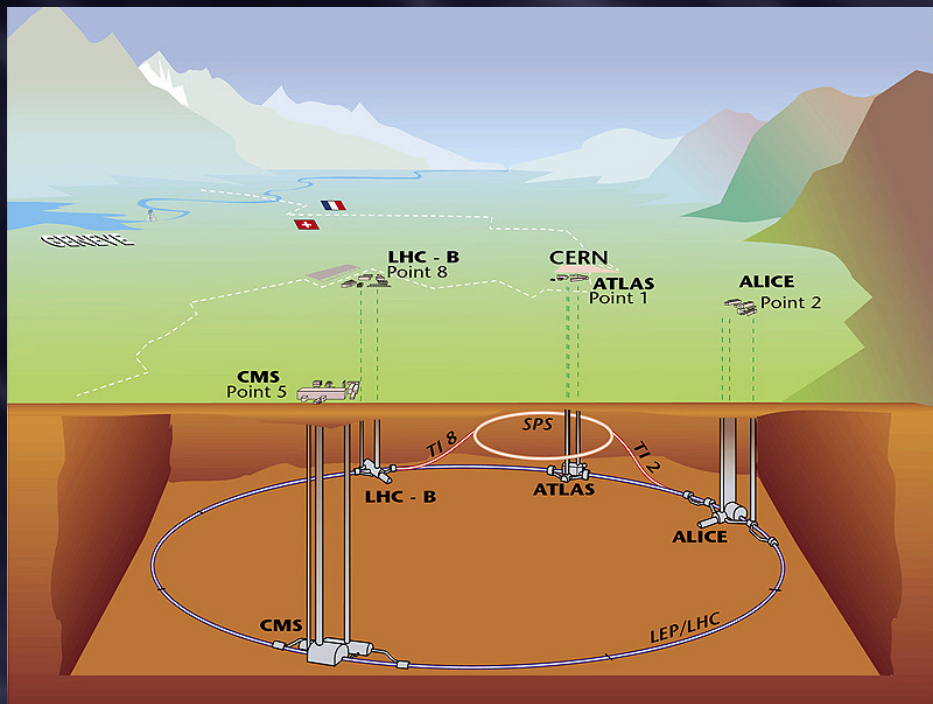


Sharing the vision of Go-Lab



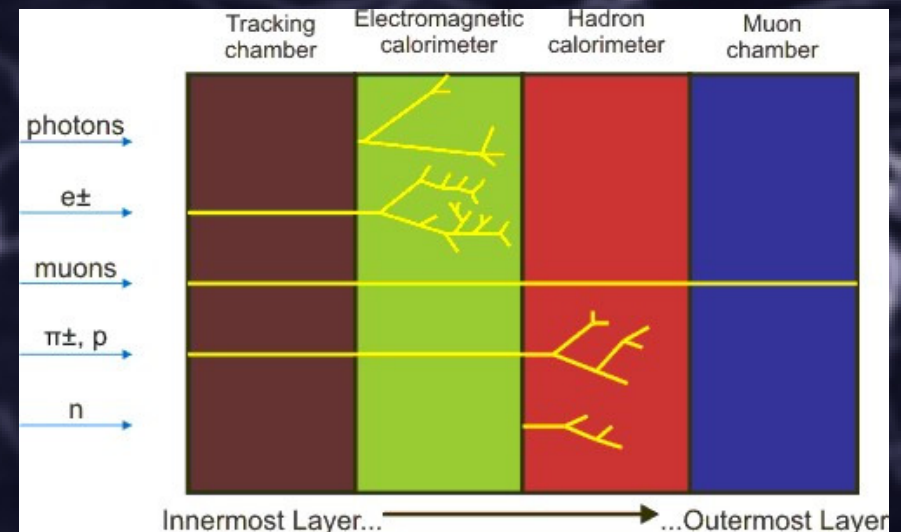
Searching using Big Ideas of Science





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



HYPATIA

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

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

HYPATIA of Alexandria



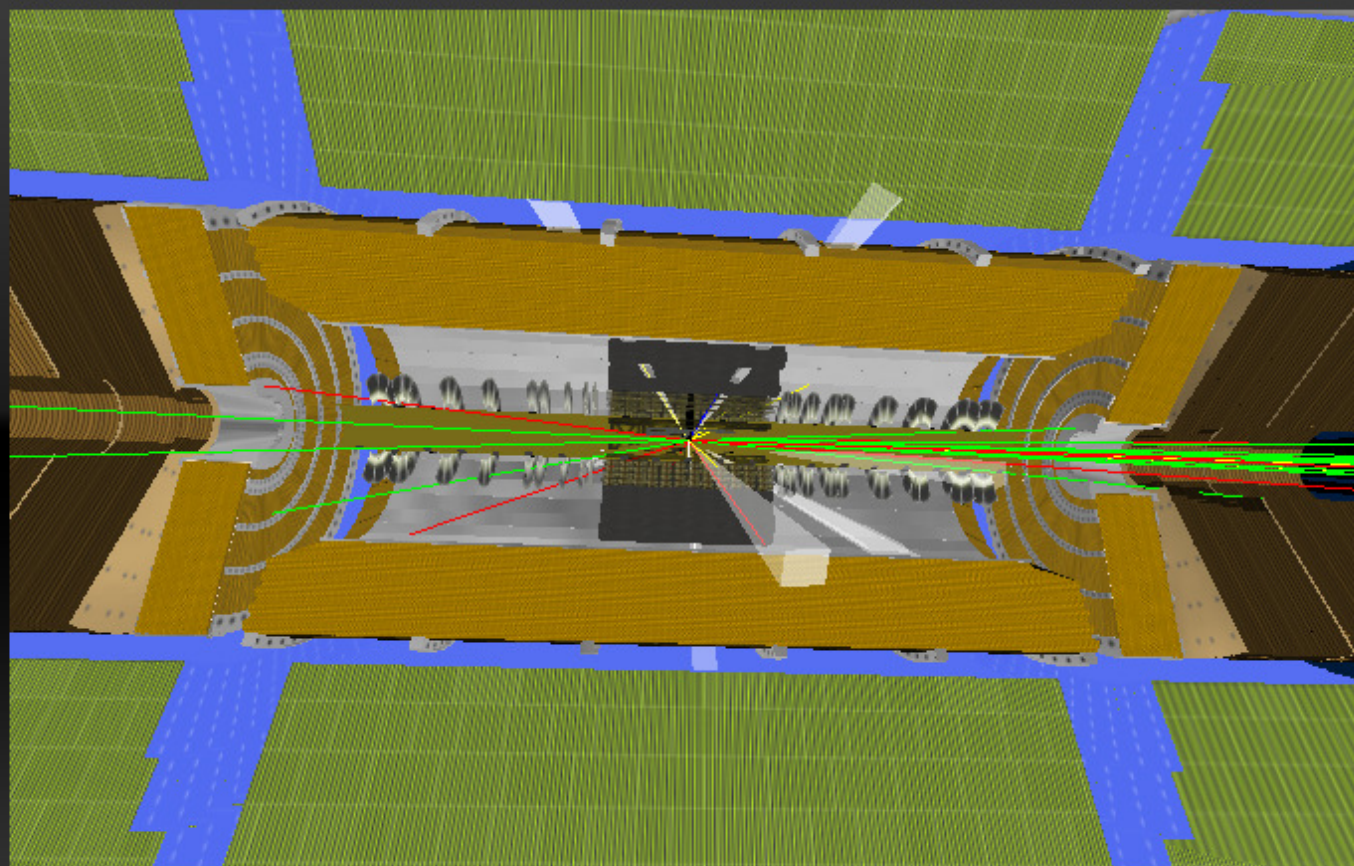
- First woman mathematician
- Alexandria, Egypt (370-418 A.D.)

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 of the 1st and 2nd class of Lyceum (16-17 years old) in Greece but also in most EU curricula
- The momentum before and after the collision have to be the same



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

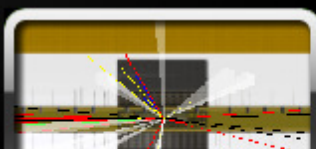
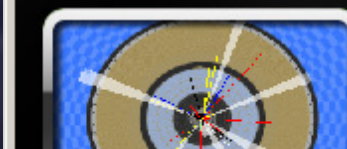
Delete
Selected Tracks

Name ▾	# Tr	Inv.Mass

Toggle Event Elements Visibility

- ☒ Electrons
 ☒ Neutral Hadrons
 ☒ Muons
 ☒ Missing Et
☒ Photons
 ☒ Charged Hadrons
 ☒ Jets

Pt Cutoff



<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



Global Online Science Labs for Inquiry Learning at School

Search the Go-Lab library

☐ On-line lab
☐ Go-Lab Environment
☐ Inquiry Process - Scaffolds

Subject Domain
Drop down menu

Big Ideas of Science
Drop down menu

Free text search

☐ View all
☐ View Alphabetically

Language
☐ en
☐ de
☐ el
☐ hu
☐ fr
☐ es
☐ it
☐ pt

Age Range
☐ less than 6
☐ 6-8
☐ 9-12
☐ 12-15
☐ 15-18
☐ 18-25
☐ 25+
☐ all ages

Most Popular on-line labs

- HYPATIA
- MINERVA
- AMELIA
- CERN Land

More popular Go-Lab environments

- Conservation of momentum
- Searching for the Higgs Boson
- Coaching Galileo
- How long does a day last on Jupiter?



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

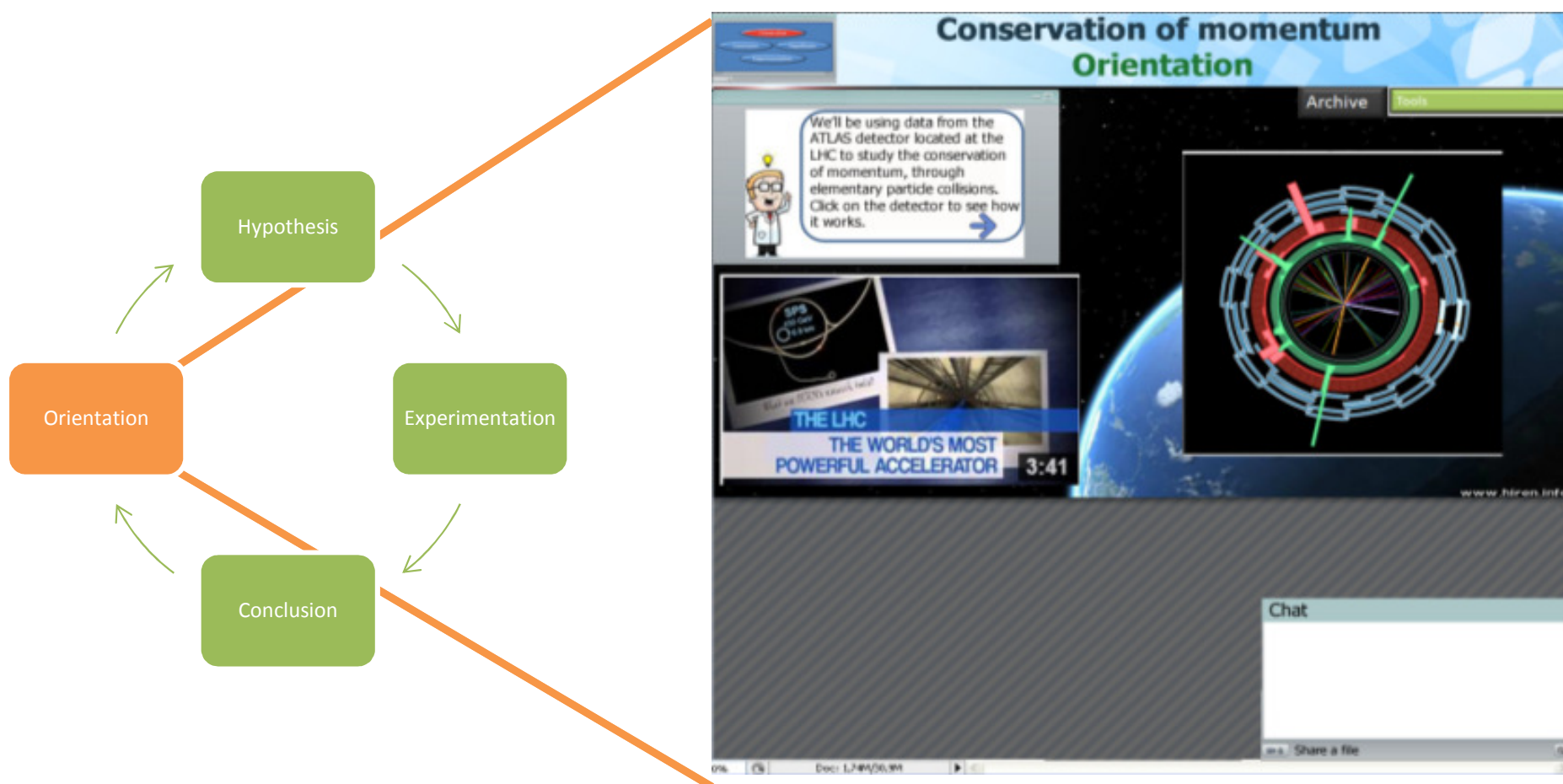
Educational Objectives
The scenario helps students understand vectors, how they are added in two dimensions and how conservation of physical quantities represented by vectors (momentum) allows us to infer information about invisible components of an experiment.

More Information
Classifications: Detectors, Calorimeters, Conservation of momentum, Collision
Age Ranges: 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





Following the Inquiry cycle Orientation





Following the Inquiry cycle Overview



My inquiry cycle

Orientation

...

Hypotheses

...

Experimentation

...

Conclusion

...

Hypothesis:

Does the conservation of momentum also apply to the plane perpendicular to the beams' direction (x-y plane) during particle collisions?

If particles collide on the z axis than momentum is conserved on all three axes.

How can we measure the total momentum in such collisions in the x-y plane?

If particles collide on the z axis than momentum is always zero at thw x-y axis.

Experimentation:

Track Name	Angle in degrees	Angle in rad	Magnitude	Normalized
SimChargedTrack0 (P ₁)	15,98552	0,2746	10,23485	100,23485
SimChargedTrack1 (P ₂)	15,98552	0,275	10,23485	100,23485
SimChargedTrack3 (P ₃)	254,2214	0,444	1	10
SimChargedTrack228 (P ₄)	16,21471	0,2818	9,143939	90,143939

Conclusion:

The principle of momentum is always valid.

The non-zero momentum means that the detector has missed to record a particle. So the momentum we calculated corresponds to a missing particle.



Escoles pilot



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

Vosaltres?