International Particle
Physics Outreach Group

CERN Cognitive Festival in Georgia

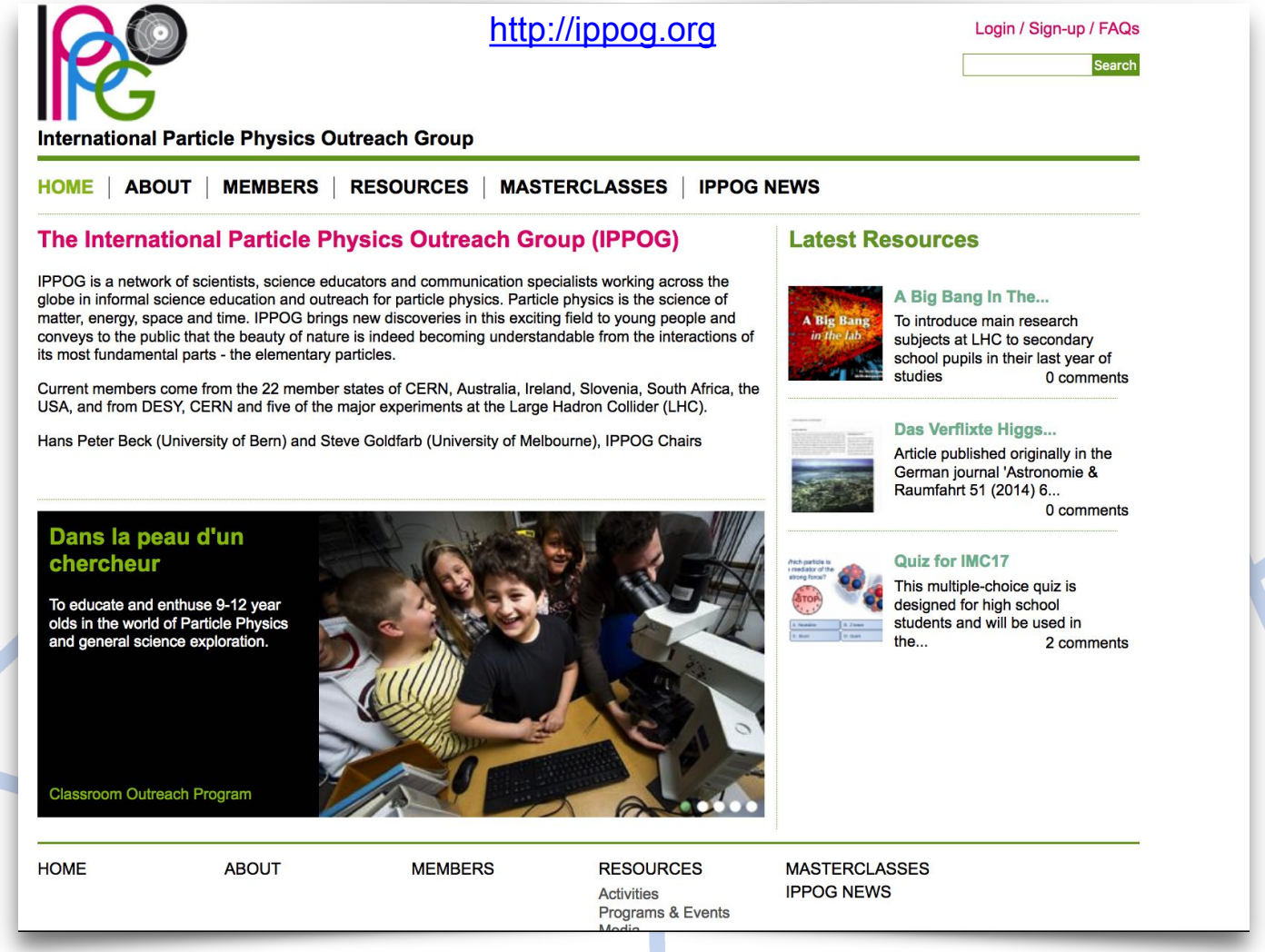
International Particle Physics Outreach Group

A global network for particle physics outreach

Hans Peter Beck
IPPOG Chair

24 October 2018

International Particle Physics Outreach Group



IPPOG Goals

Sustainable Development of Particle Physics Outreach

- Discussion forums for scientists active in Particle Physics Outreach and Informal Education
- Information exchange between individuals, institutions and laboratories
- Active working groups addressing specific challenges of global Outreach

Improving Outreach Standards Worldwide

- Development of Strategies based on current best practices and experience
- Long-Term links between scientists and education specialists
- Continual development & improvement of explanatory material

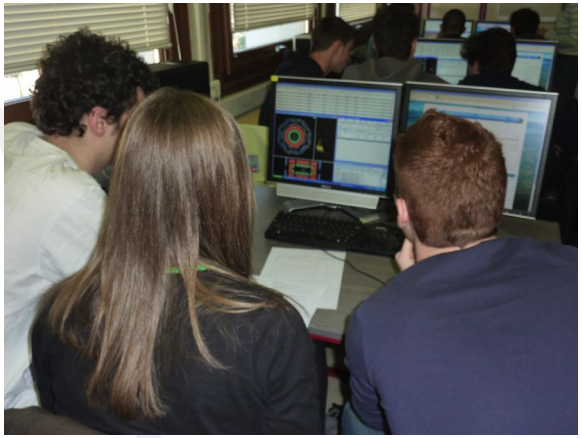
Increasing Global Reach

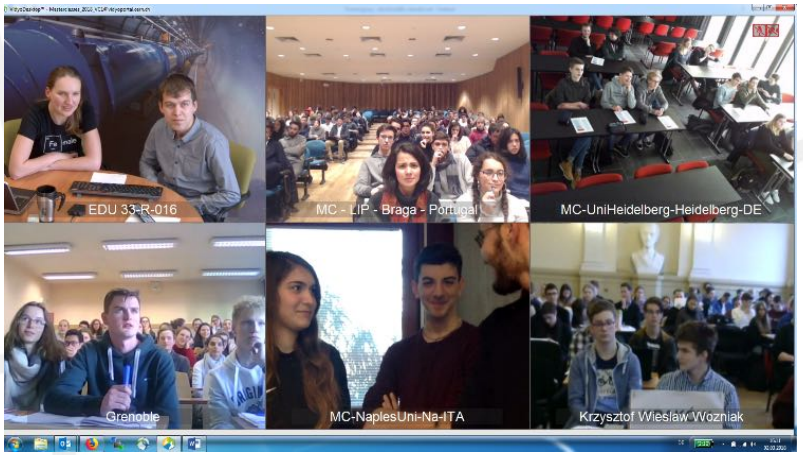
- Expansion to Countries and Peoples underrepresented in Particle Physics
- Usage of new methods, activities and topics to reach broader audiences
- Active online communication platforms

International Particle Physics Masterclasses

The Flagship of IPPOG!

- Students become “Researchers for a Day!”
- Invited to research institute or university
- Given introductory lectures on particle physics research
- Taught to use analysis tools to examine real data
- Spend 2 hours on research
- Discuss results via videoconference with other students around the world



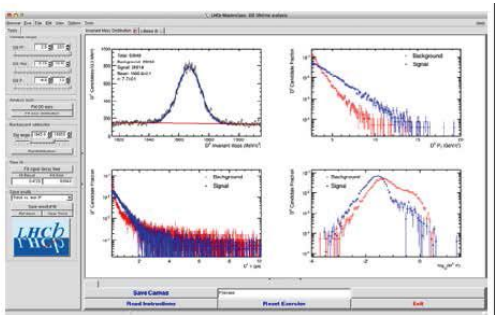


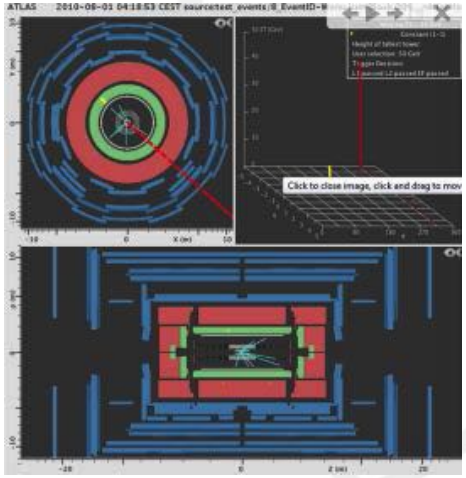
International Particle Physics Outreach Group

International Particle Physics Masterclasses

The Measurements

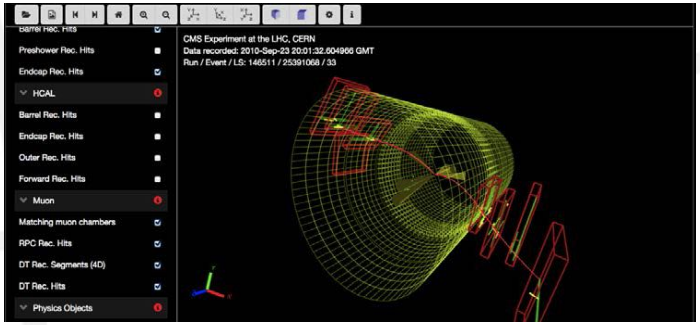
- ATLAS W-Path (Study Ratio W^+ / W^-, extra credit for H→ WW)
- ATLAS Z-Path (Measure Z Mass, extra credit for Z' bosons, H →$\gamma\gamma$)
- CMS (Identify W, Z, H Decays)
- ALICE Strange Particles
- ALICE R_AA Measurement
- LHCb D^0 → Kπ





New Masterclasses being explored

- IceCube
- Auger
- BELLE II

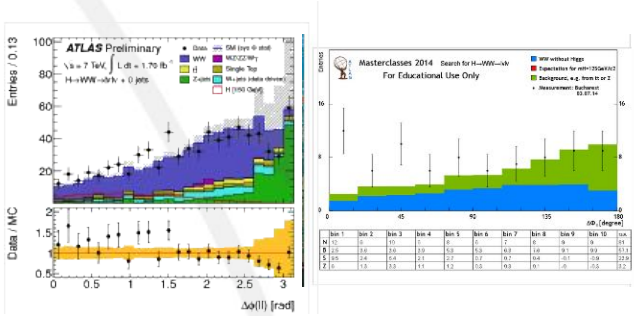


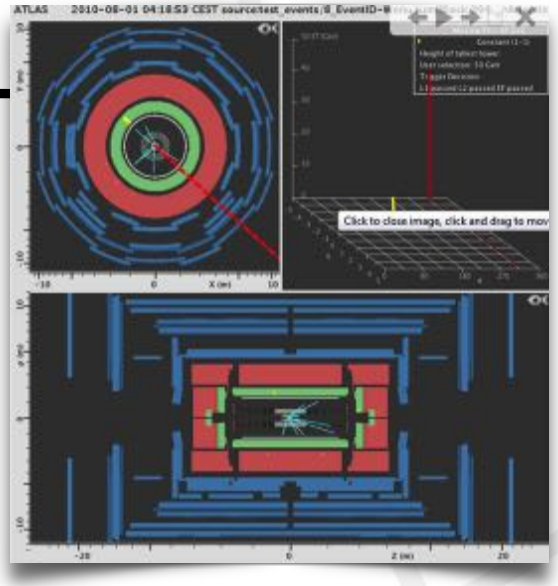
Tools & Data Continually Renewed

International Particle Physics Outreach Group

High-school students analyze LHC data

- **ATLAS**
  - W path (Higgs → WW)
  - Z path (discover Extra Z' Bosons)
- **CMS**
  - WZH measurements
- **ALICE**
  - Looking for Strange Particles
  - R_AA
- **LHCb**
  - $D^0 \rightarrow K\pi$ measurement





Measurements are kept up to date and continuously improve

Exploit known Standard Model Processes, e.g.

- W^+/W^- ratio corresponding to (uud) quarks in proton
- Understand mass peaks of J/Psi and Z

On the way to discover new particles

- Higgs → WW
- Extra Z Bosons
- ...

For example:
The CMS WZH measurement

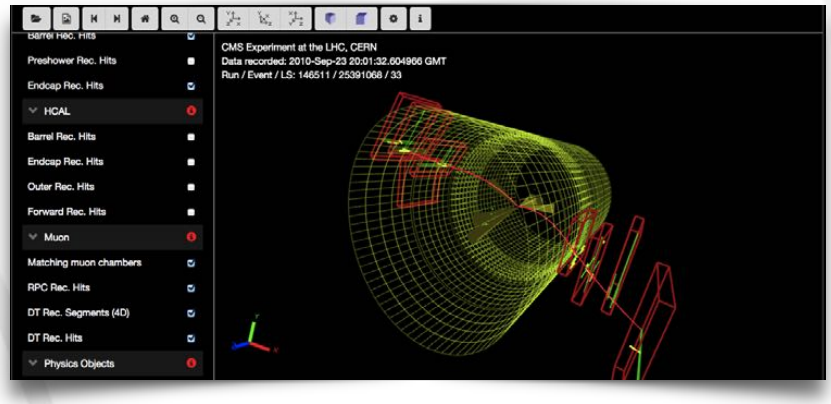
– Students visually characterize, *W*, *Z*, and *H* candidates in event display and extracting kinematics from objects ‘they see’ and fill spread sheets.

– Create mass plots of SM particles that decay in 2 leptons plus *H*

– Measure W^+/W^- ratio in *e* and *μ* leptonic channels

– 3000 events can be analyzed – with misfits, surprises, interpretation

– Website in 13 languages



International Particle Physics Outreach Group

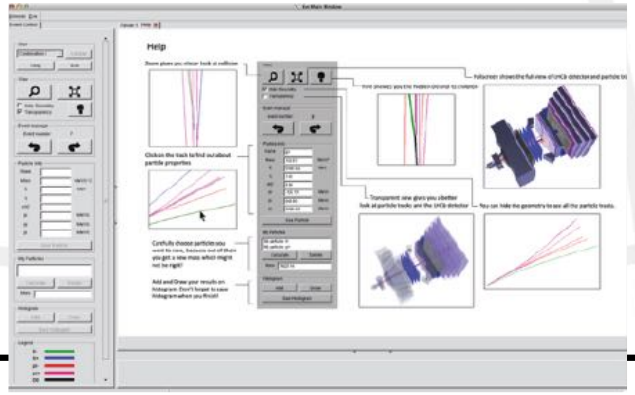
For example:
The LHCb $D^0 \rightarrow K\pi$ measurement

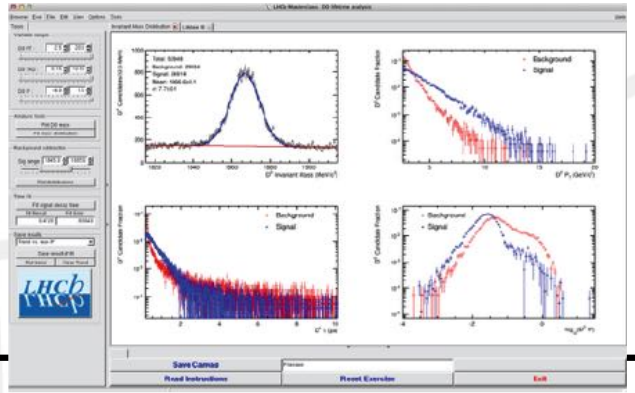
- LHCb experience has > 20 institutes involved EU and US for 2013-2016

- The experience is two-fold.

  The students search for the $D^0 \rightarrow K\pi$ decay using an event display

  The students also perform a setting measurement at the 1% level





International Particle Physics Outreach Group

Expanding to Astroparticle physics – discussions and pilot tests

IceCube Masterclass
http://icecube.wisc.edu/masterclass/home

International Muon Week
Quarknet
http://Internationalmuonweek.org

International Cosmic Day
http://icd.desy.de

Auger Masterclass

http://auger.colostate.edu/ED/

- Pilot tests in German Netzwerk Teilchenwelt

Physics for everyone:
How to explain gravitational waves to a lay audience
IPPOG Meeting – CERN, November 2-4, 2017

IPPOG is embracing all particle physics activities.

Although, historically, there is a strong bias towards LHC physics.

This bias is lingering with a broader base.

International Particle Physics Outreach Group

Masterclass Language Coverage

ALICE (Strange Particles)	-	×	-	×	×	-	×	×	-	×	-	-	×	-	-	-	-	-	-	-	-	-	-	-	-
ALICE (R_AA)	-	-	-	×	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ATLAS	-	×	×	×	×	-	×	×	-	×	×	×	×	×	×	-	-	×	-	-	-	-	-	-	-
CMS	-	-	-	×	×	-	×	-	×	×	-	×	×	-	×	-	-	-	×	×	×	-	×	×	
LHCb	-	-	-	×	×	-	×	-	-	×	-	-	×	-	-	-	-	-	-	-	-	×	-	-	
Hands On Cern	×	×	×	×	×	×	×	×	×	×	×	-	×	×	×	×	×	-	-	-	-	-	-	-	

These are the languages that are supported on http://physicsmasterclasses.org

A participating institute that doesn't find its local language here, will prepare its own set of slides. And even if you find your local language here, you will still adapt your slides according to your local needs.

International Particle Physics Outreach Group

International Particle Physics Masterclasses

New in 2018

http://physicsmasterclasses.org

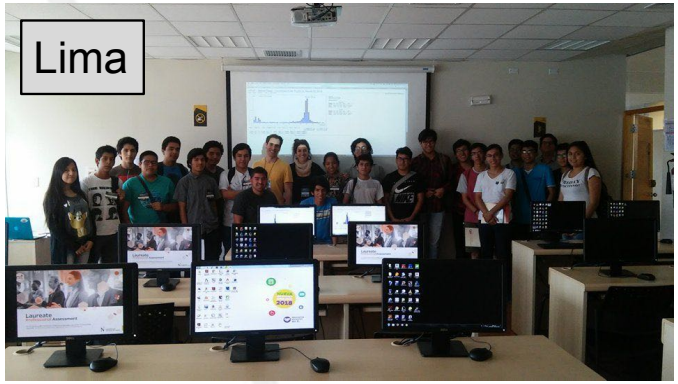
International Particle Physics Outreach Group

International Particle Physics Masterclasses

New in 2018

http://physicsmasterclasses.org

Tehran


Lima


Trujillo


Montevideo


Indore

International Particle Physics Outreach Group

International Particle Physics Masterclasses

2018 Programme

- 15 Feb – 28 Mar 2018
- 52 Countries
- 3 w/o Videoconference

Quarknet

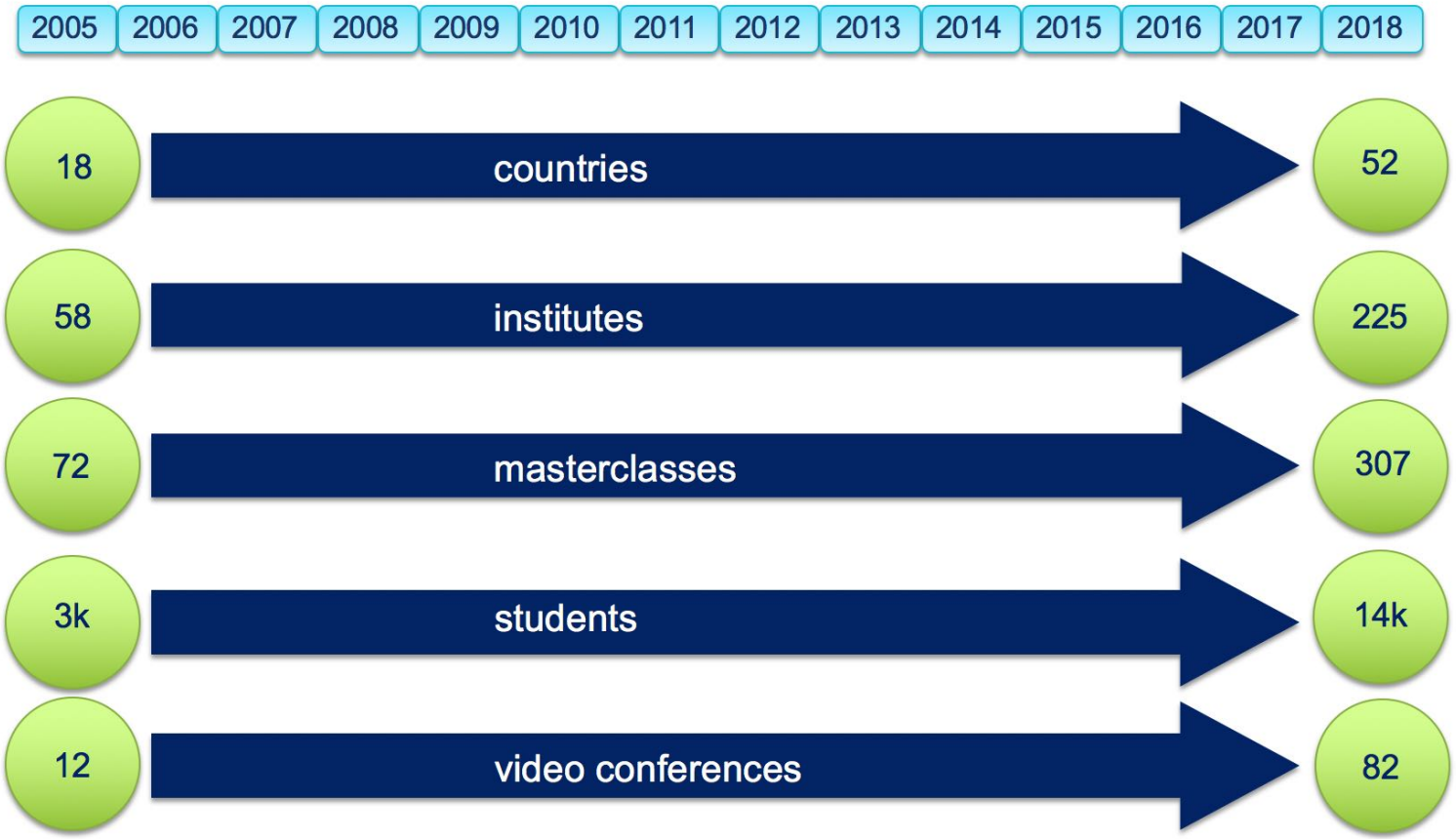
- 48 Institutes
- 50 Masterclasses
  - 31 CMS
  - 19 ATLAS

TU Dresden

- 177 Institutes
- 257 Masterclasses
  - 35 ATLAS W
  - 104 ATLAS Z
  - 58 CMS
  - 39 LHCb
  - 18 ALICE SP
  - 3 ALICE RAA

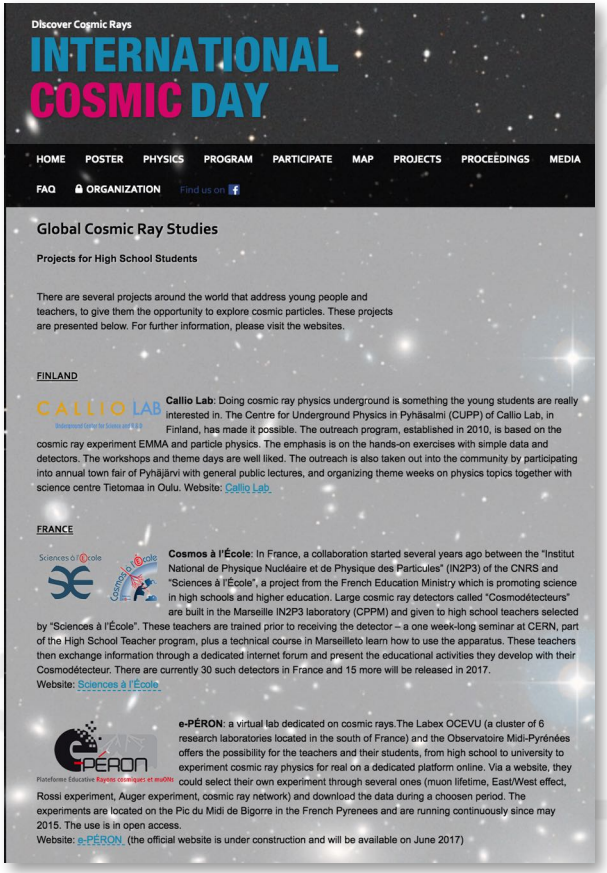
International Particle Physics Outreach Group

Growth of International Masterclasses



International Particle Physics Outreach Group

Global Cosmics



Discover Cosmic Rays

INTERNATIONAL COSMIC DAY

HOME POSTER PHYSICS PROGRAM PARTICIPATE MAP PROJECTS PROCEEDINGS MEDIA FAQ ORGANIZATION Find us on

Global Cosmic Ray Studies

Projects for High School Students

There are several projects around the world that address young people and teachers, to give them the opportunity to explore cosmic particles. These projects are presented below. For further information, please visit the websites.

FINLAND

Callio Lab: Doing cosmic ray physics underground is something the young students are really interested in. The Centre for Underground Physics in Pyhäsalmi (CUPP) of Callio Lab, in Finland, has made it possible. The outreach program, established in 2010, is based on the cosmic ray experiment EMMA and particle physics. The emphasis is on the hands-on exercises with simple data and detectors. The workshops and theme days are well liked. The outreach is also taken out into the community by participating into annual town fair of Pyhäjärvi with general public lectures, and organizing theme weeks on physics topics together with science centre Tietomaa in Oulu. Website: Callio Lab

FRANCE

Cosmos à l'École: In France, a collaboration started several years ago between the "Institut National de Physique Nucléaire et de Physique des Particules" (IN2P3) of the CNRS and "Sciences à l'École", a project from the French Education Ministry which is promoting science in high schools and higher education. Large cosmic ray detectors called "Cosmodétecteurs" are built in the Marseille IN2P3 laboratory (CPPM) and given to high school teachers selected by "Sciences à l'École". These teachers are trained prior to receiving the detector – a one week-long seminar at CERN, part of the High School Teacher program, plus a technical course in Marseilleto learn how to use the apparatus. These teachers then exchange information through a dedicated internet forum and present the educational activities they develop with their Cosmodétecteur. There are currently 30 such detectors in France and 15 more will be released in 2017.
Website: Sciences à l'École

e-PÉRON: a virtual lab dedicated on cosmic rays.The Labex OCEVU (a cluster of 6 research laboratories located in the south of France) and the Observatoire Midi-Pyrénées offers the possibility for the teachers and their students, from high school to university to experiment cosmic ray physics for real on a dedicated platform online. Via a website, they could select their own experiment through several ones (muon lifetime, East/West effect, Rossi experiment, Auger experiment, cosmic ray network) and download the data during a choosen period. The experiments are located on the Pic du Midi de Bigorre in the French Pyrenees and are running continuously since may 2015. The use is in open access.
Website: e-PERON (the official website is under construction and will be available on June 2017)

GERMANY

Cosmic@Web: is a web platform that gatheres and provides the data of different experiments in the astroparticle physics. It allows students to analyse data on their own, without special programming skills and even write their own research papers.
Website: Cosmic@Web

Netzwerk Teilchenwelt: On the track of the Big Bang. In the network "Netzwerk Teilchenwelt" one can enjoy particle physics and astroparticle physics to touch. At workshops in schools, student labs or museums, young people and teachers across the whole of Germany experience the world of Quarks, Elektron & Co. with real data from science or their own experiments. If you want to know more, join the network, develop your own projects and participate in workshops at CERN in Geneva, have a look at the website: Netzwerk Teilchenwelt

ITALY

Extreme Energy Events - Science inside Schools (EEE), is a joint educational and scientific initiative studying cosmic rays. This strategic project of Centro Fermi, Rome is conducted in collaboration with CERN, INFN and MIUR and carried out with the essential contribution of high school students and teachers. The physics research interests include the properties of the local muon flux, the detection of extensive air showers, and the search for possible long range correlations between far telescopes. The experiment is based on a network of "telescopes," the most advanced particle detectors (Multigap Resistive Plate Chambers, MRPC), built at CERN by teams of students and teachers. Telescopes are located in high schools distributed throughout Italy and are controlled by students. Currently, about 50 telescopes are taking data, and more than 90 institutes are analyzing data. Data from all telescopes are centrally collected, reconstructed and distributed to the students. Regular videoconferences, masterclasses, meetings and visits are organized with the involvement of all institutes. More than 50 billion tracks have been collected and are presently studied by students and professional researchers. The project is expanding with the construction of new telescopes. Website: EEE

The **National Institute for Nuclear Physics (INFN)** attaches great importance to and initiates programs for reaching the public and giving students an insight into research. INFN divisions provide detectors for students to measure cosmic rays. Every year, INFN takes part in International Cosmic Day, inviting about 600 students from all over the country to participate. INFN is the Italian research agency dedicated to the study of the fundamental constituents of matter and the laws that govern them. INFN researchers conduct theoretical and experimental research in the fields of subnuclear, nuclear and astroparticle physics. Website: INFN

POLAND

Cosmic-Ray Extremely Distributed Observatory (CREDO) is an expanding world wide network of cosmic ray detectors, utilising both professional observatories and public mobile devices such as smart phones. The main objective of CREDO is to look for cosmic ray events which are extended in both time and space and thus beyond the abilities of localised detectors to identify. Such events have interdisciplinary applications in areas such as geophysics and space weather as well as astrophysics. The involvement of non-professional science enthusiasts in CREDO is enhanced by Dark Universe Welcome where citizen scientists are invited to explore the cosmic ray events detected around the world, classify them and identify patterns.Website: CREDO, Dark Universe Welcome

RUSSIA

Showers of Knowledge is an open outreach educational project that aims to bring internet users worldwide to an analysis of data of the of real online cosmic-rays experiment. It is developed at Joint Institute for Nuclear Research (Dubna, Russia). The project consists of the distributed setup for researching cosmic rays RUSALKA ("mermaid"), comprising 11 stations located in the area of about 0.5 km in diameter; and the interactive internet portal livni.jinr.ru, where users can run a variety of pre-made data analysis scripts with their custom parameters. Our feature is the possibility for users to communicate with real particle physicists developing the project. Website: Showers of Knowledge

SPAIN

Cazadores de Rayos Gamma is a high energy astrophysics web application where students can analyse data from the MAGIC telescopes using a python programming environment. This outreach application combines a storytelling approach with science and programming challenges for the users. 4 PhD students introduce the user into high energy astrphysics research and the observations and analysis done with the MAGIC telescopes. The user will learn about fundamental physics related to Super Nova Remnants, Black Holes, Dark Matter,... and also about specific astronomical sources such as Casiopea A or the Crab Pulsar. The project was developed at the Institut de Física d'Altes Energies (IFAE) in Barcelona. At the moment only a spanish version is available. But soon it will be translated to other languages. Website: Cazadores de Rayos Gamma

SWEDEN

Cosmic ray outreach in Stockholm: The Royal Institute of Technology (KTH) and Stockholm House of Science offer high school projects on cosmic rays to Swedish students in the final year of high school. Muon detectors of different sizes are available for students to borrow, or use in our research labs. The participating students pose their own research questions, which they then test with one or more of our muon detectors. As part of this project a muon detector is launched on a weather balloon once a year to measure the cosmic ray flux at altitudes up to 35 000 km. The data from each flight is collected in a database which is freely available to anyone interested in collaborating with us. Website: Info kosmisk strålning

TAIWAN

QuarkNet-TW started in 2006. While we have worked with both high school and university students, most participants have been university students. We have prepared full usage of raspberry pi and python programs. (Using the QuarkNet detector is included in the senior course "Experiment for Modern Physics" by the Physics Department of National Cheng Kung University.) However, we are moving QuarkNet-TW to the Taipei Astronomical Museum (TAM) which is more practical for high school students. In addition to uploading data to e-Lab, students can analyze and view their data in real time. Extensions to astronomy become possible at TAM, and interested students can do some hands-on experiments related to electrical engineering.

UK

Detecting Cosmic Rays – possible student projects: Three portable scintillation telescopes, each comprising a pair of scintillators, have been constructed, following the QuarkNet design, in the School of Physics and Astronomy at the University of Birmingham. These telescopes can be set up and used conveniently by students to measure the flux of cosmic rays; its dependence on distance between the scintillators, on zenith angle and on height (e.g. on the successive floors of a building). Results can also be stored and analysed using standard QuarkNet software. These telescopes , with worksheets outlining possible investigations, can be borrowed by schools and colleges for student projects. For more information, please contact :
Website: Login as a guest to view Birmingham QuarkNet Project

High School Project on Astrophysics Research with Cosmics (HiSPARC) is a project in which secondary schools and academic ins... extremely high energy. HiSPARC offe... purpose of finding out more about th... detectors and students install these d... Netherlands in 2002. The HiSPARC detectors are co... Amsterdam through the internet, forming a large net... spread to the UK in 2012 with first the Universities of Bristol, Bath and Birmingham. The project has recently spread to the Universities of Cardiff and Sussex. Website: HiSPARC

QuarkNet Cymru builds on existing STEM programmes linked with HiSPARC and QuarkNet and a programme to pilot the use of cosmic ray detectors in schools across South Wales. Since January 2016, the project has tried to enthuse secondary school students in STEM activities through engagement in real hands-on astrophysics experiments — measuring cosmic rays using detectors based in schools. Equipment is available for loan to those schools that need A level particle physics laboratory equipment. A website will eventually act as a repository of the resources for using the detectors in the classroom,

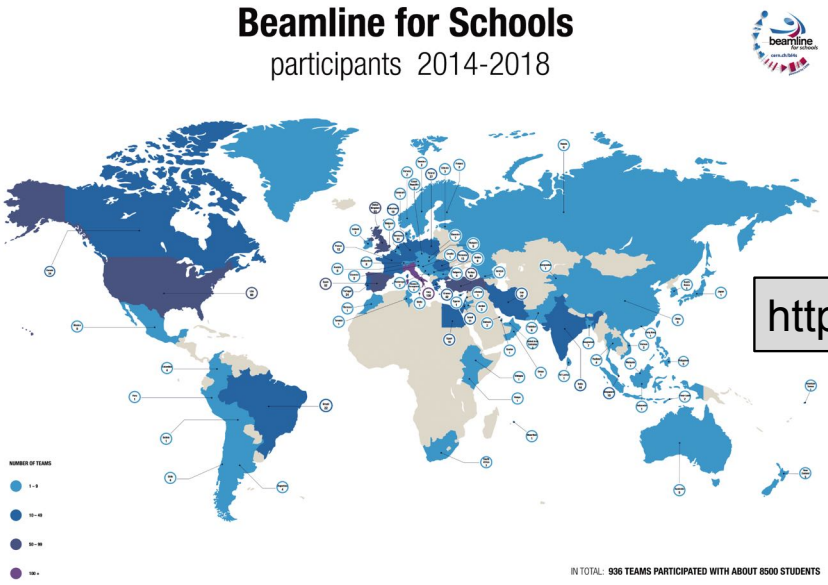
http://globalcosmics.org

International Particle Physics Outreach Group

CERN's Beamline 4 Schools

IPPOG Participation

- Local Contacts to Schools
- Help Remove Language Barrier
- Give Guidance for Physics, Feasibility



http://beamline-for-schools.org

International Particle Physics Outreach Group

IPPOG In The Media

CERNCOURIER | International journal of high-energy physics

Brazil signs up to IPPOG collaboration

Brazil joins IPPOG

The International Particle Physics Outreach Group (IPPOG) has welcomed Brazil as a new member, boosting efforts to expand the group's international impact on scientific outreach. Established 20 years ago as a European network, IPPOG has grown to a global network that involves countries, laboratories and scientific collaborations active in particle physics. It is best known for its international masterclasses programme, which evolved in the late 1990s from national outreach efforts. Following the model of collaboration in experimental particle physics, IPPOG became a formal scientific collaboration based on a memorandum of understanding (MoU) in 2017 (***CERN Courier*** March 2017 p5).

Brazil, which will be officially represented in IPPOG by Marcelo Munhoz of the University of São Paulo, is one of several countries to formally join the collaboration in recent months. In April, at the 15th IPPOG collaboration meeting in Pisa, two further countries – Slovenia and the Czech Republic – confirmed membership, while Greece and Austria are finalising the process to sign IPPOG's MoU. That will bring the number of members to 26 – including the Belle II experiment, which has just started operations in Japan (see SuperKEKB steps out at the intensity frontier).

Faces & Places, June 2018

OUTREACH

Packed house for CHEP public event

A large and enthusiastic crowd attended "Universal Science," a public event preceding the International Conference on Computing for High Energy and Nuclear Physics (CHEP), in Sofia, Bulgaria, on 8 July. With the three-part theme of research, computing and diversity, tickets for the event sold out well before deadline, and overflow had to be accommodated through online participation.

Such an outreach event is not typical for CHEP, a conference that focuses on specialised topics such as distributed computing, event reconstruction, data handling and virtualisation. This year's organising committee, however, saw it as an opportunity to reach out to the local public and to foster open discussion on the impact of particle-physics research on society. Similar events have grown in popularity at other major conferences, such as ICHEP, EPS LHCP, and the particle-physics-co community has become incr

N Kastoumis

Audience Q&A with the scientific panel (from left): Steven Goldfarb, Andreas Salzburger, Lee Bitsoi, and Hannah Short.

engaged in public outreach.

Hands-on exhibits, including interactive virtual-reality displays, entertained and informed the audience. Andreas Salzburger, a CERN physicist on the ATLAS experiment, kicked off the evening with a short talk on the motivation for and history of particle physics. This was followed by talks on diversity by Lee Bitsoi of Stony Brook University and on the growth of distributed computing by CERN computer engineer Hannah Short. Talks were followed by a panel discussion generating a barrage of questions from both the local audien hose connecting via Facebook Li vas organised and sponsored khaven National Laboratory, a ar-science platform called RATIO, G and Belle II.

● *Steven Goldfarb, CERN.*

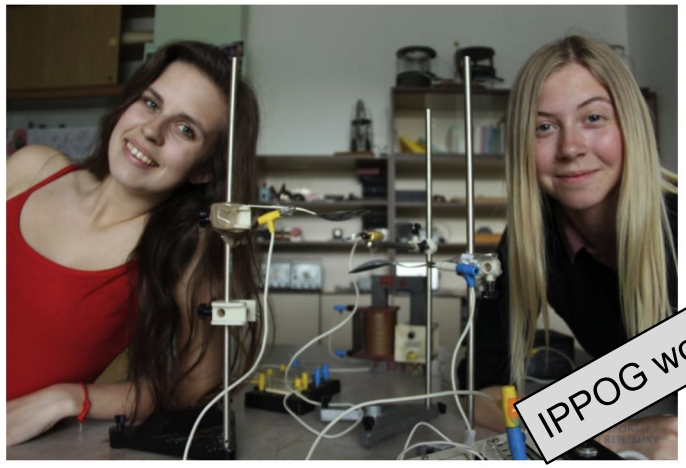
Faces & Places, October 2018

International Particle Physics Outreach Group

IPPOG In The Media

Slovenské gymnazistky zvíťazili v medzinárodnej fyzikálnej súťaži Particles4U

Jednoduchý a lacný lapač iónov priniesol dvom žiačkam Gymnázia Ľudovíta Štúra vo Zvolene víťazstvo v prvom ročníku medzinárodnej súťaže Particles4U (Častice pre teba)



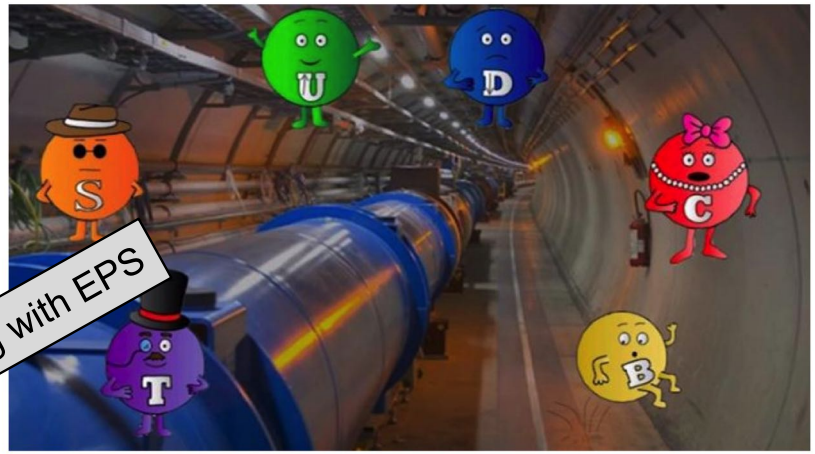
Andrea Škvareninová a Radka Veselá pod vedením svojho učiteľa fyziky **Mareka Balážoviča** uspeli v konkurencii rovesníkov z 15 krajín.

Súťaž organizovala kolaborácia **International Particle Physics Outreach Group** s podporou **Európskej fyzikálnej spoločnosti**.

IPPOG working with EPS

Σε Έλληνες μαθητές το 1ο Βραβείο Διεθνούς Διαγωνισμού για το βίντεο «The Quark show»!

Μαθητές του 2ου και 6ου Δημοτικού Σχολείου Αρτέμιδος, με την καθοδήγηση ειδικών, δημιούργησαν ένα εκπαιδευτικό βίντεο, συνδύασαν το χιούμορ με τα στοιχειώδη σωματίδια και φαντάστηκαν έναν διάλογο μεταξύ των σωματιδίων που εξηγεί, ουσιαστικά, γιατί δεν είναι τίποτα τυχαίο στη φύση.



07.03.2018 | upd: 09.03.2018 Δημιουργικότητα Εκπαίδευση Επιστήμη

Πώς θα ήταν άραγε ένας διάλογος μεταξύ...σωματιδίων; Οι μαθητές του 2ου και 6ου Δημοτικού Σχολείου Αρτέμιδος όχι μόνο κατάφεραν να απαντήσουν σε αυτό το ερώτημα δημιουργώντας ένα πρωτότυπο video με τίτλο «Η παράσταση των κουάρκ» ("The Quark Show"), στο πλαίσιο του εκπαιδευτικού προγράμματος «Παίζοντας με τα πρωτόνια» (Playing with Protons), αλλά και να κερδίσουν το Πρώτο Βραβείο του Διεθνούς Διαγωνισμού Particles4U του International Particle Physics Outreach Group (IPPOG), στην κατηγορία των Δημοτικών Σχολείων.

International Particle Physics Outreach Group

IPPOG In The Media

Jornal da USP

CIÊNCIAS | TECNOLOGIA | EDUCAÇÃO | CULTURA | ATUALIDADES | UNIVERSIDADE | INSTITUCIONAL

Home > Universidade > Na USP, jovens descobrem como é trabalhar com física de partículas

Universidade - 26/03/2018

Na USP, jovens descobrem como é trabalhar com física de partículas

No Instituto de Física, alunos do ensino médio vão interagir com participantes de outros países e com os pesquisadores do Cern

Por Redação - Editorias: Universidade - URL Curta: jornal.usp.br/?p=155888

Curtir 86

Masterclasses in Brazil

Alunos durante a Masterclasses de 2017, realizada no Instituto de Física da USP – Foto: Divulgação/IF

O Instituto de Física (IF) da USP é uma das sedes brasileiras da *International Masterclasses Hands on Particles Physics*, iniciativa que aproxima alunos do ensino médio do cotidiano dos cientistas do Cern, o maior laboratório de física de partículas do mundo.

attain | Announcements | Community | Academic | The Arts | Sport | Activities | Speakers & Visitors

Cosmic-ray Detector Awarded for Contribution to International Competition

University College School | 2 Jul 2017 |

EMAIL TO A FRIEND | TWEET THIS STORY | SHARE ON FACEBOOK

Eleven students from UCS Hampstead have won a cosmic-ray detector after reaching the top 30 entries in the Beamline for School's Competition 2017 (BL4S) established by CERN.

Working with CERN on BL4S

The "Absolute Uncertainty" team (all 15 to 17 years old) included Michael A Grodzinski, Chris Harley, Geno Racklin Asher, Ava Pettit, Kieran Ross UCS Hampstead, which successfully made it to the final round of th ams from around the world.

One of the team, Michael Aarons (17 years) expl raged to take part in the competition by their school's Physics dep enthusiasts, and were excited by the opportunity to run our own exp opportunities to enter competitions and work in such large teams, and t The team entered with a proposal to study the consequences of Van Allen B efficiency of satellite mounted solar cells, for which they were shortlisted. Michael is k e other physics enthusiasts to enter next year, and has the following advice for future team with your gut and don't look at what everyone else is doing. Don't be afraid to be innovative!"

The BL4S physics competition tasked entrants with designing a proposal to utilise a particle accelerator in an innovative fashion. Now entering its fourth year, CERN works with the International Particle Physics Outreach Group (IPPOG) to test the innovation, problem-solving and collaboration skills of teams, with the winners getting the opportunity to conduct an experiment for 10 days on-site at CERN in Geneva, Switzerland.

Related stories

Back in the classroom to look back in time

International fiction writing competition win

International Particle Physics Outreach Group

IPPOG – A formal Collaboration with MoU

Global Network

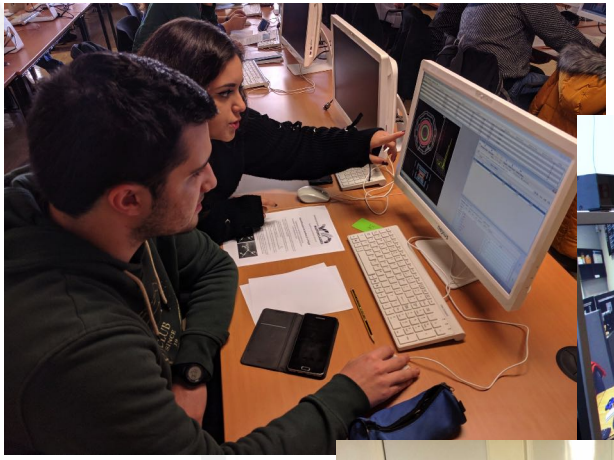
- Scientists
- Science Educators
- Communication Specialists

International Collaboration

- Countries
- Experiments
- International Labs

Bridge Builders

- Teaching Skills
- Promoting the Scientific Process
- Propagating it around the World



International Particle Physics Outreach Group

IPPOG Members – Countries, Labs, Experiments

	Signator	Country/Lab/Experiment	Date Signed
1	NIKHEF	The Netherlands	22 Sep 2016
2	DESY for KET	Germany	23 Sep 2016
3	Physics Department of University of Oslo	Norway	21 Oct 2016
4	LIP	Portugal	1 Nov 2016
5	The Section for Elementary Particle and Astroparticle Physics of the Swedish Physical Society through the Swedish LHC Consortium	Sweden	1 Nov 2016
6	CHIPP	Switzerland	4 Nov 2016
7	Ministry of Education, Science, Research and Sport	Slovak Republic	15 Nov 2016
8	Institute of Atomic Physics	Romania	17 Nov 2016
9	Helsinki Institute of Physics	Finland	29 Nov 2016
10	FWO + F.R.S.-FNRS	Belgium	30 Nov 2016
11	CERN	CERN	19 Dec 2016
12	INFN	Italy	21 Dec 2016
13	CNRS/IN2P3	France	23 Dec 2016
14	The Henryk Niewodniczański Institute of Nuclear Physics, Polish Academy of Sciences	Poland	29 Dec 2016

International Particle Physics Outreach Group

IPPOG Members

	Signator	Country/Lab/Experiment	Date Signed
15	CoEPP	Australia	14 Feb 2017
16	The University of Notre Dame on behalf of QuarkNet	USA	14 Mar 2017
17	ATLAS Spokesperson	ATLAS	1 Nov 2017
18	BELLE II Spokesperson	BELLE II	19 Feb 2018
19	Jôsef Stefan Institute, Ljubljana, Slovenia	Slovenia	19 Apr 2018
20	Institute of Physics of the Czech Academy of Sciences	Czech Republic	21 Apr 2018
21	Rede Nacional de Física de Altas Energias (RENAFAE)	Brazil	26 Apr 2018
22	Ministry for Education, Research, and Religious Affairs	Greece	19 Jun 2018
23	HEPHY, ÖAW, ÖPG	Austria	6 Oct 18
24	Danish CERN Instrumentation Centre, NICE	Denmark	6 Oct 18
25	ALICE Spokesperson	ALICE	6 Oct 18
26	LHCb Spokesperson	LHCb	6 Oct 18

Status

- Members: 21 Countries, 4 Experiments, 1 Lab
- Candidates: Bulgaria, Hungary, Ireland, Israel, South Africa, Spain, United Kingdom, CMS
- Expression of Interest: Georgia (add candidates)

Country & Lab Commitments

Signing of MoU

- Identification of National Body Responsible for Particle Physics Outreach
- Identification of Representative

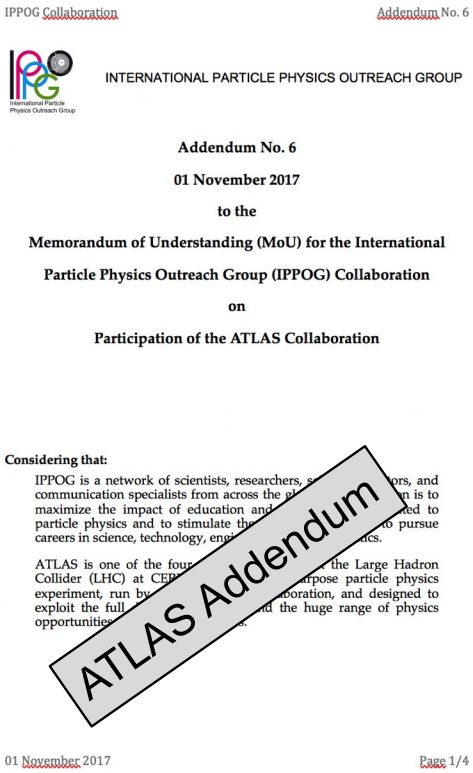
Annual Membership Fee

- Countries ranked on GDP, Particle Physics Community Size
  - 3 Country Rankings: 1 kEUR, 3 kEUR, 5 kEUR
- Labs treated case-by-case
  - CERN contributes 5 kEUR + Masterclass Coordinator + Scientific Secretary + Infrastructure for Web, Finance, Legal Support

In 2018

- Total revenues of 58 kEUR + 2 x ½ FTE + In-Kind Support
- → Core Infrastructure to Support Global Outreach Efforts (*Hired Expertise*)
  - Web and Communication Content Development (½ FTE)
  - Support for Expansion of Global Reach

Experiment Agreements



IPPOG Collaboration Addendum No. 6

INTERNATIONAL PARTICLE PHYSICS OUTREACH GROUP

Addendum No. 6

01 November 2017

to the

Memorandum of Understanding (MoU) for the International Particle Physics Outreach Group (IPPOG) Collaboration

on

Participation of the ATLAS Collaboration

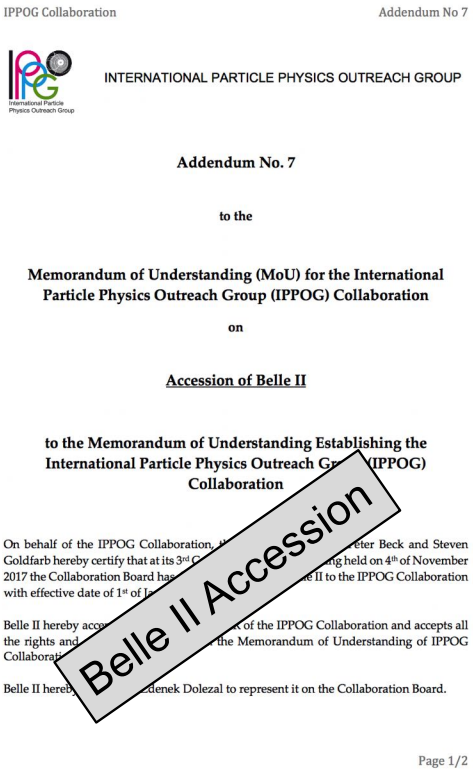
Considering that:

IPPOG is a network of scientists, researchers, s… …ors, and communication specialists from across the gl… …n is to maximize the impact of education and … …ed to particle physics and to stimulate th… …o pursue careers in science, technology, engi… …ics.

ATLAS is one of the four … the Large Hadron Collider (LHC) at CER… …rpose particle physics experiment, run by … …boration, and designed to exploit the full … …d the huge range of physics opportunities…

ATLAS Addendum

01 November 2017 Page 1/4



IPPOG Collaboration Addendum No 7

INTERNATIONAL PARTICLE PHYSICS OUTREACH GROUP

Addendum No. 7

to the

Memorandum of Understanding (MoU) for the International Particle Physics Outreach Group (IPPOG) Collaboration

on

Accession of Belle II

to the Memorandum of Understanding Establishing the International Particle Physics Outreach Gr… (IPPOG) Collaboration

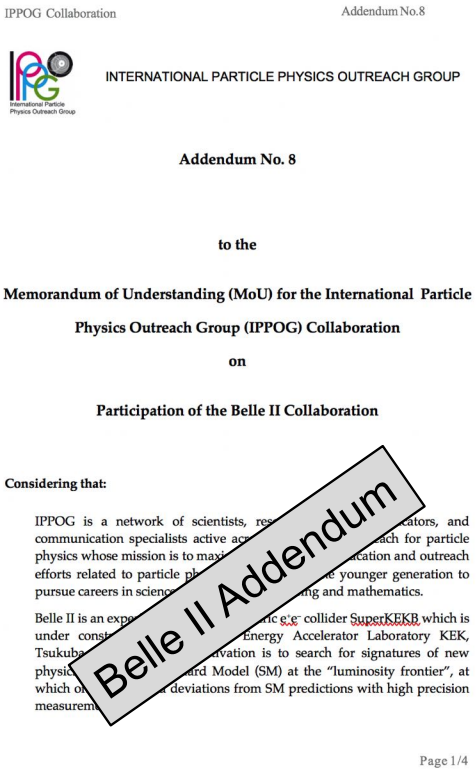
On behalf of the IPPOG Collaboration, t… …eter Beck and Steven Goldfarb hereby certify that at its 3rd C… …ng held on 4th of November 2017 the Collaboration Board has … …e II to the IPPOG Collaboration with effective date of 1st of J…

Belle II hereby acce… …k of the IPPOG Collaboration and accepts all the rights and … …the Memorandum of Understanding of IPPOG Collaborati…

Belle II hereb… …denek Dolezal to represent it on the Collaboration Board.

Belle II Accession

Page 1/2



IPPOG Collaboration Addendum No.8

INTERNATIONAL PARTICLE PHYSICS OUTREACH GROUP

Addendum No. 8

to the

Memorandum of Understanding (MoU) for the International Particle Physics Outreach Group (IPPOG) Collaboration

on

Participation of the Belle II Collaboration

Considering that:

IPPOG is a network of scientists, res… …cators, and communication specialists active ac… …ach for particle physics whose mission is to max… …cation and outreach efforts related to particle ph… …e younger generation to pursue careers in scienc… …ng and mathematics.

Belle II is an expe… …c e-e- collider SuperKEKB which is under const… …Energy Accelerator Laboratory KEK, Tsukuba … …vation is to search for signatures of new physic… …ard Model (SM) at the "luminosity frontier", at which o… …deviations from SM predictions with high precision measurem…

Belle II Addendum

Page 1/4

International Particle Physics Outreach Group

Experiment Agreements

Experiment Commits to:

- Recognise Outreach as Important Part of Research Programme
- Recognise Efforts of Collaboration Members Who Do Outreach
- In-Kind Contributions
  - Access to agreed-upon data sets for education
  - Access to analysis tools and documentation for using the data sets
  - Support for conducting Masterclasses
  - Educational material, communication support, physics expertise

IPPOG Commits to:

- Organise and Execute Particle Physics Masterclasses
- Widen Global Scope of Experiment's Outreach & Education Efforts
- Provide Stimulating Environment for Exchange of Ideas, Best Practices
- Provide Coordinated Efforts for Increased Visibility

International Particle Physics Outreach Group

http://ippog.org

http://facebook.com/ippog

http://facebook.com/groups/friends.ippog

http://twitter.com/ippogOrg

International Particle Physics Outreach Group

IPPOG In Conferences

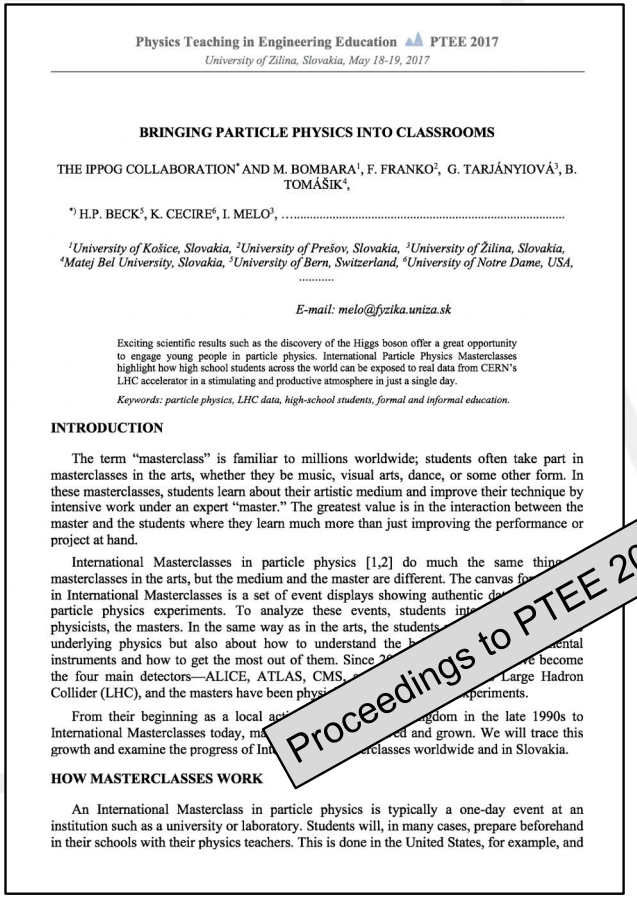
APS March 2018 – Los Angeles, CA, USA
- Outreach Parallel Session

LHCP 2018 – Bologna, Italy
- Outreach Parallel Session
- Plenary Presentation by IPPOG Chair

ICHEP 2018 – Seoul, Korea
- Education & Outreach Parallel Sessions
- Public Presentations

CHEP 2018 – Sofia, Bulgaria
- Public Forum on Physics, Computing and Diversity, Organised and Sponsored by IPPOG, et al.

ICNFP 2018 – Crete, Greece
- Outreach Masterclass



Physics Teaching in Engineering Education PTEE 2017
University of Zilina, Slovakia, May 18-19, 2017

BRINGING PARTICLE PHYSICS INTO CLASSROOMS

THE IPPOG COLLABORATION* AND M. BOMBARA[1], F. FRANKO[2], G. TARJÁNYIOVÁ[3], B. TOMÁŠIK[4],

*) H.P. BECK[5], K. CECIRE[6], I. MELO[3], ...

[1]University of Košice, Slovakia, [2]University of Prešov, Slovakia, [3]University of Žilina, Slovakia, [4]Matej Bel University, Slovakia, [5]University of Bern, Switzerland, [6]University of Notre Dame, USA,

E-mail: melo@fyzika.uniza.sk

Exciting scientific results such as the discovery of the Higgs boson offer a great opportunity to engage young people in particle physics. International Particle Physics Masterclasses highlight how high school students across the world can be exposed to real data from CERN's LHC accelerator in a stimulating and productive atmosphere in just a single day.

Keywords: particle physics, LHC data, high-school students, formal and informal education.

INTRODUCTION

The term "masterclass" is familiar to millions worldwide; students often take part in masterclasses in the arts, whether they be music, visual arts, dance, or some other form. In these masterclasses, students learn about their artistic medium and improve their technique by intensive work under an expert "master." The greatest value is in the interaction between the master and the students where they learn much more than just improving the performance or project at hand.

International Masterclasses in particle physics [1,2] do much the same thing masterclasses in the arts, but the medium and the master are different. The canvas fo in International Masterclasses is a set of event displays showing authentic da particle physics experiments. To analyze these events, students int physicists, the masters. In the same way as in the arts, the students underlying physics but also about how to understand the h instruments and how to get the most out of them. Since 2 ve become the four main detectors—ALICE, ATLAS, CMS, Large Hadron Collider (LHC), and the masters have been physi periments.

From their beginning as a local ac gdom in the late 1990s to International Masterclasses today, ma ed and grown. We will trace this growth and examine the progress of In rclasses worldwide and in Slovakia.

HOW MASTERCLASSES WORK

An International Masterclass in particle physics is typically a one-day event at an institution such as a university or laboratory. Students will, in many cases, prepare beforehand in their schools with their physics teachers. This is done in the United States, for example, and

Proceedings to PTEE 2017

International Particle Physics Outreach Group

Past Year's IPPOG Meetings

Nov 2017

- 14th IPPOG Meeting at CERN

April 2018

- 15th IPPOG Meeting in Polo Fibonacci (Pisa) and EGO-Virgo (Cascina)
  - Panel topics:
    - **Broadening the physics scope of Masterclasses**
    - **Communication Platforms and Strategy**
    - **Diversity in Science and Technology**
  - Working Group discussions:
    - **WG on Bringing Masterclasses to New Countries**
    - **WG on Explaining Particle Physics Hot Topics to a Lay Audience**
    - **WG on Exhibits**
  - ***Strong Interactions* with Gravitational Wave Community**

IPPOG as a Role Model in Physics Outreach!

Intensive 2.5-Day Meetings

International Particle Physics Outreach Group

Outlook for end 2018, 2019

Membership

- Working with remaining Candidate Members to complete MoU signing
- Developing possibility for national entities, such as labs, to become observers
- Creating new partnerships for further expansion

European Particle Physics Strategy Update

- Preparing input emphasising critical nature of Particle Physics Education & Outreach
- Significant time reserved in next week's IPPOG meeting for carving input for EPPSU

For an Open Dialogue with Society

As we entered the so-called "post-factual world" emerging from political ideologies in a growing number of modern democracies, it is more important than ever for science and society to maintain an open and transparent dialogue.

It has also become evident that the tools and methods currently used to support such a dialogue have not been as successful as we would have hoped.

Indeed, many excellent outreach activities at research centres, universities and museums often attract only those people who are already interested and appreciative of the basic and fundamental relevance of science.

Without compromising established methods, we must explore new paths to engage citizens – especially the young.

While only a fraction of young students will become scientists, and fewer still will become particle physicists, all will become ambassadors for the scientific method and evidence-based decision-making.

— HP Beck
CERN Courier (March 2017)

International Particle Physics Outreach Group

Enabling Outreach Globally

International Particle Physics Outreach Group