

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

Z⁰ 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⁻ (MINERVA) structure of the proton

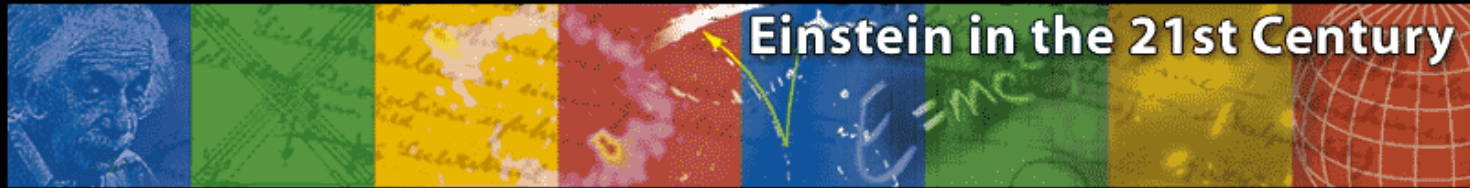
ATLAS Z⁰ (HYPATIA) mass, width (+Z' from MC)

CMS J/ψ (in 2011) and W/Z (in 2012)

ALICE Looking for strange particles (V⁰ and cascade decays)

New : this year ATLAS and CMS will be adding some Higgs events

Central organisation TU Dresden (Uta Bilow, Michael Kobel)



Hands on Particle Physics

International Masterclasses for High School Students

- **Home**
- **Participate!**
- **Schedule**
- **My Country**
- **Physics**
- **Local Organisation**
- **Press Review**
- **Archive**
- **Imprint**
- **Contact Us**

Hands on Particle Physics Masterclasses

7th 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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Home

Participate!

Schedule

My Country

Physics

Local Organisation

In the Media

Archive

Imprint

Contact Us

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Particle Physics
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International Masterclasses

9th International Masterclasses 2013

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.

International Masterclasses 2013 will be held from **25.2. - 22.3.2013**.

U.S. Masterclasses will be organized from **9.3. - 23.3.2013**.

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

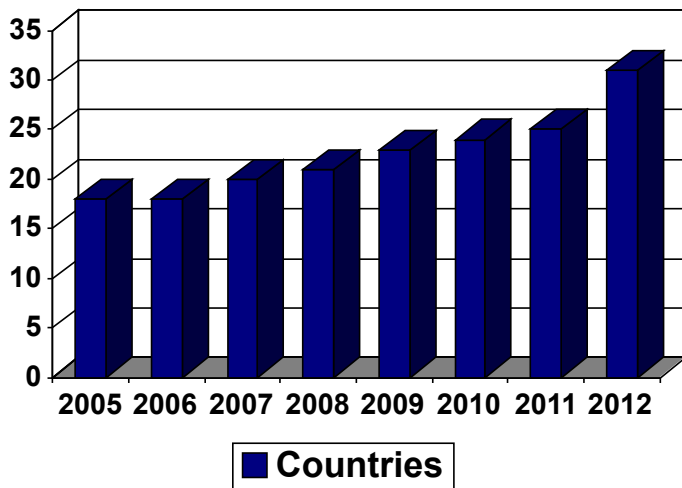
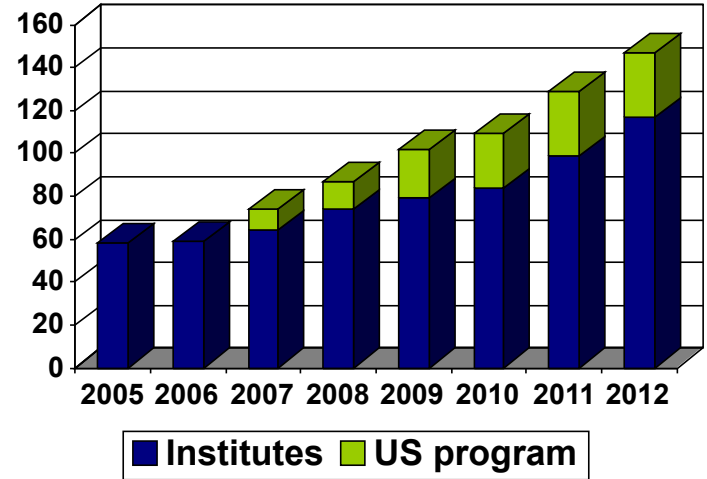
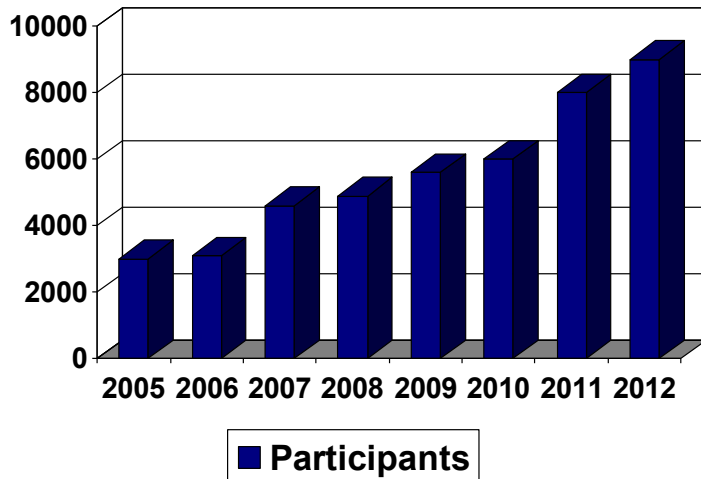


- get out of school for one day and come to a nearby university or research centre
- get insight into topics and methods of basic research at the fundamentals of matter and forces
- perform measurements on real data from particle physics experiments at CERN
- participate in an international video conference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

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



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

Local organisation can differ from country to country:

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/>