

NEWSLETTER

No5/ August 2013



# discover the COSMOS

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## Introduction



**By Prof. Kourkoumeli Christina, National & Kapodestrian University of Athens, Coordinator of Discover the COSMOS project**

Dear All,

We would like to welcome you in the 5th and last issue of Newsletters of the “Discover the COSMOS” EU funded project. In this issue you can have a concrete view about the Discover the COSMOS project’s aims and tools, some leading stories from our partners’ experiences and the Breakthrough News of the project!

### **The project:**

The “Discover the COSMOS” coordination action has reached its last Month (24 months total duration) and it provides a great number of educational resources (80.943 educational content and 576 learning activities so far) for science teachers and students through its portal (<http://portal.discoverthecosmos.eu/>).

The Discover the COSMOS community welcomes you to participate in its activities!

We hope that you will enjoy the 5th Issue of Discover the COSMOS newsletter!

Read all the newsletters of the project in the Public Area ([www.discoverthecosmos.eu/public](http://www.discoverthecosmos.eu/public)) of the Discover the COSMOS project.

## The project

The “**Discover the COSMOS**” is a **coordination action** project under the **FP7-INFRASTRUCTURES-2011-2**.

The Discover the COSMOS project welcomes teachers and students in eScience aiming to spark young people's interest in science and in scientific careers.

### **AIMS & OBJECTIVES**

Discover the COSMOS aims to demonstrate innovative ways to involve teachers and students in eScience through the use of existing e-infrastructures in order to spark young people's interest in science.

It aims to support policy development by:

1. demonstrating effective community building between researchers, teachers and students.
2. demonstrating effective integration of science education with e-infrastructures,
3. documenting the whole process through the development of a roadmap.





## TOOLS

Discover the COSMOS portal

[portal.discoverthecosmos.eu](http://portal.discoverthecosmos.eu)

Discover the COSMOS portal is an **experimental laboratory** for students and teachers, aiming to improve science instruction by expanding the **resources** for **teaching** and **learning** in schools, providing more **challenging** and **authentic learning experiences**.

Discover the COSMOS portal brings together:

- **resources,**
- **virtual experiments** and
- **online labs** from the fields of **Astronomy** and **High Energy Physics (HEP)**.

It offers access to a network of robotic telescopes and to the major CERN experiments, **ATLAS** and **CMS**.

***Become part of the Discover the COSMOS educational community and explore new ways of teaching science!***

In the Discover the COSMOS portal you can look for:

### 80.943 Online Education Content

- Powerpoint presentations,
- Pdfs,
- Images
- URLs with interactive content,
- Doc files, etc

### 576 Learning Activities

- Lesson plans,
- Educational scenarios,
- Demonstrators,
- Students' projects,
- Animations,
- Laboratory guidelines

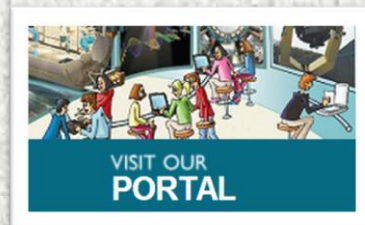
**Register NOW, design and share your educational projects and activities with Discover the COSMOS tools!**

**If you are a teacher or/& a student:**

- search for new ways to learn: astronomy, atoms & molecules, tools for science, environment, energy, light, radioactivity and so many other scientific issues.

**If you are a teacher:**

- explore the Discover the COSMOS Learning Activities that are created from teachers to teachers!



## Get to Know our e-Infrastructures



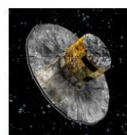
**ATLAS** ([www.atlas.ch](http://www.atlas.ch)) is a particle physics experiment at the Large Hadron Collider at CERN. The ATLAS detector is searching for new discoveries in the head-on collisions of protons of extraordinarily high energy. ATLAS will learn about the basic forces that have shaped our Universe since the beginning of time and that will determine its fate. Among the possible unknowns are the origin of mass, extra dimensions of space, unification of fundamental forces, and evidence for dark matter candidates in the Universe.



**CMS** (<http://cms.web.cern.ch/cms/>) is a high-energy physics experiment in Cessy, France, part of the Large Hadron Collider (LHC) at CERN. CMS is designed to see a wide range of particles and phenomena produced in high-energy collisions in the LHC. Like a cylindrical onion, different layers of detector stop and measure the different particles, and use this key data to build up a picture of events at the heart of the collision. Scientists then use this data to search for new phenomena that will help to answer questions such as: What is the Universe really made of and what forces act within it? And what gives everything substance? CMS will also measure the properties of previously discovered particles with unprecedented precision, and be on the lookout for completely new, unpredicted phenomena.



**The Large Hadron Collider (LHC)** is a particle accelerator used by physicists to study the smallest known particles – the fundamental building blocks of all things. It will revolutionise our understanding, from the minuscule world deep within atoms to the vastness of the Universe. Two beams of subatomic particles called 'hadrons' – either protons or lead ions – will travel in opposite directions inside the circular accelerator, gaining energy with every lap. Physicists will use the LHC to recreate the conditions just after the Big Bang, by colliding the two beams head-on at very high energy. Teams of physicists from around the world will analyse the particles created in the collisions using special detectors in a number of experiments dedicated to the LHC.



**Gaia** (<http://www.esa.int/science/gaia>) is an ambitious ESA mission to chart a three-dimensional map of our Galaxy, the Milky Way, in the process revealing the composition, formation and evolution of the Galaxy. Gaia will provide unprecedented positional and radial velocity measurements with the accuracies needed to produce a stereoscopic and kinematic census of about one billion stars in our Galaxy and throughout the Local Group. This amounts to about 1 per cent of the Galactic stellar population. Combined with astrophysical information for each star, provided by on-board multi-colour photometry, these data will have the precision necessary to quantify the early formation, and subsequent dynamical, chemical and star formation evolution of the Milky Way Galaxy.



**The Faulkes Telescope Project** (<http://www.faulkes-telescope.com/>) offers access to two 2-



**The Liverpool Telescope** (<http://telescope.livjm.ac.uk>), is a fully robotic astronomical telescope

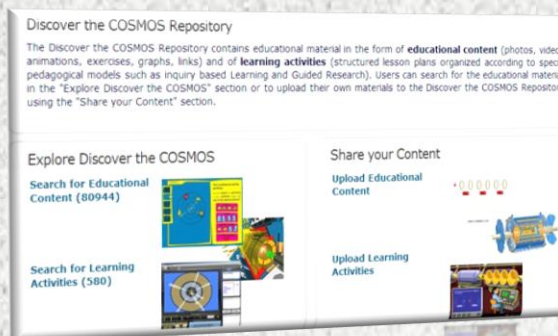


## **DISCOVER THE COSMOS' PORTAL**

### **COMPONENTS TO UPLOAD MATERIAL**

#### **1. The Discover the COSMOS–Learning Object Metadata (LOM) Toolkit**

The Discover the COSMOS–Learning Object Metadata web-based toolkit will allow Science Education Content Suppliers to characterize their resources and Science Education Learning Activities Suppliers to characterize the Learning Missions they build. This web-based toolkit allows authoring and managing of metadata for the Discover the COSMOS Educational Content and Learning Activities.



#### **2. The Discover the COSMOS Authoring Engine for Learning Activities**

The Discover the COSMOS Authoring Engine for Learning Activities will enable the definition of Learning Activities implementing the Generic Technology-Enhanced educational scenario Templates.

## **In action**

*In this section, you have the chance to learn how Discover the COSMOS was realized in real classroom and beyond activities.*

### **Discovering the Cosmos – experiences from Portugal and around the World**

For the past 2 years Portuguese schools had the opportunity to *Discover the COSMOS* in a whole new way. Under the framework of the project we were able to reach teachers and students from all over the country. The activities started with a series of very successful Visionary Workshops where teachers had the opportunity to learn about the methodology of the proposed activities and manifest their wish list of a joint successful adventure.

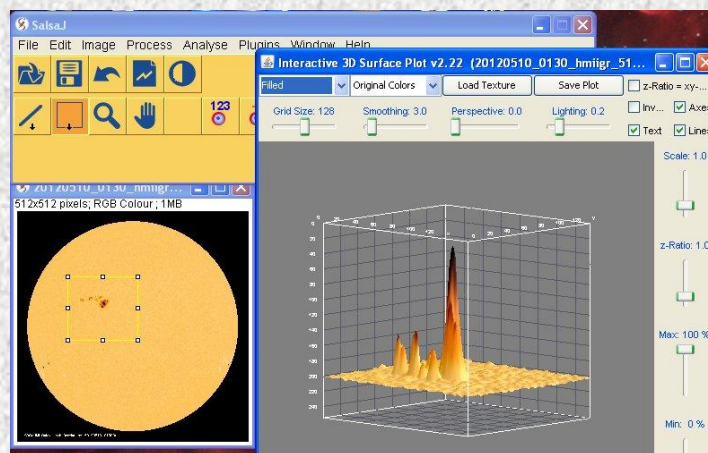
We successfully managed to reach over 500 teachers at a national and international level in face-to-face events and many hundreds more via our newsletters and social network. Discover the COSMOS travelled to several countries and was presented in important international conferences such as the International Astronomical Union General Assembly in China, COSPAR in India, Europlanet in Italy and many more. Teachers were trained to integrate the Inquiry based methodology in their teaching, to use eInfrastructures such as the Faulkes Telescope and Coimbra's Astronomical Observatory database as a teaching tool and make eScience resources such as Stellarium and Salsa J an ally to their classes.

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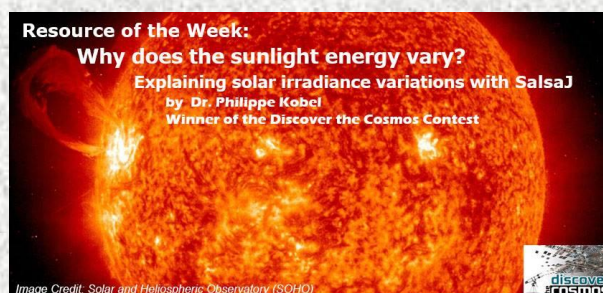


Example of a Discover the COSMOS Demonstrator introduced to the teachers

As a result of our efforts we had young scientists using the scientific method to fight light pollution, high school students using innovative methods to study the differential rotation of the Sun and young apprentices finding new asteroids. New inquiry based resources are being produced and teachers are in the process of testing their integration in the Portuguese curricula.

During most of our training events the participants had the opportunity to observe with robotic telescopes, participate in science café and night sky observing session with the participation of members of the scientific community.

They had the opportunity to use and test some of the demonstrators created under the framework of the program. Using our regular social media channels teachers from different countries started communicating and exchanging good practices under the highlight of Discover the COSMOS Resource of the Week.



Example of a resource of the week featured in our social network

The community built during these 2 years will certainly continue together in the future and fruitfully collaborations are already emerging from this effort. Hundreds of new amateur lovers of science, i.e. students, are now on the path of Discovering the COSMOS.

The Portuguese team of collaborators in this project.



The Discover the COSMOS team in Portugal from left to right, in alphabetical order – Ana Costa, Carlos Santos, João Fernandes, Leonor Cabral, Lina Canas, Maria Luísa Almeida, Mario Ramos, Nelson Alves Correia, Paula Furtado, Rita Guerra, Rosa Doran, Thilina Heenatigala, Telma Esperança



## Discovering the COSMOS – experiences from UK

Having been involved for three years previously with the EU project “Learning with ATLAS at CERN”, the University of Birmingham was enthusiastic to maintain the momentum of inquiry based science education (IBSE) and e-learning in particle physics in the UK.

Having a very strong research group, involved in the ALICE and LHCb experiments at CERN as well as the ATLAS collaboration, and also a recognized and well established outreach physics programme, Birmingham has been in a strong position to support the Discover the COSMOS project over the past two years.

From visionary workshops to teacher training events and reflective/summative evaluations and discussion, 130 teachers from around the UK and beyond have been trained to use the IBSE materials developed, disseminating ideas to colleagues in their schools, colleges and consortiums.



Prof Peter Watkins and Lynne Long helping a teacher with a Minerva exercise at a Discover the COSMOS Training workshop, Nov 28<sup>th</sup> 2012



Teachers presenting their work in the classroom at the Summative teacher workshop in Birmingham June 26<sup>th</sup> 2013

Birmingham has developed three demonstrators in particular for the portal:

- Construction and use of a cloud chamber – this involves using a “recipe” where school teachers can build their own cloud chamber at low cost, and then use the equipment with students to observe and make measurements with radioactive rods/salts.



Y10 & 11 students taking data from a cloud chamber – Physics Experience week in Birmingham July 1-5<sup>th</sup> 2013

- Experiments with a cosmic ray telescope – equipment which can be borrowed from Birmingham, as well as other research collaborations, for use in classroom projects – and used with students in various ways to investigate the properties of cosmic rays. It involves opportunities for teachers and students to design their own hands-on investigation.



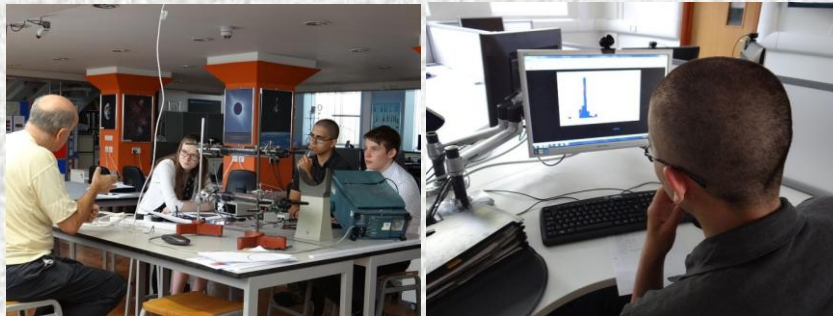
Dr John Wilson working with teachers at a College Consortium training event, Nov 29<sup>th</sup> 2012



- Identifying and Measuring the Mass of Invisible Particles at the LHC – an exercise where learners are using the Minerva Toolbox (particle track analysis tool developed and maintained by the research team at Birmingham) to identify particle tracks in the ATLAS detector and use momentum and energy conservation laws to calculate properties of short lived particles in the detector.

In addition to finding resources on the Discover the COSMOS portal, a “starter pack” of particle physics resources, articles and links, including the Minerva Toolkit and data sets, has been uploaded on to Discover the COSMOS USB sticks and distributed to around 200 teachers at training events.

Looking to the future, the University of Birmingham group is trying to integrate Discover the COSMOS into the UK school curriculum. It is working on a website link to the Edexcel extended project qualification (EPQ) page to promote the use of Discover the COSMOS resources in gaining this qualification, equivalent to 0.5 of an A Level in the UK - three enthusiastic A Level students are currently working on Case Study projects.



Students preparing for their case study EPQ projects – July 15<sup>th</sup> 2013

...and, in parallel, the group are involved in supporting schools to buy cosmic ray detector equipment getting more teachers and students involved in real research... (!)

## Discovering the COSMOS – experiences from CERN, Switzerland

“In these times of crisis we need to have teachers interested in science so that they can motivate and inspire young people”, says Rolf Heuer, CERN Director General. Since September 2011, the CERN Education Group has been working in tandem with the Discover the COSMOS partners to infuse motivation, inspiration and excitement into high school students across Europe and beyond, with the aim to spark but also sustain their interest in science and in following scientific careers.

Engaging students and teachers in e-Science through the use of large e-Infrastructures, like the Large Hadron Collider (LHC) and its associated experiments that nailed down the Higgs Boson, required creative thinking, collaborative learning and coordinated action, both internally and externally. Our partnership with Discover the COSMOS presented us with valuable opportunities to sensitize, engage with, and follow up with hundreds of physics teachers in the framework of CERN’s national and international [Teacher Programmes](#). As we speak, 51 dedicated teachers from 29 countries taking part in this year’s 3-week High School Physics Teacher Programme are offering us constructive feedback on how we could further improve hands-on exercises in the classroom that use online virtual labs and authentic LHC data, like [HYPATIA](#).

Building on synergies with our strong network of motivated physics teachers, our so-called CERN ambassadors, the Discover the COSMOS community, and the Outreach Groups of the ATLAS and CMS experiments, we were also able to pilot innovative initiatives for bringing frontier research closer to schools. Two e-Masterclasses at CERN with students from the [Netherlands](#) and [Poland](#) exemplified the power of virtual and remote labs for science learning. Numerous local Masterclasses that included virtual visits to the control rooms of the ATLAS and CMS experiments were built on an integrative approach to developing effective collaborations between schools and research centres. Last but not least, we supported important national level initiatives, like the [CERN Mini-Expo Tour](#), that proved to be particularly effective in bringing CERN, particle physics and science closer to, and often literally inside, European schools.



Taken together, our involvement in the Discover the COSMOS project has helped us understand better and demonstrate how inspiring e-Science activities can effectively be integrated into education and outreach programmes that take full advantage of the collective power of unique and authentic scientific resources. We at CERN are committed to sustain the Discover the COSMOS effort towards the design of the science classroom of tomorrow. We would like to thank all our partners for their support and collaboration over the last two years, and especially the efforts made by the Discover the COSMOS coordinator, Prof. Christine Kourkouvelis.



High school students from Greece performing measurements with real CMS data at CERN (Image Credit: Stella Tsikrika © 2013 CERN, for the benefit of the CMS Collaboration)

High school students from Poland performing measurements with the HYPATIA online applet during an e-Masterclass at CERN (Image Credit: Georgios Makkas)



The Discover the COSMOS Team at CERN (from left to right):  
Dr. Rolf Landua, Prof. Emmanuel Tsesmelis, Dr. Angelos Alexopoulos

## Discovering the COSMOS – experiences from Germany

Since 2005 the German Discover the Cosmos (Discover the COSMOS) partner Technische Universität Dresden has been coordinating the program International Masterclasses, which gives secondary school students all around the world the chance to work collaboratively and analyse real data from particle physics experiments with physicists as their mentors. In 2010, we launched the national network Netzwerk Teilchenwelt to make Particle Physics Masterclasses available at any date, at any place and for a much larger group of young people than ever before in Germany.

The Discover the COSMOS team from Dresden contributed its profound expertise in organization of these international and national hands on particle physics activities into the project. At the same time we took advantage of the European efforts bundled by Discover the Cosmos to enhance both user communities and provide them with the educational materials developed by the project.



CMS physicists at CERN welcomed a group of student from Lycée Saint Michel in Annecy, France (© CERN, Photograph: Lapka, Marzena)



High school students studying cosmic rays in a self-made cloud chamber (© TU Dresden, Photograph: Socher, Juliane)

Our latest successes: In March 2013, more than 160 institutes in 37 countries participated in International Masterclasses with 10.000 students getting their hands on data from CERN. In addition, during the first half



of 2013, about 46 National Masterclasses were held in Germany and about 200 teachers were trained in the framework of the Discover the COSMOS project.

Besides the organization of Masterclasses and teacher trainings we produced a number of demonstrators. Also teachers from our user community were active in developing teaching materials. These materials as well as the particle physics related e-science tools of the Discover the COSMOS project are included in a DVD which is currently produced by IPPOG (International Particle Physics Outreach Group) and Netzwerk Teilchenwelt. This DVD shall serve to bring together science and school and will be handed over to all present and future partners.



The TU Dresden core team of the Discover the Cosmos project:

Prof. Michael Kobel, Michael Rockstroh, Dr. Uta Bilow, Prof. Gesche Pospiech

## Discovering the COSMOS – experiences from Austria

The Austrian team (BMUKK in collaboration with University of Vienna) uses contacts to research facilities, experts in the field of astronomy and high energy physics and engaged teachers to build up and support an active user's community. As well as the foundation of the new working group A4E (Astronomy for Education) in October 2012 will further establish and foster this community. The A4E working group is part of the Austrian Society for Astronomy and Astrophysics (short ÖGAA) and has the aim to give teachers and stakeholders a platform of exchanging experiences and information which is important to conserve and improve the results and products of temporary projects in a sustainable way.

Teachers were trained in the framework of the Discover the COSMOS project during the last two years in the use of e-science tools and e-infrastructures which they successfully implemented in their school practice. Thereafter some are giving further trainings and demonstration workshops for other teachers. Furthermore practioners were identified to be contact points for interested teachers and stakeholders who want to use such innovative approaches, methodologies and tools.



Astro-Night Vienna in June 2012: real observations and presentations in addition to the work with e-science tools and e-infrastructures

A series of demonstration and training activities including astronomical observations at observatories (called Astro-Nights) were organized in several regions (Tyrol, Salzburg, Upper Austria, Lower Austria, Burgenland and Vienna) to present the Discover the COSMOS approach, educational resources, e.g. the demonstrators, and scientific tools and services for educational purposes at interesting places and engaging environments. This gives the participants some impressions of inquiry based science education and they get also in touch with scientists and could experience how scientists are doing their research. These teachers act as multipliers in their educational structure and known communities.



Teacher training activities: (left) demonstration of the e-infrastructures of robotic telescopes at the Faculty of Physics of the University of Vienna, 02/2013, (right) Training and round table on using e-science tools for different educational settings in a school in Salzburg, 11/2012.



The strategy coming up from the Discover the COSMOS project as well as from previous projects in this field is clear and will be further followed: *Give good practices – train engaged teachers, which train others – bring together researchers, teachers, students and stakeholders – build contact points and support community building*

BMUKK and the A4E working group act as a coordinating body connecting all localized networks and providing a common information platform. BMUKK also validates the approach of the project in respect to the pedagogical impact and technical and social aspects.



Austrian core team: Elisabeth Zistler (BMUKK), Christian Reimers (University of Vienna, A4E founding member, BMUKK consultant) and Teresa Pointner (BMUKK consultant)

### Discovering the COSMOS – experiences from France

Within the Discover the COSMOS project, we have organized six European 5-days teacher training sessions, gathering about 80 teachers. Teachers coming from other European countries were funded through Comenius grants, while Discover the COSMOS funding was used to allow French teachers to participate. Other specific sessions were organized around the European network of radio telescopes.

Each day of these sessions started with a general lecture about the latest advance in different fields of astronomy. We then trained teachers on related exercises/hands-on activities using our software *SalsaJ*, including Faulkes robotic observations. Collaborative works were also proposed to enhance discussions among teachers. During each session, we presented the Discover the COSMOS portal and our tools for particle physics, as well as summer schools and contests. Evaluation was done at the end of each session with a dedicated questionnaire and the standard Discover the COSMOS questionnaire. A large majority of teachers was satisfied with the organization and the balance between theory and practice. They were globally ready to use ICT tools in their classrooms.



We also developed innovative activities based on a kinesthetic approach to represent the movement of gas around the center of our Galaxy with a constant circular velocity or planets around the Sun following Kepler's laws. In the second picture, we see ellipses and plots showing different positions of planets with a 16 days interval between two successive positions. The trainers can then walk along the orbits with the correct speed.

Besides these training sessions organized in Paris, our activities were presented in several other 2-days training sessions, taking place either in schools – including French lycées in Pondicherry (India), Tachkent (Ouzbekistan) – or at the Observatoire de Haute Provence, involving about 100 teachers. We also presented our activities in several international conferences such as those of the European Astronomical Society, EuroPlanet, Hands-On Science network, EuroSakai which was focused on LMS (Learning Management System).



## Discovering the COSMOS in CERN Exhibition in Greece

The CERN Mini Expo was a traveling exhibition that presents a brief overview of the research at CERN and its flagship project, the Large Hadron Collider (LHC), through a combination of large graphic panels, on-screen displays and videos that are combined with two scale models of the ALEPH detector and a cross sectional part of the LHC. For approximately one year (2011-2012) CERN Mini Expo travelled all around Greece and more than 25.000 people attended these magnificent exhibitions!



## Breakthrough News

### 1. Discover the COSMOS presence during the CERN open days



At the end of September (28<sup>th</sup> and 29<sup>th</sup>) CERN is organizing two full open days (11hour duration each). This is a really big event (details are getting filled in at <http://opendays2013.web.cern.ch/>), expected to attract **100,000 people!**

The experiments are organizing their shows respectively. A number of visitors will go down to the cavern but the vast majority, because of lift limitations, will stay on the surface and visit the various experiments' "tents" and the Globe.

ATLAS- which is at a very central position next to the Globe- is planning to have one or two tents where visitors will go around, get their picture taken, talk to physicists, buy souvenirs, have a kid's corner etc.

"The Discover the COSMOS" and "Go-Lab" projects will be present there and have their own corner where PC's and iPad's will be set-up and have some of projects' labs running for demonstration to the public. The labs include the LHC game and CERN land for smaller kids as well as HYPATIA, MINERVA and LHSee for the ATLAS event display and analysis.

The event is organized by the ATLAS outreach group which C.Kourkouvelis is co-coordinating, IASA, EA and EPFL.

### 2. Discover the COSMOS presence in the International conference on New Frontiers in Physics

During the International conference on New Frontiers in Physics (<http://indico.cern.ch/conferenceDisplay.py?confid=198153>) in Kolympari, Chania, Greece from 28<sup>th</sup> August -5<sup>th</sup> September 2013, C. Kourkouvelis and S.Vourakis will give talks entitled "HEP EU outreach projects" and "ATLAS HYPATHIA/applet MasterClasses" respectively. During these talks the Discover the COSMOS project and its aims will be presented. About 150 participants are expected.



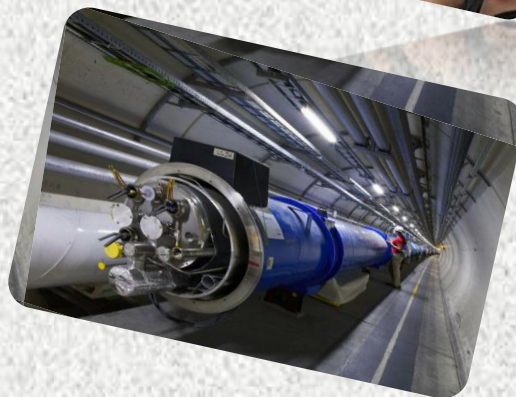
Also during the afternoon poster session on 2/9 there will be a demonstration of the Masterclasses where HYPATIA will be set-up on PC's for the participants of the conference to get experience with it and a poster presenting the project will be displayed.



## Further Information

### Project partners

1. Institute of Accelerating Systems and Applications (IASA)
2. CERN
3. Institut d'Astrophysique de Paris (IAP)
4. University of Coimbra (UoC)
5. University of Glamorgan (UoG)
6. Cambridge University (CAM)
7. Liverpool John Moores University (LJMU)
8. Technical University of Dresden (TUD)
9. University of Birmingham (UoB)
10. Ellinogermaniki Agogi (EA)
11. Núcleo Interactivo de Astronomia (NUCLIO)
12. Science View
13. Ministry of Education, Arts and Culture (BMUKK)
14. Universidad Complutense de Madrid (UCM)
15. Lawrence Berkeley National Laboratory (LBL)



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