

# INTERNATIONAL MASTERCLASSES HANDS ON PARTICLE PHYSICS



Nantes



## A day of immersion in particle physics for 16-18 year old pupils

### Typical day of International Masterclasses

**Morning** : introductory lectures on

- Particle physics (elementary particles, forces, Standard Model and beyond)
- Detectors – accelerators – experimental methods

Visit of laboratory / experimental site / discussion with scientists and graduate students

**Lunch** – typically offered by Host Institute

**Afternoon** : students do physics measurement

They work in groups of 2 per computer and analyse visually (in most cases) data from an LHC experiment

Summing of results of many groups – Discussion of results

**At the end of the day** : Video Conference

moderated by two physicists at CERN and connecting up to 5 institutes which did the same measurement that day

## A bit of history and present status

1996: Started in UK

2005: Adopted by EPPOG (European Particle Physics Outreach Group) for all Europe

Use data from LEP (the Large Electron Positron collider, CERN, 1989-2000)

**OPAL** Identifying Particles

**DELPHI** Hands on CERN

Z<sup>0</sup> decays / calculation of branching ratios

2006: U.S. joined program

2010: preparing to move to LHC-based Masterclasses

2011: Use data from LHC

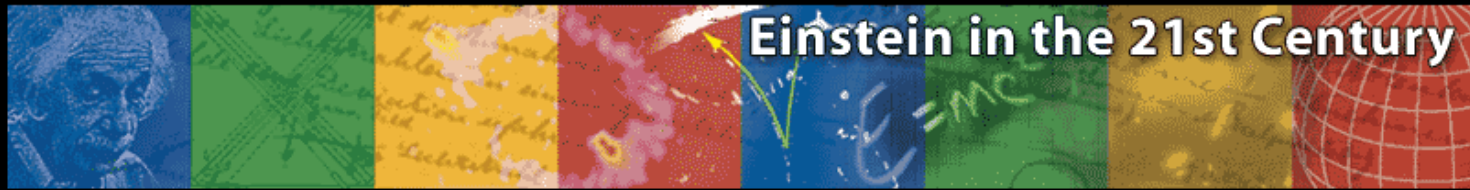
**ATLAS** W+W<sup>-</sup> (MINERVA) structure of the proton

**ATLAS** Z<sup>0</sup> (HYPATIA) mass, width (+Z' from MC)

**CMS** J/ψ (in 2011) and W/Z (in 2012)

**ALICE** Looking for strange particles (V<sup>0</sup> and cascade decays)

Central organisation TU Dresden (Uta Bilow, Michael Kobel)



# Hands on Particle Physics

## International Masterclasses for High School Students

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### Hands on Particle Physics Masterclasses

#### 7<sup>th</sup> International Masterclasses 2011

Each year about 6000 high school students in **24 countries** come to one of about 110 nearby universities or research centres for one day in order to unravel the mysteries of particle physics. Lectures from active scientists give insight in topics and methods of basic research at the fundamentals of matter and forces, enabling the students to perform measurements on real data from particle physics experiments themselves. At the end of each day, like in an international research collaboration, the participants join in a video conference for discussion and combination of their results.

The **International Masterclasses 2011** will be held from **4.3. - 26.3.2011**. Each day up to six out of about 100 institutes will participate, see **schedule**. In addition, several institutes will hold a teachers day (click **here** for dates). A parallel program in **US** will include about 20 more institutes, see **schedule**.

#### Discover the world of Quarks and Leptons with real data



- get out of school for one day and come to a nearby university or research centre
- get insight into topics and methods of basic research at the fundamentals of matter and forces
- perform measurements on real data from particle physics experiments at CERN
- participate in an international video conference for discussion of results

<http://www.physicsmasterclasses.org/>

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Name:  
International  
Particle Physics  
Masterclasses





International Particle  
Physics Outreach Group

# INTERNATIONAL MASTERCLASSES

hands on particle physics

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## International Masterclasses

8<sup>th</sup> International Masterclasses 2012

Each year about 8000 high school students in [32 countries](#) come to one of about 120 nearby universities or research centres for one day in order to unravel the mysteries of particle physics. Lectures from active scientists give insight in topics and methods of basic research at the fundamentals of matter and forces, enabling the students to perform measurements on real data from particle physics experiments themselves. At the end of each day, like in an international research collaboration, the participants join in a video conference for discussion and combination of their results.

The **International Masterclasses 2012** have been held from **27.2. - 24.3.2012**, see [here](#) for media coverage). A parallel program in [US](#) from **10.3. - 24.3.2012** has included about 30 more institutes..

### Discover the world of Quarks and Leptons with real data



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### facebook

Name:  
International  
Particle Physics  
Masterclasses

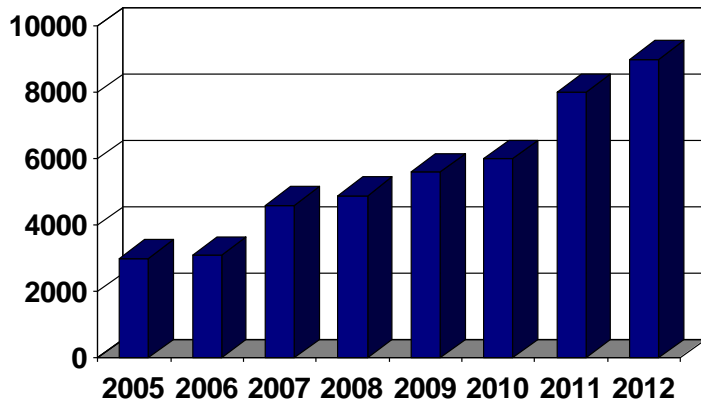


# Some numbers from the International Masterclasses 2012

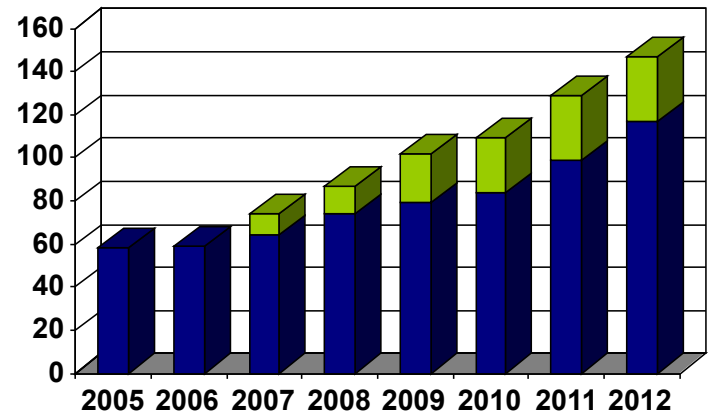
(reported by Uta Billow at the 3rd IPPOG Meeting, Innsbruck, April 2012)

- Period: 28.2. – 24.3.2012 (21 days)
- 143 Masterclasses
  - ALICE: 13
  - ATLAS W: 42
  - ATLAS Z: 53
  - CMS: 35
- 36 video conferences with CERN
- 21 moderators
- 117 institutes registered
  - + local masterclasses, teacher days

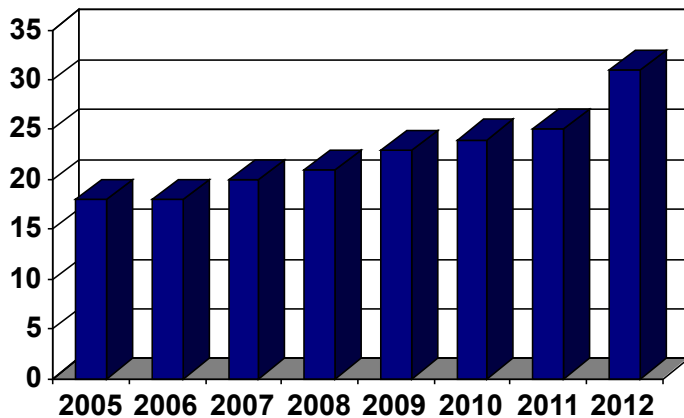
# Participation keeps increasing



■ Participants



■ Institutes ■ US program



■ Countries

## Video Conference

Often it is the highlights of the day

Presentation of the moderators

Welcome of the participating institutes

General questions from the participating institutes

Presentation of the results of the measurements by institutes

Merging of results by moderators

Comments and discussion

Quiz

## General appreciation of the International Masterclasses

Very positive

More countries participate every year



## Some information

Masterclasses are typically announced in October

They take place in February – March

Each country organises things in its own way, for example

In France, whole classes participate in a masterclass

In Greece and Germany : selected students (a few from each class)

Limiting factors :

computers/computer rooms available at Institutes

Number of institutes per video conference(maximum 5)

In Sweden : Masterclasses in Uppsala – Lund – Stockholm (in 2012)

Last IPPOG Meeting : other forms of Masterclasses discussed

Mini-masterclasses (half a day) masterclasses done locally (in schools)

useful links

IPPOG <http://ippog.web.cern.ch/>

International Masterclasses <http://physicsmasterclasses.org/neu/>