

IPPOG Resource Database

Making Particle Physics outreach & education available worldwide

On behalf of IPPOG Collaboration

Barbora Bruant Gulejova

Strategic Development and Communications Lead, IPPOG



Outline

- ❑ Why outreach in particle physics and related sciences matters?
- ❑ IPPOG - strategic pillar for worldwide outreach
- ❑ What IPPOG offers to teachers
- ❑ Resource Database (RDB)
 - What? Who for?
 - Development of new RDB
- ❑ IPPOG Global Cosmic Studies Portal
- ❑ Invitation for audience to take part!

Challenges of particle physics / science community

Main challenges of scientific community

- ❑ Challenged financial support of large experimental endeavours
- ❑ Falling interest of young people to study physics and STEM
- ❑ Mistrust in science

Reasons

- ❑ Misperception of physics / science in society – complicated, abstract, disconnected from real life
- ❑ Lack of awareness and understanding

Why is physics & basic research misperceived?

Scarce exposure of society to modern physics

- ✓ School curricula – mostly no modern physics
- ✓ Media – misinformation and disinformation

Cell phones and computers were sewn into reality thanks to fundamental science.

Despite this:

Most students finish high school believing that there are only:

- 3 elementary(?) particles (electron, proton, neutron)
- 2 types of forces (gravitational and electromagnetic)

Why exposure of society to modern physics matters?

Exposure to modern physics, like particle physics and its technological applications, like medical applications, sensor technologies, space applications, www, ... **increases the interest of students in physics** and their perception of its role in society and sustainable development.

Study in Germany and UK:

General interest in physics at schools has increased strongly thanks to inclusion of extra-curriculum activities in particle physics (exhibitions, Physics Masterclasses, teaching)!

Teaching contemporary natural science/ physics leads to understanding of:

- ✓ scientific method
- ✓ high financial and personal investments to large experiments, as LHC
- ✓ media misinformation

European Particle Physics Strategy Update

CERN-ESU-014



Exploring the fundamental properties of nature inspires and excites. It is part of the duty of researchers to share the excitement of scientific achievements with all stakeholders and the public. The concepts of the Standard Model, a well-established theory for elementary particles, are an integral part of culture. **Public engagement, education and communication in particle physics should continue to be recognised as important components of the scientific activity and receive adequate support. Particle physicists should work with the broad community of scientists to intensify engagement between scientific disciplines. The particle physics community should work with educators and relevant authorities to explore the adoption of basic knowledge of elementary particles and their interactions in the regular school curriculum.**

Importance to update physics curricula is now officially recognised by full particle physics community



Environmental and
societal impact

IPPOG Resource Database

International Particle Physics Outreach Group



- ✓ Outreach
- ✓ Informal education
- ✓ Extra-curricula activities

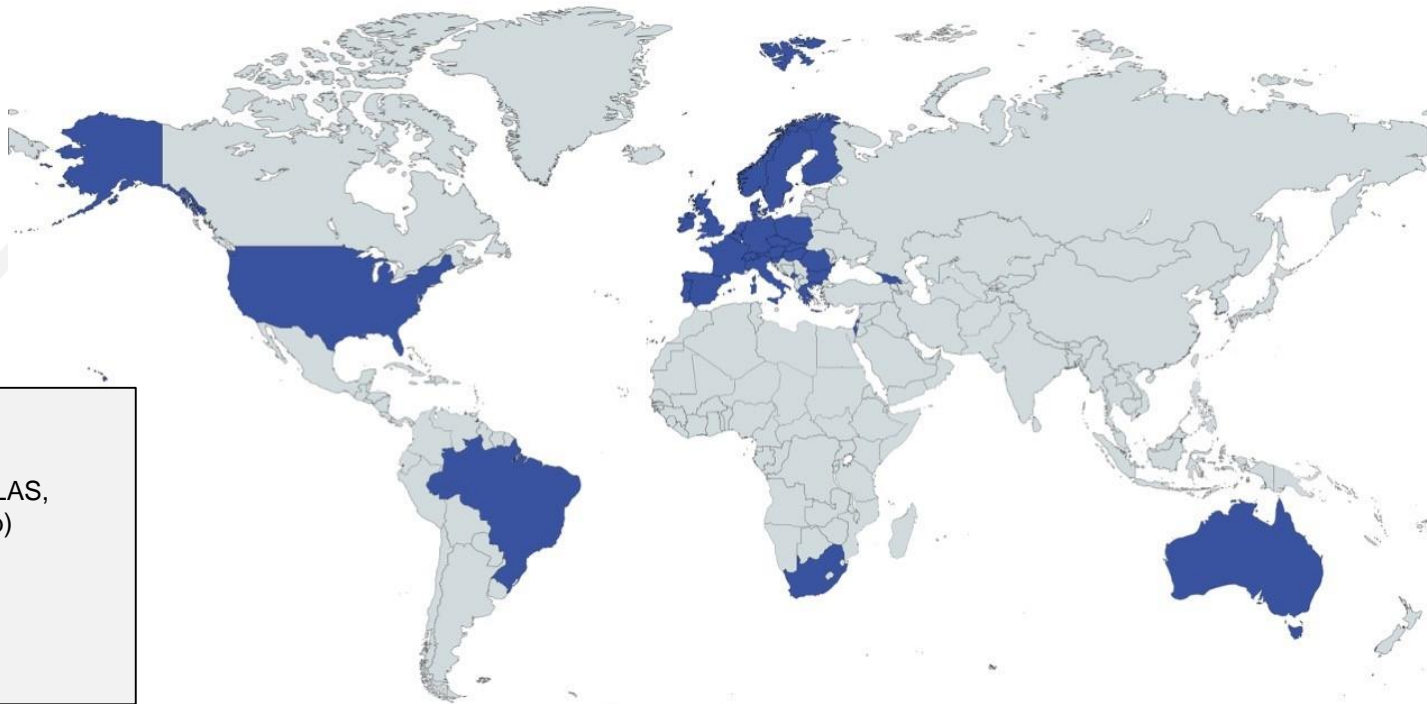
The way to bridge the gap between contemporary science and school education and increase appreciation of science by society

The International Particle Physics Outreach Group (IPPOG) has been making concerted and systematic efforts to present and popularise particle physics and related sciences across all audiences and age groups since almost 25 years.

Today, **scientific community has in IPPOG a strategic pillar** in fostering long-term, sustainable support for fundamental scientific research around the world.

IPPOG: Global Network & Scientific Collaboration

- Asia
- Africa
- Australia
- Europe
- The Americas
- International Labs and Collaborations



37 Members:

- 30 Countries
- 6 Collaborations / Experiments (ATLAS, ALICE, Belle II, CMS, HAWK, LHCb)
- 1 International Lab (CERN)

2 Associate Members:

- 2 National Labs (DESY, GSI)

IPPOG Collaboration

International Scientific Collaboration

- Active Researchers with Experience in Education & Outreach
- Experts in Communication & Education

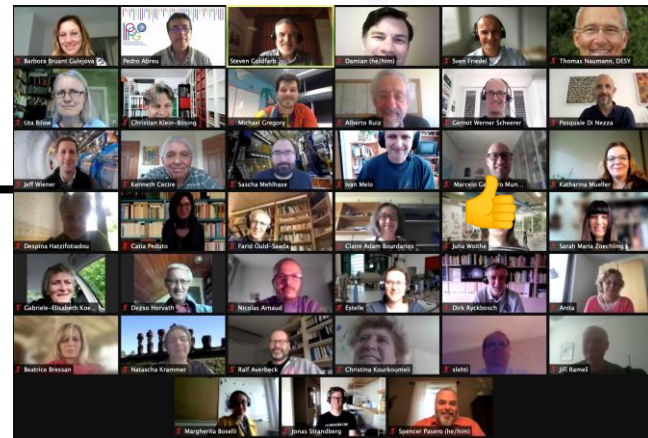
Mission

- **Establish Understanding** of scientific process
- **Instil Appreciation** of fundamental research and importance of evidence-based reasoning
- **Build Trust** with communities
- **Inspire Next Generation** of scientists

Organise Global Activities **for teachers!!**

Support Local Activities

- Sharing of expertise, best practices, resources to support events, kick-start activities



IPPOG meeting, May 2021

Activities with global reach

International Masterclasses in Particle Physics

- Flagship activity for high-school students (15–18 y.)
- **Become a physicist for a day!**
- Real Data from ATLAS, CMS, ALICE, LHC-b, Belle-II, MINERvA, Hadron therapy

Worldwide data Day

Global Cosmics: online portal! **NEW!**

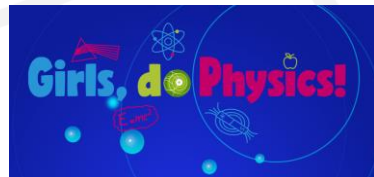
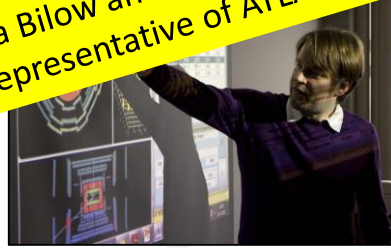
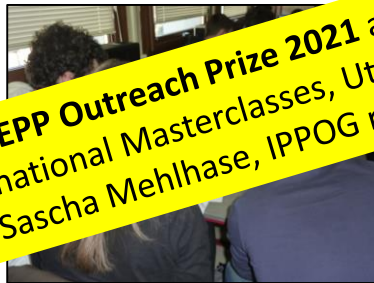
- Network of Cosmic Rays Projects for Schools
- International Cosmic Day and International Muon Week

Resource Database **NEW!**

- Primary source of particle physics outreach material in the world

... and many other projects, competitions, campaigns and activities...

EPS HEPP Outreach Prize 2021 awarded to coordinators of International Masterclasses, Uta Bilow and Ken Cecire and Sascha Mehlhase, IPPOG representative of ATLAS exp.



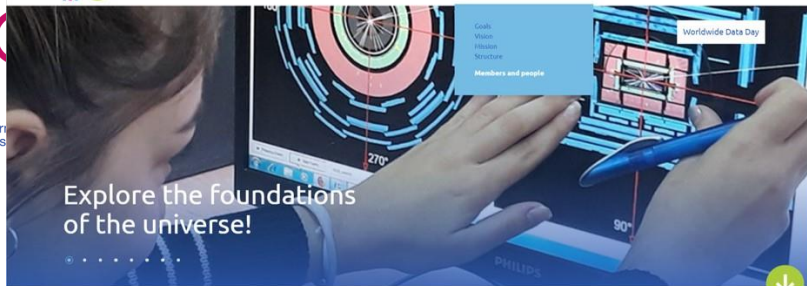
IPPOG Website & Resource Database

IPPOG is an ideal platform for:

- *sharing, developing and improving*
- *explanatory and teaching materials, strategies, methods, activities and tools*
- *“IPPOG wants the new website to become more open to students, teachers and the general public, and for the RDB to become the primary source of particle physics outreach material in the world.”*

IPPOG

- *improve the user experience across the IPPOG digital portfolio*
- *strengthen IPPOG online presence by creating a **new website including a new RDB***
- *greatly broaden the audience type and use of the webpages & available resources*



What's new



VIEW ALL NEWS

VIEW ALL EVENTS

Activities



Project

View all

Scroll down

New IPPOG website under development
Coming soon!
Will replace current ippog.org in 2022!

IPPOG Resource Database

From wonders to excitement

Example of text (might be changed in the future)
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

About IPPOG



Example of text (will be changed in the future)
IPPOG is a network of scientists, science educators and communication specialists working across the globe in informal science education and outreach for particle physics. Particle physics is the science of matter, energy, space and time. Read more.

- Goals
- Vision
- Mission
- Structure
- Members and People



IPPOG International Particle Physics Outreach Group



JOIN OUR NEWSLETTER

IPPOG meetings
IPPOG at CDS
Member Websites

Publications
Press
Contacts

Calendar
For IPPOGers
Gallery

JOIN US

GET IN TOUCH

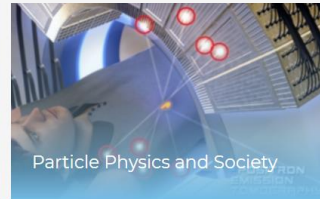
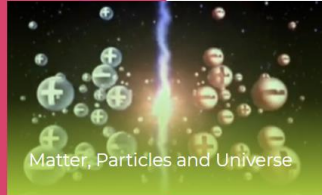
IPPOG Resource Database

IPPOG Resource Database

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Search for more



Targeted for:

☐ Teachers

classroom materials,
lesson plans,
videos, presentations,
games...

☐ Scientists doing outreach!

Inspirational materials...

- *Idea born in 2009: transformation of EPPOG (forum" to a possible world leader in informal science physics and related fields: IPPOG.*
- *Initially "EPPOG Best Practice Database" merged and laboratories for outreach and informal science*
- *self-sustaining, users vote on highest quality &*
- *First version released in 2011*
- *Today about 370 resources collected over last*



New IPPOG Resource Database is / will be...

- *online platform to facilitate the exchange of particle physics education and outreach resources across the globe*
- *collection of high-quality engaging materials (e.g. videos, posters, talks, hands-on activities, tools, brochures and more)*
- *content recommended by experts*
- *to share wonders and excitement of particle physics with teachers, students and general public*
- *readily understandable and regularly updated to reflect the latest discoveries in HEP*
- **Primary source of HEP outreach material in the world**

New IPPOG Resource Database

REVIEW and REDESIGN of Resource Database

- Several years of discussions, efforts and feedback
- New improved Resource Database proposal in 2017
- Intense collaboration with high school teachers



“IPPOG Friends” group created!

Teachers & educators worldwide!

JOIN!

Contact: barbora.gulejova@cern.ch

- Broaden audiences
- Improve functionality and user-friendliness for both users and contributors
- Simplify categories
- Full coverage of relevant topics
- Keep the content up-to-date
- Continuous feedback and improvements

GOALS

TECHNICAL

- ☐ Building interface between website (Drupal) and CERN Documents Server (where resources will be stored)

CONTENT

- ☐ Curation of existing / “old” items
- ☐ Collection of new / up-to-date best items
- ☐ New content development

IPPOG RDB Curation

RDB CURATION group (since summer 2020)

~ 40 experts from around the world: - physics teachers, scientists and science communicators

Alberto Ruiz Jimeno

Andreas Delannoy

Ani Torres

Anna Marie Wolf

Carlos Cunha

Cassandra McHugh-Lowther

Cédric Vanden Driessche

Claire Adam-Bourdarios

Claire Bonnoit-Chevalier

Daniela Ambar Gayoso Miranda

Dario Menasce

Despina Hatzifotiadou

Enrique Arce-Larreta

Harry Stuckey

Ian Bearden

Ivan Melo

Jean-Christophe Pelhate

Joel Klammer

José María Díaz Fuentes

Julia Woithe

Kevin Martz

Kevin Mosedale

Lucia Battistella

Luís Afonso

Maria Niland

Marla Glover

Michael R. Fetsko

Michael Wadness

Miki Otsuka

Moritz Springer

Patricia Teles

Pierluigi Paolucci

Ram Krishna Sharma

Richard Dower

Robert Nickson

Soleiman Rasouli

Spencer Pasero

Stefania Della Sciucca

Yury Ivanov

CRITERIA

- ✓ Is the physics right?
- ✓ Is it a topic of interest?
- ✓ Is it related to particle physics or associated fields?
- ✓ Is it up-to-date or has it been superseded?
- ✓ Are you aware of a similar resource in the same language?
- ✓ Do you consider this resource as really outstanding?

❑ Special Curation tool developed – launched Dec '20

❑ 370 resources: each evaluated by 2-3 experts =>

❑ Nearly 1000 evaluation reports have entered curation process by now! 👍

TECHNICAL

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Collecting new resources for RDB

- ❑ Collecting efforts since December 2020 ([google doc](#))

New RDB Working Group (May 2021):

- ❑ Complete

- ❑ Wrap up

- ❑ Evaluate

- ❑ Assign new tags

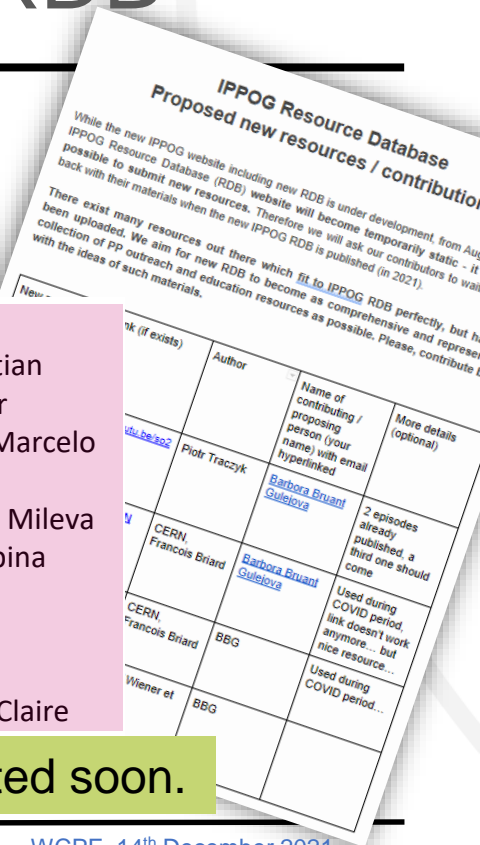
- with help of **dedicated**
curation tool

~ 100 new
resources

RUIZ JIMENO, Alberto
SHARMAZANASHVILI, Alexander
STRANDBERG, Jonas
WOZNIAK, Krzysztof Wieslaw
WETZLER, Susan
WEGNER, Jeremy
KLAMMER, Joel
GLOVER, Marla
COYLE, Helen
PAOLUCCI, Pierluigi

KIRILOVA, Galina
KLEIN BOESING, Christian
BEARDEN, Ian Gardner
GAMEIRO MUNHOZ, Marcelo
GORISEK, Andrej
HADJIISKA, Roumyana Mileva
HATZIFOTIADOU, Despina
MELO, Ivan
PRICE, Darren
BARDEEN, Marge
ADAM BOURDARIOS, Claire

RDB standing committee will be created soon.



IPPOG RDB Curation tool

| | | Search Title |
|---|----|---------------------------|
| + | 1 | Introducing the LHC L... |
| ■ | 1a | Introducing the LHC L... |
| □ | 1b | Introducing the LHC L... |
| + | 2 | Lets have a coffee wit... |
| ■ | 2a | Lets have a coffee wit... |
| □ | 2b | Lets have a coffee wit... |
| + | 3 | 3D-Printable Quadru... |
| ■ | 3a | 3D-Printable Quadru... |
| □ | 3b | 3D-Printable Quadru... |
| + | 4 | Particle Builder Board... |
| ■ | 4a | Particle Builder Board... |

GREAT FUNCTIONALITIES

(impossible with google docs)

- ✓ SECURITY: users sign in with their account and can edit only their entries
- ✓ SECURITY: editable (only new tags) and non-editable fields
- ✓ SEARCH & FILTERING : each tag / column can be filtered with chosen values
- ✓ DROPDOWN MENUS with predefined lists
- ✓ MULTIPLE CHOICE when entering values
- ✓ CLEAR: red line - taken by somebody else; blue line - mine
- ✓ UNDO / CLEAR OPTION
- ✓ VIEW and EXPORT options
- ✓ PLAN: TO BE USED (at least partly) to help populating new RDB...



IPPOG Resource Database Curation

| Keep it? | IPPOG's best? | Topic | Subtopic | Type | Audience | Language | School topic | Online usage | Additional Keyword/Tag | Related resource | Comment |
|----------|---------------|-------|----------|------|----------|----------|--------------|--------------|------------------------|------------------|---------|
|----------|---------------|-------|----------|------|----------|----------|--------------|--------------|------------------------|------------------|---------|

1. KEEP IT?

YES
NO

2. IPPOG's BEST

1-10 rating (10 is for best)

3. TOPICS and SUBTOPICS

1) MATTER, PARTICLES AND UNIVERSE

PARTICLES
INTERACTIONS
COSMOLOGY
HIGGS
ANTIMATTER
QUARK-GLUON PLASMA
NEUTRINOS

2) EXPLORING THE UNKNOWN

SUPERSYMMETRY
DARK MATTER
DARK ENERGY
EXTRA DIMENSIONS

3) TECHNOLOGIES and EXPERIMENTS

ACCELERATORS
DETECTORS
COMPUTING
DATA ANALYSIS

4) PARTICLE PHYSICS AND SOCIETY

WHY FUNDAMENTAL RESEARCH
INTERNATIONAL COLLABORATION

4. ITEM TYPE

Photos/ Posters/ Charts
Videos
Animations / Simulations
Presentations (ppt,pdf)
Games
Classroom materials / Tutorials / Lesson plans / Text books
Books
Projects / Competitions
Exhibition items
Souvenirs
Academic article

5. AUDIENCE

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

6. LANGUAGES

Arabic
Catalan
Chinese
Czech
Danish
Dutch
English
Finnish
French
German

Hungarian
Italian
Japanese
Norwegian
Polish
Portuguese
Romanian
Russian
Serbian
Slovak
Slovenian
Spanish
Swedish
Turkish

NEW

Link to school physics curriculum

7. SCHOOL TOPIC

Blue part is just to lead the choice of the tags, which are in black!

| School curriculum topic | School curriculum sub topic | Particle Physics topic | Comment |
|--------------------------------|--------------------------------|-------------------------|--|
| Nature of science | Scientific inquiry & reasoning | all | E.g. theory vs experiment: comparing predictions and observations for Higgs discovery |
| Measurements and uncertainties | Sensors | Detectors | expanding the human senses |
| | Measurements | all | E.g. non-SI units such as eV, 'particle level' origin of SI units |
| | Measurement uncertainties | | E.g. 5 sigma threshold, precision measurements |
| Matter | Structure of matter | Particles | Elementary particles, Particle systems up to atoms, molecules, vacuum as absence of matter |
| | States of matter | Quark-gluon-plasma | E.g. plasma, ionisation, LHC cooling with liquid helium (cryogenics) |
| | Phase transitions | Detectors, Interactions | E.g. as detection technique (cloud and bubble chambers), |

| | | | |
|------------------------------------|-------------------------------------|-------------------------|--|
| | Mass | Interactions, Higgs | E.g. rest energy of particles $E=mc^2$ |
| Charges & fundamental interactions | Charges | Interactions, Particles | E.g. charges as particle properties that determine interactions, colour charge, electric charge, ... |
| | Gravity | Interactions | |
| | Strong interaction | Interactions | E.g. atomic nuclei |
| | Weak interaction | Interactions | E.g. beta transformation of radioactive nuclei |
| | Electromagnetism | Interactions | Magnetic and electric fields & forces, electricity, electronics |
| Mechanics | Energy (conservation), work & power | Accelerators, Detectors | E.g. kinetic and rest energy |
| | Accelerated motions | Accelerators | E.g. circular motion |
| | Momentum (conservation) | Accelerators, Detectors | E.g. Collisions (elastic & inelastic) |
| | Oscillations and waves | Accelerators | E.g. RF cavities |
| | Relativistic mechanics | Accelerators, Detectors | E.g. SRT - relativistic muons from cosmic radiation |
| Special topics | Quantum physics | Detectors, Accelerators | E.g. uncertainty principle, photoelectric effect, tunneling, superconductivity, spin |
| | Cosmology | Cosmology | Including big bang, CMB, dark matter, dark energy |
| | Medical imaging | Applications | E.g. X-ray machines, PET |
| | Objects in the universe | | Stars, supernovae, black holes, ... |
| | Computing | all | |

9. ADDITIONAL KEYWORD / TAG

Free text

10. RELATED RESOURCES

Choose from all other items/resources!

11. COMMENT

Free text

8. ONLINE USAGE

YES
NO

New IPPOG RDB website preview



SEARCH:

1) Choose physics topic
(from picture)

2) Filter in search
engine

Hover on 1 from
4 main topics:

- Subtopics shown
- Random selection
changing at each refresh
shown below

IPPOG Resource Database

From wonders to excitement

A collection of high quality engaging materials e.g. videos, posters, talks, hands-on activities and more to help you share the wonders and excitement of particle physics with teachers, students and the general public. At the bottom of this page you'll find also the collection of webpages of IPPOG members containing resources in their national languages.

Matter, Particles and Universe
(Known Physics)

Exploring the Unknown
(Beyond Known Physics)

Technologies and Experiments

Particle Physics and Society



Random Selection

Enjoy the random selection of featured resources in English below. Search the database by clicking on topic tabs above or filter on the right.



04 September, 2020

Hidden Pieces: The LHC and our Dark Universe

Public presentation on current particle physics research at the LHC.

Read more

DARK ENERGY PRESENTATIONS (PPT,PDF) ENGLISH BROAD PUBLIC

Search the RDB

KEYWORD

Topic

- Any -

Type / Category

- Any -

Audience

- Any -

Language

English

Search

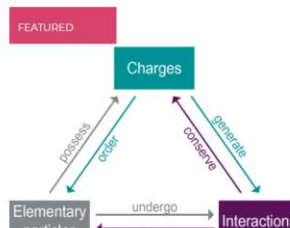


PhD TV: Dark Matters

Through hand drawn illustrations, this video creatively explains the basics on what we...

Read more

EXTRA DIMENSIONS VIDEOS ENGLISH BROAD PUBLIC



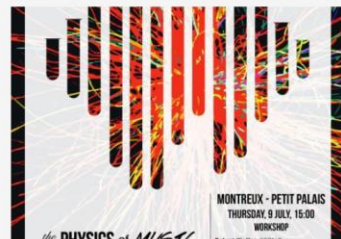
04 September, 2020

laradioactive.com

Website created and maintained by physicists to introduce radioactivity and present its...

Read more

DETECTORS ANIMATION / SIMULATIONS ENGLISH BROAD PUBLIC



04 September, 2020

MJF 2015: The Physics of Music & The Music of Physics

Material from the 3rd annual Physics of Music / Music of Physics workshop held at the...

Read more

DARK MATTER ANIMATION / SIMULATIONS ENGLISH BROAD PUBLIC



03 September, 2020

Teaching the Standard Model with charges and interactions

This article outlines the teaching approach of Netzwerk

SEARCH:

1) Choose physics topic (from picture)

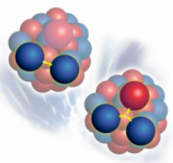
2) Filter in search engine

Order of items according to rating

WCPE, 14th December 2021



Which particle is the mediator of the strong force?



1

| | |
|---------------|------------|
| A. Neutralino | B. Z boson |
| C. Gluon | D. Quark |

03 September, 2020

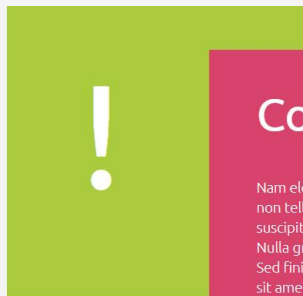
Quiz for International Masterclasses (IMC)

This multiple-choice quiz is designed for high school students and is used in the...

[Read more](#)

[ACCELERATORS](#) [CLASSROOM MATERIALS / TUTORIALS / LESSONS PLANS / TEXT BOOKS](#) [ENGLISH](#) [UPPER SECONDARY SCHOOL LEVEL](#)

1 2 >



Contribute Now!

Nam elementum convallis nibh at auctor. Integer fermentum nunc non tellus convallis molestie. Phasellus id orci nunc. Nullam sit amet suscipit magna. Nunc sit amet purus nunc. Nunc vitae tempor lectus. Nulla gravida augue vel nunc auctor, nec malesuada lorem commodo. Sed finibus congue nulla, ac aliquet odio commodo sit amet. Nullam sit amet mauris malesuada, sagittis nunc hendrerit, vestibulum velit. Vestibulum quis blandit ex. Duis nec volutpat dui.

[Become a contributor](#)

[Add a resource](#)

USER FRIENDLY SUBMISSIONS:

- Clear instruction
- Form for contributors



Become a contributor

Nam elementum convallis nibh at auctor. Integer fermentum nunc non tellus convallis molestie. Phasellus id orci nunc. Nullam sit amet suscipit magna. Nunc sit amet purus nunc. Nunc vitae tempor lectus. Nulla gravida augue vel nunc auctor, nec malesuada lorem commodo. Sed finibus congue nulla, ac aliquet odio commodo sit amet. Nullam sit amet mauris malesuada, sagittis nunc hendrerit, vestibulum velit. Vestibulum quis blandit ex.

Login

[Become a contributor](#)



TECHNICAL

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CONTENT

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IPPOG Working Groups

❑ Explaining PP to Lay audience

Analogies, images, examples, stories...

❑ Outreach of Applications for Society

Stories with human touch

Tool for community to shape attitude and perception of physics and fundamental research by decision makers, funding bodies, media and public and even motivate young people to undertake physics studies.

Studies (CERN) show: Context matters much more than content when raising interest of students in physics!

RDB main topic No 4



International Particle Physics Outreach Group

About Resources Activities News Events

ACTIVITY

Global cosmic rays portal

Projects for High School Students

There are several projects around the world that address young people and teachers. It gives them the opportunity to explore cosmic particles. These projects are announced here, for further information, please visit the website.

Activities

- Adapted Physics
- Projects
- Events
- Requests
- How to obtain a detector for your experiment
- FAQ
- About

Astroparticle Physics

Learn more about the world of astroparticle physics. We will provide you with the necessary information to get started. You will find the necessary information to get started. You will find the necessary information to get started.

Projects

Project: CALLIO LAB

France:

Germany: COSMIC@WEB

Italy: INFN

Poland: CREDO

Japan: 探Q

Russia: Showers of Knowledge

Spain: QuarkNet-TW

Sweden: QuarkNet Cymru

UK: UNIVERSITY OF BIRMINGHAM

About

Learn more about the world of astroparticle physics. We will provide you with the necessary information to get started. You will find the necessary information to get started. You will find the necessary information to get started.

Events

Resources

Requests

International Particle Physics Outreach Group

IPPOG Meetings
IPPOG at CERN
Member Websites

Publications
Press
Contacts

Calendar
For IPPOGers
Gallery

Global Cosmic Rays Portal

Projects

Finland: CALLIO LAB

France:

Germany: COSMIC@WEB

Italy: INFN

Poland: CREDO

Japan: 探Q

Russia: Showers of Knowledge

Spain: QuarkNet-TW

Sweden: QuarkNet Cymru

UK: UNIVERSITY OF BIRMINGHAM

USA: QuarkNet

Coming soon: early 2022!

Making Cosmic Rays Studies available to schools worldwide

18 open-data projects, 12 countries

International Particle Physics Outreach Group

About Resources Activities News Events

Cosmos à l'École

Activities

- Events
- Website

Each project own entry site

Experiments 1

Experiments 2

Enter Cosmos à l'École website

International Particle Physics Outreach Group

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TAKE PART!

- ✓ **STAY TUNED!!!** New IPPOG websites coming up end 2021
- ✓ **Join IPPOG FRIENDS!**
- ✓ **Take part in IPPOG ACTIVITIES for schools!**
 - Masterclasses
 - Global Cosmics – from 2022
 - Use IPPOG Resources – from 2022
- ✓ **If you have good material to share, become an RDB CONTRIBUTOR!**
 - Submit resources from 2022

Contact barbora.gulejova@cern.ch

Learn more

❖ IPPOG - Bridging the gap between science education at school and modern scientific research

Article submitted to World Scientific WSPC Gribov 90 (Pre-print available)

<https://cds.cern.ch/record/2746338> and <http://arxiv.org/abs/2011.14743>

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

Proceedings paper, 37th International Cosmic Ray Conference (ICRC 2021)

<https://cds.cern.ch/record/2775675>

❖ Strategic importance of dialogue between science and society

Article in last Swiss Physical Society Communication, Section: «Physics and Society»

[SPS Mitteilungen.64.pdf \(www.sps.ch\)](#) (page 48)

THANK YOU!