THE INTERNATIONAL PARTICLE PHYSICS OUTREACH GROUP

WHO WE ARE – WHAT WE DO – WHAT WE TRY TO ACCOMPLISH

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on behalf of the IPPOG Collaboration

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WHY OUTREACH

Outreach refers to activities designed to raise awareness, appreciation and understanding of particle physics, the research methods and the experimental results to a mainly non-scientific audience. It is an integral part of the scientific process.

• Goals:
  ➢ demystify scientific research and increase scientific literacy
  ➢ Inform public – Inspire youth – prepare next generation of scientists
  ➢ Ensure (continuation of) support and funding
  ➢ Tell contributors the outcome of their efforts
  ➢ Inform media (strong amplification factor)

Outreach is of particular importance nowadays, when there is a lot of:
  ➢ Wrong information and even mud-throwing on science all over the web
  ➢ Conspiracy theories which have some impact - at least to a percentage of the public
IPPOG IN A NUTSHELL

IPPOG: Global network of particle physicists active in education and outreach

Main aims:
- Networking and coordination of global activities
- Exchange information, experiences and best practices in outreach activities
- Share resources

Members: 24 country representatives, 5 experiments, 1 international laboratory (CERN)

Flagship activity: International particle physics masterclasses

Meetings take place twice a year (spring & autumn)

First EPPOG Meeting Sep. 1997 at CERN, DG Chris Llewellyn-Smith: “the particle physics community has a moral obligation to inform the public on its activities. To do this well experiences must be shared among countries in view of the need to optimize the use of resources”
BRIEF HISTORY

• 1997 EPPOG (European Particle Physics Outreach Group) formed under ECFA and EPS-HEPP board.
• First chair: Frank Close, University of Oxford, UK
• Members: representatives of CERN member states, CERN, DESY, later big LHC experiments
• 2011 EPPOG becomes IPPOG (European -> International)
• 2016 IPPOG becomes International Collaboration with MoU
  Member countries no longer required to be CERN Member States
  Membership fees to be paid by member countries depend on GDP and Particle Physics community size
  International Laboratories provide strong financial and in-kind support
  Experiments provide in-kind support (measurements, tools and other resources, e.g. to be used for the masterclasses)

Increase prestige: new countries, experiments and labs express interest to become members
Introduce associate membership
IPPOG MEMBERS

CERN, ALICE, ATLAS, CMS, LHCb, Belle2
Accepted as associate members : DESY
Hands-on activity for 16-18 year old pupils: Invited by a University or Institute, they spend a day of immersion in particle physics.

Goal: Interest. Inspire. Motivate. (can’t teach all of particle physics in a day!)

Typical schedule of the day:

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 – usually offered by the Host Institute

Afternoon: students analyse real data from an experiment and do a physics measurement
- They work in groups of 2 per computer; analysis is visual in most cases

At the end of the day (16:00 CET): Video Conference
- Moderated by two physicists at CERN and connecting up to 5 institutes
- Presentation / merging / discussion of results, answering questions, quiz

24.08.2019
IPPOG’S FLAGSHIP ACTIVITY: INTERNATIONAL MASTERCLASSES IN PARTICLE PHYSICS

History and present status

- 1996: Masterclasses started in the UK
- 2005: Adopted by EPPOG for the international launch in Europe
  - Video-conference linking the institutes participating on the same day
  - 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: Start using 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 decays)
- ALICE Nuclear modification factor
- LHCb Measurement of the D⁰ lifetime

Central organisation: Uta Bilow (TU Dresden) and for the USA: Ken Cecire (Notre Dame and QuarkNet)
International Masterclasses

15\textsuperscript{th} International Masterclasses 2019

Each year more than 13,000 high school students in 55 countries come to one of about 225 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. See here for media coverage.

International Masterclasses 2019 will take place from 7.3. - 16.4.2019.

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
Statistics International Masterclasses

- 2005: 18 countries
- 2006: 58 institutes
- 2007: 72 masterclasses
- 2008: 3k students
- 2009: 12 video conferences
- 2010: 52
- 2011: 225
- 2012: 307
- 2013: 14k
- 2014: 82
- 2015:
- 2016:
- 2017:
- 2018:
IPPOG REACH: THE 2019 MASTERCLASSES

Masterclasses: 7.3. - 16.4.2019
54 countries
239 institutes
15k students (preliminary number)
1k teachers (preliminary number)

Coordination.: QuarkNet

- 51 institutes (48)
- 54 LHC Masterclasses (50)
  - 22 ATLAS (19)
  - 32 CMS (31)
    (Incl. TRIUMF program)
- 12 MINERvA Masterclasses

Coordination.: TU Dresden

- 188 institutes (177)
- 266 LHC Masterclasses (257)
  - 30 ATLAS W (35)
  - 101 ATLAS Z (104)
  - 64 CMS (58)
  - 41 LHCb (39)
  - 27 ALICE SP (18)
  - 3 ALICE R_AA (3)
BUILDING ON THE SUCCESS OF INTERNATIONAL MASTERCLASSES

International Data Day: students analyse LHC data at school with help from teacher and connect to videoconference (availability 24 hours to cover as many countries/continents as possible)

International Day of Women and Girls in Science (11 February, introduced by UN): masterclasses for girls

Working Group: Extending Masterclasses to New Countries
Aims to introduce masterclasses to new countries

New Physics measurements in addition to LHC data
• Neutrino physics masterclasses – Minerva
• Astroparticle physics masterclasses - IceCube
• Hadron Therapy masterclass presented at last IPPOG meeting (@GSI, May 2019)
GLOBAL COSMICS

Various projects for measuring cosmic rays in schools exist in many countries. In the last ~4 years IPPOG started a campaign to bring all these under a common umbrella – working group GLOBAL COSMICS.

Workshop
“High School Cosmic Ray Experiments”, February 2017, Centro Fermi, Rome

Previous effort: Eurocosmics
A list of Cosmic rays experiments at schools can be found at: https://icd.desy.de/e49245/

Promotion and support for activities such as:
• **International Cosmic Day** (in November), organised by DESY
• **International Muon Week** (in Spring), organised by Quarknet
CERN competition for high-school students
They participate in the competition by proposing experiments
Two winning teams every year are invited to CERN (to DESY in 2019 and 2020) to do their experiment at a beam line in an experimental hall of CERN; CERN also provides the equipment necessary and support by physicists dedicated to BL4S.

IPPOG members help as:

• Ambassadors for spreading the word about the BL4S competition through their networks of school teachers
• Reference persons (per country) during the phase of preparation of the proposals
• Members of the pre-selection committee of the proposals
IPPOG RESOURCES DATABASE

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

Search by
- Learning Topic
- Audience
- Item Type
- Availability
- Duration
- Language
- Key Words

Resources in your language
- English
- French
- German
- Italian
- Portuguese
- Spanish

Filter by audience
- 6 to 9 years

Last updated: 24.08.2019
PARTICLES4U COMPETITION

Competition by IPPOG for young students funded by an EPS award

Develop projects describing the relevance of particle physics in everyday life

77 responses From 15 countries
Girls, do Physics! is an Instagram campaign organised by the International Particle Physics Outreach Group (IPPOG) to inspire girls to become interested in and study physics and related STEM subjects and break the stereotype that physics is more suitable for boys.

The campaign will run between February 11, the UN International Day of Women and Girls in Science, and March 8, the International Day of Women.
Concerted effort started some years ago to bring outreach in International Conferences. Main aims:

- To convince the members of our community (physicists) about the importance of outreach
- To increase awareness about existing resources and activities

- Outreach talks in plenary sessions
- Outreach parallel sessions
- Outreach activities during conferences
IPPOG AT INTERNATIONAL CONFERENCES IN 2019

- **APS April Meeting, 14 Apr, Denver, Colorado, USA**
  “International Masterclasses: Particle Physics for High School Students and Teachers”
  – Ken Cecire, IPPOG Masterclass Coordination
- **LHCP 2019, 20-25 May, Puebla, Mexico**
  “Particle Physics Outreach as a Strategic Pillar for Society: A report from IPPOG,”
  – Sascha Mehlhase, ATLAS IPPOG Representative
- **EPS HEPP 2019, 10-17 July, Ghent, Belgium**
  “Future Challenges in Particle Physics Education and Outreach,”
  – HPB, IPPOG Chair
  “Developments in International Masterclasses”
  – Uta Bilow, IPPOG Masterclass Coordination
- **CHEP 2019, 4-8 Nov, Adelaide, Australia**
  “Open Data and Software for Particle Physics Outreach”
  “The IPPOG Resource Database for Education & Outreach”
  “Reaching the Public with Event Visualisation? Virtual Reality”
IPPOG’s VISION

• Expand geographically (new members from all continents)
• Expand beyond CERN and even beyond particle physics (BELLE, contacts with Astroparticle Physics community, recently also contacts with Gravitational Waves community)
• Expand the topics of masterclasses
RECOMMENDATIONS FOR PHYSICISTS

• If you are a PhD student – young post-doc : share your enthusiasm with the young generation.
• If you are a more senior (older) physicist : share your enthusiasm and experience; encourage your younger colleagues
• If you are a group leader / in managerial position : choose candidates who are enthusiastic about outreach; encourage participation in outreach
• Remember : it is rewarding and satisfying
• More concerted and systematic effort toward presentation and popularization of science would be helpful in many respects; it would provide a potent antidote to overspecialization; it would bring out clearly what is significant in current research, and it would make science a more integral part of the culture of today.

Victor Weisskopf Science, Vol. 176 (1972)

➢ Contact IPPOG representatives for information
➢ Contact your IPPOG representatives to make them aware of activities/resources
Appendix: IPPOG References

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Thanks a lot for your attention!