

A word from the coordination team



Dear IPPOGers,

Last year has been very rich and productive for IPPOG, and we can be proud of many achievements and successes. Thank you, all, for your contributions, which are crucial!

The initiative of IPPOG to become an official body on its own right and with secured funding has advanced considerably. The Memorandum of Understanding is now with CERN Legal Service for scrutiny and will be soon ready for signatures. Thus, 2016 will be marked by at least two joyful events: IPPOG becoming a formal collaboration and our scientific secretary Barbora Gulejova, welcoming a little IPPOG baby boy!

Our membership is growing worldwide and IPPOG is becoming truly international. In 2015 we got one new member and several others intend to become members this year. Summer 2015 was memorable 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/440711/>) was very fruitful. Tradition from 2014 continued, and EPPCN colleagues joined us for a half-day session, which was opened by the new CERN DG, Fabiola Gianotti, who stressed the relevance of both IPPOG and EPPCN. The former Head of the Education and Outreach Group of CERN Directorate Office, Rolf Landua, also highlighted the importance of IPPOG and the willingness of CERN to support it in the future. The program of the meeting was very rich and diverse and we hope you will enjoy reading 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 next IPPOG meeting on 19-21 May in Cracow.

Hans Peter, Marge and Barbora

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IPPOG growing truly international



Last year Australia has been unanimously voted in as the 26th country in IPPOG! Australia aims to introduce the IPPOG Masterclasses programme 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 delegate to IPPOG.



Moreover, two new other countries, China and Slovenia expressed interest for membership and potential candidacy for membership from two other continents is in the pipeline!

IPPOG activities

- New Twitter account for International Masterclasses
- IPPOG working on particle physics future's communication strategy

New structure of CERN

CERN Council congratulates IPPOG

In its 177th meeting 'European strategy matters' the CERN Council took note of the report by the IPPOG Co-Chair, Dr H. Beck, and congratulated the group on the continuing success and rapid growth of its Master-class programme.



From 1st January 2016, CERN is led by the new Director-General Fabiola Gianotti, who has implemented a new structure for the Organisation. Good news for IPPOG is that the international dimension of CERN has gained more visibility and recognition with the creation of a new 'International Relations Sector' to complement the three other sectors: Accelerators and Technology, Research and Computing, and Finance and Human Resources. The IR sector includes the new 'Education, Communications and Outreach (ECO) group' – a fusion of the former E&O and Communications groups - and a 'Stakeholders Relations group' (host states, member states, non-member states, international organisations, etc...). Charlotte Warakulle, who comes from a long career with the UN is the new IR Sector Director and also interim Head of the ECO group.

Charlotte recognises IPPOG as an important player for CERN international relations in the future.

As she says, *"IPPOG is a key platform for reaching out on the relevance, value and impact of particle physics research, to students, teachers and the broader public, across the globe. This matches the vision of CERN of worldwide open and collaborative science, exploring the fundamental structures explaining the Universe. IPPOG is well positioned to be an important pillar in reaching these goals, and I very much look forward to close collaboration"*.



IPPOG also looks forward to good and fruitful collaboration!

Higgs in the sky

Is the Higgs produced in LHC dangerous? Nature's hadron collider produces Higgs boson all the time, high in the sky!



In the recent bachelors thesis from Josua Unger (<https://cds.cern.ch/record/2019394>) supervised by IPPOG German delegate Michael Kobel, the percentage of proton-proton collisions in the atmosphere resulting in Higgs production was studied using the spectrum of cosmic rays. It has been found, that

the steeply falling energy spectrum of primary cosmic ray protons, when convoluted with the steeply raising Higgs production cross-section as function of collision energy, determines the most probable kinematic parameters for Higgs production in the atmosphere pretty well. The primary cosmic rays produce 1 Higgs ~ every 8 seconds in the atmosphere, which is comparable with the Higgs production rate of LHC during runtime 2012 and will be dwarfed with the Hi-Lumi LHC coming to operation. In the atmosphere the distribution is, of course, over much bigger volume. Nature does the biggest production of Higgs bosons at much lower energies than the LHC and at just a little lower energies than those of Tevatron in the USA.

The question may arise *"Why do you need LHC if Higgs is produced in atmosphere?"* Well, in comparison to the Earth-spanning detector, a 27 km long LHC is even cost-efficient!

International Masterclasses on social media!

International Masterclasses have a brand new Twitter account! You can follow us at [@physicsIMC](https://twitter.com/physicsIMC) with the hashtag [#LHCIMC16](https://twitter.com/physicsIMC). Join the growing number of followers (~ 120 as of February 2016) and add to this discerning group!



Extending the term of office of current chairs



Given the transition of CERN management starting from 2016 and the planned transformation of IPPOG into a formal international collaboration with its own funding structure, which is a critical step in IPPOG history, it is important that the current chairs Hans Peter Beck and Marge Bardeen are given time and possibility to ensure the smooth implementation phase of the IPPOG MoU and to hand over the IPPOG Collaboration in a good stable position, so that the new chairs can take up the work with clear vision for going forward.



Therefore, Marge Bardeen and Hans Peter Beck were re-nominated for the period of one extra year, effective from 1st of January 2016 until the end of 2016, and the preparations for finding the IPPOG chairs for the 2017-2020 term will start at the next Spring meeting in Cracow.

Thank you for your great work, Hans Peter and Marge!

IPPOG members' testimonials

"IPPOG has always been a great source of ideas and inspiration for me."

- IPPOG's delegate of Slovakia, Ivan Melo



"IPPOG is a unique platform to exchange ideas beyond the usual LHC circles"

- ATLAS outreach coordinator, Claire Adam-Bourdarios

Benefits of membership as seen by country and big experiment

Slovakia joined IPPOG 10 years ago and as the delegate Ivan Melo states, "IPPOG has always been a great source of ideas and inspiration for me." Indeed, thanks to IPPOG, 7 out of 8 Slovak universities run Masterclasses (IPPOG's flagship activity, where high-school students become particle physics (PP) scientists for a day) every year. Another educational project inspired by IPPOG, CASCADE (of knowledge and interest in PP) also became very popular today including 15 successful teams of high-school students. Membership in IPPOG helped to attract attention of Slovak media and to raise profile of some universities. The recognition of outreach, which used to be considered as inferior in HEP (high energy physics) community, has been built up and today it is even easier to obtain the grants for outreach programs.

An inside view from IPPOG members

"The outreach activities of large LHC experiment, like ATLAS, wouldn't be that efficient as they are today without IPPOG", says Claire Adam-Bourdarios, ATLAS outreach coordinator. "IPPOG is a unique platform to exchange ideas beyond the usual LHC circles", she adds. Indeed, networking helps to give echo and visibility to often fragmented efforts. Impossible without IPPOG, the major enterprise and success from many points of view, Masterclasses, brings ATLAS closer to outreach. IPPOG database, the backbone of the particle physics community's resources, serves not only as a source of inspiration but also as a collective memory of worldwide PP outreach efforts. Another advantage of being a member of IPPOG is benefiting from the new regime of Open Data, which has been launched by CERN last year and represents many challenges which are tackled collectively in the IPPOG group. Growing introduction of talks on outreach and communication is a result of efforts from a very small group of pioneers and IPPOG has been very active in this respect, especially in 2015. Moreover, the efforts are now more centralised and coordinated thanks to IPPOG's Publications and Speakers Committee. "Go ahead, IPPOG! We (large and not so large experiments) need you!" concludes Claire.

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- ATLAS outreach coordinator, Claire Adam-Bourdarios

IPPOG working on communication strategy for future of particle physics!

“Why do we need bigger and bigger machines?”

The need for scientific community to be able to answer this question becomes more and more pressing as the costly construction of big machines after the LHC (like high luminosity LHC, FCC, ILC and CLIC) must be justified, especially following the Higgs discovery.

There are two crucial arguments. First, bigger machines allow research to go **from discovery to the precision**; and second, we need to understand Standard Model limits of validity and which model could be applied beyond this scope. We need to measure the Standard Model at unprobed energy scales. **Expanding the scale** at which a model is probed will either further strengthen the validity of the model or will tell when the model collapses and a new model will need to be found. A good way to explain this is to point to an analogy with known examples, clearly showing that **scale matters**. Take for example the **Beyond Flat Earth Model**.

“Beyond flat Earth model”

As Hans Peter Beck explains, even a good and axiomatically well-motivated mathematical model i.e. Flat Earth or, if you like, the Standard Model, is only as good as it has been tested by experiment. As the flat Earth is a good approximation in our local environment, knowing the Earth is round doesn't help building a better house, your architect doesn't rely on knowing Earth's radius when drawing your new house. However, already when measuring the trajectory length from CERN to Bern (130 km), the sizeable discrepancy between theoretical prediction and measurement appears (1%), which will build up slowly with increasing distance scale. You may detect further unknown territory while on your way out to India via going west. It is exactly the deviation from the predicted value that tells how a better model can be constructed. Old models embed in the new and better model describing the world and keep their validity within a limited but now well understood scope. Another example is Newtonian mechanics, which is truly embedded in Einstein's General Relativity (Newton's theory is useful for almost any engineering project, including some space projects, but for GPS we need Einstein's theory). Once we know how to **expand out of the Standard Model**, we may be in a position to understand Dark Matter or even Dark Energy, find new particles or something completely else. This could be done only by **exploring new higher energy scales and measuring with higher precision**, possible at the machines like High-Lumi LHC, FCC, ILC, CLIC etc.



Article about IPPOG

IPPOG's new Associate from University of Sofia,

Iva Raynova wrote a nice article on our recent IPPOG meeting that appeared in ALICE Matters

<http://alicematters.web.cern.ch/?q=content/node/885>

which is also linked from the CERN Bulletin

<https://cds.cern.ch/journal/CERNBulletin/2015/47/News%20Articles/2069140?ln=en>

Thank you, Iva!

Explaining new physics

The IPPOG physicists summarised what are the greatest mysteries, which the particle physics community is still looking for and which could be understood thanks to the new bigger machines.

Clearly, we are missing major parts of the understanding of our universe.

The unknown topics are: 1) **Dark matter** known to exist from gravity observations but only new precision of measurements could explain it; 2) **Dark energy** connected with the behaviour of gravity at very short scales; 3) **Unification of 4 forces**: Do they really have the same origin?; 4) **Antimatter** – matter mystery; 5) **Early universe** (quark-gluon plasma, baryon genesis, lepton genesis).

The theories and concepts trying to explain these mysteries which are "hidden" for the moment, are: 1) **Symmetries** and their breaking, which is very useful as otherwise we wouldn't be here; 2) **Extra dimensions** connected with the gravity on the short scales; 3) **Spin**; 4) **New scales**; 4) **New state of matter**; 6) **Role of new scalars** beyond the mass.

So much exciting research and discoveries ahead!

Editorial: Barbora Gulejova (feedback welcome at barbora.gulejova@cern.ch)

Contributors: Hans Peter Beck, Marjorie Bardeen; **Contact:** ippog@cern.ch; **Web:** ippog.web.cern.ch