High School Teachers Program, CERN, July 2016

IPPOG and International Masterclasses

Kate Shaw (ICTP)
IPPOG: International Particle Physics Outreach Group

Network of scientists, educators and communicators

- Contribute to global efforts in
  - strengthening cultural awareness
  - understanding and support of particle physics and related sciences
  - developing the next generation of researchers.

IPPOG’s purpose is to raise standards of public outreach and science education efforts.
IPPOG organise and support the International Masterclasses

And are a source of resources for all particle physics outreach.

IPPOG is a network of scientists, science educators and communication specialists working across the globe in informal science education and outreach for particle physics. Particle physics is the science of matter, energy, space and time. IPPOG brings new discoveries in this exciting field to young people and conveys to the public that the beauty of nature is indeed becoming understandable from the interactions of its most fundamental parts - the elementary particles.

Current members come from the 21 member states of CERN, Ireland, Romania, South Africa, the USA, and from DESY, CERN and five of the major experiments at the Large Hadron Collider (LHC).

Marge Bardeen (FNAL) and Hans Peter Beck (University of Bern), co-chairs of IPPOG.

To educate and enthuse 9-12 year olds in the world of Particle Physics and general science exploration.

Hand-outs for... to prepare secondary school children for Particle Physics Masterclasses

Particle Physics:... to teach secondary school children about research in particle physics

The ATLAS-Detector to inform secondary school children about the ATLAS Project
Resources

Activities
- Cart Demonstration
- Classroom Activity
- Facilitated Activity
- Presentation
- Game
- Display

Programs & Events
- Science Fair
- Science Festival
- Science Camp
- Science Shows & Performances
- Symposium / Conference
- Classroom Outreach Program
- Multi-Media Contest

Media
- Audio / Podcast
- Film / Video
- Animation - real event
- Animation - simulated event
- Images
- Photos
- Illustrations
- Event Displays (static)
- Plots
- Computer game
- Non-game inter-actives / Virtual Tours
- Website

Print Media
- Fact Sheet
- Brochure / Flyer / Leaflet
- Article / Journal
- Poster
- Banner / Print
- Pannel
- Book

Learning Topics
- Physics
- Technology
- International Collaboration
- Broader Impacts

Search by

Learning Topic
- Any

Audience
- Any

Item Type
- Any

Availability
- Any

Duration
- Any

Language
- Any

Key Words

Resources in your language

English
French
German
Italian
Portuguese
Spanish

Filter by audience

6 to 9 years
9 to 12 years
12 to 15 years
15 to 18 years
18 to 25 years
25 years+
Science Educator / Science Explainer

Hand-outs for participants of Particle Physics Masterclasses

to prepare secondary school children for Particle Physics Masterclasses
Results

WHAT DOES A HIGGS BOSON EAT DURING THE WINTER AND OTHER ESSENTIAL DETAILS

Presentation to explain to general audiences what is the Higgs boson. It reviews first what are the fundamental particles and the Standard Model, then explains the role of the Higgs field and the Higgs boson as an excitation of the field. It also shows how it was discovered at the LHC...

Presentation

THE BASICS OF THE HIGGS BOSON (A TED ED LESSON)

Let’s Begin...

In 2012, scientists at CERN discovered evidence of the Higgs boson. The what? The Higgs boson is one of two types of fundamental particles and is a particular game-changer in the field of particle physics, proving how particles gain mass. Using the Socratic method, CERN...

Website

CRACKING THE COSMIC CODE

A simple presentation to explain the excitement surrounding the discovery of the Higgs boson. Borrowed heavily from other presentations but adds lots of animation. Two versions are included: one is in English only; the other is in English and traditional Chinese. Talk was given in Taiwan in...

Presentation, Symposium / Conference

Chinese, English

THE LHC AND THE HIGGS BOSON: NATURE 96 - SCIENCE 4 (BUT IT'S EARLY IN THE GAME)

Buried 100m below the French / Swiss countryside, between the Alps and the Jura Mountains, is a 27km tunnel housing the Large Hadron Collider at CERN. This chain of superconducting magnets accelerates protons to high energies and then collides them in four different underground halls. Inside...

Presentation

THE LHC AND THE HIGGS BOSON: COMMUNICATING SCIENCE

Buried about 100m below the French / Swiss countryside, between the Alps and the Jura Mountains, is a 27km tunnel housing the Large Hadron Collider at CERN. This chain of superconducting magnets accelerates protons to very high energies and then collides them at four different places....

Presentation, Game

Animation - simulated event

CMS SLICE (JULY 2010 VERSION)

Outreach

This slice shows a colorful cross-section of the CMS detector with all parts of the detector labelled. Viewers are invited to click on buttons associated with five types of particles to see what happens when each type interacts with the sections of the detector. The five types of particles users...

Animation - simulated event, Non-game Inter-actives / Virtual Tours

OUTREACH ATLAS

This colorful 3D animation is an excerpt from the film "ATLAS-Episode II, The Particles Strike Back." Shot with a bug’s eye view of the inside of the detector. The viewer is taken on a tour of the inner workings of the transitional radiation tracker within the ATLAS detector. Subjects covered...

Animation - simulated event

MUON SPECTROMETER IN THE ATLAS DETECTOR ON THE LHC AT CERN

ATLAS Outreach

This colorful 3D animation is an excerpt from the film "ATLAS-Episode II, The Particles Strike Back." Shot with a bug’s eye view of the inside of the detector. The viewer is shown the design of the Muon Spectrometer, what happens when particles pass through it and what it measures.

Running...

Animation - simulated event

JOURNEY TO DISCOVER THE NATURE OF MASS (THE HIGGS FIELD)

Chris Mann

Produced by: Mannmade Productions
Director: Chris Mann
05:00 min. / 10 September 2006 / CERN Copyright
http://www.mannmade.co.uk/
See files here: http://cdsweb.cern.ch/record/1128122...

Film / Video, Animation - simulated event

ATLAS EVENT - HOW ATLAS DETECTS PARTICLES

ATLAS Outreach

This is a segment of the movie 'Episode II, The Particles Strike Back', illustrating how the ATLAS detector detects different types of particles.

Running Time (min): 47 sec
For video files, see here: http://cdsweb.cern.ch/record/1096390...

Animation - simulated event
International Masterclasses

Organised by IPPOG *Spring* each year

- High school students (15 – 19) get to be “Researchers for one day” at their local university or research institute
- **Morning:** Introductory talks on Standard Model, Detectors, Accelerators, possible tours
- **Afternoon:** *Hands on session*, 2 hours to perform measurement using data from ALICE, ATLAS, CMS or LHCb
- At the end of the day they have an international Video conference with CERN or Fermilab in a group of 3-5 institutes
International Masterclasses

Sample Agenda

LOCAL TIME: ACTIVITY:
8:30 - 9:00 registration & welcome
9:00 - 10:00 introduction to Particle Physics
10:30 - 11:30 second talk or tour
12:00 - 13:00 lunch
13:00 - 15:00 data analysis, including introduction
15:00 - 16:00 local combination and discussion
16:00 - 17:00 video conference with CERN

• Engage students with state of the art particle physics research
• Encourage them to study physics
• Inspire them to do research
International Masterclasses

Hands on session

- Analyse data and do a measurement from one of the four main experiments at the LHC
International Masterclasses

Hands on session

LHC@InternationalMasterclasses

Join us on a journey to the smallest pieces of matter! Learn what is happening 100 meters below the ground at the European Organization for Nuclear Research (CERN). In the Large Hadron Collider, with a circumference of 27 kilometres, the experiments ALICE, ATLAS, CMS, and LHCb are running. The following short video gives an impression of the start of a fascinating journey looking for the origin of mass, Dark Matter, and new phenomena such as Supersymmetry or Extra Dimensions.

International Masterclasses

Hands on session

**ATLAS: Z Path**

**HYPATHIA** event display program

Download data samples, giving each group one data package with 50 events

Students **find the Z boson**, and maybe find the Higgs or even unknown particles

Upload results to an online plot submission page

Discuss results locally, then present results in the **video conference**
International Masterclasses

Hands on session

ATLAS: Z Path

HYPATHIA event display program

Students learn how to identify Z boson decays and Higgs boson decays

From this enlarged view into the direction of the proton, you can clearly see the two muons. Both particles might arise from one particle that decayed after its creation.
International Masterclasses

Hands on session

Z-Path

Di-leptons
International Masterclasses

Hands on session

Z-Path

Di-leptons
International Masterclasses

Hands on session

ATLAS: W Path

The structure of the proton

Ratio W+/W−
International Masterclasses

Hands on session

ATLAS: W Path

The structure of the proton

Ratio $W^+/W^- \sim 1.4 \pm 0.2$

-> Stat error only

-> What is the students conclusion from this?
International Masterclasses

Hands on session

ATLAS: W Path

The structure of the proton

\[
\begin{align*}
\text{Charge up} & = +2/3 & \text{antiup} & = -2/3 \\
\text{Charge down} & = -1/3 & \text{antidown} & = +1/3
\end{align*}
\]

up + antidown \rightarrow W^+ (charge +1) 

down + antiup \rightarrow W^- (charge -1)
International Masterclasses

Hands on session

ATLAS: W Path

The structure of the proton

quark-antiquark sea
Hands on session

ATLAS: W Path

up + antidown -> W+ (charge +1)
down + antiup -> W- (charge -1)

Ratio $W^+/W^- \sim 1.4 \pm 0.2$

-> Stat error only
-> What is the student's conclusion from this?
International Masterclasses

Video Conference

- At 4pm CERN time **two scientists** from CERN will have a one hour live video conference with 3-5 institutes around the world

- Each institute will have two minutes to present their results

- The results are **combined and discussed**, just as in normal scientific meetings

- At the end there is a **fun quiz** and that’s the end of the day!
International Masterclasses

- Dates announced: July
- Registration opened: Aug
- 1. Schedule: Sep
- Institutes’ Profiles: Oct
- Vidyo tests: Nov
- Info. measurements: Dec
- Question time: Jan
- Info. video conference: Feb
- Mar
- Apr
In summary, for a Masterclass the following is needed:

- a group of students (aged 15 - 19)
- an inviting institute, providing the infrastructure
- at least 1 scientist, holding the lecture
- some tutors for students during the measurement (1 tutor per 10 students)
- a lecture hall
- PC-pool (students work in groups of 2)
- facility for video conferencing, if possible
Welcome to the organisation section of International Masterclasses!
Here, we hope to provide you with all that you’ll need in order to organise an event that students, teachers and staff will never forget.
Therefore, you can find:

- an introduction to the overall organising scheme including a step-by-step list for preparation
- some example lectures
- information on the measurements
- a manual for the video conference, including information on the quiz
- corporate material (logos, poster, invitation letters, participation certificates)
- english press release 2014 (template)
- english alternative press release 2014 (template)
- german press release 2014 (template)
- french press release 2014 (template)
- CERN 60 years (presentation)
International Masterclasses

41 countries, all continents (except Antarctica)
International Masterclasses

• 39 institutes
• 41 Masterclasses
  • 25 CMS
  • 16 ATLAS
• 19 video conf. with Fermilab

• 160 institutes
• 200 Masterclasses
  • 119 ATLAS
  • 46 CMS
  • 21 LHCb
  • 14 ALICE
• 48 video conf. with CERN
International Masterclasses
Summary

IPPOG website – great place to get resources for teaching and organising particle physics events

http://ippog.web.cern.ch

International Masterclasses Spring each year – take part!

http://www.physicsmasterclasses.org/index.php