PROCEEDINGS OF SCIENCE

Updates on the IPPOG activities

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Abstract

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 public engagement. IPPOG members activities include the International Particle Physics Masterclasses programme, the International Muon Week and International Cosmic Day organization, as well as a wide spectrum of activities such as public talks, festivals, exhibitions, teacher training, student competitions, and open days at local institutions. These independent activities, often carried out in a variety of languages to public with a variety of backgrounds, all serve to gain the public trust and to improve worldwide understanding and support of science. Special focus will be given to the flagship activity of IPPOG, the particle physics masterclasses, a hands-on activity giving the opportunity to more than 15000 high-school students every year to get a flavor of the way research is done by analyzing data from high energy physics experiments.

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1. Introduction

Contemporary man lives in a growing information flow. Distinguishing between real and fake news can happen only through constant enrichment and extending the personal knowledge of the one. High energy physics (HEP) experiments are large-scale undertakings funded by public funds from various countries. Therefore, the obtained results and developed technologies should be publicly available. But in order to realize the true potential of the acquired knowledge, it is necessary not only to provide this knowledge to society, but also to draw its attention to it, as well as to popularize scientific work. By their nature, HEP experiments are international and foster a collective and international spirit of work and networking. Transferring this style of communication to society, and especially among young people and students, supports their development as individuals, adequate to the modern dynamic technology development, broadens their horizons and, last but not least, provokes them to choose professional development in the field of natural science disciplines or engineering. Because of this, science communication and bringing scientific achievements to society in an understandable way is of utmost importance and priority for the scientific community.

IPPOG (International Particle Physics Outreach Group) is a collaboration of high energy and particle physics scientists, science communicators and educators, unified around the idea and working to promote particle physics and technological advances to the general public. In this article the latest news from the IPPOG events will be presented. A special focus will be given to the International Masterclasses for secondary students with data from HEP experiments.

2. IPPOG timeline and today

IPPOG [1] was born in 1997 as a European Particle Physics Outreach Group (EPOG), formed under the joint auspices of ECFA and EPS-HEPP, as a forum for exchange of ideas, best practices, tools and outreach experience among the countries. The first international masterclasses in particle physics with real data from DELPHI and OPAL experiments were launched in 2005, and in 2011 were launched the classes with data from ATLAS, CMS and ALICE experiments. Meanwhile the group were joined by many non-European countries: Israel, Australia, USA, South Africa, India, Mexico and others. Thus in 2011 the name of the collaboration was changed to IPPOG (International Particle Physics Outreach Group). More details about the history of the collaboration can be found in [2].

Nowadays, the collaboration consists of 41 members - 33 countries, 7 HEP experiments (ALICE, ATLAS, BELLE II, CMS, HAWC, LHCb, Pierre Auger Observatory) [3-9], CERN [10] as an international laboratory and two associate members - the national laboratories DESY and GSI [11, 12]. The IPPOG principal aim is to maximize the impact of education and outreach efforts related to particle physics. It contributes to global efforts in strengthening the cultural awareness in the understanding and support of particle physics and related sciences, in raising scientific literacy in society, educating the public on the values of basic research and in developing and training the next generation of researchers, scientists and engineers. The individuals who are contributing to the collaboration work are active researchers with experience in education and public engagement, and experts in communication and education,

as well. IPPOG organizes many global activities like International Masterclasses, International Cosmic Days or World-Wide Data Days, supports international or local activities like exhibitions and public events, provides Web and Database outreach resources, and many others. More information and details might be found on the home page of the collaboration [1].

3. International Masterclasses

Every year, more than thirteen thousand high school students from all over the world are invited to universities and research institutes to participate in the International Masterclasses (IMC) with data from high energy experiments [13]. The classes are mainly dedicated to students between 15 and 19 years of age, with an interest in natural science disciplines. Students from about 60 countries have participated in the international masterclasses in 2023. Scientists from about 220 scientific institutes joined the classes as tutors. Special attention is also paid to the attraction of students from new countries [14].

Figure 1. Students taking part in IMC 2023, analyzing CMS data.

Over the course of a day, under the guidance of researchers, students become "scientists" who analyze real data, provided by the experiments. The students are taught in the basics of particle physics and depending on the class they rediscover particles such as the Z boson or J/psi or study the Higgs boson decays to photons op 4 leptons (CMS and ATLAS); they look for strange particles or study various properties of the quark gluon plasma (ALICE); investigate D0 decays (LHCb); or they are introduced to neutrino physics (MINERvA); learn more about the particle reconstruction and how to measure the quark colors (Belle II); study cosmic rays (Pierre Auger Observatory); or they learn more about the direct impact of fundamental research on medical applications within the Particle Therapy Masterclasses (GSI/FAIR). Class work allows the students to gain some knowledge about elementary particles while practicing familiar concepts such as the laws of conservation of energy and momentum. At the end of the day, up to 5 institutes from different countries participate in. a video-conference. The students talk to

CERN scientists and their peers from other countries, present and defend their results and take part in fun quizzes to reinforce their knowledge. This gives them the opportunity to experience a day in the life of a scientist, to feel the spirit of teamwork and, last but not least, to feel themselves significant and part of the global scientific effort.

4. Activities with cosmics

Another flagship activity of IPPOG are the projects for high school students exploring cosmic data. Astroparticle physics combines particle physics with astronomy observations and studies. Cosmic data experiments provide various opportunities for students to perform cosmic ray measurements and thus to discover the fascinating world of space exploration. The main activities are International Cosmic Day (ICD) which happens usually in the autumn and International Muon Week (IMW) in spring. More details about the organization can be found on the IPPOG Global Cosmic Rays Portal [15, 16].

The participation of the students in these classes gives them the opportunity to answer questions such as: What are cosmic particles and where do they come from; How can they be measured and what can be learnt from them. In the last few years more than 60 institutions from 23 countries have been joining regularly the ICD or IMW, where young people are supervised by scientists and teachers to study cosmic rays. During the classes the students perform various measurements such as a muon lifetime evaluation , time of flight of the particles or an estimation of the cosmic ray flux.

4. Conclusions

Education, communication and outreach are essential pillars for the development of high energy and particle physics. Many scientists and teachers, at different levels of commitment, are already bringing to the public the excitement of the field with many activities. Our field needs the support and contribution of all, either as a scientist or active teacher engaging the students or as an individual engaging friends and family. Many challenges are still ahead, such as increasing the reach of our activities in terms of geography, diversity, inclusion or age; and thus achieving a wider recognition of the value of fundamental science for the society.

References

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[7] HAWC (High Altitude Water Cherenkov Experiment): [https://www.hawc-observatory.org/]

[8] LHCb (Large Hadron Collider beauty Experiment): [https://www.home.cern/science/experiments/lhcb]

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