

The IPPOG Resource Database: Making particle physics outreach & education available worldwide

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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 outreach for particle physics. Members initiate, develop and participate in a variety of activities in classrooms, public events, festivals, exhibitions, museums, institute open days, etc. The IPPOG Resource Database was designed to provide a central location hosting written and multimedia material, tools, recipes, and other content to serve these activities. Objects in the database are categorised by language, target audience, age group, media type, and physics topics. Current efforts include porting the database to the new CERN web infrastructure and improving the interface to serve a public audience. We present our efforts to update procurement and categorisation of educational content, in addition to implementation of a redesigned user interface.

1 Introduction

Education and outreach is an important pillar of every scientific process. It serves to build a society that is excited by science, values its importance and supports scientists. Therefore, there is a pressing need for high quality engagement with society on all levels. This involves triggering the curiosity of younger generations about the world around them to inspire them to study scientific subjects and work in research and scientific careers. It is also important to engage with society, in a broader sense, because well-informed citizens can make better choices in life.

International collaborative efforts are essential to tackle these challenges. One such collaboration that plays a key role in education and outreach in High Energy Physics (HEP) is the International Particle Physics Outreach Group (IPPOG) [1].

IPPOG is a network of scientists, science educators and communication specialists working across the globe in the field of informal science education and outreach for particle physics. The collaboration comprises 33 members representing 26 countries, 6 experiments and CERN as an international laboratory.

The diversity of IPPOG members' cultural and educational backgrounds brings a large and important variety of skills to the table, allowing for the effective development of novel methods of explaining scientific concepts that have a potential to spread across the globe.

In this document, we present an overview of IPPOG's "raison d'être" and its growing commitment to foster science dissemination by building a platform to facilitate the exchange

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of particle physics education and outreach resources across the globe. We describe the organisation's history and current status, as well as expected future expansion.

2 IPPOG's mission and goals

The mission of IPPOG is "to maximize the impact of education and outreach efforts related to particle physics around the world". [2] This happens mainly through information exchange and sharing of expertise.

IPPOG's researchers and educators work jointly:

- to improve public understanding and appreciation of the benefits of particle physics and fundamental research
- to spark interest and enthusiasm in Science Technology Engineering Mathematics (STEM) among young people
- to help teachers and science explainers spark curiosity about science by providing them with the best material to use in the classroom and beyond
- to build people's trust in publicly funded research
- to establish commitment of key stakeholders and policy makers, throughout Europe and the world, for the future large-scale projects of particle physics community

The expertise needed to address these goals goes beyond the capabilities of any one institution or nation. It requires a world-wide effort, involving international teams of researchers, engineers and technicians working together, each bringing their own expertise. It is this heterogeneous combination of expertise and diverse points of view that allows for the effective development of outreach activities with maximal impact. Different backgrounds of IPPOG members bring a large and important variety of skills to the table. This allows for the effective development of novel education and outreach activities and tools.

3 IPPOG Activities

3.1 IPPOG International Masterclasses (IMC)

International Physics Masterclasses (IMC) is a flagship activity of IPPOG, offering students the chance to experience modern science first-hand. Since 2005, high-school students in countries around the world have been invited to a nearby university/laboratory for a day in order to take part in an authentic research process. They analyse data from a variety of experiments (including those of the LHC), under the direct supervision of scientists that are active in research. As "scientists for a day," the students learn the fundamentals of the field, the scientific process, and the methods that are utilised in headline-making discoveries. At the end, like in a real international research collaboration, the participants join a video-conference hosted at CERN or Fermilab to combine and discuss results and ask questions. The programme continues to broaden; special versions of IMC were developed recently, such as the International Day of Women and Girls in Science Masterclasses (IMC engaging young women in science) and Worldwide Data Day.

3.2 Festivals and public events

IPPOG members are involved with the organization of various festivals and events held in their countries. Some of these events permit to reach non-traditional public, for instance music festivals provide an extraordinary opportunity to explain science to those who would very likely never approach scientists on their own. Hence, these festivals are an opportunity

for them to learn about science and particle physics. Examples of such public events are Colours of Ostrava (Czech Republic) [3] and Universal Science (Bulgaria 2018 and Australia 2019) [4].

3.3 Competitions

3.3.1 IPPOG Competition Particles for You (P4U)

In 2016 IPPOG launched a competition [5], sponsored by the European Physical Society, challenging primary and secondary students and teachers to use their creativity to help IPPOG bring the thrill of particle physics to the world and to teach the rest of the world how particle physics is everywhere and how it affects our lives in many ways. The task was to create an educational, fun, and inspiring tool showcasing how elementary particles are present in our everyday lives.

3.3.2 Cascade Competitions

Cascade Competitions invited high school students to submit 15-minute presentations of their physics projects. Winning teams presented in front of up to 500 people including their parents, friends, school etc. This competition was first presented in IPPOG by the representative of UK [6] and later was organised by Slovak representative in Slovakia [7] with lasting tradition.

3.4 Social media campaigns and more

One of the first social media campaigns that IPPOG has introduced was “Girls, do physics!”. [8] Focused on Instagram, the campaign aimed at inspiring girls to become interested in and study physics and related Science Technology Engineering and Mathematics (STEM) subjects.

Many other activities were originally organised in one country and have been spread around the world thanks to IPPOG.

4 IPPOG Resource Database - making particle physics education and outreach available worldwide

As CERN’s then Director General Chris Llewellyn Smith explained in September 1997 at the first-ever IPPOG (called EPOG at that time) meeting, “the particle physics community has a moral obligation to inform the public on its activities. To do this well”, he explained, “experiences must be shared among countries in view of the need to optimize the use of resources.” [9]

IPPOG began primarily as an information exchange forum between science institutions and laboratories, with a view to fostering outreach initiatives; members held two meetings per year to give briefings on countries’ activities. Communication between members has encouraged idea sharing. Yet IPPOG members wanted to go further, to strengthen outreach on a global scale. With this in mind, to extend the reach of IPPOG-driven outreach programmes, the concept of a database was born.

In response to the group’s desire to foster exchange of replicable education and outreach activities, IPPOG started working on the development of a resource database. While the activities were driven by individual countries, the database [10] was created to facilitate access to those resources freely.

The concept of an online platform for sharing the wealth of resources available through IPPOG representatives was first proposed at the October 2009 EPPOG meeting at CERN. Consequently, the first version of the Resource Database was released in 2011.

4.1 Target audience

Specific effort was directed at creating a design that would be appealing to a broad range of stakeholders. For instance, supporting other particle physicists, teachers, informal science educators, and explainers across the globe, was a primary goal for the initiative. Secondary target audiences included students, general public, decision makers and funding bodies.

The majority of users were expected to seek the material in support of their own particle physics outreach projects and inspiration, extra-curricular activity, lesson plans or projects for the classroom. Others would be students seeking material or activities in particle physics complementary to what they are being taught in school. The database would also contain material for young generation students; to inspire them and motivate to study STEM subjects. The rest of users were expected from: general audience, IPPOG stakeholders and decision makers, who would find the basic information about the IPPOG collaboration, its mission, vision, structure, activities, resources and materials, news etc.

4.2 Development phases

4.2.1 Phase 1 – important technical specifications

One of the biggest challenges for the database was to provide an easy to use tool. For instance, to design it in a way to allow the users to easily navigate between different types of material, where some consist of comprehensive outreach campaigns, while others point to single products, activities or events that communicate a specific message to a defined target audience.

This was addressed by building an extended menu, allowing users to browse by category, country, outreach tools, target audience or language.

4.2.2 Phase 2 – review and re-design

With a view to create a tool that addresses needs of its primary audience, teachers and education professionals, in 2017 IPPOG worked closely with a group of teachers to review the existing content and the functionality of the database.

As a consequence, two groups of high-school teachers attending the High School Teachers (HST) Programme at CERN [11] helped to curate categories, determine the structure and the interface, procure the content and rework storage and workflow. Among the most required changes was a simplification of the user interface in order to diminish large number of categories, item types and audience types to new simpler ones [**Figure 1**].

TOPICS: From 44 to 16

1) MATTER, PARTICLES AND UNIVERS (KNOWN PHYSICS)
 PARTICLES AND THEIR INTERACTIONS
 COSMOLOGY
 HIGGS
 ANTIMATTER
 QUARK-GLUON PLASMA
 NEUTRINOS

2) EXPLORING THE UNKNOWN (BEYOND KNOWN PHYSICS)
 SUPERSYMMETRY
 DARK MATTER
 DARK ENERGY
 EXTRA DIMENSIONS

3) TECHNOLOGIES and EXPERIMENTS
 ACCELERATORS
 DETECTORS

4) PARTICLE PHYSICS AND SOCIETY
 WHY FUNDAMENTAL RESEARCH
 INTERNATIONAL COLLABORATION
 APPLICATIONS & SPIN-OFFS
 PEOPLE BEHIND THE SCIENCE

ITEM TYPES /CATEGORIES: From 41 to 10

Photos/ Posters/ Charts
 Videos
 Animations / Simulations
 Presentations (ppt,pdf)
 Games
 Classroom materials / Tutorials / Lesson plans / Text books
 Books
 Projects / Competitios
 Exhibition items
 Souvenirs (could go also to separate item on the website)

FILTERING / SEARCH BY: From 6 to 4

1) Topic (see above = 17)
2) Type / Category (see above)

3) Language

- Arabic
- Catalan
- Chinese
- Czech
- Danish
- Dutch
- English
- Finnish
- French
- German
- Greek
- Hungarian
- Japanese
- Norwegian
- Polish
- Portuguese
- Romanian
- Russian
- Serbian
- Slovak
- Slovenian
- Spanish
- Swedish
- Turkish

4) Audience

- Primary school level
- Lower secondary school level
- Upper secondary school level
- Broad public
- Educators

5) Keyword
We should think first carefully how to address keywords, if we can manage to be coherent or not...otherwise could be confusing, like CDS

Additional tag will be added to all items in database to sort out and show the resources by their **quality** (IPPOG recommended, good, old but still ok)

Figure 1. New IPPOG Resource Database categories

These guidelines were greatly appreciated later on, when in 2019 IPPOG embarked on a project to improve the user experience across its digital portfolio to strengthen the IPPOG brand online. This included re-design of the IPPOG website and the database. A new design for the IPPOG website was proposed and the database profited from it [Figure 2].

CERN Accelerating science Sign in Directory

ACTIVITIES

MEMBERS

RESOURCES

IPPOG RESOURCE DATABASE

From wonders to excitement

We contribute to global efforts in strengthening cultural awareness, understanding and support of particle physics and related sciences and in developing the next generation of researchers. More specifically, IPPOG's purpose is to raise standards of public outreach and science education efforts.

Search for more

Particle Physics and Society

Matter, Particles and Universe

Exploring the Unknown

Technologies and Experiments

Figure 2. New IPPOG Resource Database design, proposed in 2019.

4.3 Technical specifications

4.3.1 Drupal

The new IPPOG website and the database will be based on a common platform for all CERN websites - Drupal 8. It is an open-source platform with a large community supported by CERN IT. Technical specifications for the new site were drawn up in February, 2019 [12].

4.3.2 Storage

All resources/contributions collected in the database will be stored at CERN Document Server (CDS) [13] which will provide to the user the interface to upload the files. Its use will keep the IPPOG website “light”, easy and quick to load. In addition, storage of files at CDS provides a sustainable solution, in case of future migration to new versions of Drupal or other systems. New CERN Drupal 8 themes and components provide integration with CDS; images and videos from CDS are automatically embedded onto CERN-hosted websites.

4.3.3 Tags

A new tag was proposed by HST who reviewed the database in 2018. Teachers recommended to include the link to the high school physics curriculum, so that they would immediately see where the resource can be used in the classroom, given that particle physics is not included in most of the school curricula.

It was also proposed to tag the resources by their quality, so that the best ones appear as first ones in the search results. It was discussed that IPPOG admins could decide which is the “evergreen content” or the rating could be done by users directly (stars).

4.3.4 Search

The search mechanism was also reviewed in order to design it in the most user-friendly way. See the proposal by IPPOG in the Figures 3 and 4 below. The main idea is that one can search by a filter (located on the left), but also use the quick search by topics located in the middle, while at every step there is a possibility to refine the search using the filter on the left, which always remains in view.

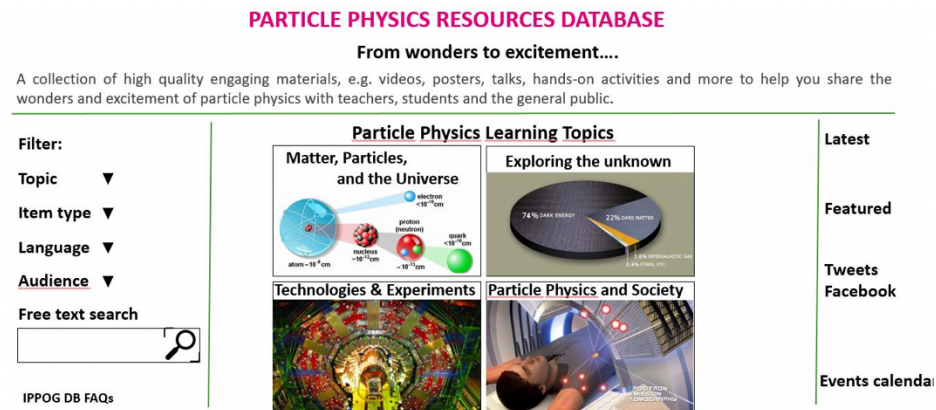


Figure 3. Proposal on how to search in the IPPOG Resource Database

PARTICLE PHYSICS RESOURCES DATABASE
Matter, Particles, and the Universe

Intro Text of what **Matter, Particles, and the Universe** is all about. [The picture here on the right](#) appears so that one knows that he/she is in Matter, Particles and Universe section.

Filter:

Topic ▼

Item type ▼

Language ▼

Audience ▼

Free text search

[IPPOG DB FAQs](#)

| | | |
|--|------------------------------|------------------|
| Particles and their interactions THE STANDARD MODEL matter particles quark particles lepton particles scalar particle(s) | Cosmology Big Bang | Higgs |
| Quark-Gluon plasma | Antimatter | Neutrinos |

Latest

Featured

Tweets

Facebook

Events calendar

Figure 4. What you see when you click on “Matter, Particles and Universe”

5 Conclusions

Bringing science closer to everyday lives is vital to building well-rounded society members. The IPPOG Resource Database addresses this challenge by providing a source of outreach material on particle physics for science explainers across the globe.

One of the IPPOG aims for 2020 is to strengthen its brand online. The redesigned IPPOG website and the improved database will see daylight. New functionalities will enable easy access to the tools. These materials will hopefully be adapted to new needs and contexts and will help share the wonders and excitement of particle physics worldwide.

IPPOG aims for the database to be more open to students, teachers, and the general public, and for it to become the primary source of particle physics outreach material in the world. The new branding will be reflecting this spirit, values and the mission of IPPOG – to bring the beauty of particle physics to society.

References

1. International Particle Physics Outreach Group, <http://ippog.org/>
2. IPPOG Collaboration, *Future Challenges in Particle Physics Education and Outreach*, (18 December 2018)
https://indico.cern.ch/event/765096/contributions/3295747/attachments/1785273/2906293/EPPSU_IPPOG_final.pdf
3. <https://www.colours.cz/>
4. Universal Science, <https://universalscience.web.cern.ch/>
5. Particles4U, <http://ippog.org/particles4u>
6. Cascade Competitions UK,
<https://www.birmingham.ac.uk/schools/physics/outreach/secondary-schools/cascade.aspx>
7. Cascade Competitions Slovakia, <https://fyzika.uniza.sk/cascade/>
8. Girls, do physics !, <https://ippogorg.wixsite.com/girlsdophysics>
9. L. McCarthy, M. Kobel, D. Barney, *EPPOG → IPPOG: An Evolution of Particle Physics Outreach* (14 October 2010),
https://indico.cern.ch/event/107976/contributions/1309725/attachments/24972/35951/EPPPOG_IPPOG_MKandLMandDBv4.pdf

10. IPPOG Resource Database: <http://ippog.org/resources>
11. CERN High-School Teachers Programme, <https://teacher-programmes.web.cern.ch/>
12. B. Bruant Gulejova, *New IPPOG Website Design and Development Technical Specification*, February 2019, <https://cds.cern.ch/record/2719227>
13. CERN Document Server (CDS), <http://cds.cern.ch/>