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IPPOG Global Cosmic Rays Portal: Making Cosmic Rays Studies available to schools worldwide

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IPPOG Global Cosmic Rays Portal: Making Cosmic Rays Studies available to schools worldwide

Barbora Bruant Gulejova on behalf of the IPPOG Collaboration

(a complete list of authors can be found at the end of the proceedings)

University of Bern, Sidlestrasse 5, Bern, Switzerland

barbora.gulejova@cern.ch

Abstract. The International Particle Physics Group (IPPOG) is a global network active in informal education and outreach in particle physics and related research, including cosmic-ray and astro-particle physics. Since many years, IPPOG has been actively supporting the International Cosmic Day organized by DESY and the International Muon Week organized by Quarknet. In 2015 IPPOG started work on establishing a universal portal through which successful cosmic-ray study programmes can reach out to teachers and students around the world. This common web platform is being developed by IPPOG in the frame of its new IPPOG web pages. It will contain all information for schools interested in taking part in cosmic-ray experiments and analysing real data in classroom; also instructions about how to build, borrow, or purchase cosmic-ray detectors. The platform will also facilitate collaboration and exchanges between the experiments' project managers and advertising of related events.

1. Introduction: Challenges of the particle physics community

Threatened financial support for large experimental endeavors, falling interest of young people to engage in studies of STEM, especially physics, and mistrust in science are the main challenges the scientific community is faced with currently. These are based on the misperception of science, especially physics and basic research in society. This attitude towards physics by non-scientific audiences is largely caused by the scarce exposure of society to modern physics, which is in most cases not included in school curricula. Introducing particle physics and related sciences to students and the public, while showing the current state of art of contemporary physics and bringing the understanding of the world we live in and its technologies, is of vital importance.

Before the update of physics school curricula is achieved, the science outreach and extra-curriculum activities are the only possibility to bridge the gap between contemporary scientific research and science education at schools and thus the awareness of modern science by society.

2. International Particle Physics Outreach Group

The International Particle Physics Outreach Group (IPPOG) has been making concerted and systematic efforts to present and popularise particle physics across all audiences and age groups for more than two decades by developing suitable methods, tools and activities. Today the scientific community has in IPPOG a strategic pillar to aid the fostering of long-term, sustainable support for fundamental research around the world.

The IPPOG's principal aim is to maximise 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. In particular, IPPOG's purpose is to raise standards of global outreach and informal science



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education efforts of particle physics, to communicate its results and findings to the public, to bring new discoveries in all areas of particle physics research to young people and to convey to the public that the beauty of nature is indeed becoming understandable from the interactions of its most fundamental constituents - the elementary particles.

Current IPPOG activities include the ever-growing and well-established International Masterclasses on Particle Physics programme [1], the outreach Resource Database [2], the Global Cosmic Rays experiments at schools platform currently in development [3], support for exhibitions and activities at public events and festivals (e.g. Colours of Ostrava in Czech Republic [4], Universal Science [5]), and different topical programmes and competitions targeting young and diverse audiences (like Particles4U [6], Girls, do Physics! [7], Creating Ambassadors for Science in Society [8], Cascade competitions in UK [9] and Slovakia [10] etc...). These diverse activities allow IPPOG to bridge the gap between science education at school and modern scientific research by inspiring, motivating and educating an especially young audience, offering hands-on experience and connecting physics to real life while using cutting edge technologies.

3. IPPOG Global Cosmics

Global Cosmic Rays Studies are at heart of IPPOG since several years, and recently have been established as a second IPPOG's main activity, after the International Masterclasses, the flagship activity since the beginning of the IPPOG's history. "IPPOG Global Cosmics" aim is to establish the global common web-platform for all existing succesful cosmic rays studies programmes available for students and teachers around the world.

3.1. IPPOG and astroparticle physics

IPPOG's physics scope is broad, including not only particle physics, but also related sciences. This means, that its expertise goes beyond LHC physics and other subjects, like neutrinos, astroparticle physics, gravitational waves, heavy ions etc. Cosmic rays studies represent considerable added value for particle physics outreach, as they allow to establish the connection with real life and even curriculum in more straightforward way, compared to other more abstract subjects. Everybody sees the stars and therefore it is relatively easy for the public to grasp the idea that particles are falling on us from the cosmos. This makes cosmic rays studies more "tangible". It allows to establish the understanding, that we are all made of particles, particles are everywhere, and they are showering on the Earth all the time in form of cosmic rays. Therefore detecting and analysing these showers by schools, using the detectors and analysis tools especially designed for educational purposes but using real data, also the data measured by big projects, have a big success.

Much of our early understanding of particle physics came from the study of cosmic rays [11]. The subsequent discoveries of massive fundamental particles in addition to the lighter, stable collection in the existing models motivated physicists to develop accelerators and detectors, eventually leading to the large-scale programmes that define the field today. Fortunately, construction and operation of the instruments needed to detect and make simple measurements of cosmic rays can be straightforward and inexpensive, making them excellent tools for the classroom. Students learn basic particle physics concepts and methods, while learning how to set up experiments, operate hardware, take data and perform analysis. As a result, cosmic ray experiments, employing a variety of detector types, have been installed in classrooms around the world. Many of these have been connected together into networks, allowing students to share data and to produce scientific results in a manner similar to our much larger-scale international collaborations.

In order to better exploit the great potential of cosmic-ray experiments for particle physics outreach, IPPOG launched an effort to create a common umbrella for these separate programmes and create a common global cosmic rays studies online portal. IPPOG has been actively supporting and promoting International Cosmic Day (ICD) [12] organised by DESY and International Muon Week [13] organised by Quarknet on yearly basis. Through the new Global Cosmics portal, IPPOG wants to reach out to even more students worldwide and give the possibility to perform the experiments and analysis during the whole year long.

3.2. History: From idea to new global online portal

Following the ASPERA meeting on cosmic ray detectors for education held at CERN in 2010, several high school cosmic ray project representatives expressed an interest in working together to develop a common website and data format so that teachers and students worldwide, with or without a detector, could design and conduct studies using data from one or more projects. At the April 2015 IPPOG meeting, a panel representing five of the original cosmic ray projects (COSMIX, Extreme Energy Events, HISPARG, QuarkNet and Teilchenwelt Netzwerk) presented a brief overview of their projects and discussed renewing collaboration talks. IPPOG members made a number of suggestions and expressed an interest in participating if the initiative goes forward. In the meantime, Hans Peter Beck and Marge Bardeen had discussed a possible partnership between IPPOG and APPEC with APPEC representatives, who expressed an interest for collaboration. The efforts and strategic discussion how to kick-off the project continued during the several panel discussions on Global Cosmic Rays collaboration at following IPPOG meetings.

In February 2017 a 2-days “Workshop on High School Cosmic Ray Experiments” was organised by IPPOG at the Centro Fermi in Rome, bringing together experts from a global spectrum of cosmic-ray related educational activities.. Around 25 different programmes were presented and the willingness to continue collaboration was expressed by most of them. Valuable experiences and experimental fact-sheets were shared, the information and data sharing were discussed and student’s analysis of data showcased. IPPOG has demonstrated its important role as a community builder and collaborations enabler. Indeed, the aspect of bringing people together allowed IPPOG to identify those participants of the workshop who are willing to provide their experiments, results and data for educational purposes. There are several projects around the world that address young people and teachers, to give them the opportunity to explore cosmic particles. These include projects from Finland, France, Germany, Italy, Poland, Russia, Spain, Sweden, Taiwan, UK and the US. They have been preliminarily summarised at the ICD website [14]. The workshop also resulted in creating an IPPOG Global Cosmics Steering Group, the goal of which is to develop and promote worldwide activities, connecting classrooms through their cosmic ray studies (see overview of the Global Cosmics programme in [15]). The decision has been taken to build the Global Cosmic Studies Educational Platform as part of the new IPPOG website (see below) and development of IPPOG new online portfolio started soon after.

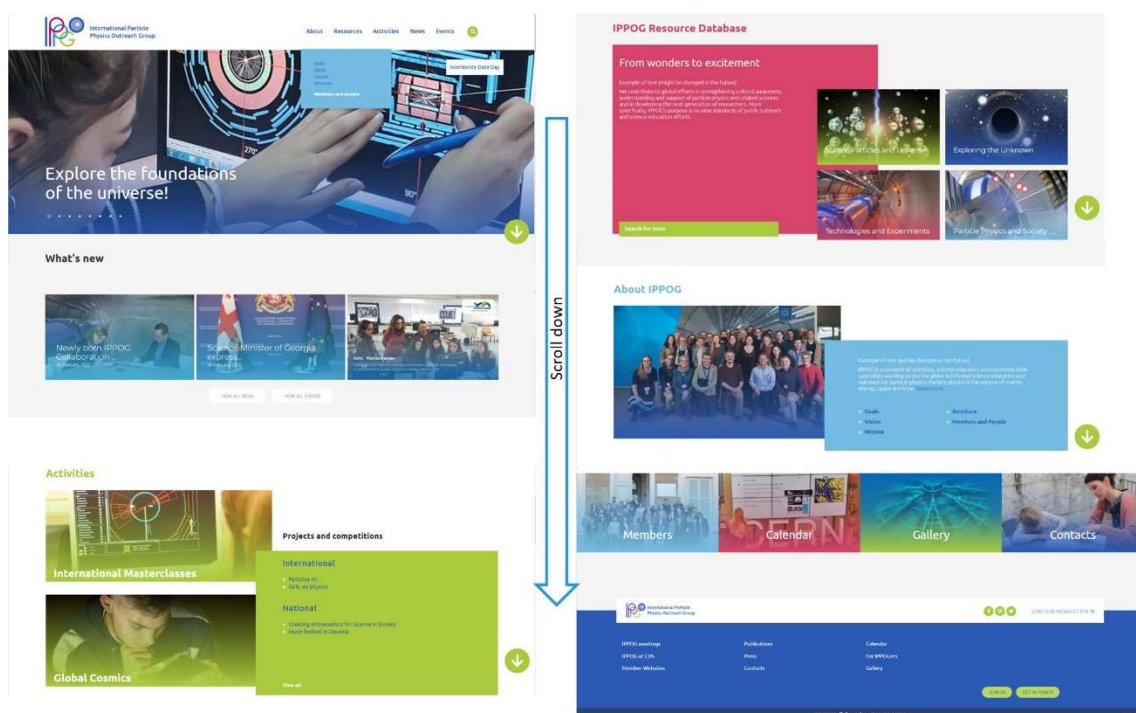


Figure 1: New IPPOG website in development. Global Cosmics Portal is accessible from the main menu on the top (submenu of “Activities”) and also directly from Frontpage (see green part).

3.3. IPPOG new website

Since 2018, IPPOG embarked on an ambitious project to improve the user experience across the IPPOG digital portfolio (website and social media channels) and to strengthen the IPPOG brand online by creating a new website including a new Resource Database and new Global Cosmics Platform. The goal of the new design is to greatly broaden the audience type and use of the web pages and available resources. The visual impact needs to be enhanced in order to pursue IPPOG's mission and communicate its messages to its existing and new audiences, as well as new potential members, partners and sponsors. IPPOG wants the new website to become more open to students, teachers and the general public.

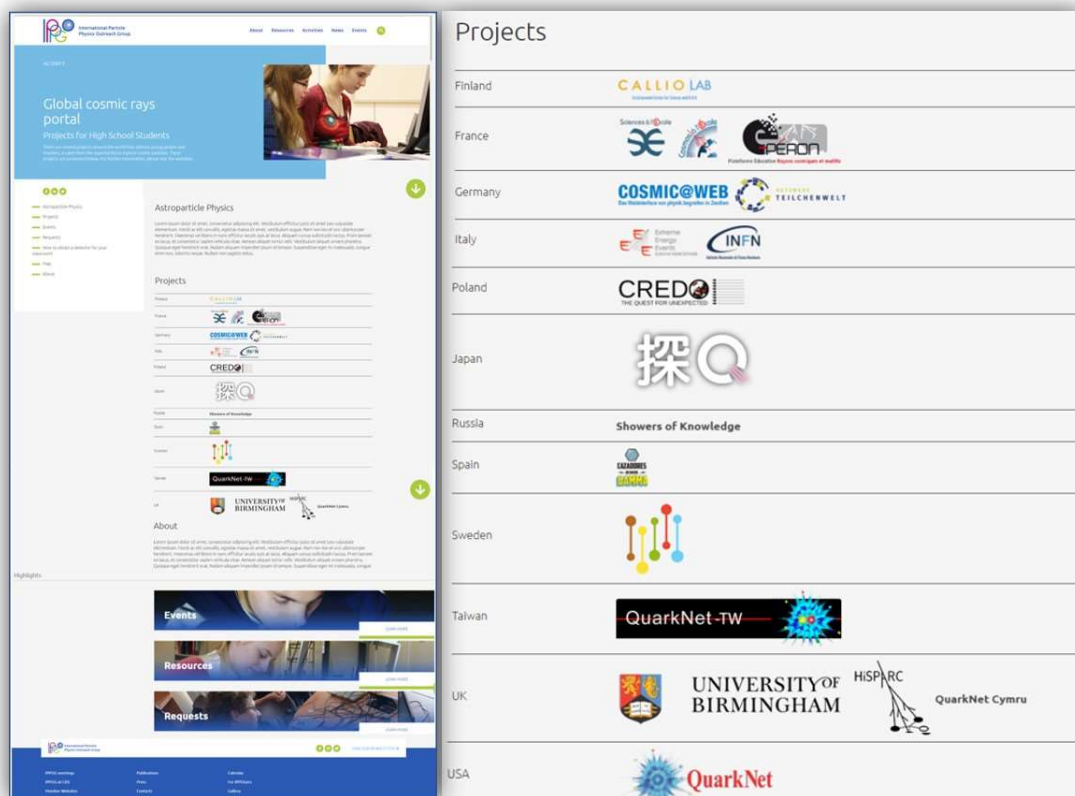


Figure 2: Global Cosmics Portal website under the development. Right: Overview of projects.

3.3.1. IPPOG new Global Cosmic Rays Platform.

The idea is to establish a 'universal' portal through which successful cosmic ray studies programmes can reach out to teachers and students around the world. This common webpage on cosmic rays will contain information on astroparticle physics for lay audience, list of all projects, each with dedicated entry webpage with description and links, world map and list of events with possibility to request information, to join etc. The website will also offer the resources, including background information, data, analysis tools and educational framework for students' investigations. Teachers and students will learn how to build, borrow or purchase a detector for use in the classroom and translations are also envisaged. The goal is that every teacher around the world can do cosmic ray studies, get a detector for his/her school either for little money or for free and get also all the instructions and necessary guidance – through the help of IPPOG's national experts even in their language.

3.3.2. IPPOG Resource Database

One of the main tools IPPOG has been offering the scientific community, teachers and educators for almost ten years is the Resource Database (RDB), an online platform containing a collection of high quality engaging educational and outreach materials in particle physics and related sciences. In the last few years IPPOG has been investing considerable efforts in redesigning the RDB with the aim for it to become the primary source of particle physics outreach material in the world. IPPOG RDB is a collection of high quality engaging materials (e.g. videos, posters, talks, hands-on activities, tools, brochures and more) recommended by IPPOG representatives and contributors to help sharing the wonders and excitement of particle physics with teachers, students and the general public. The information available is regularly updated to reflect the latest discoveries in particle physics. Everything is freely available with the spirit of open access. The items are submitted to the database by IPPOG representatives, members of IPPOG Forum and group of trusted contributors. The IPPOG RDB is an ideal place for educational and outreach materials also for the astroparticle physics community, which is encouraged to submit the resources once the new website including RDB will be published.

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Full Authors List: International Particle Physics Outreach Group

Note: IPPOG Collaboration members are countries, international experiments and international laboratories. The decision-making body, Collaboration Board is composed of the representatives of IPPOG members. IPPOG Coordination Team comprises IPPOG co-chairs, IPPOG Staff, and Projects Coordinators. Both IPPOG Coordination Team and IPPOG Collaboration Board are listed below in alphabetical order. In the brackets after the names are not the affiliations, but the IPPOG member the person is representing or his/her function in IPPOG. Not listed are the members of IPPOG Forum, which is composed of experts contributing to IPPOG in different ways (see <https://ippog.org>).

Ana Godinho (CERN), Alberto Ruiz Jimeno (Spain), Alexander Sharmazanashvili (Georgia), Andrej Gorišek (Slovenia), Anita Bens (IPPOG Coordination team), Barbora Bruant Gulejova (IPPOG Strategic Development Lead), Bolek Pietrzyk (LHCb), Carolin Schwerdt (IPPOG Global Cosmics Coordinator), Catia Peduto (Italy), Charles Timmermans (Netherlands), Christian Klein-Bösing (Germany), Darren Price (United Kingdom), Despina Hatzifotiadou (ALICE), Dezső Horváth (Hungary), Dirk Ryckbosch (Belgium), Eduh Duchovni (Israel), Farid Ould-Saada (Norway), Freya Blekman (CMS), Gabriel Stoica (Romania), Ian Bearden (Denmark), Ivan Melo (Slovakia), Ivana Lagator (Montenegro), Jonas Strandberg (Sweden), Jonivar Sküllerud (Ireland), Jose Ruben Alfaro Molina (HAWK), Katharina Müller (Switzerland), Ken Cecire (IPPOG International Masterclasses Coordinator), Krzysztof Wozniak (Poland), Marcelo Munhoz (Brazil), Natascha Hoermann (Austria), Nicholas Tracas (Greece), Nicolas Arnaud (France), Paul Jackson (Australia), Pedro Abreu (IPPOG Co-chair), Ralf Averbeck (GSI), Ricardo Goncalo (Portugal), Roumyana Mileva Hadjiiska (Bulgaria), Sabine Hemmer (IPPOG Global Cosmics Coordinator), Sahal Yacoob (South Africa), Sami Lehti (Finland), Sascha Mehlhase (ATLAS), Spencer Pasero (USA), Steven Goldfarb (IPPOG Co-chair), Thomas Naumann (DESY), Uta Bilow (IPPOG International Masterclasses Coordinator), Vojtech Pleskot (Czech Republic), Zdenek Dolezal (Belle II)