Prelude

During the past century particle physics has provided incredible insights into the nature of matter, and the origin and fate of the universe. Theories have been tested and, through an almost-Darwinian process, only those that are substantiated by experiment survive. Along the way, the technological advances we have made to facilitate our studies have found their way into everyday life, through communication techniques, medical imaging and disease treatment, to name but a few. The present experiments are able to measure phenomena to a precision that was not dreamt of when they began construction, and there are solid plans for continuing the exploration until the 22nd century, to help answer the many questions that remain and bring further insight into the Universe.

<u>WE</u> are all convinced of the overwhelming benefits our basic research has for humanity. But, as we face increasing challenges for resources, both financial and personnel, as well as environmental concerns for example, for the field to thrive for the next century it is vital to bring the rest of the world with us on our journey. And today we want to explore, with our distinguished panel, the role that communications, education and outreach need to play in achieving this, as well as your part in all of this!

Education & Outreach Summary, ICHEP 2024

10 Posters plus 29 talks in 3 parallel sessions: 35 - 60 attendees

With lots of discussion during and after the sessions

Educational Activities, Art & Science, E&O Strategy, Visits, Games, Social Media

+ **Panel Discussion** on importance of E&O

Dave Barney, Miroslav Myska & Connie Potter

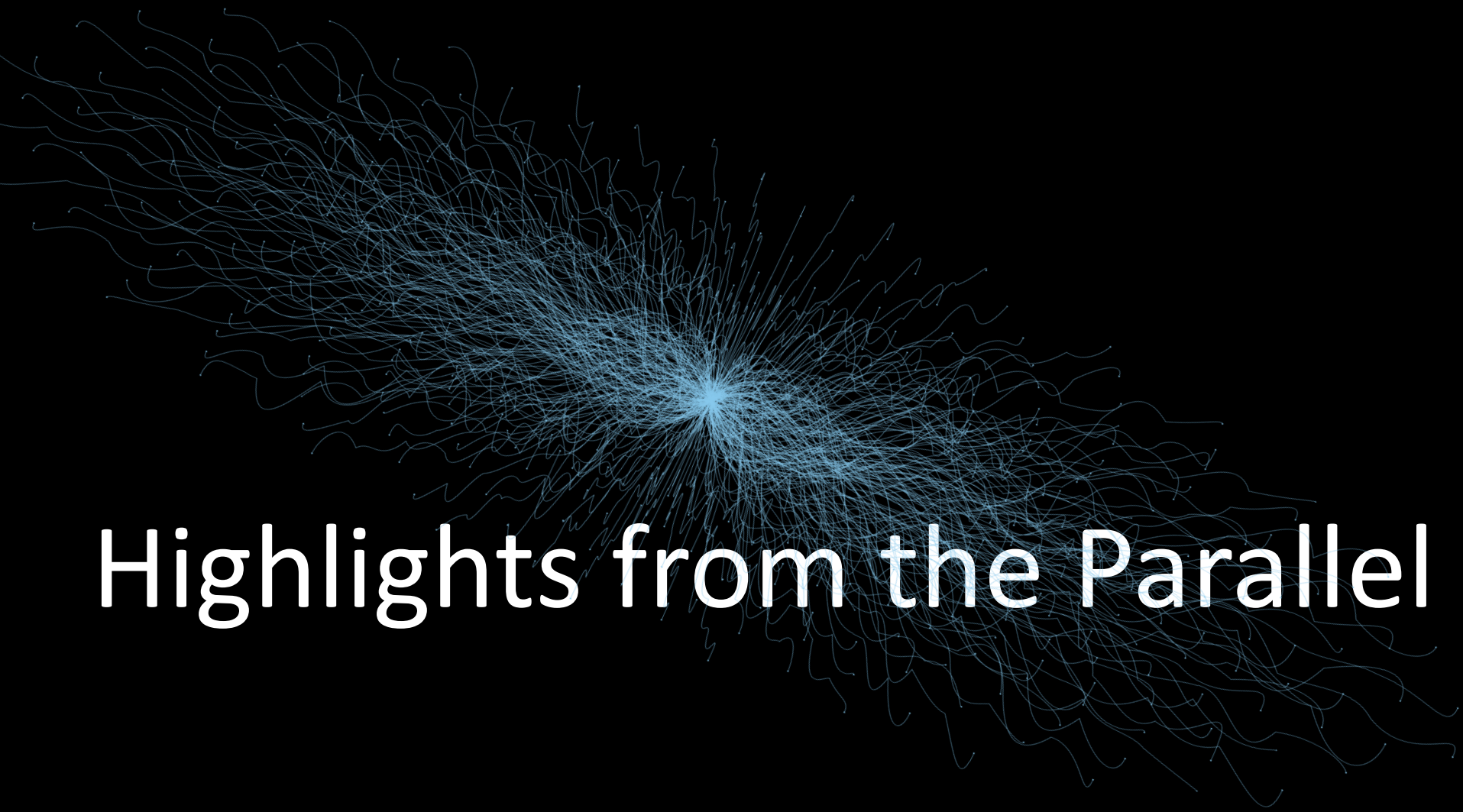
With many thanks to the LOC:
Jiri Dolejsi, Barbara Trzeciak, Oldrich Kepka

The bottom lines

To help overcome the challenges faced by our field in the coming decades, communication from **everyone** involved in HEP, and at all levels, will be critical. This cannot be left to a handful of dedicated "outreach activists!"

The skills obtained from being involved in outreach are **valuable for our lives as physicists and engineers**

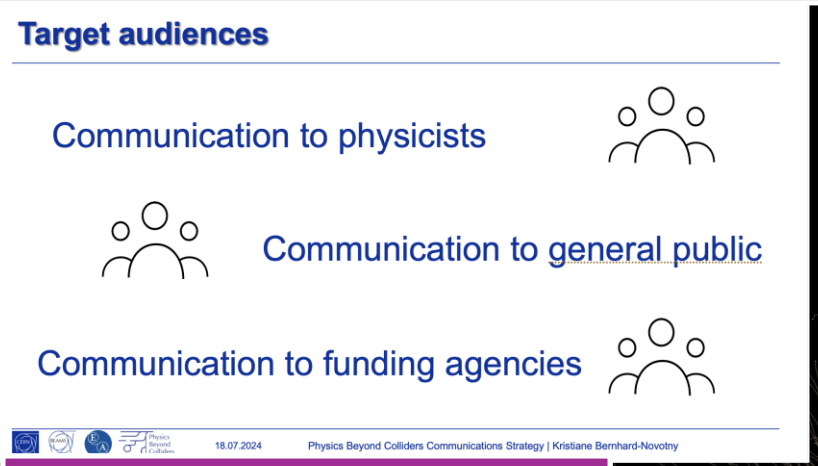
Education & outreach efforts by our physicists/engineers must be **encouraged, supported and acknowledged accordingly**



Highlights from the Parallel Sessions

Highlights: E&O Strategy

Physics Beyond Colliders Comms Strategy



kristiane.novotny@cern.ch

Outreach can:
- build public appreciation
- aid financial support
- inspire young people

Social Media is important

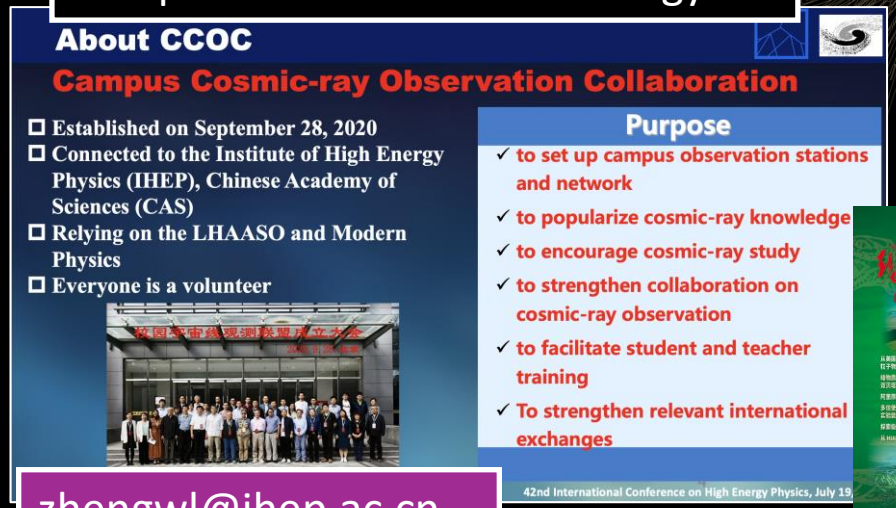
Printed Media is also important!

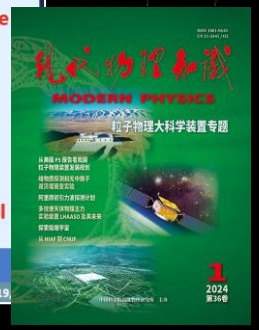
Pierre Auger Communication Strategy

Emphasis on local-community engagement

viviana.scherini@unisalento.it

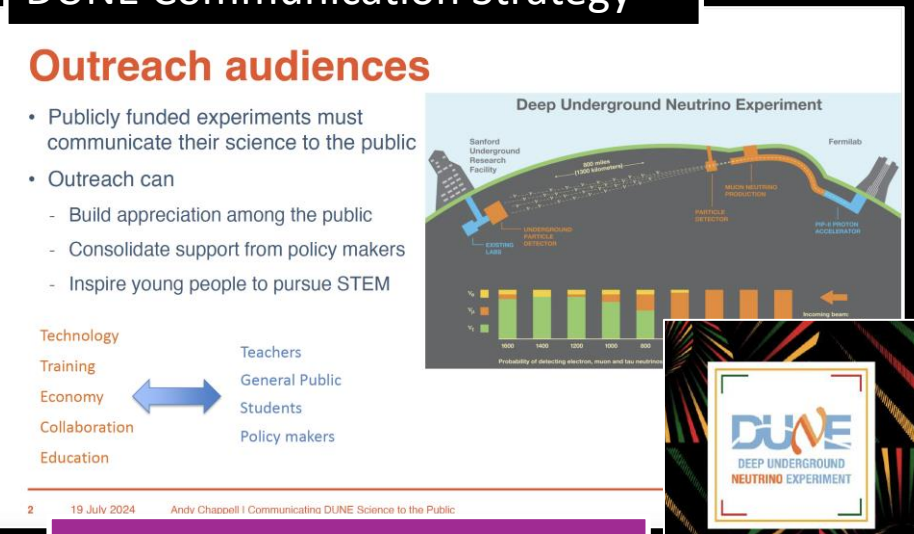
Campus Cosmic Comms Strategy





zhengwl@ihep.ac.cn

DUNE Communication Strategy



andrew.chappell@cern.ch

Highlights: Educational Activities

Teaching astronomy through Sci-Fi

A New Kind of University Class

An introductory astronomy class that blends a science fiction world and story with learning astronomy

- Designed for intermediate university students who are comfortable with low-level math and science
- Aims to increase engagement through an immersive narrative
- Develops "soft" skills like problem solving, critical thinking, creativity, and collaboration
- Increases intrinsic motivation to learn
- Fosters a "Learner Mindset" over "Performer Mindset"
- Gives students agency in what and how they learn

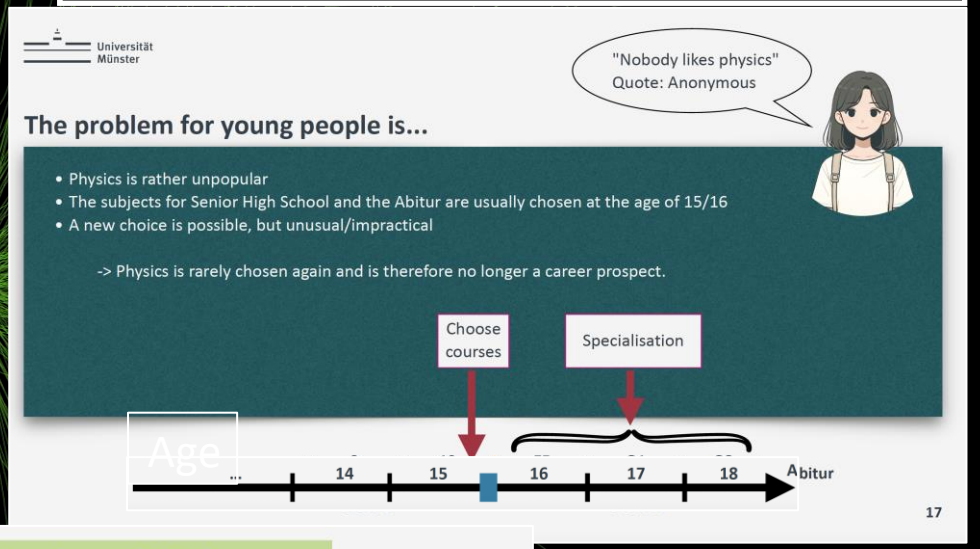
Course Symbol
The World Tree Yggdrasil

Course Website
Spring 2024 Version

slindsay@utk.edu

Imaginative and peer-led teaching programs are beneficial to everyone

Engaging young minds (12-16) in Germany



Young people teaching younger people!

SCIENCE OUTREACH – BENEFITS

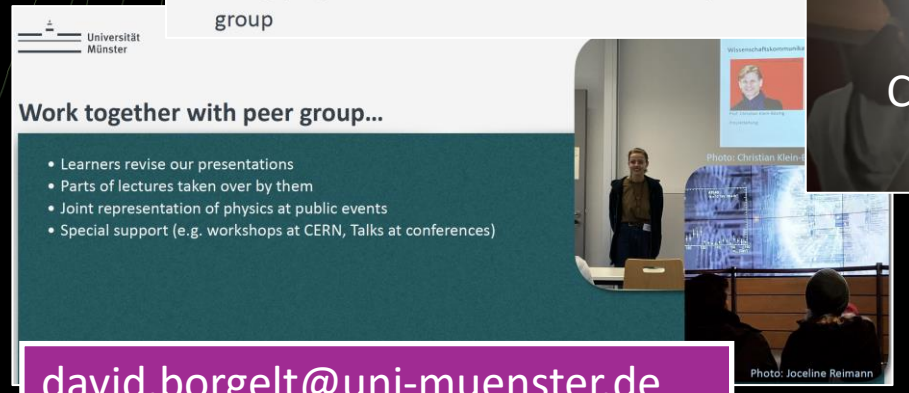
- PRESENTING SKILLS
- PRACTICAL SKILLS
- OTHER TRANSFERRABLE SKILLS
- CONFIDENCE
- REMAINING ENGAGED WITH SCIENCE

david@physicsinthefreezer.co.uk

Peer Teachers (15+)

„In short, peer teaching occurs when students, by design, teach other students." (www.teachthought.com

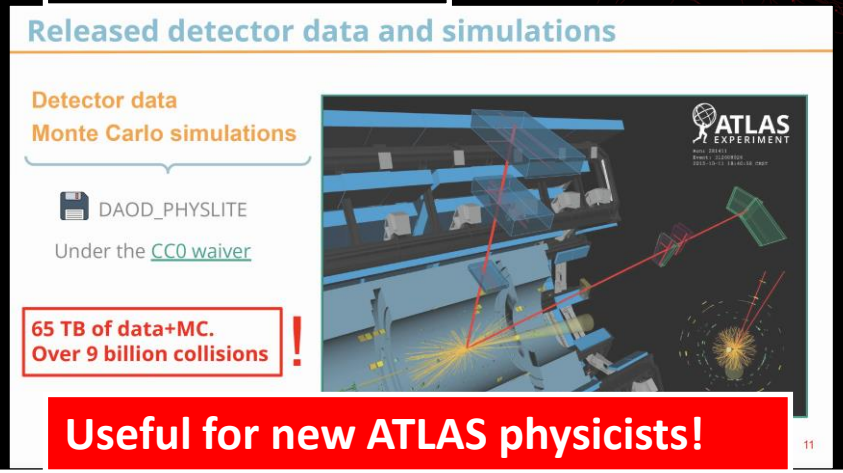
- Young people are experts regarding young people
- Young people are better role models within their peer group



david.borgelt@uni-muenster.de

Highlights: Educational Activities

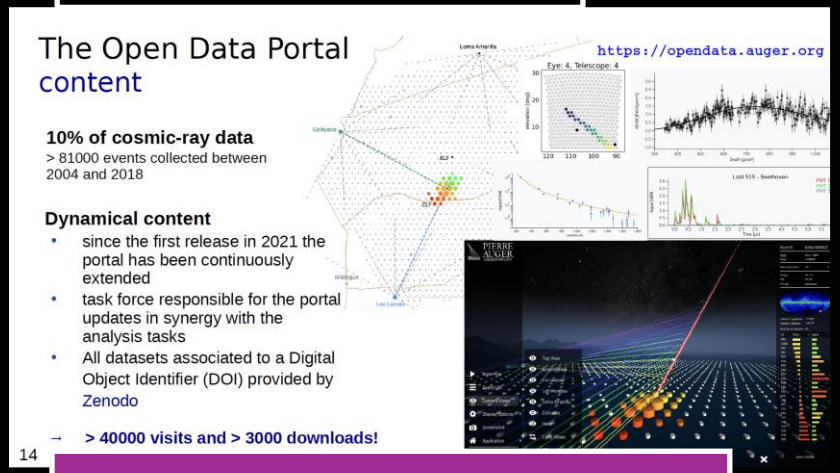
ATLAS Open Data



Useful for new ATLAS physicists!

mariana.isabel.vivas.albornoz@cern.ch

Pierre Auger Open Data



viviana.scherini@unisalento.it

Programs reaching tens to thousands of students!

Czech PP Outreach Project

US-Ukraine Student Program

Steven.Goldfarb@cern.ch

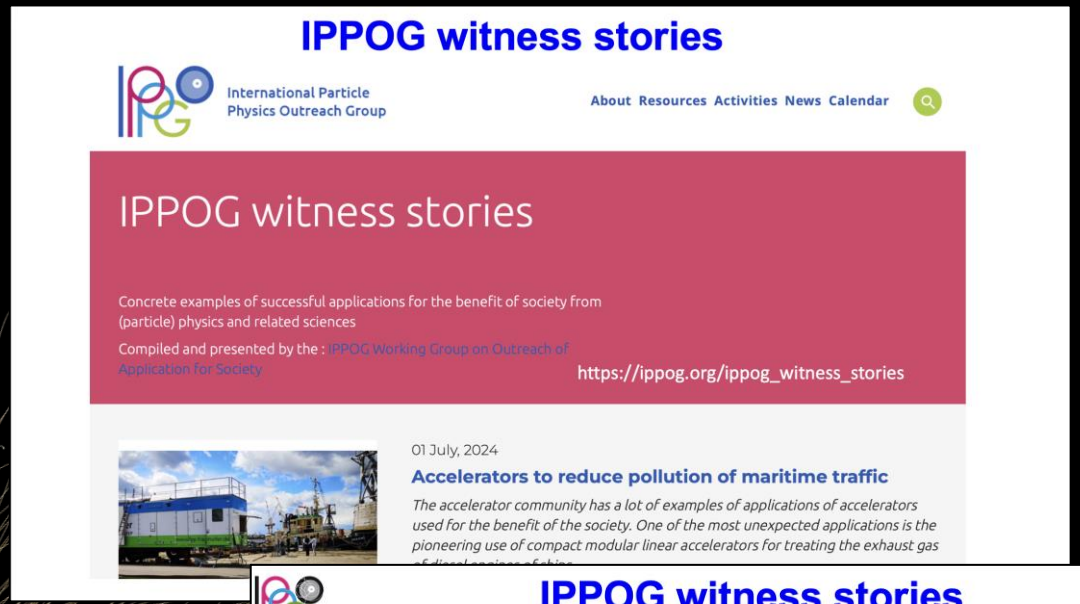
Italian Inspyre Student Program

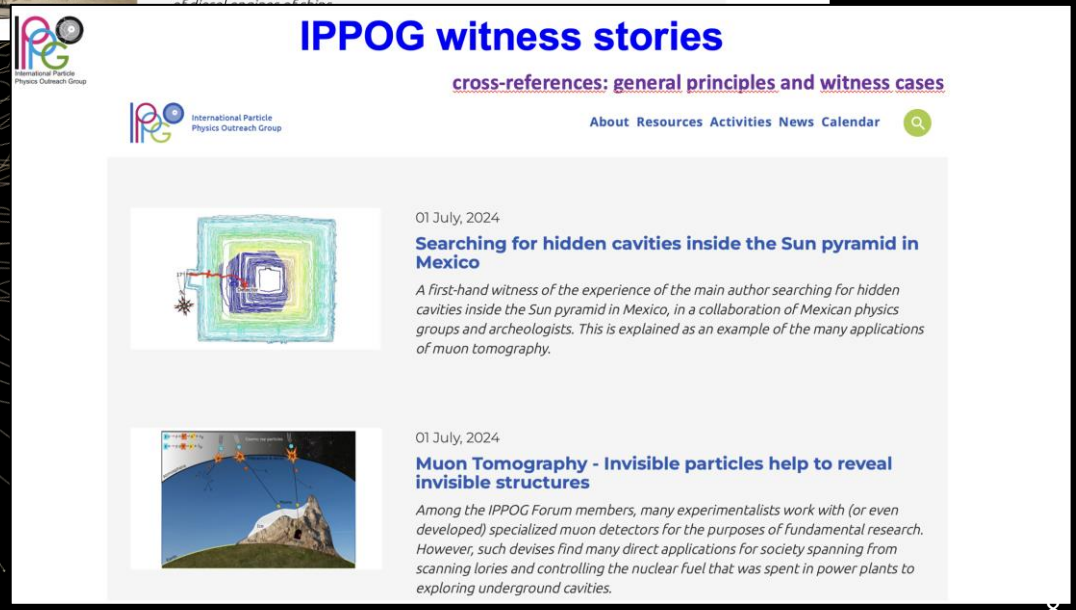
adriana.postiglione@lnf.infn.it

Highlights: Spinoffs from HEP Research

IPPOG Particle Therapy Masterclass

Yiota.foka@cern.ch





Direct and indirect applications of HEP research are powerful persuaders for some audiences

Highlights: Arts & Science

Beinspired student artworks

Michael.Hoch@cern.ch

Being active in Outreach improves creative thinking, crucial for our field!

Proton cookies

Katharine.Leney@cern.ch

Image: Matt Le Blanc

Arts & Science in Italy

giuliana.galati@cern.ch

~8000 high-school students creating science-inspired artworks

Highlights: Arts & Science

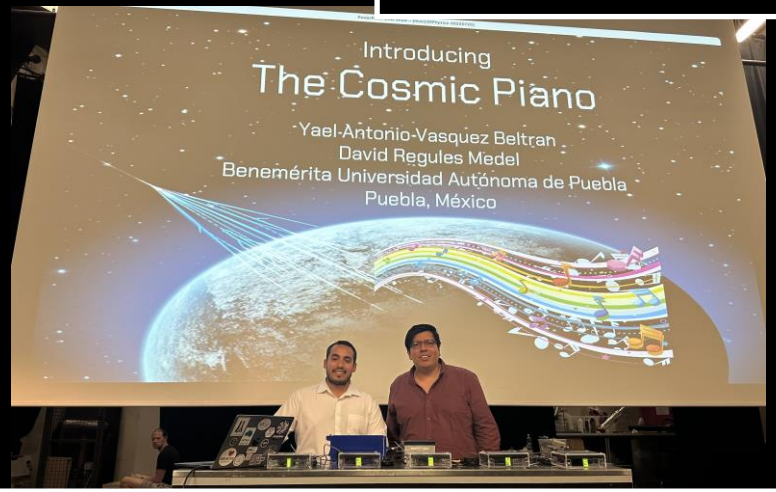
Cosmic Piano…

"Don't be afraid to try something new"

"Collisions" – Science & Literature

Connie.Potter@cern.ch

…at "Colours of Ostrava" festival 20/7/24

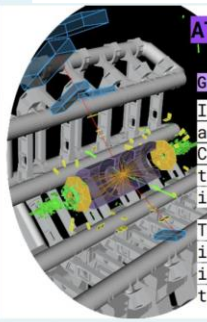


yael.antonio.vasquez.beltran@cern.ch
regules.medel.hector.david@cern.ch

~300 people attended talks by Fabiola and Charlotte
Many great & intelligent questions!

Highlights: Games

ATLAS Game Workshops



ATLAS Game Jam

Group Activity:

Imagine you are a videogame developer and have been asked by scientists at CERN to create a new videogame using the LHC and the Atlas Detector as inspiration.

They would also like you to incorporate physics (real or imagined) in an interesting way… the rest is up to you!

Genre	Goal
1. Racing	1.Escape
2. Sandbox	2. Survive
3. Puzzle	3. Reach Destination
4. Multiplayer	4. Remove all Enemies
5. Battle Royale	5. Rescue or Capture
6. Platformer	6. Highest Score

Feedback

Workshop tested with over 50 participants so far

Feedback received from 25

Workshop rated as outstanding: 4,4 ★★★★½

Rated difficulty as 2.8 -
right in between too hard (5) and too easy (1)

50% feel more likely to consider studying science for A Level or at university

50% feel they are more likely to consider a career in science

University of

k.lohwasser@sheffield.ac.uk

Sci-Me Board Game

michal.jex@fjfi.cvut.cz

Board game includes the **funding process for scientific research, publications etc.**

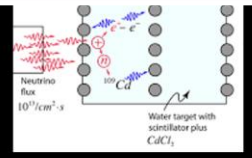
Initiatives target audiences who may not normally look at HEP/science
→ Creates support and interest

Exographer – Ubisoft/LLR Development

A SCIENCE-INSPIRED WORLD BUILDING

in game

raphael.granier.de.cassagnac@cern.ch



scenes

(to be revealed in a wiki, reddit, discord, forum…)

9 | EXOGRAPHER

"Platform" game in style of "Super Mario" with **Feynman diagrams, forces, Higgs**…
5000 people already added this to their "wishlist" on the Steam platform – 20 €

Highlights: Exhibitions

Quantum Mechanics exhibition in Trento

francesca.scianitti@presid.infn.it

Public's response

- **100,000 visitors in 6 months**
- 5,000 visitors guided tours
- 5,700 students attended guided tours

Exhibition focussed on storytelling:
macrocosm, microcosm, quanta, paradoxes

Excellent involvement from PhD students & post-docs who learned how to explain their own topics more clearly

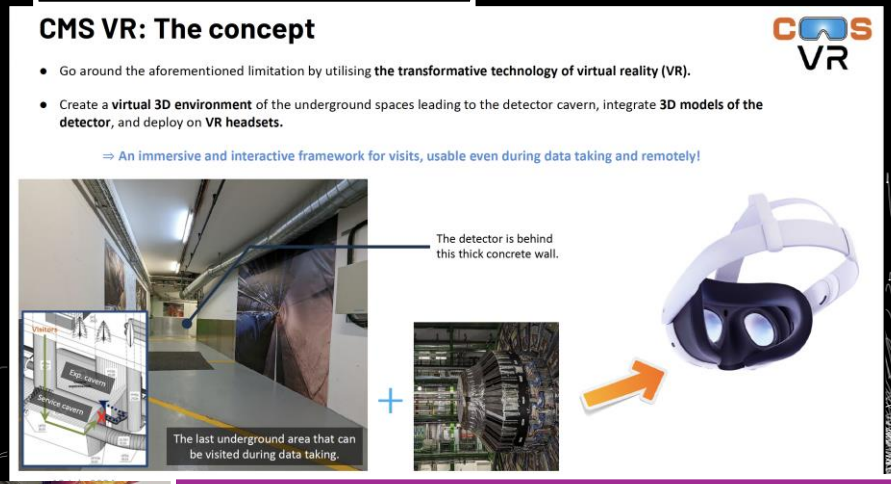
European Researchers Night across Italy

Guided tours of labs were by far the most impactful activity

Livia.Soffi@cern.ch

Highlights: Visits – improving inclusivity

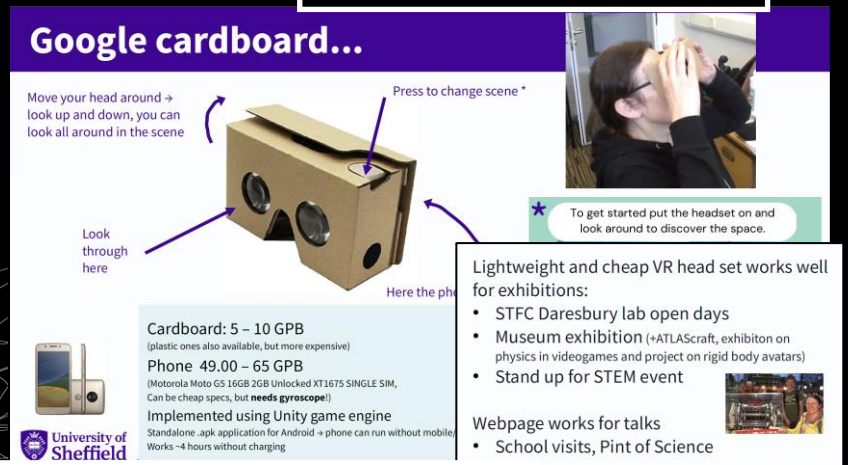
CMS Virtual Reality



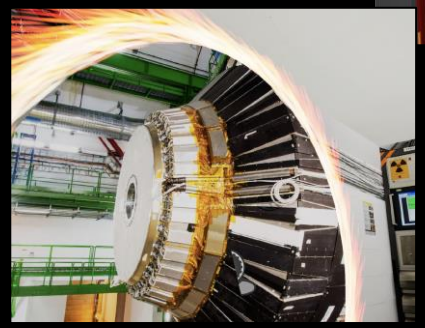
muhammad.ansar.iqbal@cern.ch

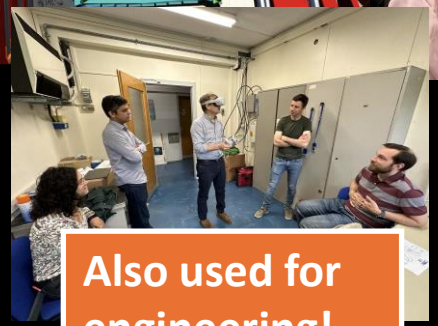
Visits to major facilities can be done cheaply and effectively without traveling

ATLAS Virtual Reality



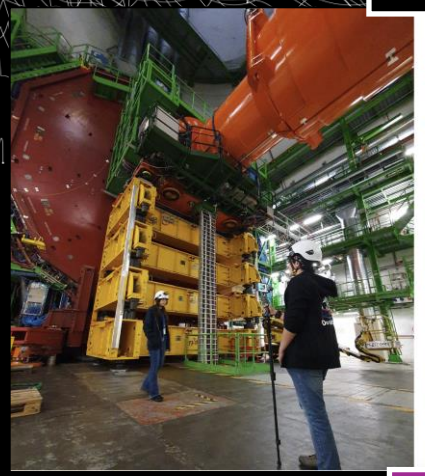
k.lohwasser@sheffield.ac.uk





Also used for engineering!

CMS Virtual Visits



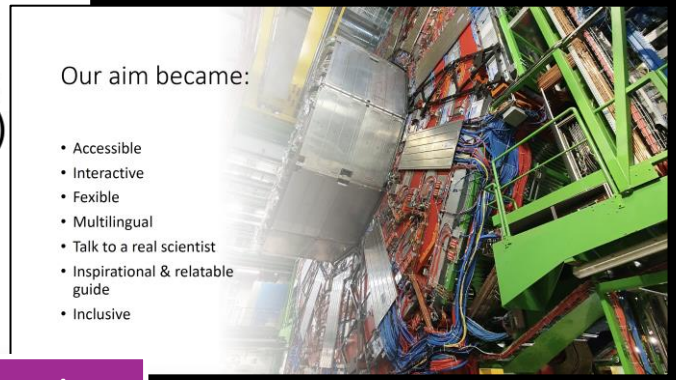
Visiting CMS from your living room (virtually!)

Noemi Beni, Zoltan Szillasi
on behalf of CMS Collaboration

ICHEP2024, Prague, Czech Republic

Our aim became:

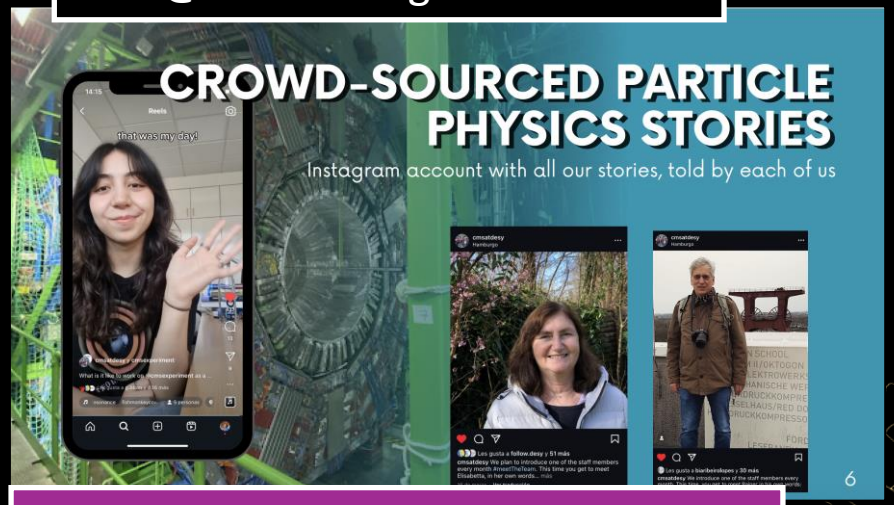
- Accessible
- Interactive
- Fexible
- Multilingual
- Talk to a real scientist
- Inspirational & relatable guide
- Inclusive



Noemi.Beni@cern.ch

Highlights: Social Media

CMS@DESY Instagram Stories

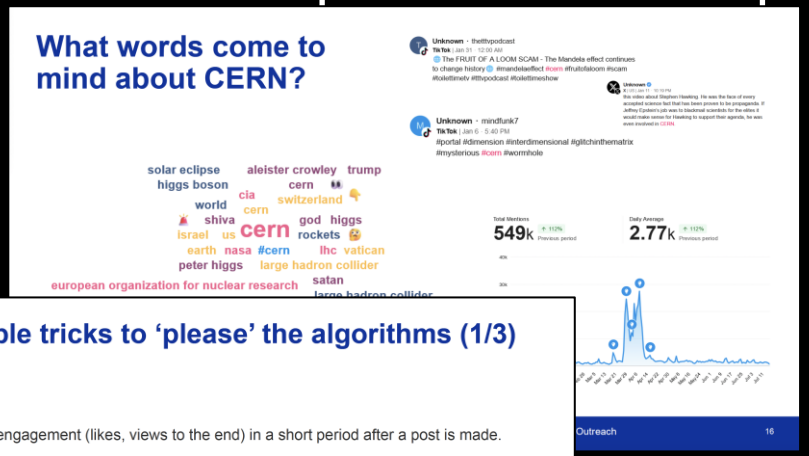


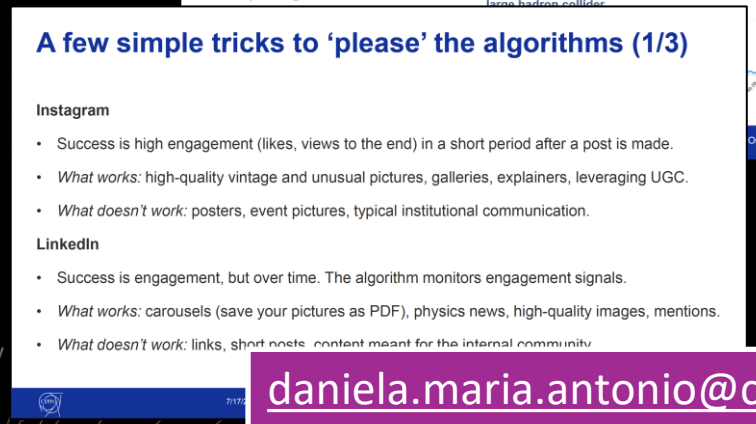
lucia.ximena.coll.saravia@desy.de

"The power of a smartphone"

Advice given to people hosting Social-Media accounts

CERN Social Media





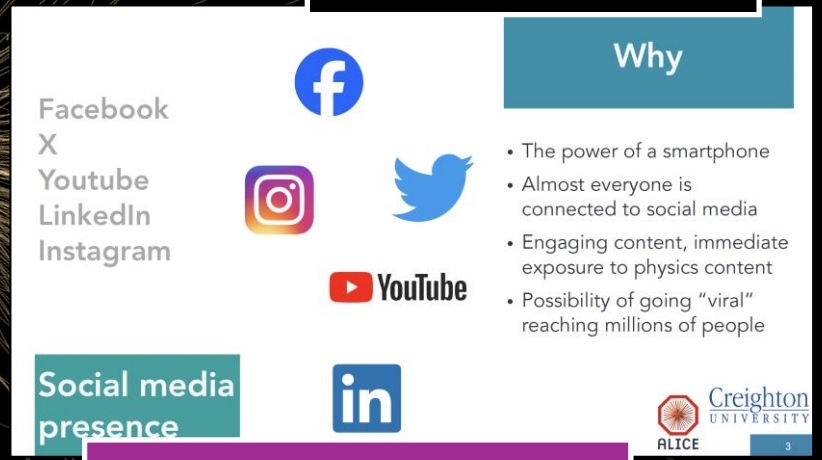
daniela.maria.antonio@cern.ch

Highlights individuals and groups

Show the "real life" of physicists, engineers, technicians…

Help in recruitment

ALICE Social Media



simone.ragoni@cern.ch

Benefits of involvement in E&O

Several talks emphasized the benefit to physicists/engineers from participating to E&O, including:

- Improving creative thinking
- Better understanding of the “big pictures” of HEP (physics, detectors, past & future)
- Better appreciation of the whole HEP landscape
- Helps physicists/engineers explain more clearly their own research

Young people teaching younger people!

SCIENCE OUTREACH – BENEFITS

- PRESENTING SKILLS
- PRACTICAL SKILLS
- OTHER TRANSFERRABLE SKILLS
- CONFIDENCE
- REMAINING ENGAGED WITH SCIENCE

Presenting HEP to non-HEP audiences

Another good way to end a talk is with a summary of the main messages!

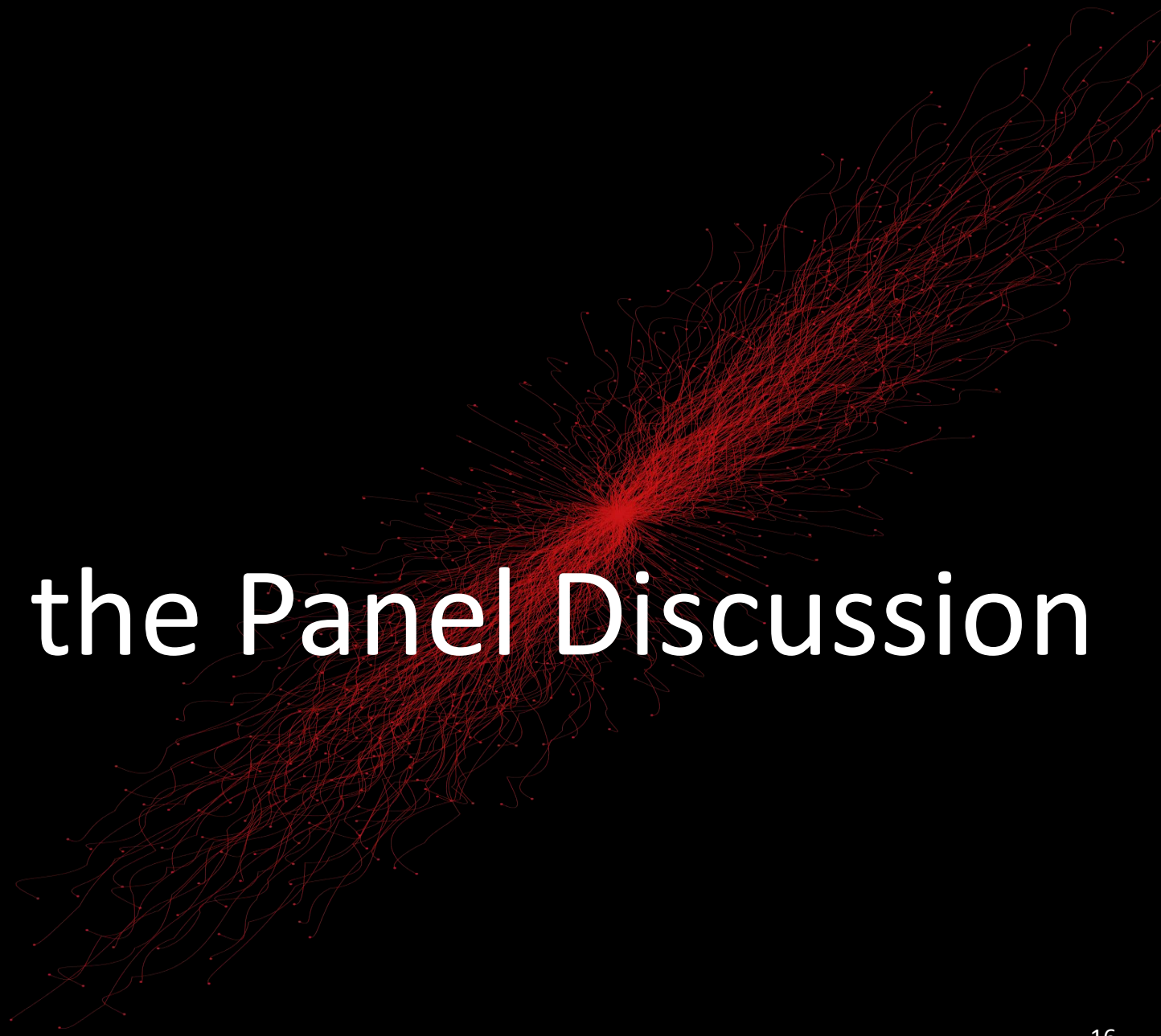
- **Know your audience** and target them!
- Select a few main messages that you want to get across and **focus** the talk around these messages
- Anecdotes – especially **triumph over adversity** – are really powerful
- Add **local interest** if you can
- Add some **personal history** in your own
- Be **interactive** (if appropriate)
- **Simplify plots** to focus on the main message
- Don’t be afraid to **think differently** for the content ordering

All of these guidelines are perfectly applicable to any talk you give – including to the HEP community!

ICHEP 19.07.24 35

David.Barney@cern.ch

Highlights from the Panel Discussion



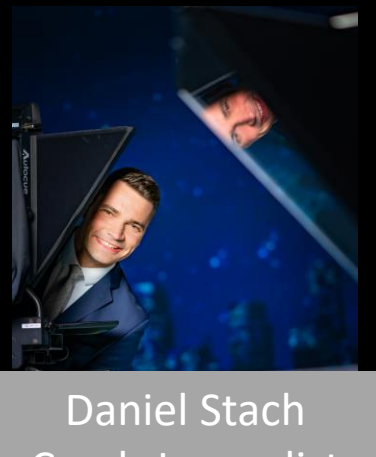
Panel Discussion#1 – Participants & Reason

Paris Sphicas
ECFA Chair

Spencer Kelly
BBC Journalist

Sarah Demers
Yale Physicist

Matt Chalmers
CERN Comms



Daniel Stach
Czech Journalist

HEP faces enormous challenges that put its future at risk, including:

- Limited likelihood of major **discoveries** in the coming years
  - But huge progress in **precision physics**, that may point to deeper understanding
- "**Competition**" from other "big science" fields, such as astrophysics, AI, environment science etc.
  - So **can we still attract the best scientists/engineers** into our field?
- **Cost** of major new collider facility is large in absolute terms
  - Although cost per TeV will be **lower than any present accelerator**
- **Environmental impact** of any new collider facility
  - Electricity, construction etc. – but **advances driven by HEP will limit this**

Communication from **everyone** involved in HEP is necessary!

Brief summary of the panel discussion

~150 people for 1.5 hours!

Very lively discussion, inc. audience. Video available

Suggestions for E&O participation included:

- Storytelling – everyone has a story to tell
- Don’t promise things - focus on always exploring further (like in astrophysics)
- Adapt to your audience
- Practice practice practice
- Everyone can – and should - play a role – many different ways to communicate
- Education & Outreach activities must be recognized by our hierarchies as important

Some quotes from the Panel Discussion

"Make people want to talk about particle physics to their friends"

Daniel Stach

"The story of particle physics is the ultimate narrative and lifts people outside of their everyday lives"

Matt Chalmers

"Start with a headline that grabs their attention and then slip in something new that excites them"

Spencer Kelly

"We're getting paid to create knowledge. And if you are going to create knowledge you need to share it as well"

Paris Sphicas

"Do at least one thing per year to engage non-HEP audiences, that takes you out of your comfort zone. You will be a better scientist"

Sarah Demers

Some comments from Future Facilities Panel Discussion

"The Public are fascinated by our research. Particle physics is the modern equivalent of "where are we going?"

Fabiola Gianotti (CERN)

"It might be time to add science communication courses to undergraduate science courses"

Lia Merminga (FNAL)

"Share our stories with passion. We owe it to the taxpayers who fund our science"

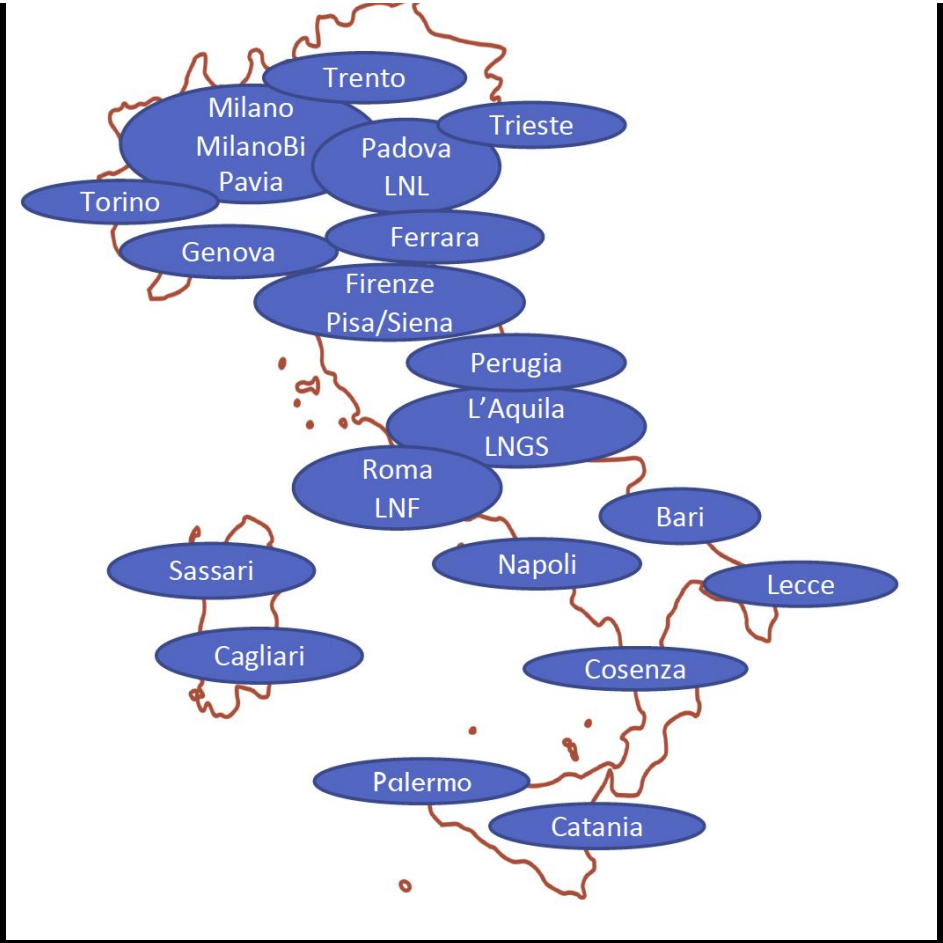
Shoji Asai (KEK)

"We need to educate the public on the importance of science"

Yifang Wang (IHEP)

Acknowledgment & support of E&O is crucial

Outreach Cosmic Ray Activities throughout Italy



Italian example: many activities ongoing!

- "Mission 3" in INFN is to pursue E&O activities
  - Directive from the top!
- Several hundred k Euros/year for E&O
- Percentage of "score" for jobs and promotions comes from E&O

Some other countries include the need for E&O explicitly in grant applications

Education & outreach efforts by our physicists/engineers must be **encouraged, supported and acknowledged accordingly**

The bottom lines

To help overcome the challenges faced by our field in the coming decades, communication from **everyone** involved in HEP, and at all levels, will be critical. This cannot be left to a handful of dedicated "outreach activists!"

The skills obtained from being involved in outreach are **valuable for our lives as physicists and engineers**

Education & outreach efforts by our physicists/engineers must be **encouraged, supported and acknowledged accordingly**

HEP needs YOU to communicate & educate!

Response to first audience comment

The first audience comment basically said “it takes weeks to plan an event like a Masterclass…it is a waste of our valuable time”.

My response was along the lines of “actually there are many types of activity that don’t take so much time” and another audience member added “and there are people to help you”.

What I should have added was “doing the type of research we do, that is funded by the public, without telling anyone about what we do: that would be a waste of time. Several funding agencies have acknowledged the need to recognize E&O work explicitly, in grants and in job applications/promotions – as it is vital for our field to proceed. The lab directors also emphasized the need to communicate our work and future plans as being imperative. In the words of Paris Sphicas: “we just have to do it!””