

# Outreach of Applications for Society

As physicist we are all "good observers"

So, I think, we all agree that somebody did the mistake to put only 24 hours per day....

Having said that, and after contacting most of you via individual emails let us see:

- where we stand
- what we can do now
- how we could progress and make reality our good intentions !

# Outreach of Applications for Society

**For the newcomers:**

- a reminder of our good intentions
- collected material
- ... ToDo Lists
- .... and Infrastructure !

# Outreach of Applications for Society

Dear contributors to the IPPOG working Group on “Outreach of Applications for Society”,

Many thanks for signing up to this group! We are looking forward to work with you at the upcoming IPPOG meeting.

This time the format of the WG is different from past years – it is “results oriented”!:) We will not only discuss, but really work. We have 90 minutes and at least 45 minutes will be spent on working on deliverables of this WG in the small groups.

Our goal is to create “IPPOG made” content for the IPPOG Resource Database and for the science outreach community: the aim is to collect information and write stories about applications for society.

Please, find all the information in this google drive folder:

<https://drive.google.com/open?id=1NbS36dbhx25u0VDtxW3oP2sasPBbAOs3>

It is important that you have a look at the document introducing the WG working plan: [https://docs.google.com/document/d/10Klu9nDx\\_Cliz16QYE7LqgtncfrwWWzB31ZRT7vDLR0/e/dit](https://docs.google.com/document/d/10Klu9nDx_Cliz16QYE7LqgtncfrwWWzB31ZRT7vDLR0/e/dit)

There is a list of many applications, but you’re welcome to bring more on board. Also, don’t hesitate to sign up for the application/topic where you would like to contribute with story writing, in the document above.

Thank you for your attention and looking forward to see you soon,

Barbora and Yiota  
WG Conveners

Dear all,

Those of you, who participated at 17<sup>th</sup> IPPOG meeting, know, that we are starting to work on “**IPPOG Wisdom collection**” – the collections of explanations, analogies, etc., which in our experience work well when addressing lay audience. The arguments to defend and justify the future endeavours of PP (e.g. in line with EPPSU) and investment to fundamental research, will be also part of the collection. More information is to be found [here](#).

The goal is to produce a useful tool for our science outreach community, to be used as an inspiration for outreach efforts.

The aim is not to collect the existing resources, but to produce coherent e-publication with well written contributions which won’t be very long (around 1 page max).

We have agreed on the provisional structure and topics.

Many resources to be used as an inspiration when writing [are](#) added in the list, these come from the discussions in IPPOG during last 3,5 years (from reports, newsletters), CERN backgrounders [etc...](#)

Several [IPPOGers](#) have already committed to write some contributions.

- 1) **ALL OF YOU are invited to subscribe to the concrete topics in the [list here](#), and contribute to our “IPPOG Wisdom Collection”. Please, write resources You can of course, also add some resources.**

Another effort partly connected to this collection is **writing the stories about applications for society**. The aim is to write engaging stories with no or minimum of technical details and ideally with human aspect of how the application was born.

- 2) **You are invited to contribute to this effort as well, all the topics and resources identified so far, are [here](#) (subscribe at page 3 of the document, get inspired by story draft [here](#)).**

Thank you in advance!!!

Best regards,

Barbora, Dirk, Thomas and Yiota

Co-Conveners of IPPOG WG on “Explaining PP to Lay Audience” & IPPOG WG on “Outreach of Applications for Society”

# Outreach of Applications for Society

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

## **IPPOG Working Group: “Outreach of Applications for Society”**

Formed October 2018 at 16th IPPOG meeting:

See panel report:

[https://indico.cern.ch/event/742487/contributions/3147691/attachments/1729453/2794540/Panel\\_Outreach\\_PP\\_applications\\_report.pdf](https://indico.cern.ch/event/742487/contributions/3147691/attachments/1729453/2794540/Panel_Outreach_PP_applications_report.pdf)

### **Conveners:**

Barbora Bruant Gulejova, Yiota Foka

### **Advisors:**

Manuela Cirilli, Manjit Dosajnh, Anais Rassat

## **REMIT and STRATEGY:**

- 1) Collect information about applications from PP and fundamental research in general used for the benefit of the society: stories, pictures, videos, animations, presentations, articles, posters....
- 2) Write easy understandable stories of fundamental research applications for society, which are currently missing and will be part of the IPPOG resource database (category “PP and society”)

# Outreach of Applications for Society

## 4) Resources to be used:

- KT webpage
- links and materials provided by CERN experts (see general resources below)
- CERN brochures: on impact, KT reports etc...
- search for companies, who are part of the stories and work with them (CAEN, etc.)

- find all here:

[https://docs.google.com/document/d/1vJnm2a7wmzHVHpM\\_0xUveNw\\_JMPqmwQlbdZ-HwUozGc/edit?usp=sharing](https://docs.google.com/document/d/1vJnm2a7wmzHVHpM_0xUveNw_JMPqmwQlbdZ-HwUozGc/edit?usp=sharing)

- Inspiration would come also from the panel discussion on “**Outreach on the benefits to society from fundamental research**” on Friday morning at IPPOG meeting:

<https://indico.cern.ch/event/767060/timetable/?view=standard>

## 5) Format of the stories:

Abstract
Structure of the body
Pictures
Resources
Related links

## 6) Recommended length: ~ 2 pages

# Outreach of Applications for Society

## IPPOG WG Outreach of Applications for Society

### General resources

- 1) CERN KT website: <http://kt.cern>
- 2) CERN impact brochure: <https://cds.cern.ch/record/2256277>
- 3) Presentation BBG on impact on society and sustainability:  
[https://indico.cern.ch/event/572852/contributions/2639248/attachments/1491684/2318975/Impact\\_on\\_society\\_and\\_sustainable\\_development\\_HST\\_2017\\_BB\\_G.pdf](https://indico.cern.ch/event/572852/contributions/2639248/attachments/1491684/2318975/Impact_on_society_and_sustainable_development_HST_2017_BB_G.pdf)
- 4) Report on Impact of Science on Society and Sustainable Development showcased by CERN - from 13th IPPOG meeting, Lisbon, April 2017:  
[https://indico.cern.ch/event/622184/attachments/1447785/2435444/Report\\_13th\\_IPPOG\\_meeting\\_CERN\\_final.pdf](https://indico.cern.ch/event/622184/attachments/1447785/2435444/Report_13th_IPPOG_meeting_CERN_final.pdf) - report 5.3, pages 22-25
- 5) And these two issues of the Courier contain useful material:  
<https://iopp.fileburst.com/ccr/archive/CERNCourier2017Oct-digitaledition.pdf>  
<https://iopp.fileburst.com/ccr/archive/CERNCourier2018JanFeb-digitaledition.pdf>
- 6) KT survey results:

<https://drive.google.com/open?id=1wzZbdD5xICRIMdEZMAyKEfUWezywA0HL>

- 7) Lectures for 60th anniversary of CERN
- 8) Book: From physics to everyday life!

# A nice example

by [lorenzo.galante@to.infn.it](mailto:lorenzo.galante@to.infn.it)

GPS and Einstein Theories			Lorenzo	<a href="https://docs.google.com/document/d/1LjDjQF MkSj4hYj HrNaTF4 OaEhxilX">https://docs.google.com/document/d/1LjDjQF MkSj4hYj HrNaTF4 OaEhxilX</a>
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## WANT TO KNOW WHERE YOU ARE? BETTER KNOWING ABOUT EINSTEIN'S THEORIES

### Abstract.

Can Research in theoretical Physics and in mathematical structures bring innovation? The question touches on complex issues and is still open to many possible answers. Here we report one example about the Einstein's Theory about Space and Time.

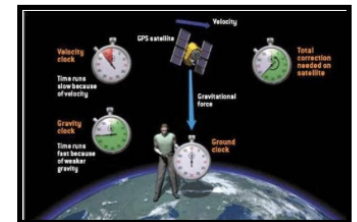
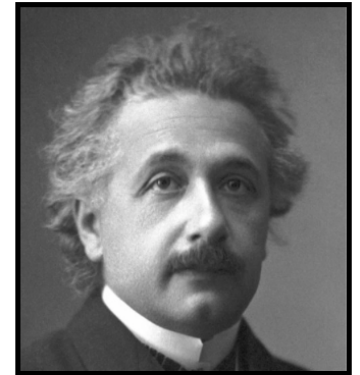
### The Story.

Nowadays is very easy to know where we are and when we are in a certain position. We just have a look at our GPS. The Global Positioning System which relies on 24 satellites that transmit information on where they are. Your GPS unit registers the exact time at which it receives that information from each satellite and then evaluates how long it took for the individual signals to arrive. In first approximation, by multiplying the elapsed time by the speed of light, it can figure out how far it is from each satellite, compare those distances, and find its own position. What is less known is that in order to perform this task with precision we have to take into account both the Einstein's theories about space and time. It's not that difficult to understand why. The GPS tells our position in space and time and both space and time are ruled by the theories of Special and General Relativity.

This [video](#) can give you a good overview of the situation.

### The return of a favour.

The GPS wouldn't exist if it were not for Relativity. However it has found the way to return the favour to the Einstein's theories. How? With a launch failure of one of the satellites. In this [video](#) the full story.



### Useful Links:

<https://www.wired.com/2011/06/st-equation-gps/> [short article from "Wired"]

<http://theconversation.com/how-einsteins-general-theory-of-relativity-killed-off-common-sense-physics-50042>

# Particle Therapy

**Ions for cancer therapy: next generation facility to propel cancer research and therapy with heavy ion beams.**

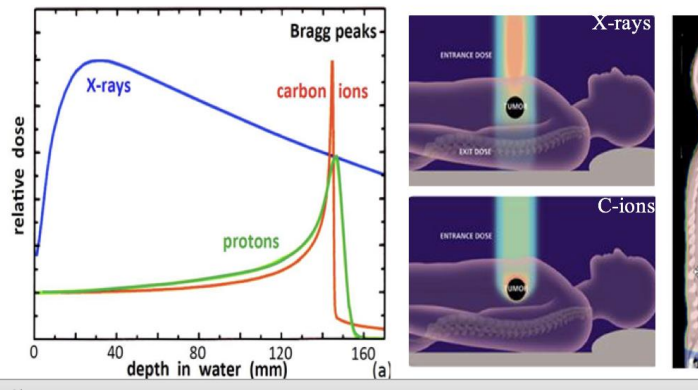
The battle against cancer is a priority for our society. Twenty years after the design of the initial generation of **such** facilities<sup>1</sup>, the time is ripe for a **breakthrough in accelerator technology and treatment modalities** that will make cancer treatment with heavy ion beams accessible to a larger fraction of people. After years of experimentation and clinical trials, the use of particle beams for radiotherapy of cancer has proven its advantages over conventional X-ray radiation therapy (RT) for many types of cancer<sup>2</sup> (with **particle beams** leaving a low dose of radiation in the healthy tissues surrounding the tumour). The goal of particle therapy is not requires a smaller and less expensive infrastructure, but to provide an alternative tool for the fraction of tumours that are **not curable** with conventional RT, **better survival rates** or **lower recurrences** when treated with

In the past decades, therapy with protons has become widely used, with as 24 centres in Europe<sup>3</sup>. Therapy with **heavy ions** instead, in contrast to X-rays, is delivered only in four centres in Europe primarily for **prostate cancer** and **head and neck cancer**, where it is **required infrastructure**. Thanks to their higher energy deposition, heavy ions are effective for tumours resistant to X-rays and protons, and they deposit a lower overall dose. Recent tests of combining heavy ion therapy with immunotherapy are encouraging results in reducing diffused cancers, via the immune response released during heavy ion treatment. In addition to Carbon, there are other heavy ions as well as a strong demand for **clinical treatment procedures**.

All these elements lead to consider heavy ion therapy as **one of the most promising**. However, to make it accessible to a larger fraction of the European population, a breakthrough with respect to the present generation of conventional radiotherapy is drastically needed. The new infrastructure must be **innovative and sustainable**; to propel this new generation, it must have a special focus on the extensive use of **superconductivity** is proposed for the accelerator and operation costs, and also to adopt innovative beyond state-of-the-art modalities in order to provide users and patients with excellent requirements for future experimentations and clinical trials.

X-rays (photons) radiotherapy (RT) is a widely used treatment modality to fight various types of cancer, exploiting the damage made by radiation to the cells' DNA when the radiation dose is concentrated on the tumour. X-rays have a dose distribution in tissues characterised by an almost exponential attenuation and absorption, delivering a large energy near the beam entrance, reaching a maximum at few cm depth, and then continuing to deposit significant amounts of energy beyond the cancer target. To minimise the radiation dose and the damage to the healthy tissues around the tumour, X-ray RT is usually administered from different angles, which improves the situation but still leaves important radiation doses in the surrounding tissues. The X-rays for RT are produced by relatively small electron linear accelerators installed in hospitals; more than 3500 RT units are presently installed in the EU<sup>4</sup>. This treatment technique has now reached a high level of sophistication, in terms of simulations, planning, delivery and the introduction of high-precision techniques as Intensity-Modulated RT (IMRT) based on 3D CT and MRI diagnostic imaging.

The **high radiation dose around the tumour** remains however a major concern, in particular in the treatment of tumours close to critical organs or for young patients that have a high risk of developing secondary tumours in the surrounding organs in their lifetime. Impaired quality of life and organ dysfunction have sustained damage to organs close to the tumour is another cause for concern.



## A more verbose example: extracts from HITRI proposal

In Europe GSI was the first to treat 440 patients with carbon ions. This subsequently led to the construction of the HIT-facility in Heidelberg and then Marburg (Germany). Thus far, around 28.000 patients have received carbon treatment at 13 functioning centres in Japan, Germany, Italy, Austria and China. Further facilities are being planned in USA, South Korea, Taiwan and France. Although the number of patients treated with ions adds up to only about 15% of those treated with protons (Figure 6), carbon centres have reported impressive disease-free survival rates with their initial studies.

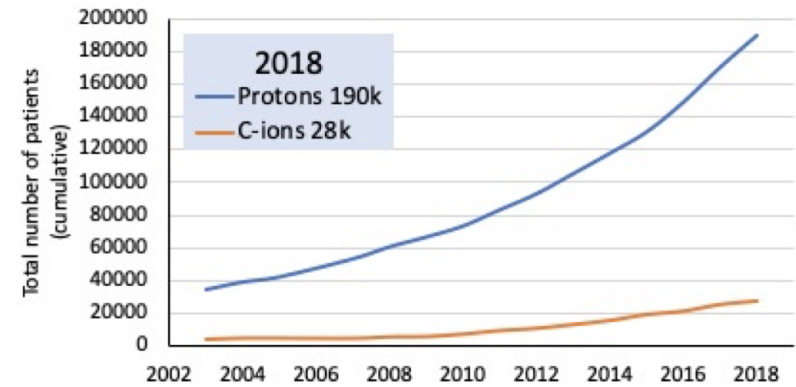


Figure 6: Patients treated with protons and C-ions worldwide. Source: PTCOG.

The present state of clinical knowledge still requires further evidence-based medicine and more comparative clinical trials aimed at confirming and extending the use of heavy ion therapy.

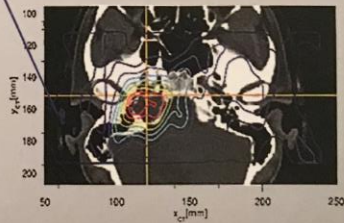
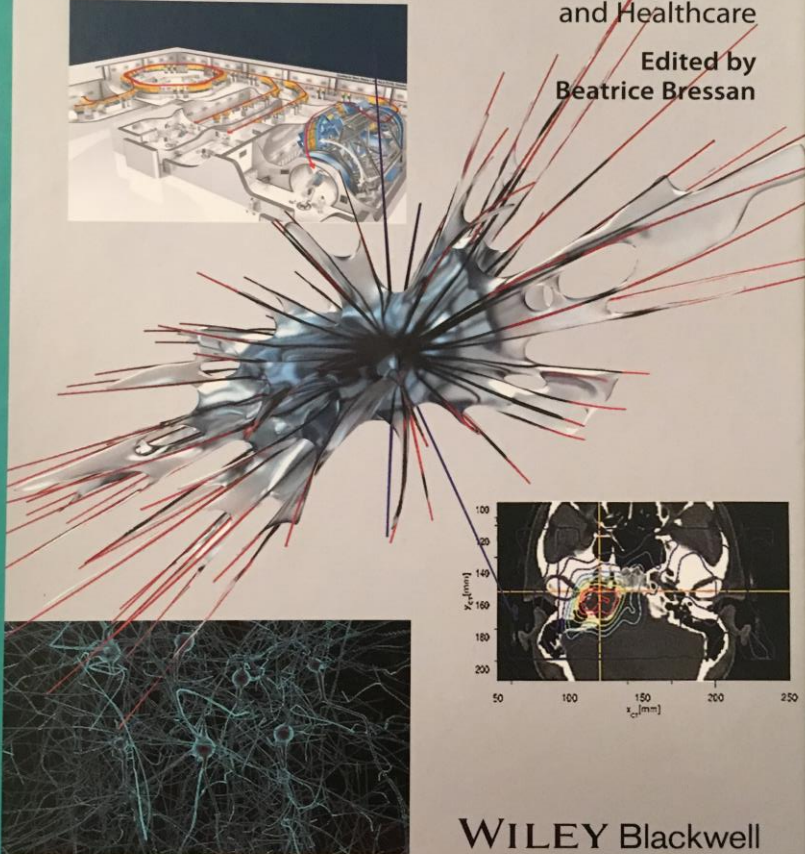
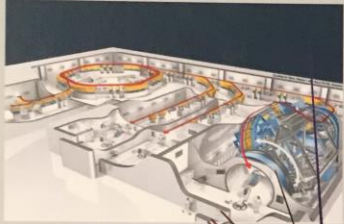
Further studies will bring heavy ion therapy, particularly multi-ion therapy, into the realm of precision and personalised medicine and will allow exploring emerging treatment modalities (such as microbeams or FLASH therapy).



# From Physics to Daily Life

Applications in Biology, Medicine,  
and Healthcare

Edited by  
Beatrice Bressan



WILEY Blackwell

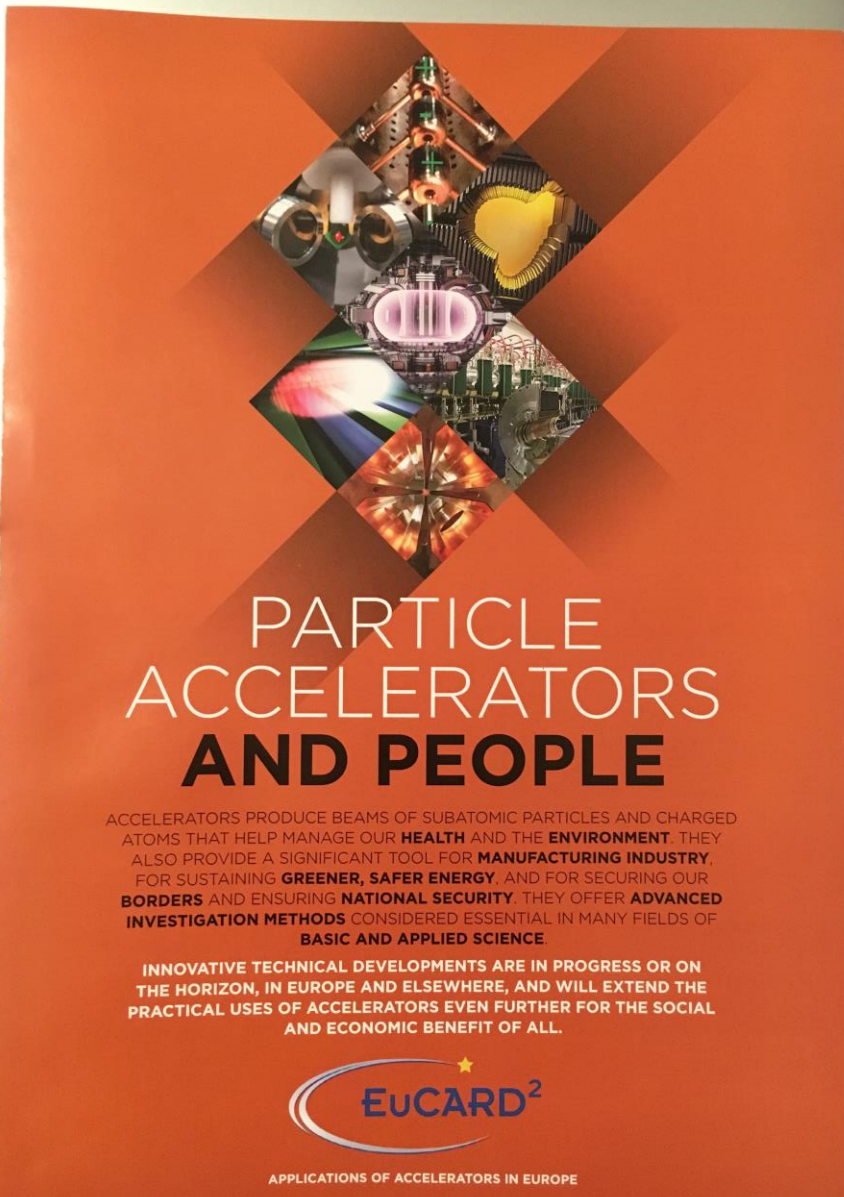
## More resources

Special Edition for 60<sup>th</sup> CERN anniversary, 2 volumes  
Accompanied by related lectures

Chapter on PET

Accompanied by presentation and interview  
on “human aspects story” by MW (still to be processed)


# More resources: Accelerators for people EuCARD2




**PARTICLE  
ACCELERATORS  
AND PEOPLE**

ACCELERATORS PRODUCE BEAMS OF SUBATOMIC PARTICLES AND CHARGED ATOMS THAT HELP MANAGE OUR **HEALTH** AND THE **ENVIRONMENT**. THEY ALSO PROVIDE A SIGNIFICANT TOOL FOR **MANUFACTURING INDUSTRY**, FOR SUSTAINING **GREENER, SAFER ENERGY**, AND FOR SECURING OUR **BORDERS** AND ENSURING **NATIONAL SECURITY**. THEY OFFER **ADVANCED INVESTIGATION METHODS** CONSIDERED ESSENTIAL IN MANY FIELDS OF **BASIC AND APPLIED SCIENCE**.


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**APPLICATIONS OF  
PARTICLE ACCELERATORS  
IN EUROPE**



## **Presentations:**

- **Marina Trimarchi : GPS measurements on EEE experiment**
- **Despina Hatzifotiadou : PET and Cultural heritage (muon tomography)**
- **Yiota Foka : Particle Therapy and Accelerators for society**
- **Name Name Name**


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The Nuclear Physics European Collaboration Committee is an Expert Committee of the European Science Foundation



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## NEWS

[FAIR Construction Progress Video](#)  
September 2019





## ACTIVITIES

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**Sent:** 21 May 2019 16:15

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**Subject:** WG on "Outreach of Applications for Society" - important information

Please, find all the information in this google drive folder:

<https://drive.google.com/open?id=1NbS36dbhx25u0VDtxW3oP2sasPBbAOs3>

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

Please, write your name as a volunteer to the list of the topics.

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