



Report to ECFA, November 20th 2014

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The Significance of Science

Victor F. Weisskopf

14 APRIL 1972
SCIENCE, VOL. 176



*Victor Weisskopf
1908 - 2002*

More **concerted** and **systematic effort** toward **presentation** and **popularization of science** would be helpful in many respects; it would provide a potent antidote to overspecialization; it would bring out clearly what is significant in current research, and it would **make science a more integral part of the culture** of today.

The European strategy update – 2013

CERN-Council-S/106

What the European Strategy for Particle Physics says on the

Wider impact of particle physics

n) Sharing the excitement of scientific discoveries with the public is part of our duty as researchers. Many groups work enthusiastically in public engagement.

They are assisted by a network of communication professionals (EPPCN) and an **international outreach group (IPPOG)**.

For example, they helped attract tremendous public attention and interest around the world at the start of the LHC and the discovery of the Higgs boson.

Outreach and communication in particle physics should receive adequate funding and be recognised as a central component of the scientific activity.

EPPCN and IPPOG should both report regularly to the Council

IPPOG – an International Network

33 members representing 25 countries + CERN, DESY, FNAL and 5 experiments

Founded in 1997 (as EPPOG), IPPOG is an International network of physicists who commit a fraction of their time in education and outreach.

IPPOG members have a national mandate or a mandate from a big experiment or a mandate from a big national or international lab

New countries, laboratories, experiments engaged in all fields of particle physics are welcome to strengthen IPPOG further.



http://ippog.web.cern.ch/ippog_membership

IPPOG PURPOSE

The principle aim of the International Particle Physics Outreach Group (IPPOG) is to contribute to global efforts in **strengthening cultural awareness, understanding** and **support of particle physics** and related sciences.

More specifically, IPPOG's purpose is to raise standards of **global outreach and informal science education efforts of particle physics** and to communicate its results and findings to the public by, amongst other things:

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

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 an umbrella for making outreach global

CERN Courier June 2014

Education



High-school students from all geographical regions master real event-display programmes, software tools and analysis methods. Having been introduced to the problem, they identify electrons, muons, photons and jets by exploiting their characteristic signals in various detector elements, perform event selection and categorization, and achieve the final analysis goals. (Image credits, left to right: Caroline Hamilton/CoEPP/University of Melbourne, Jayne Ion/ION creative, Franziska Viebach/TU Dresden.)

International Masterclasses in the LHC era

Each year in spring, the International Particle Physics Outreach Group organizes the International Masterclasses, which give students the opportunity to analyse data from the LHC.

The International Masterclasses (IMCs) began in 2005 as an ini-

ATLAS "discovery" data are available for students. Higgs boson, CMS approved 13 Higgs candidates of interest, which are mixed with a more abundant Z events, for "treasure hunt" activities; ALICE data to study the relative production of strange particles; a tell-tale signal of quark-gluon plasma production; students how to measure the lifetime of the D meson containing b and c quarks are studied extensively to mystery of antimatter in the universe.

Students quickly master real event-display prog-

CERN Courier
June 2014 edition

International Masterclasses, the flagship activity of IPPOG trained over **10'000 students in Spring 2014.**

200 institutions in 40 countries participating.

CERN Courier June 2014

Education



More than 200 institutions in 40 countries and more than 10,000 high-school students participated in the 2014 IMC, analysing LHC data.

parameters are all inferred from the decay products – pairs of e^+e^- or $\mu^+\mu^-$ leptons. When a hypothetical new heavy gauge boson, Z' , is

Measurement	No. of masterclasses (CERN + Fermilab)	No. of video conferences (CERN + Fermilab)
ALICE	16 (16+0)	4 (4+0)
ATLAS	132 (118+14)	33 (27+6)
CMS	70 (46+24)	23 (10+13)
LHCb	21 (21+0)	7 (7+0)

Table 1. Use of the different measurements in 2014.

The LHCb measurement allows students to extract the lifetime of the D^0 meson after having studied and fitted an invariant-mass distribution of identified kaons and pions. The next step is to compare and discuss properties of D^0 and \bar{D}^0 decays.

All of these educational packages are tuned and expanded to follow the LHC's "heartbeats". The intention is for the IMCs to bring measurements for new discoveries in the coming years.

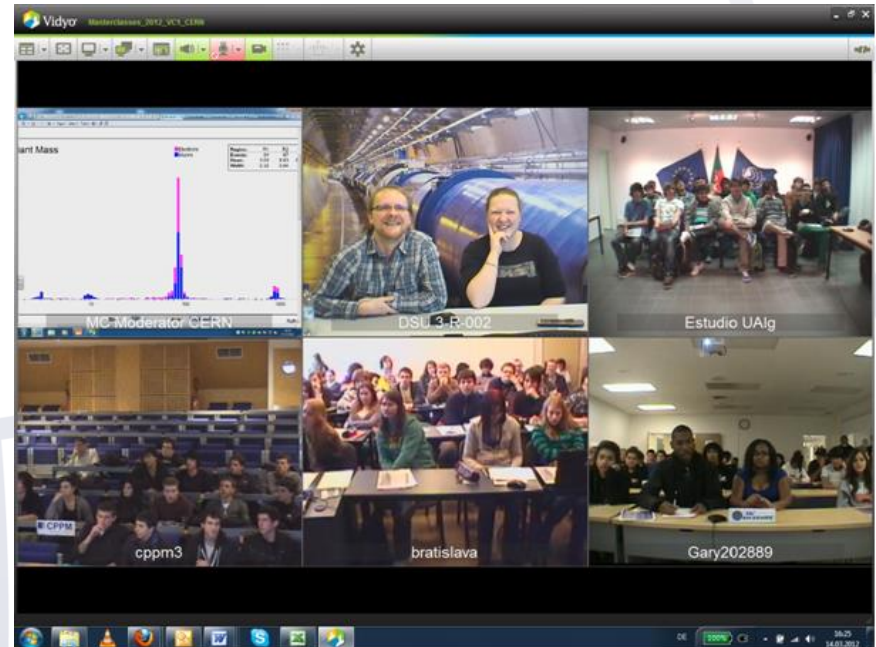
A model for science education

The IMCs have led to other masterclass initiatives. National programmes bring masterclasses to students in areas far from the research institutes that host the international programme. In sev-

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 measurement with LHC data
- International video conference (2 – 5 inst. + CERN/Fermilab)



High-school students analyze LHC data

- **ATLAS**

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

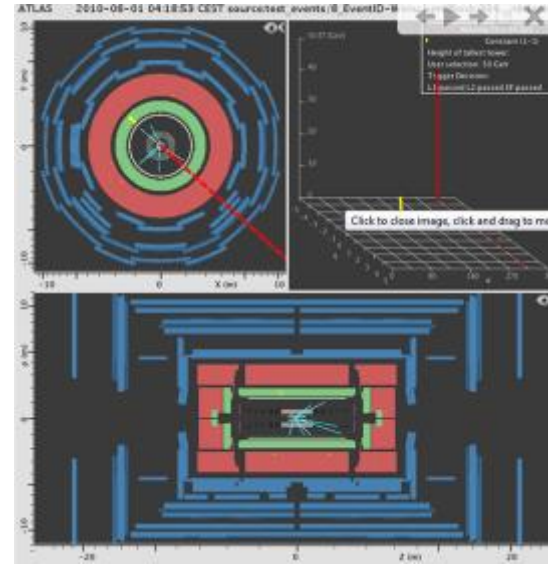
- **CMS**

- **ALICE**

- Looking for Strange Particles
- R_AA

- **LHCb**

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



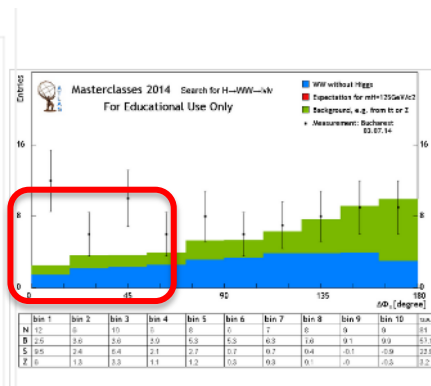
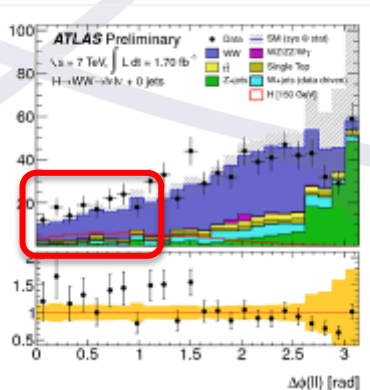
Analyses are kept up to date and improve

- 2011: Exploit known Standard Model Processes, e.g.

- W⁺/W⁻ ratio corresponding to (u,d) quarks in proton
- Understand mass peaks of J/Psi and Z

- 2012: On the way to discover new particles

- Higgs → WW
- Extra Z Bosons
- ...



Masterclasses: Worldwide spread



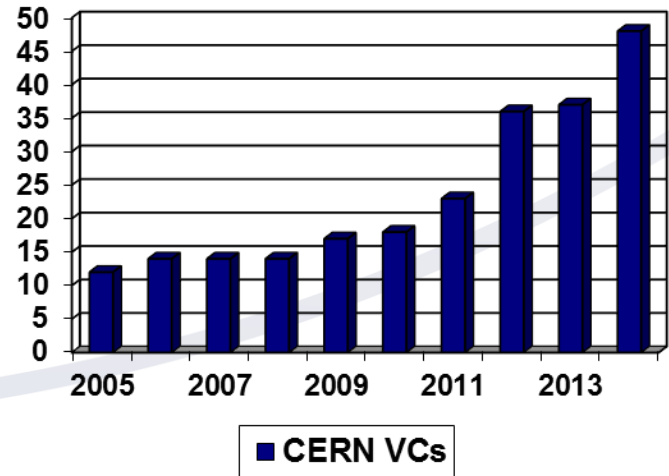
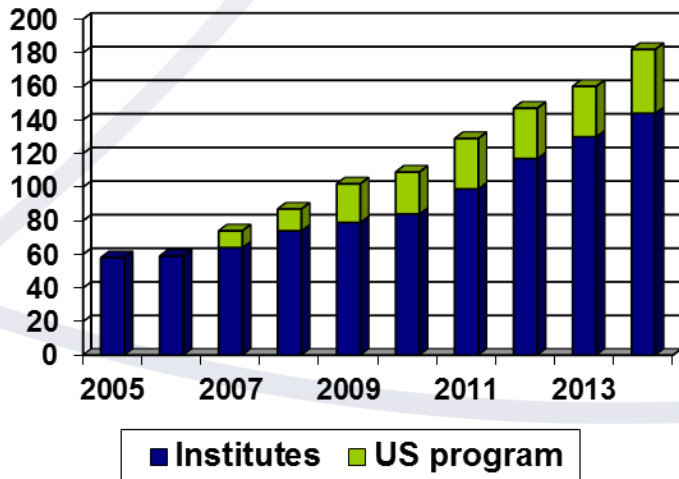
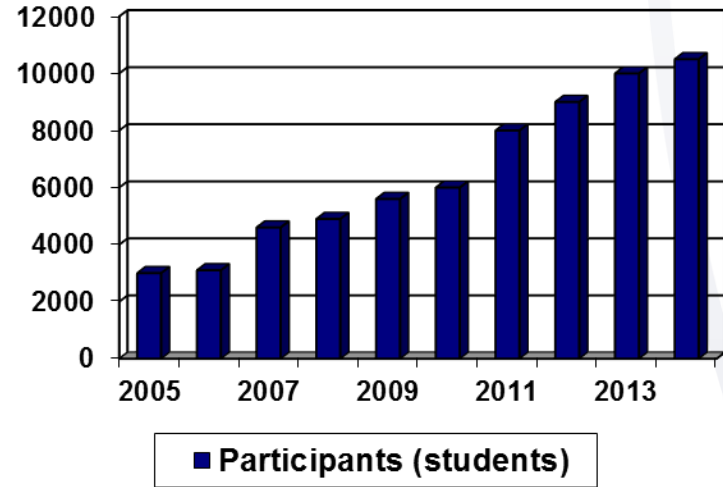
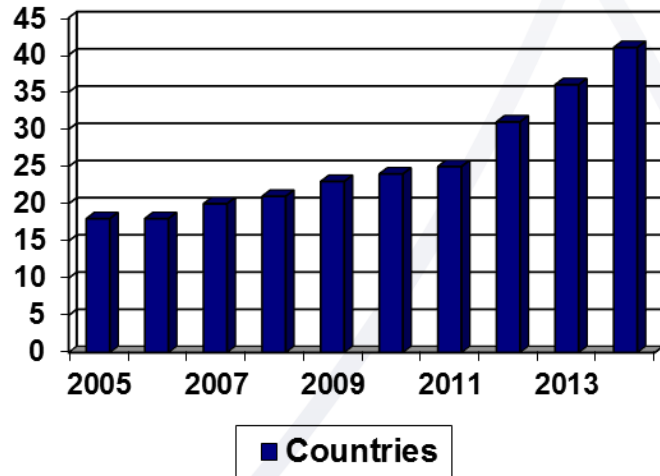
41 countries in 2014

In 2015:

- + Marocco
- + Mexico
- + Thailand
- + ...



Participation Statistics



Expanding to Astroparticle physics – discussions and pilot tests

IceCube Masterclass

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

- Pilot: 21.5.2014, 5 institutions, 100 students

International Muon Week

Quarknet

<http://Internationalmuonweek.org>

International Cosmic Day

<http://ippog.web.cern.ch/resources/2014/international-cosmic-day-2014>

Auger Masterclass

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

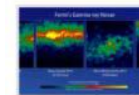
- Pilot tests in German Netzwerk Teilchenwelt



Astroparticle Physics European Consortium

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NEWS



FIFTH INTERNATIONAL FERMI SYMPOSIUM
October 20-24 2014, Nagoya, Japan

The 6th International Fermi Symposium starts today at Nagoya University in Japan. This meeting will focus on the new scientific investigations and res...

[Read more](#)



International Cosmic Day 2014

The 3rd International Cosmic Day on **October 8, 2014** is organized by [CEISY](#), [Fermilab](#), [QuarkNet](#), and [Netzwerk Teilchenwelt](#) and will enable students in many different countries around the world to get in contact with astroparticle physicists to get a first insight into their research and experimental methods. Students will be invited to do their own experiments in nearby universities, research institutions or even in their classrooms. More information can be found [here](#).

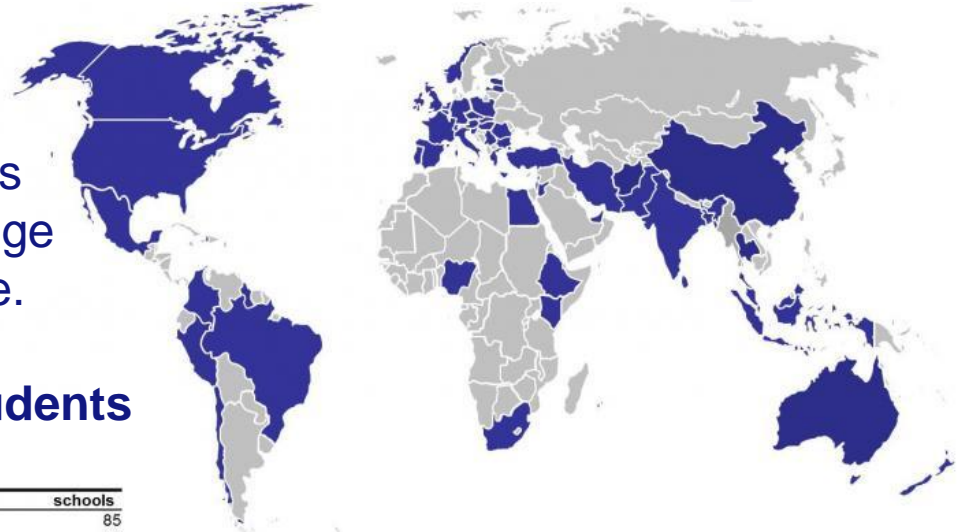


Competition: a beam line for schools

IPPOG acted as local contacts to schools in many countries.

Many IPPOG members took responsibilities for multiple countries to ensure that language barriers will not be a insurmountable hurdle.

IPPOG did **encouraging schools and students** to participate in the competition and enabling access to the right level information needed by the competitors.



Country	schools								
Italy	85								
Spain	66								
United States	45	Netherlands	6	Egypt	3	Jordan	1		
United Kingdom	43	Singapore	5	Slovakia	3	Mauritius	1	Belgium	
India	28	South Africa	5	New Zealand	2	China	1	Sri Lanka	
Greece	19	Indonesia	4	Czech Republic	2	Kuwait	1	Cyprus	
Germany	17	Hungary	4	Brazil	2	Nigeria	1	Malta	
Canada	13	Austria	4	Norway	2	Malaysia	1	Qatar	
Poland	10	Mexico	4	Serbia	2	Ethiopia	1	UAE	
Switzerland	8	Ireland	4	Slovenia	2	Haiti	1	Israel	
France	7	Iran	3	Bulgaria	2	Pakistan	1	Chile	
Portugal	7	Colombia	3	Australia	2	Guyana	1	Bangladesh	
Romania	6	Estonia	3	Afghanistan	2	Peru	1	Kenya	
Turkey	6	Thailand	3	Lebanon	1	Latvia	1	Total	

455 teams from 60 countries registered to participate in the competition

292 teams filed in written proposals

16 teams short listed

2 teams selected (GR and NL) to form a collaboration and perform their proposed experiment

These two teams have been performing their experiment at CERN in September!

Competition: a beam line for schools



GR and **NL** at CERN performing their experiment in September 2014 !

The beamline for schools competition in 2015 has just been launched

IPPOG is recognized internationally

- ❑ ICHEP 2014 – Valencia
 - ❑ Two parallel sessions – sessions chairs are IPPOG members
 - ❑ IPPOG chair invited for a plenary talk in the closing session

- ❑ Xth Workshop on Particle Correlations and Femtoscopy (WPCF-2014), 25-29 August 2014, Károly Róbert College, Gyöngyös, Hungary
 - ❑ The Slovak IPPOG representative

- ❑ invitation - keynote (video-)conference at the International Olympiad for Astronomy and Astrophysics, August 2-19 2014, Stefan cel Mare University, Suceava (Romania)
 - ❑ The Romanian IPPOG representative was able to accept the invitation

- ❑ Frontiers of Fundamental Physics 14, July 15-18 2014, Marseille
 - ❑ However, could not find support to send a speaker

- ❑ Report to CERN Council – 19 September 2014
- ❑ Report to RECFA and PECFA – 20 November 2014

IPPOG & EPPCN

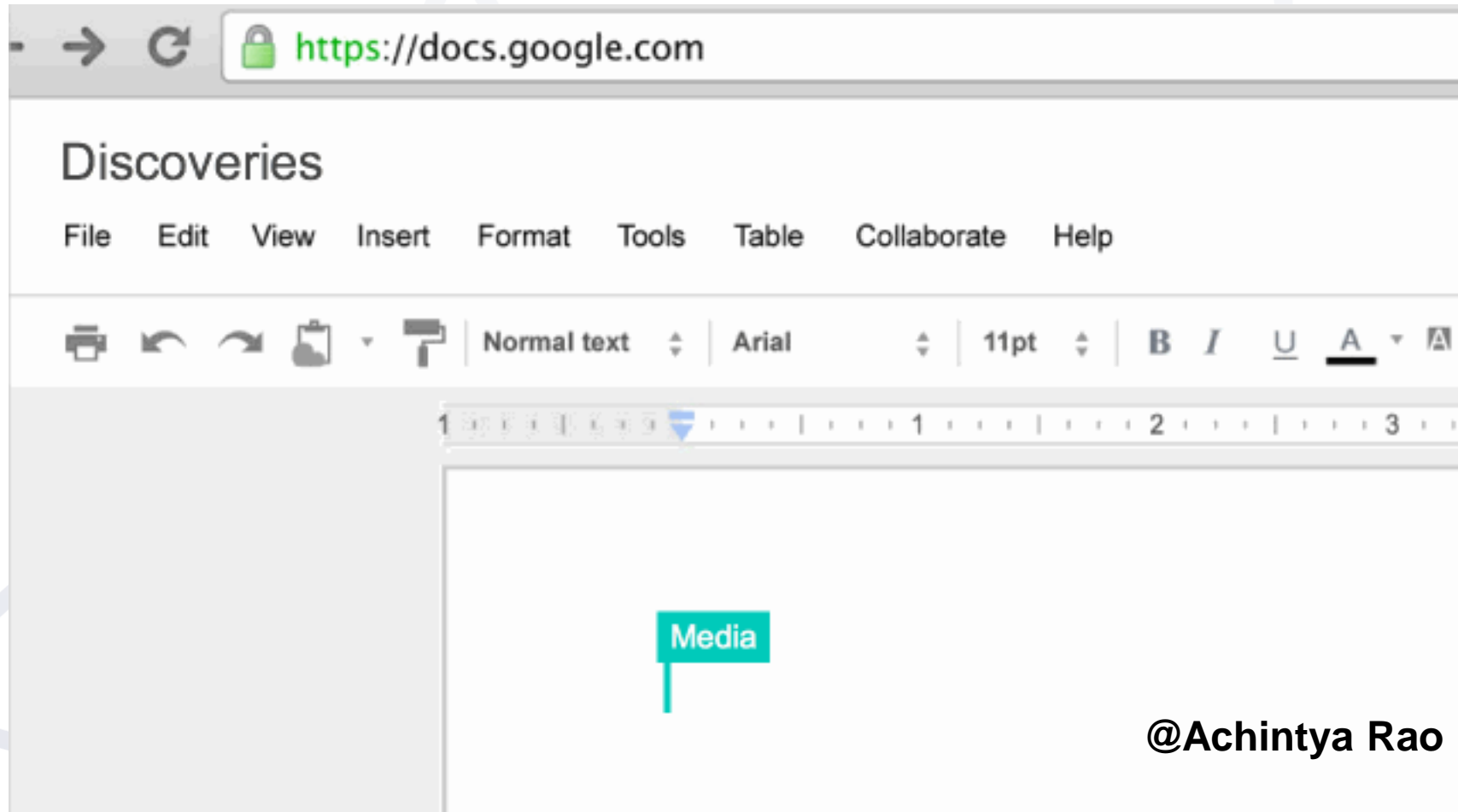
- **EPPCN and IPPOG can and do build up on synergies**
 - **IPPOG (physicists) and EPPCN (professional communicators) need to work together when making communication and outreach a success**
 - **Regular discussions between James Gillies and HP Beck**
 - **Joint session between EPPCN and IPPOG once a year at CERN**



IPPOG, EPPCN and Interactions.org on 7 November 2014

The Communicator and the Physicist

an interesting relation

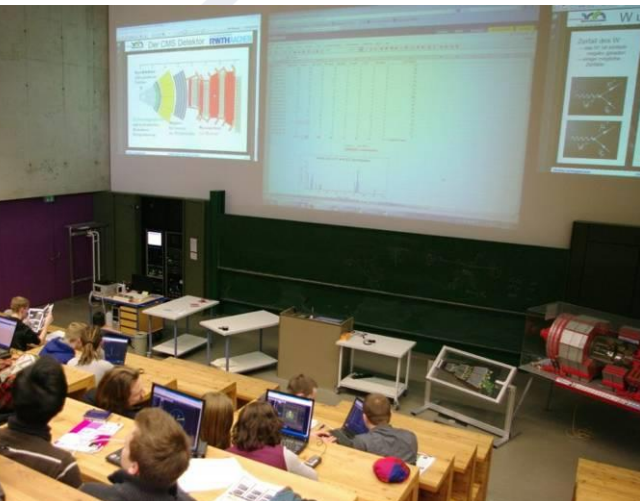


SUMMARY

- **IPPOG**
is an established successful outreach and education group now integrated into the European Strategy
- provides tools & activities ready to be implemented at your institute
- is expanding internationally
 - Israel & South Africa and FNAL have recently joined IPPOG
 - discussions with more new countries ongoing
 - Spreading programs and experiences
- is sharing experiences with existing successful national networks
 - QuarkNet (US, teachers)
 - Netzwerk Teilchenwelt (DE+CERN, teachers and students)
 - ...
- **needs sustainable funding structures**
 - especially when enlarging its activities further

Victor Weisskopf, *Physics in the 20th Century*

“lucid and impressive presentation of some aspect of modern science is worth more than a piece of so-called original research of the type found in many Ph.D. theses, and it may require more maturity and inventiveness.”



The background of the slide features several thick, light blue curved lines that sweep across the frame, creating a sense of motion and depth. The lines are smooth and vary in curvature, some appearing more vertical while others are more horizontal or diagonal.

BackUp Slides

IPPOG

The International Particle Physics Network

*IPPOG was **formed in 1997** under the joint auspices of the European Committee for Future Accelerators ([ECFA](#)) and the High Energy Particle Physics Board of the European Physical Society ([EPS-HEPP Board](#)). Initially IPPOG was called European Particle Physics Outreach Group (EPPOG) **which transformed to IPPOG in 2011**, to reflect its true international stature.*

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

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

Latest Resources


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

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

 **The ATLAS-Detector**
to inform secondary school children about the ATLAS Project
0 comments

PhD TV: The Higgs Boson Explained

A clever animation explaining what the Higgs Boson is and how the LHC will find it (if it exists).



Film / Video, Book

<http://ippog.web.cern.ch>

Education & Outreach Collection – The IPPOG DB

Resources

- Activities
 - Cart Demonstration
 - Display
 - Classroom Activity
 - Facilitated Activity
 - Presentation
 - Game
- Programs & Events
- Media
 - Professional Development & Coaching
- Exhibits
- Souvenir / Novelty Item
- FAQs

Welcome !

What is this?

Who is this for?

Want to share items, leave comments and rate stuff too?

[Learn more](#) about joining the collection's user group.

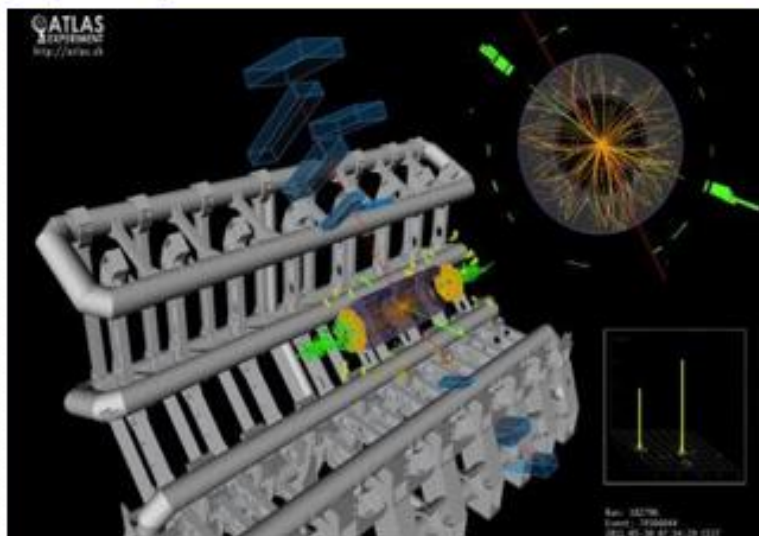
Learning Topics



- ▶ Physics
- ▶ Technology
- ▶ International Collaboration
- ▶ Broader Impacts

LATEST

FEATURED



The Large Hadron Collider at CERN: Exploring the frontiers of our universe (Part 1 of 2)

Inform the general public of the importance and necessity of fundamental research, describe the LHC, its experiments, collaborations, and recent achievements.

Presentation

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