

# International Particle Physics Outreach Group

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## WG on Applications for Society IPPOG meeting Marid, 23 April 2024

Barbora Bruant Gulejova & Yiota Foka (Conveners)

# Executive Summary

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**WG meeting 12 April 2024:** housekeeping cleanup

**ICHEP2024 Abstract:** submitted (by Despina) and accepted oral presentation During 12 april 2024 WG meeting: speaker YF

**HACKATHONS:** helpful for progress (useful links)

- [1st Hacathon of IPPOG's WG on Applications for Society \(26-27 January 2023\)](#)
- [2nd Hackathon of IPPOG's WG on Applications for Society \(27-November 28, 2023\)](#)

**WG stories**

- WG finalised stories  
[https://drive.google.com/drive/folders/19\\_I3v\\_xpDSGTL7smJYgKks-ZYZT\\_oV4J](https://drive.google.com/drive/folders/19_I3v_xpDSGTL7smJYgKks-ZYZT_oV4J)
- WG almost finalised stories  
<https://drive.google.com/drive/folders/1HP6WeAvllp2GRCYjtIRQQrFBkNsmgEO->
- WG proposed topics colour coded  
[https://docs.google.com/document/d/10Klu9nDx\\_Cliz16QYE7LqgtncfrwWWzB31ZRT7vDLR0/edit](https://docs.google.com/document/d/10Klu9nDx_Cliz16QYE7LqgtncfrwWWzB31ZRT7vDLR0/edit)

**Collection of existing stories (from elsewhere)**

[https://docs.google.com/document/d/10Klu9nDx\\_Cliz16QYE7LqgtncfrwWWzB31ZRT7vDLR0/edit](https://docs.google.com/document/d/10Klu9nDx_Cliz16QYE7LqgtncfrwWWzB31ZRT7vDLR0/edit)

**Final approval:** by IPPOG chairs:

stories should go in IPPOG web page latest in June (meeting with Fabiola: Monday 29 May)

# ICHEP 2024 Abstract

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## Particle Therapy MasterClass plus WG Applications

IPPOG and spin-offs from particle physics

The main mission of IPPOG, the International Particle Physics Outreach Group, is to bring the excitement of particle physics to the public and especially to the young generation. In the last years, IPPOG has undertaken to emphasize also the benefits to society from fundamental research. A tangible example is the particle therapy masterclass, an integral part of the masterclasses programme, which introduces high-school students to applications of accelerators in the fight against cancer. Another example is the effort of the working group “Outreach of applications for society”. Its objective is to create a collection of short stories, covering a wide spectrum of spin-offs from our field. The ultimate goal is to connect fundamental research to everyday life.

# ICHEP 2024 Guidelines

E&O is increasingly important for our field, given the worldwide financial and political situation, as well as the many other interesting “big science” projects. A common theme of the E&O sessions at ICHEP2024 is therefore to encourage all scientists to participate in these crucial activities. We would thus like you to address the following

- Who are the target audiences for your activity?
- Do you have any measures of “success” of your activity?
- Can you give guidelines for how others can do similar activities in their institutes/experiments/countries? (including resource requirements)

We would also encourage you not to have much detail in your presentation, but to focus on a few key and clear messages (along the lines of the above) that the audience can take away and act upon. Discussion will also form a key part of this year’s sessions, so we also encourage you to “prompt” the audience with statements/questions that will provoke discussion. Talk timing will be strictly observed so we appreciate you structuring your presentation accordingly.

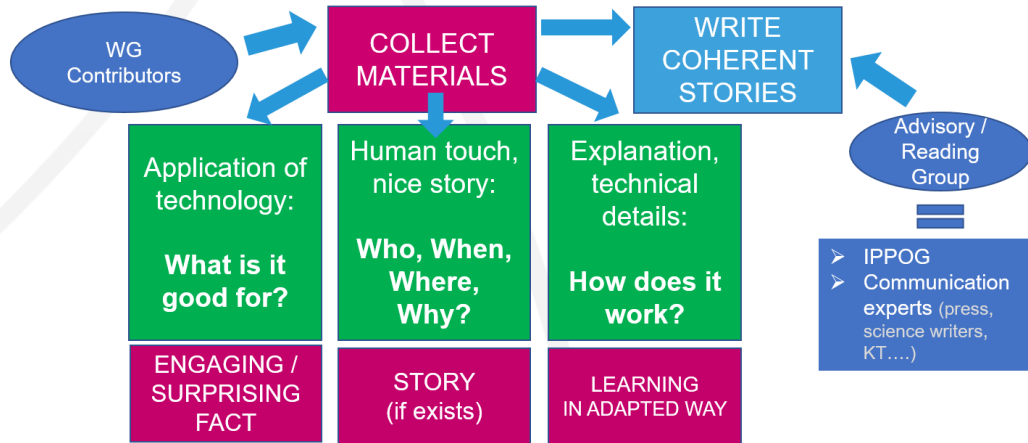
Please note that as part of our real attempt to address the challenging future path we are facing with our field, there will be a very special panel on Monday 22 July at lunchtime, to which you are invited. More info in upcoming bulletins.

**Concrete deadlines**  
**Concrete questions**

**How do we go about**  
**“measuring success”**

# WG Stories

Write short publishable stories on most pertinent success stories



Revised Format:

starting with 2 pages + Addendum with more details and links  
but adapting to the needs (see WG presentation in Sofia)

# Hackathons at CERN

Contributions by: Katharina, Despina, Thomas, Beatrice, Ruben, Pinelopi, Verania Yiota and Barbora

**Ready stories on google drive:**

[https://drive.google.com/drive/folders/19\\_I3v\\_xpDSGTL7smJYgKKs-ZYzt\\_oV4J](https://drive.google.com/drive/folders/19_I3v_xpDSGTL7smJYgKKs-ZYzt_oV4J)

W CERNandISS.docx 👤

W General Relativity and GPS.doc 👤

W How crystals used by CERN experiments save lives fin... 👤

W Medipix detectors, from colour X-ray imaging to educa... 👤

☰ Mexican-Pyramid-Muons-V4 👤

W MuonTomography.doc 👤

W PET\_story.docx 👤

W Superconductivity.doc 👤

## plus ISS by Verania



Working group  
OUTREACH OF APPLICATION FOR SOCIETY  
April, 2024

### Unraveling Cosmic Mysteries: The collaboration between International Space Station and CERN

#### What is the International Space Station?

The **International Space Station (ISS)** is a large spacecraft in orbit around Earth. Think of the ISS as a regular laboratory, but with one tiny difference, it orbits over 250 miles above Earth's surface. There, astronauts conduct scientific research and analyze social dynamics in space.

The 2000 experiments on the ISS have been conducted with the most important mission: enhance life on Earth and prepare us for future stages of space exploration, with the goal of reaching Mars. So, why do we find particle physics experiments within the ISS?

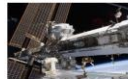


Fig. 1) The starboard view of the International Space Station. Credit: NASA

#### CERN: Pioneering Particle Physics on Earth

Museum, nestled near Geneva in Switzerland, CERN, the world's largest particle physics laboratory, operates at the forefront of scientific inquiry. Renowned for its monumental discoveries and the birthplace of the World Wide Web, CERN's Large Hadron Collider (LHC) delves into the fundamental fabric of the universe by probing subatomic particles and unveiling their enigmatic behaviors.

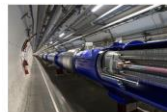


Fig. 2) 3D cut of the LHC dipole magnet. Credit: CERN

The Cosmic Link:

# Hackathons at CERN

Contributions by: Katharina, Despina, Thomas, Beatrice, Ruben, Pinelopi, Verania Yiota and Barbora

Almost Ready stories on google drive:

<https://drive.google.com/drive/folders/1HP6WeAvIlp2GRCYjtIRQQrFBkNsmgEO->

## plus Accelerator on ships by YF

### A crazy idea that may actually work?

Can you imagine trying to convince a ship captain to trust a team of physicists, even assisted by engineers and technicians, to make the engine of his ship available for what one could call futuristic experiment, namely, aiming at cleaning the exhaust gas of his ship's diesel engine using a particle accelerator.

### What is a particle accelerator?

Searching the internet for "particle accelerator" basically results in as definition "a device that accelerates particles". According to Wikipedia it is a machine that can propel [charged particles](#) to very high speeds and energies, and to contain them in well-defined [paths](#) — using [electromagnetic fields](#) (see LINK: principle of operation of particle accelerators)

### What particle accelerators are used for?

Many people, nowadays, associate "particle accelerators" with research laboratories such as [CERN](#), near Geneva, Switzerland, where large accelerators are used for fundamental research in [particle physics](#). However, it comes as a surprise, even to scientists, the fact that currently, there are more than 30,000 accelerators in operation around the world — and only a small fraction, about 6%, is used for research. A large fraction of them are actually used for societal applications, for example, in industry, for medical applications (reference LINK to story) and even art authentication (reference LINK to story).

### An unusual application of particle accelerators

But who could imagine that they could be used for cleaning the exhaust gas of ships diesel engines aiming at reducing the content of pollutants! What a remarkable example of how society could benefit from particle accelerator technologies!

Indeed, maritime traffic claims the first place, by far, as the largest contributor to air pollution. In fact, one single cruise ship can harm the environment as much as one million cars emitting particulate matter which contains microscopic solids or liquid droplets that are so small that they can be inhaled and cause serious health problems, among them [sulphur](#) and nitrogen oxides.

### Who developed it

Such an innovative idea was explored within the EU-funded project ARIES and its collaborators (see LINK: Contributors, Credits) leading to a real-scale test reported in 2019 in the Accelerating News: <https://acceleratingnews-07.archive.web.com.ch/node/132>.

### How it works

The proposed solution by the ARIES accelerator scientists combined irradiation by an electron-beam accelerator followed by purification in a "wet scrubber". The electrons induce processes that go under the terms "molecular excitation, ionization and dissociation" thus breaking the larger molecules of [sulphur](#) and nitrogen oxides. This enables their removal in a small scrubber placed after the accelerator. This scrubber, using water, washes them out the polluting molecules.

### The actors

The real-life test-bench was the old and rusty Latvian tugboat [Odians](#) moored at the Riga Shipyard on the Baltic Sea which provided its old but powerful engine for the test. A long pipe, equipped with several detectors, connected the tugboat to an accelerator which was loaded on a truck. A specially built chamber allowed the treatment of the exhausts, which then passed through the small scrubber and finally released into the air.

	GPS
	IPPOG WG Apps Submitted
	Mexican-Pyramid
	Muons
	Superconductivity
	FLASH.docx
	How crystals used by CERN experiments save lives.do...
	IPPOG_WG_Application_Society_report_29_11_2023_B...
	Medipix detectors, from colour X-ray imaging to educ...
	Muon Tomography.docx
	PET_story_BBG_v2.docx

# Draft Stories Summary

## Compilation of previous 2 slides

- ✓ Searching for hidden cavities inside the Sun pyramid in Mexico (muography) (Ruben)
- ✓ Technologies developed for future accelerators used for new radiotherapy method (FLASH) (Despina)
- ✓ Medipix detectors applications (Pinelopi)
- ✓ Invisible particles help to reveal invisible structures (Muon tomography) (Katharina)
- ✓ Accelerators on ships (Yiota)
- ✓ UNOSAT: CERN big data expertise in service of disaster relief (Barbora)
- ✓ Superconductivity – quantum mechanics at work (Katharina)
- ✓ Einstein's Relativity in Action: GPS Navigation System knows it (Federico, Thomas, Katharina, Yiota)
- ✓ Particle physics at work in fighting cancer (PET scanners) (Yiota, Beatrice, Despina, Barbora)
- ✓ How crystals used by CERN experiments save lives? (Barbora)
- ✓ International Space Station (Verania)



# Proposed Topics

## Resources available

[https://docs.google.com/document/d/10Klu9nDx\\_Cliz16QYE7LqgtncfrwWWzB31ZRT7vDLR0/edit](https://docs.google.com/document/d/10Klu9nDx_Cliz16QYE7LqgtncfrwWWzB31ZRT7vDLR0/edit)

Science response to COVID



Tesla

CERN laser technology in telecoms

ABB + CERN energy efficiency

Open Lab stories

RMI

Hadron therapy

Precise dose calculations based on simulations

MEDICIS (Radioisotopes treatment and diagnosis)

Touchscreen

FOSS4I

ActiWiz

TERABEE

INVENIO

Hyperloop

CERN against COVID	<p>Presentation from James Gillies at IPPOG <a href="#">here</a></p> <p>CERN against COVID19 seminar <a href="#">here</a></p> <p>Website CERN against COVID TF <a href="#">here</a></p>	Planetwatch CARA	B	All COVID related materials could be tackled together....
LIP and COVID	Ricardo's presentation at IPPOG <a href="#">here</a>		B	
Science response to COVID	<p>Presentation from Savannah at IPPOG <a href="#">here</a></p> <p>Initiative "science</p>			

## Potential contributors?

# IP and publishing matters

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- Authorship: WG active members / contributors
  - Official co-authors of stories
  - Featured on the WG website and stories
- Exact formulation of acknowledgements at the very end of each story

# Collection of Existing Stories

## Benefits of fundamental research for society

*Collection of success stories*



List of existing stories to add :

blue links from [here](#) + all the yellow links from [here](#)

**For DISCUSSION:**

Do we want to create a specific category to distinguish the IPPOG WG stories and those that are collected links from elsewhere?

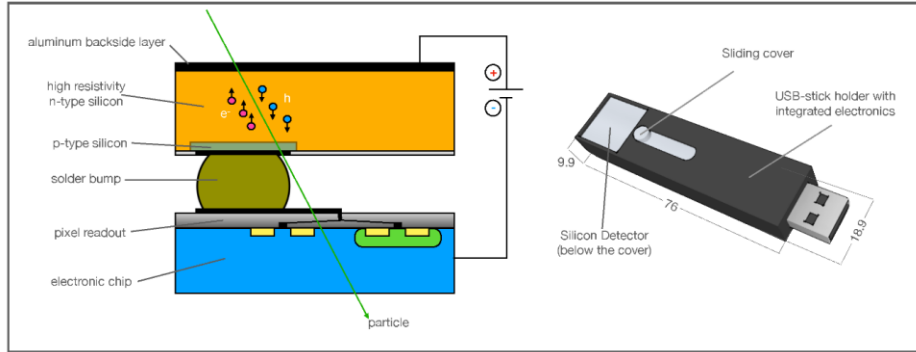
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# Thank you for your attention !

Feedback and Contributors Needed !

# Medipix detectors education kits

Pinelopi Christodoulou



### Alpha $\alpha$

Alpha particle  
Two protons and two neutrons

Mother nucleus (e.g. Radon)

#### Radon decay

$^{222}\text{Rn}$	Radon	$\alpha$	3.8 days
$^{218}\text{Po}$	Radium A	$\alpha$	3.1 min
$^{214}\text{Pb}$	Radium B	$\beta^-$	26.8 min
$^{214}\text{Bi}$	Radium C	$\beta^-$	19.9 min
$^{214}\text{Po}$	Radium C'	$\alpha$	164.3 $\mu\text{s}$
$^{210}\text{Pb}$	Radium D	$\beta^-$	22.20 years

### Gamma $\gamma$

U 92

Excited nucleus of atom

Gamma photon  
Electromagnetic radiation of short wavelength

### Beta $\beta$

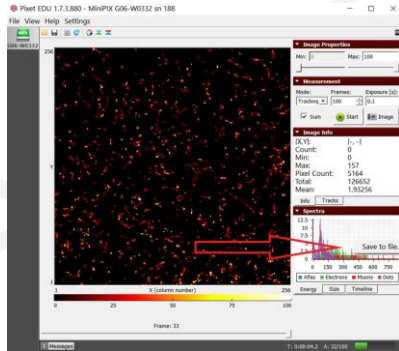
Beta particle  
Electron or positron

Mother nucleus (e.g. Radon)

#### Radon decay

$^{222}\text{Rn}$	Radon	$\alpha$	3.8 days
$^{218}\text{Po}$	Radium A	$\alpha$	3.1 min
$^{214}\text{Pb}$	Radium B	$\beta^-$	26.8 min
$^{214}\text{Bi}$	Radium C	$\beta^-$	19.9 min
$^{214}\text{Po}$	Radium C'	$\alpha$	164.3 $\mu\text{s}$
$^{210}\text{Pb}$	Radium D	$\beta^-$	22.20 years

### Muon $\mu$



Similar to experiments  
CERN@school in UK  
with great results:

Growth of interest in engineering studies (from -33% to +38%)