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Physics & Education – Perspectives from Particle Physics

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Physics & Education – Perspectives from Particle Physics

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Tackling deep questions on the structure, inner working, birth, evolution and fate of the Universe are challenging endeavours, often requiring scientific collaborative effort in designing and realizing projects of unprecedented scales and complexity – in all aspects and metrics considered.

Particle physics research has a long tradition of making important scientific advancement through large-scale collaborative efforts. Many of these projects started at the national level, but quickly grew to become international in scope and, by pure necessity to master the complexity that arises when large-scale projects are realised successfully, have evolved into fully global enterprises.

Through these efforts, not only science paces ahead but society as a whole has the chance for advances for the better in many aspects of scientific, philosophical, societal and economical values, when world-views evolve, when large collaborations learn to work together without borders, and when spin-offs occur that become applications of wide use [1].

However, despite a long list of successes made and new promising projects being sought, fostering consent for new large-scale infrastructure to be considered is all but easy, nor straight forward. Not only a scientific consent is needed, but societal support is needed as well. In today's so-called "post-factual world" emerging from political ideology, ignorance or complete mistrust in democratic institutions, it becomes even more apparent how high the challenges that need to be faced really are.

This problematic has been understood already more than 70 years ago, as the following quote states it with much fore-

sight: *"It is crucially important that the general public has the opportunity to inform itself knowledgeably and intelligibly on the endeavours and results of scientific research. Restricting scientific findings to a small group of people weakens the philosophical spirit of a nation and leads to its intellectual impoverishment."* [Albert Einstein, Princeton 1948]

However, 70 years after Einstein's quote, it has become evident that the duty is not on the side of the general public to proactively inform itself. In contrary, the duty is on the side of physicists to make sure that not only opportunities to inform oneself knowledgeably and intelligibly are made available, but that a real engaging dialogue with a broad audience is established.

It has also become evident that the tools and methods currently used to support such a dialog have not been as successful as one would have hoped for. Indeed, many activities at research centres, at universities, and museums often attract only those people who are already interested and appreciative of the basic and fundamental relevance of science.

New paths in reaching out must though be explored, without compromising the established ways, which remain truly relevant for all those who are interested in science. These must always be given the opportunity to engage further and deeper.

It is those who are not immediately interested or do not show a self-driven interest in engaging further that make out large portions of society. Finding ways to reach out further is therefore a crucial act for society, and with it also for continued and broad support of science, especially of the

often called ‘blue sky research’ without seemingly imminent economic value.

Involving and engaging young and very young pupils and students comes with a special benefit. Indeed, fostering programs targeting high-school students and their teachers in the methods and tools used in fundamental science is a well deserving investment in the future. Not only will few of these young students become one day scientists themselves, but all of these young students will find their role in society. All of them can be ambassadors of the scientific method and of science-based decision taking, whenever it is about discussing the scientific approach to acquire knowledge and to base decisions upon careful reflections of information over beliefs and ideology.

Paving ways to reach out further to those who no-longer are students but who are now active in their life, is of enormous relevance and involves taking courageous steps. Partnering with artists, musicians, and celebrities, science can get into the spot light. Not ending up in trivialities but raising curiosity and interest is a tightrope walk but one with enormous potential that already has demonstrated to build interest, while keeping the spot light on science.

IPPOG – The International Particle Physics Outreach Group

With the unprecedented global scale of the Large Hadron Collider (LHC) came a real and explicit need for extensive efforts in communication, education, and outreach. This in turn has led to the creation of new communication and outreach networks more than 20 years ago. The European Particle Physics Outreach Group (EPPOG) 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). EPPOG widened its regional scope to become an international player in 2005 with the development of the International Particle Physics Masterclass programme, which is also reflected by its new name, now to be called the International Particle Physics Outreach Group (IPPOG) in 2011 [2]. With the growing global scale and scope of its activities, IPPOG became an international collaboration in 2016, following the way large-scale international scientific collaborations are built and function [3]. This has enabled IPPOG to secure limited financial support at a critical time, allowing it to continue to extend its network and develop much-needed infrastructure.

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 declared goal is to bring new discoveries in this exciting field to young people and to convey to the public that the beauty of nature is indeed understandable from the interactions of its most fundamental parts - the elementary particles. Today, the IPPOG collaboration comprises 37 members (30 countries, 6 experiments and CERN as an international laboratory) and 2 associate national laboratories as associated members.



The 17th IPPOG Collaboration meeting 2019 in Darmstadt.

The primary methodology adopted by IPPOG requires the direct involvement of scientists active in current research with education and communication specialists, in order to effectively develop and share best practices in outreach. IPPOG member activities include the International Particle Physics Masterclass programme, the International Day of Women and Girls in Science, the Worldwide Data Day, the International Muon Week and the International Cosmic Day organisation [4], and participation in a wide range of activities from public talks, mounting science pavilions at festivals, setting up new exhibitions, teacher training, student competitions, and supporting open days at local institutions. These independent activities, often carried out in a variety of languages to a broad public with a variety of backgrounds, all serve to gain the public trust and to improve worldwide understanding and support of science.

IPPOG Masterclasses

It is worth pointing out one of IPPOG’s activities, which helped gaining its world-wide reputation most, the IPPOG Masterclass [5]. A Masterclass differs from a typical class, as it is taught by an expert in the field, who is not necessarily a professional educator. The advantage of such extra-curricular or informal training is that students take a break from their usual routine and be inspired by experts and role models in their specialty. IPPOG Masterclasses are run by parti-



International Particle Physics Masterclasses are the flagships of IPPOG. Here students become "researchers for a day", getting to know the various aspects of scientific methods and workflows.

