



Enabling Outreach Globally

Report to ECFA, November 16th 2017

Hans Peter Beck: IPPOG Chair, Bern University
Steve Goldfarb: IPPOG Chair, Melbourne

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)



<http://ippog.org>

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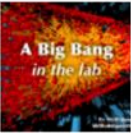
The International Particle Physics Outreach Group (IPPOG)

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 22 member states of CERN, Australia, Ireland, Slovenia, South Africa, the USA, and from DESY, CERN and five of the major experiments at the Large Hadron Collider (LHC).

Hans Peter Beck (University of Bern) and Steve Goldfarb (University of Melbourne), IPPOG Chairs

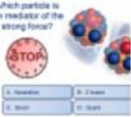
Latest Resources



A Big Bang In The...
To introduce main research subjects at LHC to secondary school pupils in their last year of studies 0 comments



Das Verflixte Higgs...
Article published originally in the German journal 'Astronomie & Raumfahrt 51 (2014) 6... 0 comments




Quiz for IMC17
This multiple-choice quiz is designed for high school students and will be used in the... 2 comments

Dans la peau d'un chercheur

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

Classroom Outreach Program



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IPPOG's Purpose

Strengthening the sustainability, reproduction and growth of **outreach activities in particle physics**

through the provision of reliable and regular discussion forums and information exchange for science institutions and laboratories as well as for individual scientists engaged in science outreach and informal science education world-wide

Raising standards

for outreach and informal science education initiatives by proposing and implementing strategies designed to share lessons learned and best practices for outreach in particle physics and related fields

Providing explanatory materials

for helping disseminate results from particle physics and related subjects.

IPPOG's Flagship: International Masterclasses

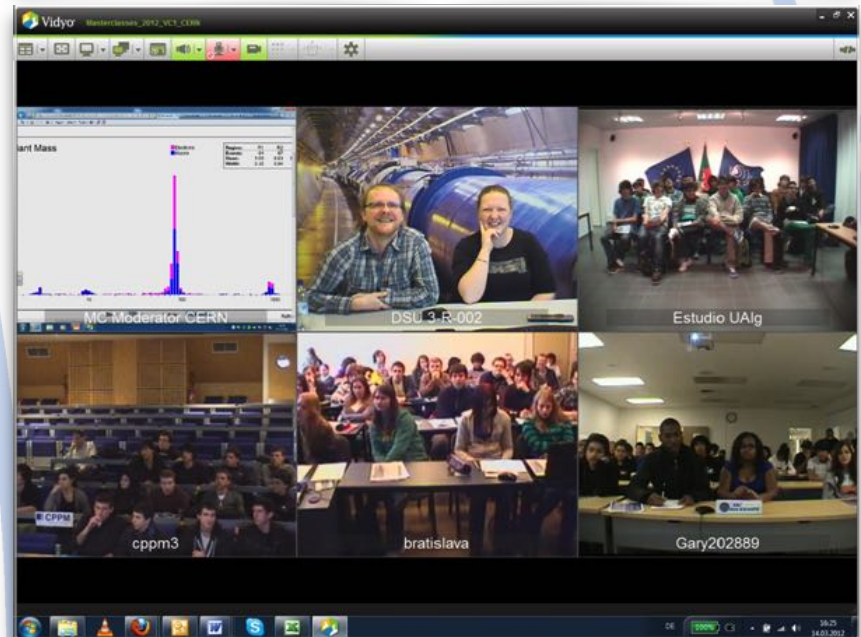
High school students (15 – 19) are
„scientists for one day“

Get invited to a research institute or
university

Introductory talks (standard model,
detectors, accelerators)

2 h hands-on analyzing LHC data

International video conference (2 – 5
inst. + CERN/Fermilab)



International Masterclasses 2017

1 March – 11 April 2017

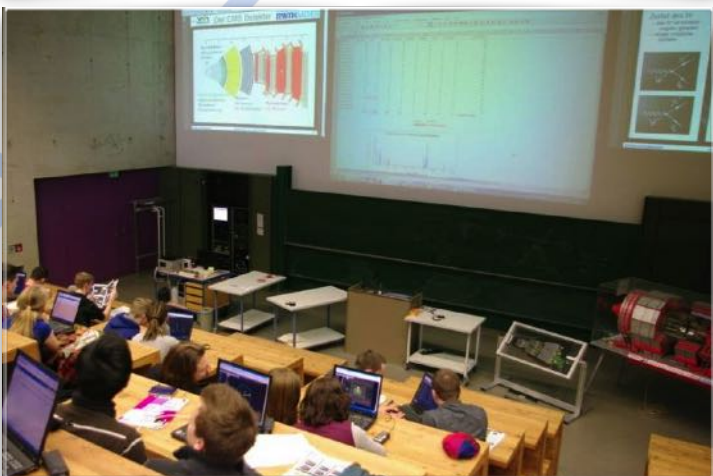
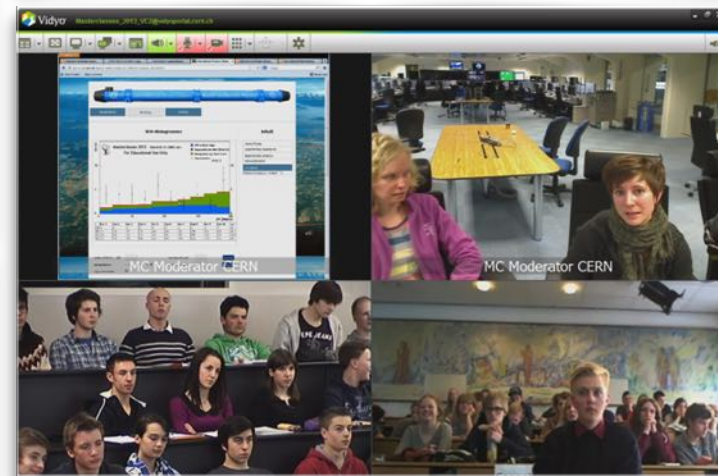
50 countries – 216 institutes – 14'000 high-school students – 1'100 teachers



Coord.: QuarkNet / TU Dresden

- 43 institutes (43)
- 50 Masterclasses (48)
 - 35 CMS (33)
 - 15 ATLAS (15)

- 173 institutes (169)
- 264 Masterclasses (227)
 - 45 ATLAS W (42)
 - 93 ATLAS Z (83)
 - 52 CMS (49)
 - 45 LHCb (34)
 - 24 ALICE SP (15)
 - 5 ALICE R_AA (4)



High-school students analyze LHC data

- **ATLAS**

- W path (Higgs → WW)
- Z path (discover Extra Z' Bosons)

- **CMS**

- WZH measurements

- **ALICE**

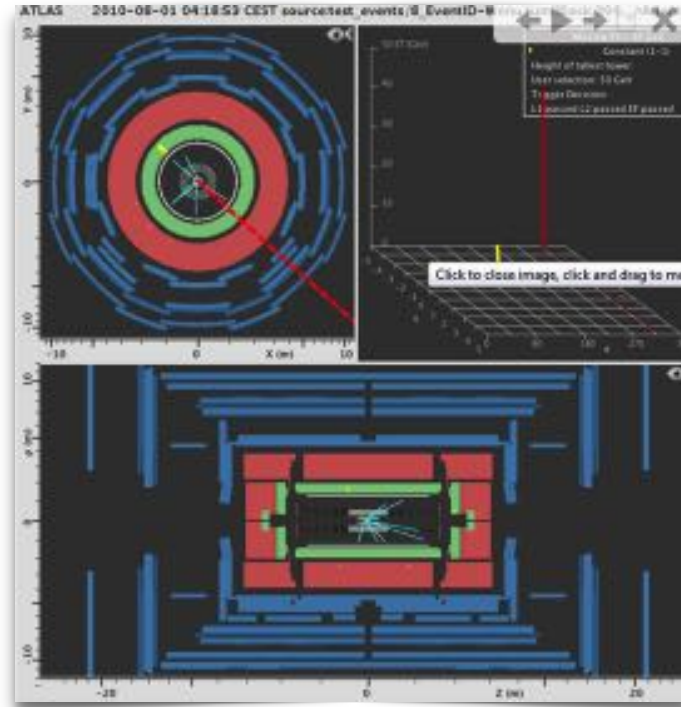
- Looking for Strange Particles

- R_AA

- **LHCb**

- $D^0 \rightarrow K\pi$ measurement

- in the future: **TOTEM**, ...



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

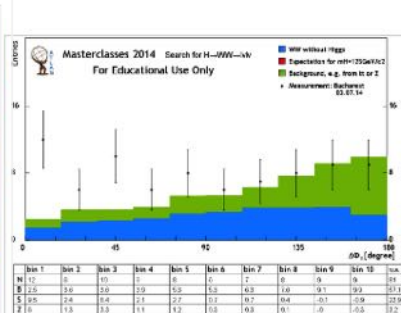
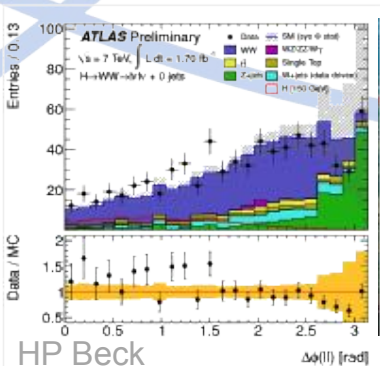
Understand mass peaks of J/Psi and Z

On the way to discover new particles

Higgs → WW

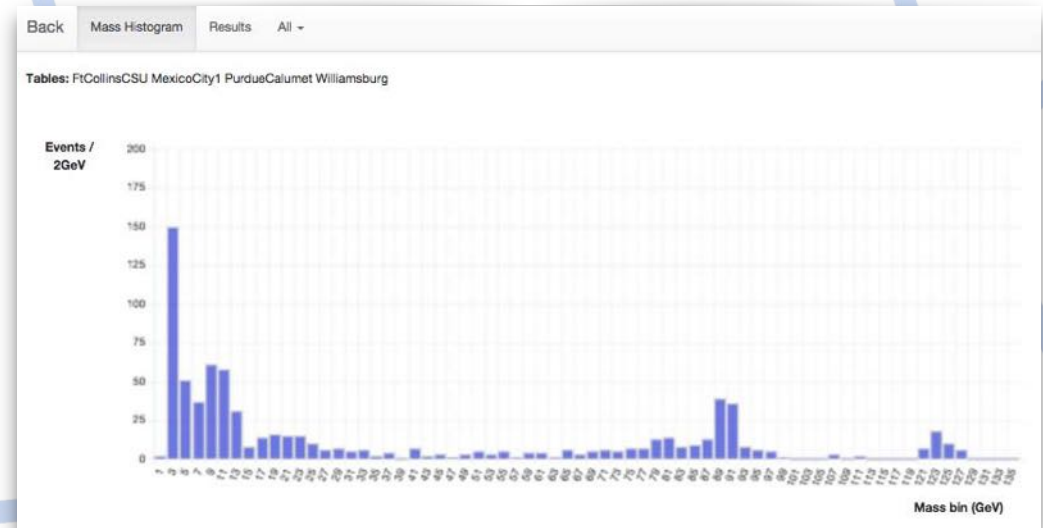
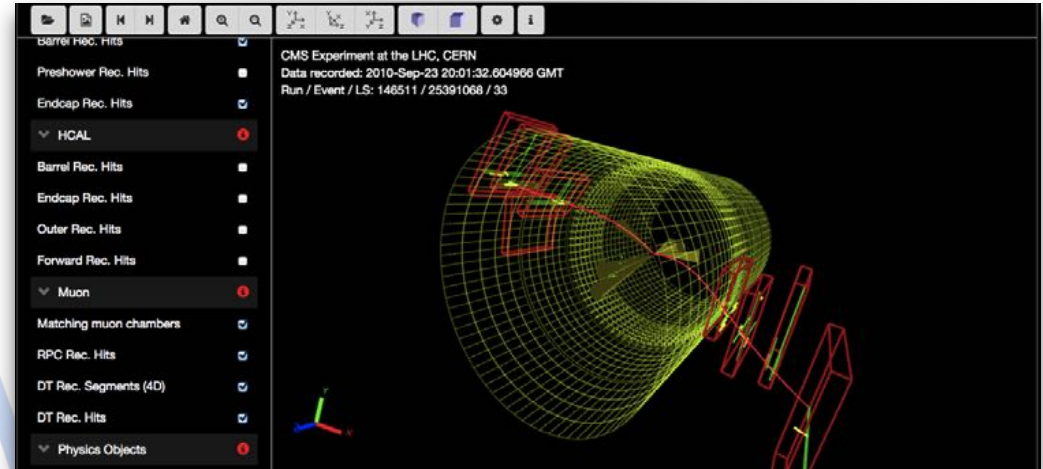
Extra Z Bosons

...



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



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



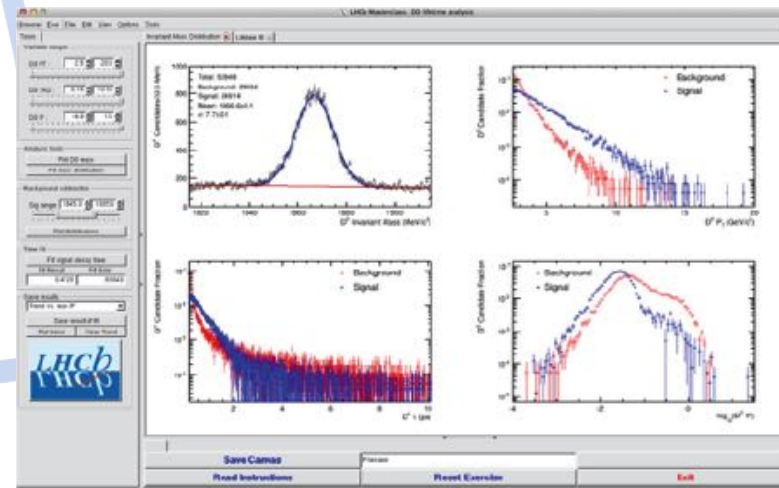
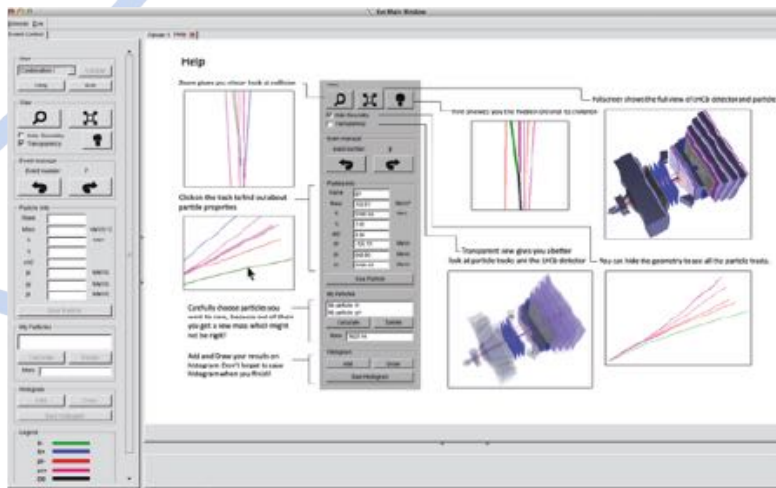
- LHCb experience has > 20 institutes involved EU and US for 2015-2016

- The experience is twofold:

























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

the students also perform a lifetime measurement at the 1% level

Seicento ragazzi con Masterclass



Masterclass Language Coverage

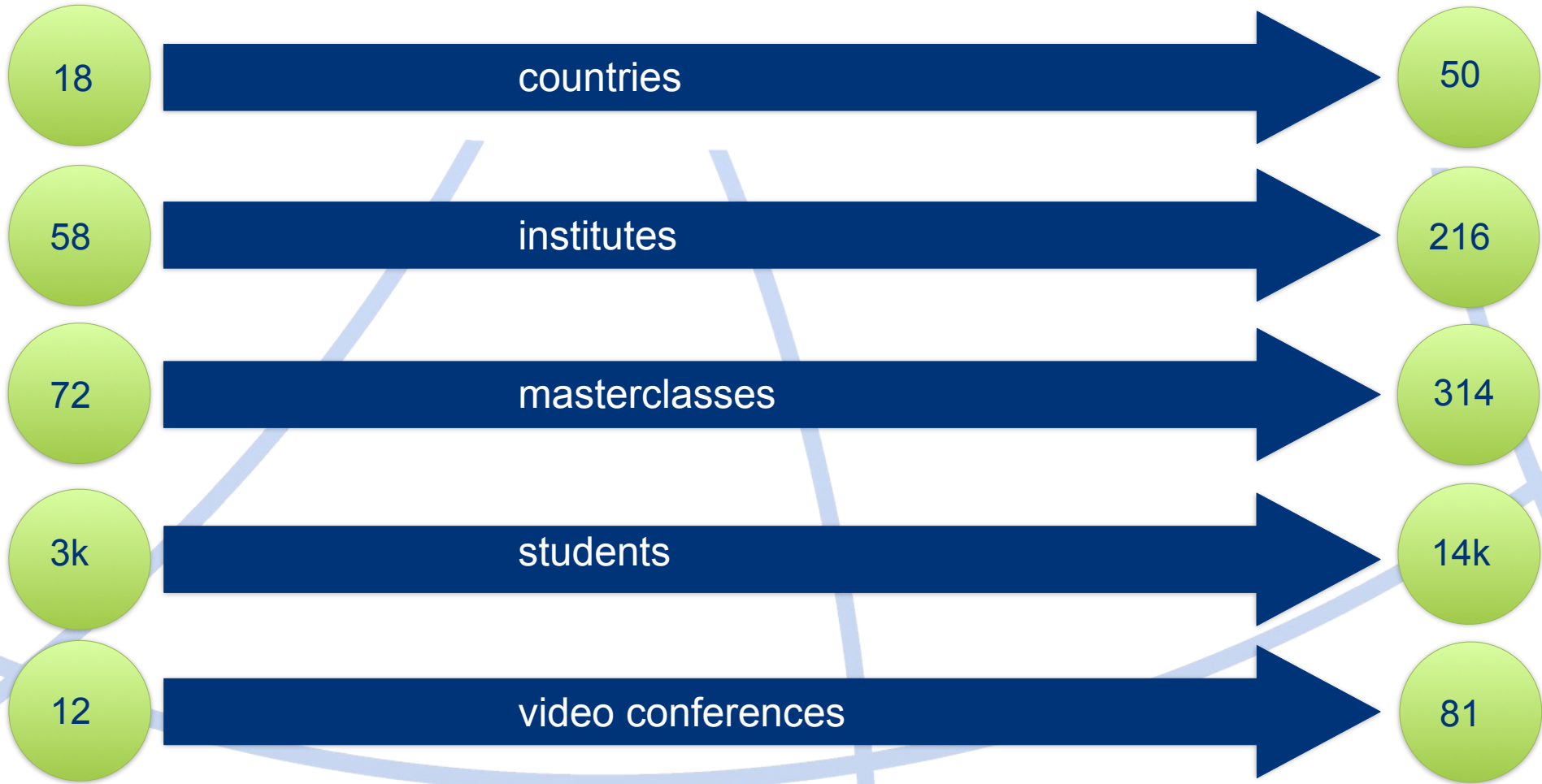
																									
ALICE (Strange Particles)	-	x	-	x	x	-	x	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
ALICE (R_AA)	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ATLAS	-	x	x	x	x	-	x	x	-	x	x	x	x	x	x	-	-	x	-	-	-	-	-	-	-
CMS	-	-	-	x	x	-	x	-	x	x	-	x	x	-	x	-	-	-	x	x	x	-	x	x	
LHCb	-	-	-	x	x	-	x	-	-	x	-	-	x	-	-	-	-	-	-	-	-	x	-	-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

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.

An ever growing success story

2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017



New Participants 2017

Russia

- St. Petersburg (ALICE)
- St. Petersburg, Moscow (LHCb)

Georgia

- Tbilisi (CMS, ATLAS); Ken + Uta greeted on video

Bangladesh

- Dhaka (ALICE); planned to participate also on UN Girls day, but had to cancel

Philippines

- German European School Manila (CMS, ATLAS)

Montenegro

- Podgorica (CMS)

(Rwanda)

- Kigali planned to participate, but had to cancel

New announcing institutes for the 2018 edition from

- Qatar, Iran, India, Libanon

IPPOG – an International Network

Current members come from the 22 member states of CERN, Australia, Brazil, Ireland, Slovenia, South Africa, the USA, and from DESY, CERN and five of the major experiments at the Large Hadron Collider (LHC), and the Belle II experiment at KEK's SuperKEKB accelerator in Japan.

International network of (mainly) **physicists** who commit a fraction of their time in **education** and **outreach**.

These are your **local contacts** in your **country**, **laboratory**, and **experiment** when you need, **advice**, **help**, **support**, in your education and outreach activities.

IPPOG meets twice a year in Spring and Autumn to discuss and exchange **thoughts** and **success stories**, get **inspirational ideas**, and getting **organized world-wide**.



IPPOG Spring meeting 2017 — Lisbon, LIP Portugal



IPPOG Fall meeting 2017 — CERN

IPPOG – A formal Collaboration established on 19 December 2016

CERN Courier March 2017

Viewpoint

Reaching out in the era of big science

Now a formal collaboration, IPPOG provides a new force for global particle-physics outreach.



CERN director for international relations, Charlotte Warakalle, signs the memorandum of understanding with IPPOG chairperson Hans Peter Beck on 19 December, allowing the IPPOG collaboration to officially enter into force.

By Hans Peter Beck

Establishing and maintaining a strong link between science and society is vital, and is something that has long been recognised by CERN. Writing in 1972, former Director-General Victor Weisskopf put it well when he argued that a concerted effort towards the presentation and popularisation of science would “provide a potent antidote to overspecialisation, bring out clearly what is significant in current research, and make science a more integral part of the culture of today”.

Forty-five years later, as we enter 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. Reaching out to high-school students and their teachers to convey the methods and tools used in fundamental science is a strong investment in the future. 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. Developing a dialogue with those who have left school early raises important challenges of its own, and requires that scientists take courageous steps. Partnering with artists, musicians and celebrities, for instance, has enormous potential to get science into the spotlight.

Hans Peter Beck is chairperson of IPPOG, member of the ATLAS experiment and a reader at the University of Bern. (Image credit: C Marcelloni.)

But it involves a delicate balance between raising curiosity and descending into trivialities.

The International Particle Physics Outreach Group (IPPOG) is making a concerted and systematic effort to present and popularise particle physics across all audiences and age groups. Established 20 years ago following the recommendations of former CERN Director-General Christopher Llewellyn Smith, IPPOG has evolved from a European to a global network that involves countries, laboratories and scientific collaborations active in particle-physics research. It is best known for its International Masterclasses (IMC) programme, which evolved in the mid-1990s from national outreach efforts in the days of the LEP collider and has gone from strength to strength. Since 2005, the programme has offered high-school students the opportunity to become physicists for a day by performing a tailor-made physics analysis involving real LHC data (CERN Courier June 2014 p37). In terms of numbers, last year’s edition of the IMC included 213 institutions in 46 countries and around 13,000 students took part.

Particle physics has become a truly global activity, with experimental collaborations such as those of the LHC experiments featuring thousands of researchers from all over the world. With this trend, IPPOG is evolving further to cover more countries, laboratories and experiments spanning all aspects of collider and non-collider research, including astroparticle physics and accelerator and detector technology. This expanding remit demands that IPPOG adopts a more formal structure to guarantee the quality and sustainability of its work.

Following the model of collaboration in experimental particle physics, on 19 December IPPOG became a formal scientific collaboration based on a memorandum of understanding. A total of 13 countries have now signed as members, with several candidate members expected to join soon, and each is required to contribute a membership fee weighted by its GDP and the size of its particle-physics community. Laboratories and even individual scientific collaborations are also part of IPPOG, where they contribute to the expert knowledge and skills required to inspire young thinkers.

The new collaboration status of IPPOG, and CERN’s formal membership, demonstrates a clear commitment to sustainable science outreach. With further countries and organisations expected to join soon, and others invited to get involved, the worldwide particle-physics community has a strong partner at hand when reaching out to wider society in diverse ways that are adapted for every target audience.

CERN Courier March 2017

Viewpoint Article

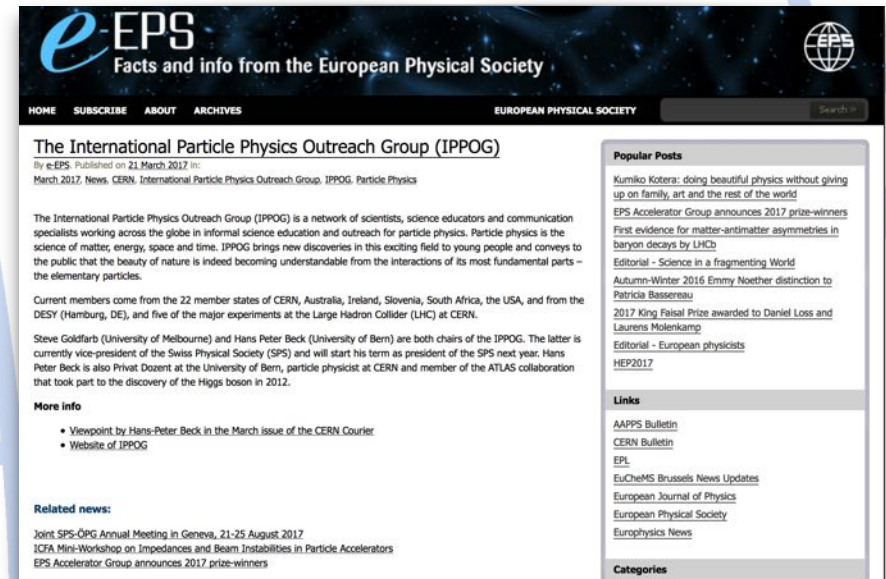
<http://cerncourier.com/cws/article/cern/67712>

INFN Newsletter

http://home.infn.it/newsletter-eu/pdf/NEWSLETTER_INFNO_33_inglese_pag11.pdf

EPS newsletter

<http://www.epsnews.eu/2017/03/the-international-particle-physics-outreach-group-ippog/>



The screenshot shows the website for the European Physical Society (EPS). The main article is titled "The International Particle Physics Outreach Group (IPPOG)" and is dated 21 March 2017. The article text is partially visible, starting with "The International Particle Physics Outreach Group (IPPOG) is a network of scientists, science educators and communication specialists working across the globe in informal science education and outreach for particle physics." The website also features a "Popular Posts" section with links to various news items, a "Links" section with links to AAPPS Bulletin, CERN Bulletin, EPL, EuChemS Brussels News Updates, European Journal of Physics, European Physical Society, and Europhysics News, and a "Categories" section.

CERN Courier March 2017

5



INTERNATIONAL PARTICLE PHYSICS OUTREACH
GROUP

MEMORANDUM OF UNDERSTANDING

Establishing

The International Particle Physics Outreach Group (IPPOG) Collaboration

PREAMBLE

IPPOG is a network of scientists, researchers, science educators, explainers and communication specialists active across the globe in outreach for particle physics;

IPPOG's mission is to maximise the impact of education and outreach efforts related to particle physics;

The European Strategy for Particle Physics, as adopted and updated regularly by the CERN Council, acknowledges the important role played by IPPOG in the promotion of particle physics;

The IPPOG stakeholders recognise the need to create a formal legal structure permitting IPPOG to increase the scope and quality of its work;

This Memorandum of Understanding (the "MoU") creates the IPPOG Collaboration and sets out its governance and the rights and obligations of participants.

ARTICLE 1 PURPOSE OF THIS MOU

- 1.1 This MoU creates the IPPOG Collaboration and sets out its governance and the rights and obligations of participants.
- 1.2 This MoU is not legally binding, but its signatories recognise that the long-term success of the IPPOG Collaboration depends on their adherence to the provisions of this MoU.

- ❑ Massive consultations and discussions with stake holders in and outside IPPOG over the past few years.

- ❑ After an initial proto-MoU was established, CERN Legal Service took over to give it its final form.

- ❑ Non-legal binding, as is typical in HEP experimental collaborations

- ❑ **Collaboration established
19 December 2016**

Annual membership fees

- ❑ Countries based on GDP and community size: 1k€, 3k€, 5k€

- ❑ Experiments commit to IPPOG and outreach, they contribute in-kind

- ❑ Labs upon individual negotiations

Membership Fee - Countries

The **annual membership fee** asked from a national member representing a country in IPPOG shall be one of three values (low, medium, high), as are agreed by the IPPOG Collaboration board, **considering the specific situation of the country.**

This breaks down to to 1k€, 3k€, and 5k€ depending on GDP and community size.

...Furthermore, in general matters **the minimum representative's engagement** are the following:

4.1 Enable IPPOG activities in representative's country;

4.2. Disseminate IPPOG information in representative's country, including to **all national particle physics institutes and laboratories**, where there shall be dedicated contact/link persons defined. Where relevant, enable that also **secondary and high-school teachers** are informed (e.g. through teachers associations, through direct contacts, etc.) such that they can participate and also inform their students about upcoming IPPOG activities. Enabling means that the **broad public, media and decision makers** can be informed and contacted. Thus, **maintaining a nation-wide network discussing and disseminating IPPOG matters**;

4.3. The national Member organization in IPPOG shall **recognise outreach as an important element of its overall research activity**, by providing the needed resources and support to the representative in IPPOG enabling him to actively fulfil his above specified role in IPPOG.

Membership Fee - Scientific Collaborations

- 1 Participation of Scientific Collaboration in the IPPOG Collaboration shall imply a strong commitment to participate in IPPOG recognized activities through **providing access to data, expertise, tools and methods for outreach and educational purposes that are based on their physics program.**

- 2 **The membership fee asked from a Scientific Collaboration in IPPOG can be waived** upon a written agreement between this Scientific Collaboration and IPPOG in form of an Addendum to the IPPOG MoU subject to decision made by IPPOG Collaboration Board in mutual agreement with the concerned Scientific Collaboration, specifying the exact areas of commitment relevant for its participating in IPPOG.

- 3 In general matters the minimum requirements are the following:
 - 3.1 **Recognition** of outreach as an important element of research activity.
 - 3.2 Recognition and **support** of those members of their collaboration who devote a considerable fraction of their time to educational and outreach efforts.
 - 3.3 Strong commitment to provide **access to experimental data** for IPPOG recognized educational and outreach activities, which implies **developing and maintaining tools, methods and documentation to exercise analysis and scientific reasoning based upon the Scientific Collaboration's actual and continuing physics program.**

Membership Fee - International Laboratories

- 1 Participation of Scientific Laboratories in the IPPOG Collaboration shall imply a strong commitment to participate in IPPOG and its recognized activities through **substantial In-kind and monetary contributions enabling the sustainable success of IPPOG efforts**. **These contributions shall be mutually negotiated on an individual basis per Scientific Laboratory and agreed by the IPPOG Collaboration Board and the signing Scientific Laboratory.**

2. The exact areas of commitment relevant for participating in IPPOG shall be specified in form of an Addendum to the IPPOG MoU between this Scientific Laboratory and IPPOG, which shall be subject to a decision made by the IPPOG Collaboration Board in **mutual agreement with the concerned Scientific Laboratory**.
 - 2.1 They may include **contribution to the personnel** needed to execute IPPOG coordination, development and expansion of the IPPOG Collaboration (e.g. IPPOG Scientific Secretary, IPPOG Administrative Secretary);
 - 2.2 They may include **contribution to logistics** for the IPPOG meetings when on their site;
 - 2.3 They may include support to **IPPOG website development and maintenance**;
 - 2.4 They may include **contribution to the personnel needed to organize and execute the IPPOG recognized activities** relevant to the specific scientific program conducted by its hosted and recognized Scientific Laboratories.

Effort, Needs & Support

Support (FTEs, use of infrastructure, in-kind, ad-hoc,...) from CERN, Fermilab, EPS HEPP High-Energy and Particle Physics Division of the European Physical Society, TU Dresden, US National Science Foundation and the US Department of Energy.

Staff

Uta Bilow (Dresden) ½ FTE funded by CERN

before: Helmholtz Alliance: Physics at the Terrascale 2008-2012

Ken Cecire (Notre Dame) funded by Quarknet for US based Masterclasses

Barbora Gulejova (CERN) ½ FTE Fellow IPPOG Scientific Secretary

A lot of in-kind effort provided by IPPOG Members (incl. experiments), and local teams at universities

With the IPPOG Budget from the Membership Fees ca 50k€ for 2018, we can improve IPPOG's communication, develop, print and distribute educational material, give support to global and worthwhile activities.

An addendum to the IPPOG MoU, detailing the exact contributions of CERN to IPPOG, is being finalized these days.

In order to function properly, being professional, reaching out globally and in a sustainable manner, IPPOG relies on all Candidate Members to sign.

Expanding to Astroparticle physics – discussions and pilot tests

IceCube Masterclass

<http://icecube.wisc.edu/masterclass/home>

International Muon Week

Quarknet

<http://Internationalmuonweek.org>

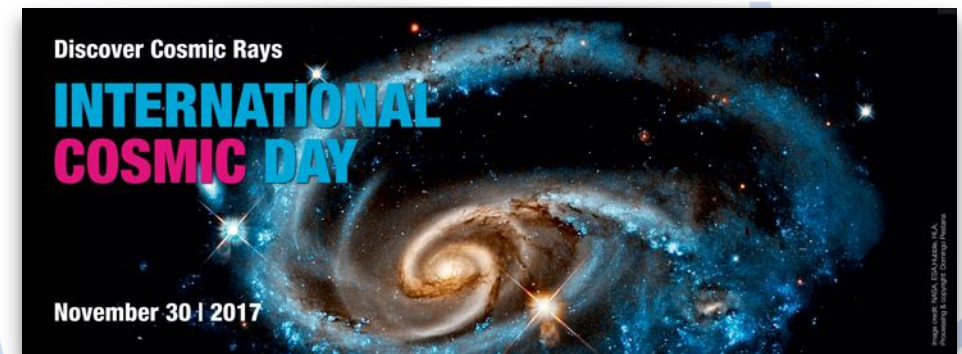
International Cosmic Day

<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.

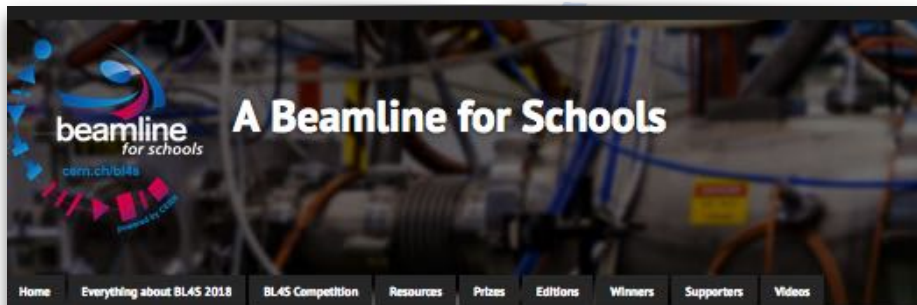
Although, historically, there is a strong bias towards LHC physics.

This bias is lingering with a broader base.

CERN Competition: a beam line for schools

IPPOG acts as local contacts
to schools in many countries.

IPPOG members take responsibilities
for multiple countries to ensure that language
barriers will not be an insurmountable hurdle.



BEAMLINE FOR SCHOOLS is an official competition powered by CERN, the European Organization for Nuclear Research in Geneva, Switzerland. It is open for all high-school students around the world.

The competition invites teams of high-school students to propose a scientific experiment that they want to perform at CERN. First prizes for two winning teams is a trip to CERN to carry out their proposed experiments on a fully-equipped accelerator beamline. There are additional prizes for short-listed teams and certificates for all participants.

Be inspired and take part in hands-on scientific experiments on-site at CERN, a world-leading international research institute! CERN offers a great opportunity for students to learn, make new discoveries and apply their knowledge into new settings.

CURRENT EDITION - 2017

The two winning teams of 2017 will be visiting CERN end of September to perform their proposed experiments.



Stay tuned about news from the winning teams being at CERN soon.

PAST EDITIONS

Would you like to be inspired by our previous editions? To discover more about the previous winners click [here](#).



Winner participants from the Beamline for schools competition in 2016.

NEWS

Follow our latest news! You can also subscribe to our BL4S newsletter at the bottom of this page.



High-school students performing their proposed experiments at CERN.



The fourth edition of the Beamline for Schools competition, reached a total of **41 countries** with the impressive number of **181 proposals received** - 30 more than last year - showing the competition's success!

Two teams of high-school students, "**Charging Cavaliers**" from **Canada** and "**TCO-ASA**" from **Italy**, have been selected to travel to CERN in September to carry out their own experiments using a CERN accelerator beam.

<http://beamline-for-schools.web.cern.ch>

Education & Outreach becoming an integral part in international HEP conferences, where IPPOG is an active player and driver

❑ **EPS HEP 2017 – Venice**

- ❑ Parallel sessions, poster session and panel discussion on education and outreach with IPPOG representatives at all levels

❑ **PTEE 2017 – Physics Teaching in Engineering Education – Žilina**

- ❑ invited talk “Ivan Melo: Bringing particle physics into classrooms”

❑ **LHCP 2017 – Shanghai**

- ❑ Parallel sessions and panel discussion on education and outreach

❑ **DPF 2017 – FNAL Chicago**

- ❑ Diversity, Education, and Outreach
Developments in International Masterclasses (talk, Ken Cecire)
IPPOG Resources Database (poster, Marjorie Bardeen)

❑ **ICNFP 2017**

- ❑ Physics Education and Outreach Activities
Masterclasses for school pupils
Masterclasses for school teachers

❑ **WCPE 2016 – Sao Paulo**

- ❑ *CERN Masterclass courses and the impact on school physics* (Uta Bilow – IPPOG Masterclasses)

❑ ...



Exhibition "The beginning of everything. About galaxies, quarks and collisions"	Jochen Schieck	14:30 - 14:45
Room Amici, Palazzo del Casinò		
Picturing diversity in the ATLAS Experiment	Silvia Biondi	14:45 - 15:00
Room Amici, Palazzo del Casinò		
CREATIONS: Infusing creativity in science education through the arts	Dr. Angelos Alexopoulos	15:00 - 15:15
Room Amici, Palazzo del Casinò		
HEP interactive activities in high schools in the framework of the CREATIONS project	Christine Kourkoumelis	15:15 - 15:30
Room Amici, Palazzo del Casinò		
The Junior Community in ALICE	Hans Beck	15:30 - 15:45
Room Amici, Palazzo del Casinò		
The LHCb Starterkit initiative	Albert Puig Navarro	15:45 - 16:00
Room Amici, Palazzo del Casinò		
Outreach initiatives in Colombia in the LHC era	Carlos Sandoval Usme	09:00 - 09:15
Room Mangano, Palazzo del Casinò		
Go to the astroparticle physics school with the Toledo Metro Station Totem-Telescope for cosmic rays	Carla Aramo	09:15 - 09:30
Room Mangano, Palazzo del Casinò		
THE ROLE OF IMAGES IN THE STORYTELLING OF THE INVISIBLE	Francesca Scianitti	09:30 - 09:45
Room Mangano, Palazzo del Casinò		
« La Nuit des ondes gravitationnelles » : a multi-site outreach event about gravitational waves	Nicolas Arnaud	09:45 - 10:00
Room Mangano, Palazzo del Casinò		
The "Beamline for Schools" competition at CERN	Markus Joos	10:00 - 10:15
Room Mangano, Palazzo del Casinò		
3D-Printable Experiments in CERN's S'Cool LAB	Julia Woithe	10:15 - 10:30
Room Mangano, Palazzo del Casinò		
An introduction to the Higgs mechanism based on classical physics secondary school curriculum	Giovanni Organtini	10:30 - 10:45
Room Mangano, Palazzo del Casinò		
The challenge of explaining new physics concepts and phenomena	Eirik Gramstad	10:45 - 11:00
Room Mangano, Palazzo del Casinò		

Gender inclusive teaching. An experiment conducted at the CERN International High School Teacher Programme. First lessons learnt.	Ms. Kristin Kaltenhäuser	
Room Amici, Palazzo del Casinò		
Early Career, Gender & Diversity Office at the LHCb experiment	Olaf Steinkamp	16:45 - 17:00
Room Amici, Palazzo del Casinò		
PROJECT JUNO: ADVANCING GENDER EQUALITY IN PHYSICS CAREERS IN HIGHER EDUCATION IN THE UK	Prof. Valerie Gibson	
Room Amici, Palazzo del Casinò		
Women in Science and Engineering at Syracuse University	Marina Artuso	17:15 - 17:30
Room Amici, Palazzo del Casinò		
XMaS Scientist Experience and Science Gala	Mrs. Kayleigh Lampard	17:30 - 17:45
Room Amici, Palazzo del Casinò		
TeamScience - a new approach to engaging 8-13 year olds	Lucy Stone	17:45 - 18:00
Room Amici, Palazzo del Casinò		
Discussion panel on diversity and inclusion	Justine Serrano et al.	18:00 - 18:30
Room Amici, Palazzo del Casinò		
Outreaching particle physics to Latin America: CEVALE2VE and the use of ATLAS open data	Reina Coromoto Camacho Toro	
Room Mangano, Palazzo del Casinò		
Particle Physics for Primary Schools – enthusing future Physicists	Maria Pavlidou et al.	11:45 - 12:00
Room Mangano, Palazzo del Casinò		
PHYSICS ON SOCIAL MEDIA: IMPACT AND INTERACTION TO DEAL WITH FAST COMMUNICATION	Francesca Mazzotta	
Room Mangano, Palazzo del Casinò		
Working with the media - The role of the Public Information Officer -	Saeko Okada	12:15 - 12:30
Room Mangano, Palazzo del Casinò		
Discussion panel on science communication in HEP	Ms. Lucy Stone et al.	12:30 - 13:00
Room Mangano, Palazzo del Casinò		

3 sessions, 260 minutes in total

45 abstract submissions!!

18 talks (some merged) + 14 posters

Very popular sessions!
Full house!
Fruitful panel session



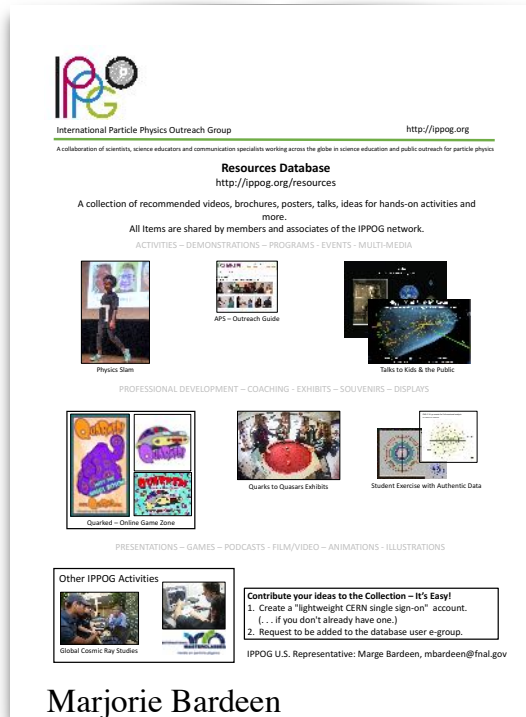
CREATIONS <http://creations-project.eu/>
Developing an Engaging
Science Classroom

A Horizon 2020 European outreach project to Develop an Engaging Science Classroom

- Will last till 30/9/2018
- Main objective: to improve skills of youngsters in STEM subjects
- HEP partners are UoA/IASA, UoBirmingham, Art@CMS, STFC
- Many teachers' and students' activities/resources (masterclasses, workshops etc)

4/7/2017 C. Kourkoumelis

Christine Kourkoumelis



International Particle Physics Outreach Group <http://ippog.org>
A collaboration of scientists, science educators and communication specialists working across the globe in science education and public outreach for particle physics

Resources Database
<http://ippog.org/resources>

A collection of recommended videos, brochures, posters, talks, ideas for hands-on activities and more.
All Items are shared by members and associates of the IPPOG network.

ACTIVITIES – DEMONSTRATIONS – PROGRAMS – EVENTS – MULTI-MEDIA

- Physics Slam
- APS Outreach Guide
- Talks to Kids & the Public

PROFESSIONAL DEVELOPMENT – COACHING – EXHIBITS – SOUVENIRS – DISPLAYS

- Quark – Online Game Zone
- Quarks to Quasars Exhibit
- Student Exercise with Authentic Data

PRESENTATIONS – GAMES – PODCASTS – FILM/VIDEO – ANIMATIONS – ILLUSTRATIONS

Other IPPOG Activities

- Global Cosmic Ray Studies

Contribute your ideas to the Collection – It's Easy!
1. Create a "lightweight CERN single sign-on" account.
[... if you don't already have one.]
2. Request to be added to the database user e-group.
IPPOG U.S. Representative: Marge Bardeen, mbardeen@fnal.gov

Marjorie Bardeen



Uta Bilow, Technische Universität Dresden

INTERNATIONAL MASTERCLASSES
on the UN International Day of Women and Girls in Science

International Masterclasses¹ are a successful tool to engage high school students with particle physics. Young people become scientists for one day and perform a tailor-made physics analysis involving real LHC data under the supervision of physicists. In this way students experience methods and tools used in research and an appreciation for fundamental science is created.

Masterclass activities for girls² were launched by IPPOG for the first time on February 11, 2017, the UN International Day of Women and Girls in Science.

International Day of Women and Girls in Science
11 February

Goal: Promote gender equality in science
• support access of females to science education and research
• awareness-raising events encouraged by UN

Participation numbers:
• 10 universities and research labs
• 320 girls
• 3 videoconferences with CERN

Concept of International Masterclasses³
• High school students (15 – 19) are invited to a university or research lab as „scientists for one day“
• Introductory talks (standard model, detectors, accelerators)
• Hands-on: measurement with LHC data (ATLAS, CMS, ALICE, LHCb)
• International video conference (3 – 5 groups + CERN Fermilab)
• Organized by IPPOG!

Fri, 10.2_V C1	Fri, 10.2_V C2	Sat, 11.2_V C1	
Paris, APC + U Diderot	Moscow, CERN	Paris, Jussieu	• ATLAS W
Cosmos, CTU	Palo de Janeiro, CERN	Frankfurt, STFC	• ATLAS Z
Prague, CTU	Cagliari, INFN	São Paulo, STFC	• LHCb
Barcelona, IFAE			• CMS

Paris, APC + Univ. Diderot
• 2 extra talks by female researchers about their professional path
• joined lunch for informal discussion

Prague, Czech Technical University
• great media coverage
• 2 newspapers and Czech public television

Barcelona, IFAE
• Friday: Masterclass and visit of tier-1 data center PIC
• Saturday: Astroparticle Masterclass (Gamma Ray Hunters)

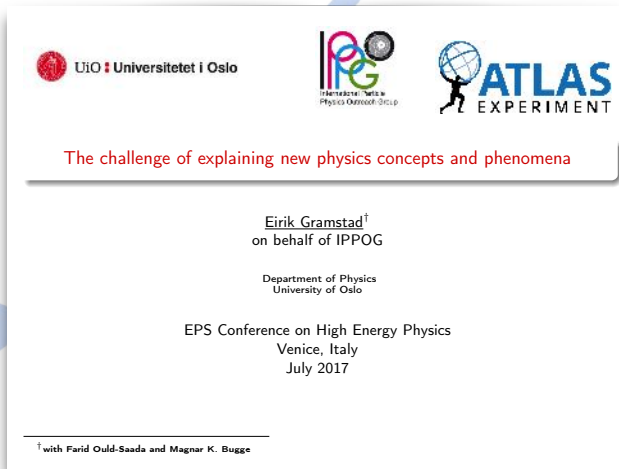
Cosmos, Università della Calabria & INFN
• extra talk: Le donne nella ricerca
• Council of Physics acknowledged February 11 as special day of the Physics Department dedicated to girls

1 <http://ipponmasterclasses.org>
2 http://atlascosmasterclasses.org/index.php?title=cosmos_in_sciences_day
3 <http://www.org/development/and-girls-in-science-day/>
4 <http://cosmoscourse.com/articles/cosmos2305>
5 <http://www.ifae.es>

International Masterclasses
TU Dresden Institute for Nuclear and Particle Physics | D-01062 Dresden
Email: uta.bilow@tu-dresden.de

TECHNISCHE UNIVERSITÄT DRESDEN

Uta Bilow



Uio + Universitetet i Oslo

ATLAS EXPERIMENT

The challenge of explaining new physics concepts and phenomena

Eirik Gramstad[†]
on behalf of IPPOG

Department of Physics
University of Oslo

EPS Conference on High Energy Physics
Venice, Italy
July 2017

[†]with Farid Ould-Saada and Magnar K. Bugge

Eirik Gramstad

COMMUNICATIONS REVIEW

Hans Peter Beck - Ivan Melo - Thomas Naumann*

SOME ETHICAL QUESTIONS IN PARTICLE PHYSICS

Authors will discuss a few ethical questions in today's particle physics: high costs and purported dangers of Big Science projects, relevance of fundamental research for society and the way particle physicists fill their duty to communicate with the public. Examples will be given including the story of a possible mini-black hole creation at CERN and two outreach activities for high school students, International Particle Physics Masterclasses and Cascade competition.

Keywords: Particle physics, Big Science projects, communication, outreach, role of science in society.

1. Introduction

Nowadays we are witnesses of increasing distrust of governments and political system in society. Some groups explaining what holds the world together in its most fundamental constituents.
Modern physics relies on an elegant +Standard Model of particle physics, a quantum field theory based on three

HP Beck, Ivan Melo, Thomas Naumann

IPPOG Meetings: Intense 2½ days



Explaining Particle Physics Hot Topics to a Lay Audience

Beauty and Physics

Ideasquare

IPPOG and gravitational waves

Bringing Masterclasses to New Countries

Beamline for schools 2017 and call for 2018

Reaching new audiences at non-science festivals

Broadening the physics scope of Masterclasses

Inspiring success stories

Exhibitions and Event Highlights

Masterclasses 2018

Collaboration Board

MoU Addenda

Country highlights

Budget 2017 + 2018

Masterclass in a Box

Portraits

An inside view from IPPOG

Physics for everyone – What is Spin ?

Global Cosmic Rays

IPPOG NEWSLETTER 

SEPTEMBER 2015 **Number 1**

A word from the coordination team

Dear

We are very you this first newsletter, twice a year meetings. Tradition is to live also in things and ma about the happenings and thus to f collaboration little periodic us to show external eye and does.

After a very interactive and productive spring meeting in Paris <https://indico.cern.ch/event/1100000> IPPOG is now ready to take several new actions and continue its mission with source! The future of IPPOG is very promising and a lot of upcoming initiatives We hope you enjoy this first number of IPPOG newsletter and looking forward next meeting in autumn at CERN.

Hans Peter, Margy and Barbora

Universe of Particles : Explore, Discover, Understand

International network of scientists, science educators and explainers science and education and outreach for particle physics across the globe

Vision for the future:
Understanding and enthusiastic support of particle physics and related sciences

IPPOG's current members come from CERN's 21 member states, plus Ireland, Romania, South Africa and USA institutions in Europe and USA and 5 major experiments of LHC. Since 2013 the co-chairs of IPPOG are Margy and Barbora.

"The discovery of Higgs boson is not the end of the story... it is just the beginning of a new era... The scalar era."

- IPPOG on LHC as a discovery machine

"Higgs-what now?"

IPPOG feels the need for LHC Run 2 communication strategy especially in the context of the future of fundamental research in particle physics and non-scientific audience acceptance.

"How to prepare/approach the discoveries beyond the Standard Model?"

IPPOG NEWSLETTER 

FEBRUARY 2016 **Number 2**

A word from the coordination team

Dear

Last year has productive for be proud of ma successes. Th contributions, v

The initiative of an official body with secured f considerably. Understanding Legal Service I soon ready f 2016 will be m joyful events: formal collabora tific secretary welcoming a lit

IPPOG meeting, 6-7 November at CERN, IPPOG & EPPCN family

Our membership is growing worldwide and IPPOG is becoming truly international member and several others intend to become members this year. Summer in terms of conference education and outreach contributions on behalf of IPPOG

The last IPPOG meeting in November 2015 at CERN (<https://indico.cern.ch/event/1100000>) was fruitful. Tradition from 2014 continued, and EPPCN colleagues joined us for a h was opened by the new CERN DG, Fabiola Gianotti, who stressed the relevant EPPCN. The former Head of the Education and Outreach Group of CERN D Landua, also highlighted the importance of IPPOG and the willingness of CER future. The program of the meeting was very rich and diverse and we hope y about the highlights in this second edition of the IPPOG Newsletter.

Wishing you a great and successful 2016. We look forward to see you at the 19-21 May in Cracow.

Hans Peter, Margy and Barbora

IPPOG growing truly international

Last year Australia has been unanimously voted in as the 25th country IPPOG! Australia aims to introduce the IPPOG Masterclasses program as part of their formal science education in high schools in New South Wales. We are glad to have on board such a proactive partner, and we welcome Paul Jackson, the Australian director.

Moreover, two new other countries expressed interest for membership and potential candidacy for membership if news is in the pipeline!



IPPOG pilots World Wide Data Day

line a 24 hour span of masterclass-like videoconferences for still job. To cover that, we'd need world-wide collaboration. And the assumptions that their teachers can readily explain. Well, we are pilot of world Wide Data Day (<http://www.worldwidedata.org/>) on 2 December this year. Students will measure theta and phi of muon tracks in dimuon events from online ATLAS and CMS displays and try to understand their distributions. Physicists at TRIUMF, CERN, Fermilab and even in Australia will be on hand to help them see the big picture when they connect on Vidyo.

Contact Ken Cochrane (kcoc@trn.edu) to discuss how you, a colleague or a good physics teacher you know might be involved.

IPPOG NEWSLETTER 

NOVEMBER 2016 **Number 3**

A word from the coordination team

Dear

This third edition which is much IPPOG meeting out just before CERN 10-12 a time when IP so close to collaboration professionalis ments we all m way we can impact we are though setting boration turned complex and a than originally final MoU doc and signatures

IPPOG meeting, 19-21 May 2016, Krakow

IPPOG is an international body open for new member countries, laboratories and With Australia, Ireland, South Africa, United States of America and more clearly stepping into the global realm of collaboration. With the burden of the Migration building (almost) behind us, IPPOG can now concentrate on growing its discussing adding a neutrino program and 'cosmic rays going global' to IPP Broadening the scope of masterclasses, the flagship activity of IPPOG, geograph content will be key for continued success. The efforts to improve the IPPOG website materialise.

We wish you fun reading this newsletter, great meeting at CERN and wonderful e

Hans Peter, Margy and Barbora

DOWNLOAD the electronic form of this newsletter with clickable

http://ippog.web.cern.ch/files/ippog_web.cern.ch/files/ippog_newsletter

NEW IPPOG pilots World Wide Data Day

line a 24 hour span of masterclass-like videoconferences for still job. To cover that, we'd need world-wide collaboration. And the assumptions that their teachers can readily explain. Well, we are pilot of world Wide Data Day (<http://www.worldwidedata.org/>) on 2 December this year. Students will measure theta and phi of muon tracks in dimuon events from online ATLAS and CMS displays and try to understand their distributions. Physicists at TRIUMF, CERN, Fermilab and even in Australia will be on hand to help them see the big picture when they connect on Vidyo.

Contact Ken Cochrane (kcoc@trn.edu) to discuss how you, a colleague or a good physics teacher you know might be involved.

IPPOG NEWSLETTER 

JULY 2017 **Number 4**

A word from the coordination team

Dear IPPOGers,

Last 9 months have been very memorable period for IPPOG. The 12th IPPOG meeting at CERN, 5-7 November 2016, was historically the last meeting of IPPOG as a group of volunteers enthusiastic about outreach in particle physics. In December 2016 IPPOG became an official scientific collaboration with MoU entering into force upon MoU signature at CERN. In 2017 signatures kept coming and as of today there are 10 with many others in the pipeline. 2017 is marked as a 'focussing year' where the MoU and new way of functioning of IPPOG Collaboration is being implemented and tested. The terms of participation of all types of members (countries, scientific collaborations) and also the laboratory have been discussed and are being defined in details. We have agreed on our first ever budget and we are really proud of this achievement which brings us to a new era of IPPOG.

The 13th IPPOG meeting in Lisbon, 20-22 April 2017 (where we were very well received by Pedro and Catarina) was also very special. Not only we celebrated IPPOG's newly born official collaboration with the IPPOG slogan: "CERN Special IPPOG 2016", but we also had our first IPPOG Collaboration Board meeting. Moreover, thanks to the overlap of the IPPOG meeting dates with March for Science IPPOGers had an occasion to participate at this event as an official organisation. A lot of work done, still a lot ahead, we would like to thank to all IPPOGers for your valuable contribution and looking forward to continue paving way to the promising future.

Hans Peter, Margy and Barbora

IPPOG growing truly international

Last year Australia has been unanimously voted in as the 25th country IPPOG! Australia aims to introduce the IPPOG Masterclasses program as part of their formal science education in high schools in New South Wales. We are glad to have on board such a proactive partner, and we welcome Paul Jackson, the Australian director.

Moreover, two new other countries expressed interest for membership and potential candidacy for membership if news is in the pipeline!

IPPOG at March for Science

By coincidence the March for Science happened at the same place at different seasons around the world, including Lisbon right after the 13th IPPOG meeting on Saturday 22 April 2017. This provided a great occasion for IPPOGers to participate officially as an organisation and support the March for Science, diverse international group to call for science that upholds the common good, and for political leaders and politicians to stand evidence-based policies in public interest.

The idea of Science March aligns well with the IPPOG objectives to promote normal science education and outreach for particle physics, as well as our core values as a diverse, international collaboration of scientists. About 15 IPPOGers joined March for Science in Lisbon wearing new IPPOG T-shirts and holding posters showing the solidarity with scientists over the world as in the past of 'Silêncio não, ciência sim' (silence no, science yes), and accompanied by the Portuguese minister of science and European coordinators for science.

IPPOG internal affairs

- Newly born IPPOG Collaboration
- New IPPOG charts

IPPOG activities

- Explaining particle physics to laymen
- Global cosmic rays studies
- From STEM to S-EMM

IN THIS ISSUE

- IPPOG worldwide
- Viewpoint on IPPOG - CERN Courier
- IPPOG members' testimonials
- IPPOG on social media
- EPS awards
- Let's cheer working for IPPOG
- IPPOG at March for Science
- IPPOG in US Newsletter
- Articles about IPPOG - INFN Newsletter

Exploring New Paths

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.

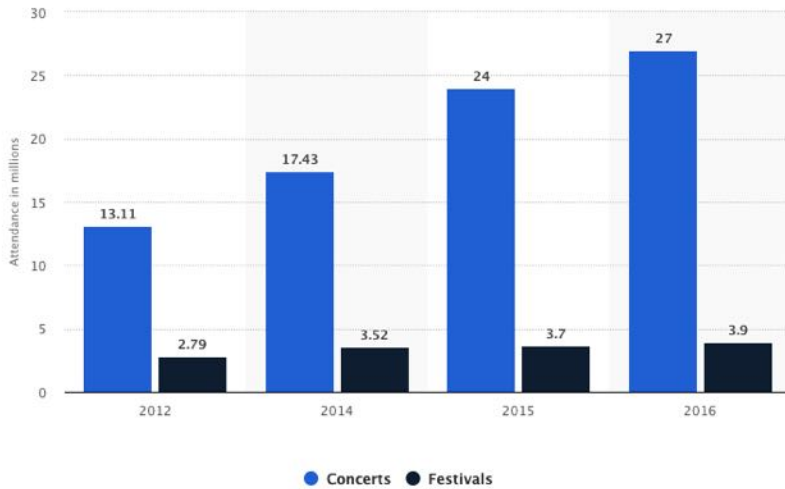
While only a fraction of young students will become scientists, and fewer still will become particle physicists, all will become ambassadors for the scientific method and evidence-based decision-making.

— HP Beck
CERN Courier (March 2017)

Go where people go

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.



© Statista 2017

ABOUT THIS STATISTIC

This statistic displays information on the attendance at music concerts and festivals in the United Kingdom (UK) from 2012 to 2016. The data refers to both local attendants and music tourists from abroad. Over the period of consideration, attendance at UK live music events increased. The number of festival visitors grew by over one million in the three years between 2012 and 2016, *from 2.79 million to 3.9 million.*

In a survey carried out by Billboard in 2016, average *thirty two million people* go to at least one **U.S. music festival** every year.

Music Festivals ?????

Faced with stiff competition from an ever growing number of festivals, organisers are looking to add areas and activities that are a bit different, something unexpected

WOMAD2016

Charlton Park, Wiltshire, UK

At the invitation of the director of the Festival (after a special visit to CERN)
“Why don’t we have a World of Physics?”

Partners:

with the Lancaster University ATLAS group and the UK Institute of Physics
with support from the STFC
and involving CERN

Team camped in basic tents provided by the festival

**Physics Pavilion ran for the full 3 days
offering talks ... workshops ... ATLAS virtual visit**



PHYSICS PAVILION

Tweet us!
#PhysicsPavilion
#WOMADphysics

- 12⁰⁰ Physics in the freezer
- 13⁰⁰ Make your own cloud chamber workshop
- 14⁰⁰ Virtual visit to ATLAS control room at CERN (LIVE LINK)
- 15⁰⁰ What's the matter with anti-matter?
- 16⁰⁰ Mixing it up with neutrinos
- 17⁰⁰ Time travel - fact or fiction?





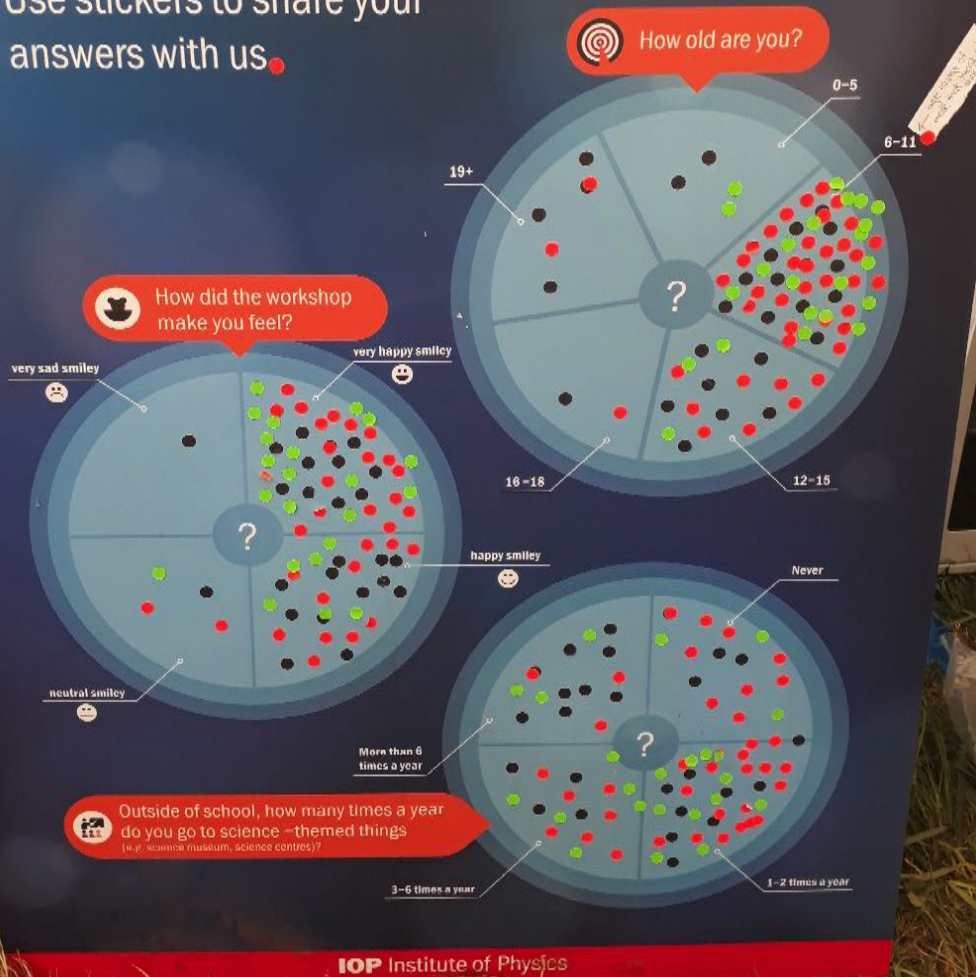


WOMAD2017



Tell us about yourself

Use stickers to share your answers with us.



Amazingly successful

4500 people in 2016 !

5400 people in 2017 !

**WOMAD2018
26 to 29 July**

Fascinating feedback - wide variety of ages

WOMAD2017 'THE PHYSICS PAVILION' Feedback Form

Please give us your feedback on your experience at The Physics Pavilion. We want to hear your thoughts, good or bad. Thanks!

Title of Workshop

In the freezer

Did you enjoy your visit to The Physics Pavilion? YES NO

Was the activity as you expected? YES NO

Was the duration and level of the talk/activity?

Just right Too complicated/too long, I didn't understand anything

Could you please indicate your age range?

5-10 11-15 16-18 19-24 25-39 40-64 65+

Would you come back to The Physics Pavilion? YES NO

E-mail (optional):

Any comments or suggestions you'd like to give us please include here...

Superb. I loved the clarity of the explanations given by the students (and the teacher!)

WOMAD2017 'THE PHYSICS PAVILION' Feedback Form

Superb. I loved the clarity of the explanations given by the school and the teacher

Please give us your feedback on your experience at The Physics Pavilion. We want to hear your thoughts, good or bad. Thanks!

Title of Workshop

Mark Lewney rock guitar

Did you enjoy your visit to The Physics Pavilion? YES NO

Was the activity as you expected? YES NO

Was the duration and level of the talk/activity?

Just right Too complicated/too long, I didn't understand anything

Could you please indicate your age range?

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Any comments or suggestions you'd like to give us please include here...

Great show, made the very complex really interesting and accessible

Great show, made very complex really interesting and accessible

WOMAD2017 'THE LAB' Feedback Form

Please give us your feedback on your experience at The Lab. We want to hear your thoughts, good or bad. Thanks!

Title of Workshop

where am I

Did you enjoy your visit to The Lab? YES NO

Was the activity as you expected? YES NO

Was the duration and level of the talk/activity?

Just right Too complicated/too long, I didn't understand anything

Could you please indicate your age range?

5-10 11-15 16-18 19-24 25-39 40-64 65+

Would you come back to The Lab? YES NO

E-mail (optional)

Tina.Laczko@gmail.com

Any comments or suggestions you'd like to give us please include here...

YOU MUST COME BACK NEXT YR!

You must come back next year!

WOMAD2017 'THE LAB' Feedback Form

Please give us your feedback on your experience at The Lab. We want to hear your thoughts, good or bad. Thanks!

Title of Workshop

Where Am I?

Did you enjoy your visit to The Lab? YES NO

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5-10 11-15 16-18 19-24 25-39 40-64 65+

Would you come back to The Lab? YES NO

E-mail (optional)

Loved the physics pavilion, can't wait to see more! Some biological applications of the work at CERN would be cool!

Any comments or suggestions you'd like to give us please include here...

Love the physics pavilion, can't wait to see more! (Some biological applications of the work at CERN would be cool.)

First-ever public Masterclass @ MOOGFEST2017



Keynote talk @ MOOGFEST2017

Masterclass was heavily oversubscribed (hundreds)

Keynote talk went way over scheduled end time because of non-stop questions from a tremendously curious audience

Pub talk and virtual visits very popular and Mark asked many times since to give more in other towns

asked to return in 2018

Beauty in Fundamental Physics

The beauty of the basic laws of natural science, as revealed in the study of particles and of the cosmos, is allied to the liveness of a merganser diving in a pure Swedish lake, or the grace of a dolphin leaving shining trails at night in the Gulf of California.

— [Murray Gell-Mann](#)
Nobel Banquet Speech (10 Dec 1969)

John Keats in Ode on a Grecian Urn:

"Beauty is truth, truth beauty," – that is all
Ye know on earth, and all ye need to know.



Physics in general, and particle physics in particular, is beautiful.

Conveying the beauty of physics is fundamentally relevant for outreach.
But what is 'Beauty'?

Defining Beauty

Two criteria suggested by **Frank Wilczek**

1. **Productivity**

getting out more than you put in

The more phenomena one can explain with less equations, the more beautiful the theory is.

2. **Symmetry**

According to Wilczek it's change without change.

“You can make changes in physical objects or changes in the laws that could change them but don't”.

Artistic beauty is different

Ernst Gombrich (“The Story of Art”, “Art and Illusion”)
Artistic beauty relies on a tension between symmetry and asymmetry.

Philip Ball (Science Writer)
... for Plato it was precisely art’s lack of symmetry
(and thus intelligibility) that denied it access to real beauty.

Beauty in Art

- Matter of taste
- Temporary

Beauty in Science

- Universal
- Eternal



Jackson Pollock

But the Beauty of Science seems invisible to most

Jesus Zamora Bonilla (professor of philosophy of science, UNED MAdrid)
divides scientists and science philosophers into

1. Platonists

ultimate explanation of the Universe must possess beauty
beauty = essential part of research

2. Sceptics

scientific research has nothing intrinsic to do with beauty)

Sceptics are the most common within the philosophers of science,
and **within most practicing scientists outside of quantum physics**

**Conveying the beauty of particle physics is hard to achieve - even to our
fellow colleagues in other departments, even harder for the broad public.**

Popular beauty is different

Often, lay people find mystery beautiful

— **once explained, it is boring !**

you put the rainbow in a set of formulas - now it's ugly

you found the Higgs - now what?

The opposite is true

— **once you understand, it becomes beautiful**

Think of an archeological excavation site:

It is just a pile of old stones until you start understanding

Screening this evening



The Sense of Beauty (not related to IPPOG)

Using beauty and art for conveying **the deep cultural roots there are in studying and understanding nature**, indeed is a way to reach out to those, who otherwise would never get in touch with science - other than using the **spin-offs** it created, like **everything there is in our today's technology enhanced world.**

IPPOG

an example for concerted and systematic effort for outreach
Enabling Outreach Globally
as a Collaboration in a collaborative effort



CERN, 2-4 November 2017