EUROPEAN
PLASMA RESEARCH
ACCELERATOR WITH
EXCELLENCE IN
APPLICATIONS

EuPRAXIA
Preparatory Phase

Research Initiatives in Developing Communities and Potential Opportunities for EuPRAXIA

Christine Darve / European Spallation Source, ERIC

September 27, 2024

This project has received funding from the European Union´s Horizon Europe research and innovation programme under grant agreement No. 101079773

Outline

Funded by the European Union

- Research Infrastructure to develop community
  - The ESS case
  - Common projects for Neutrons, Photons and beyond
  - Using Data as Tools
- Research Initiatives for Developing Communities
  - IUPAP – WG14
  - Educational platforms: Schools; MOOCs
  - Communication w/o Borders !

Context and Paradigm

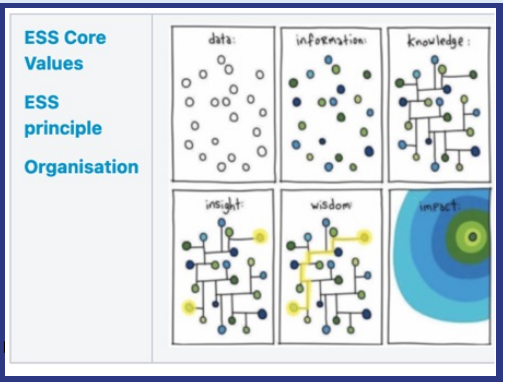
Funded by the European Union

Will EuPRAXIA enable the next Revolution ?

INDUSTRIAL economy

INFORMATION economy

MOLECULAR (NBIC) economy



ORGANIZATION (society)

BUSINESS (maturity)

TECHNOLOGY (growth)

SCIENCE (gestation)

The Adaptive Enterprise

New media
IT services
Portals

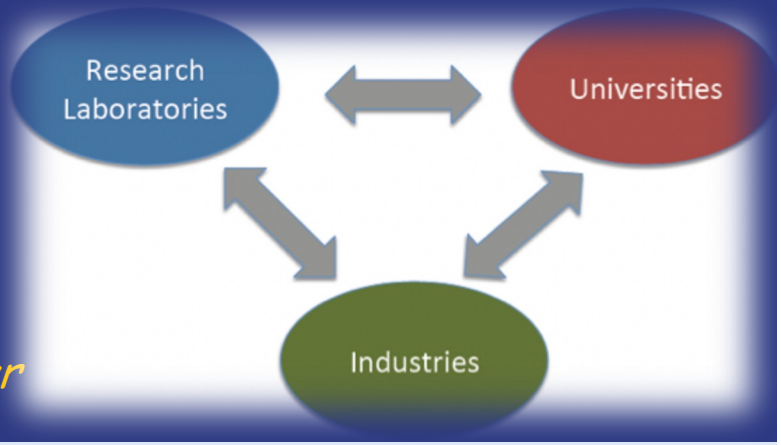
Chips
Operating systems
WWW

Solid state physics
Information theory

- Nanotechnology
- Biotechnology
- Information technology
- Cognitive science
- Materials

Economic value added

1750s 1850s 1950s 2050s Year



It's Alive - The Coming Convergence of Information, Biology, and Business Christopher Meyer 2003

Research Infrastructure to develop community

Funded by the European Union

The European Spallation Source, ERIC … from green field to reality!

Research Infrastructure (RI) and industries supported by the enlightened organizations and education, can generate a sustainable environment to serve this purpose

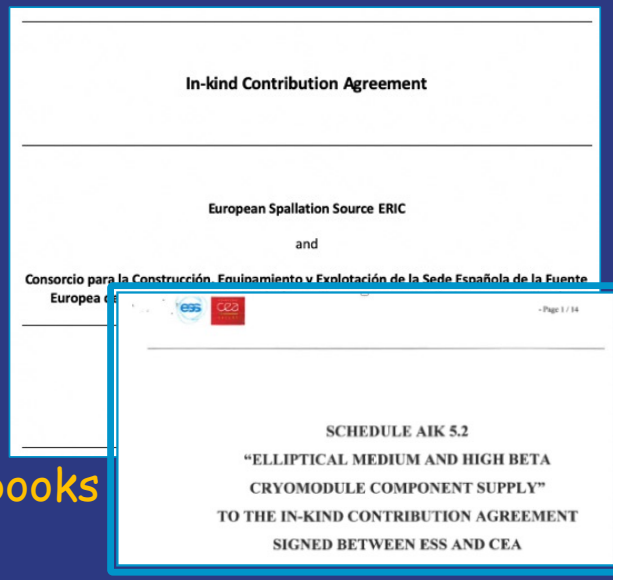
Synergies between 4 main stakeholder groups, that together empower solution driven and results focused execution of projects.

Research Infrastructure to develop community

Funded by the European Union

Contracts between ESS and In-Kind partners are composed of In-Kind Collaboration Agreements and Technical Annexes

- Technical requirement/scope
- Product compliance with European Directives
- National regulation and harmonized standards
- Project Quality Plan



→ Methodology supported by ESS Management System and ESS handbooks

→ Tools to facilitate data transfer and integration

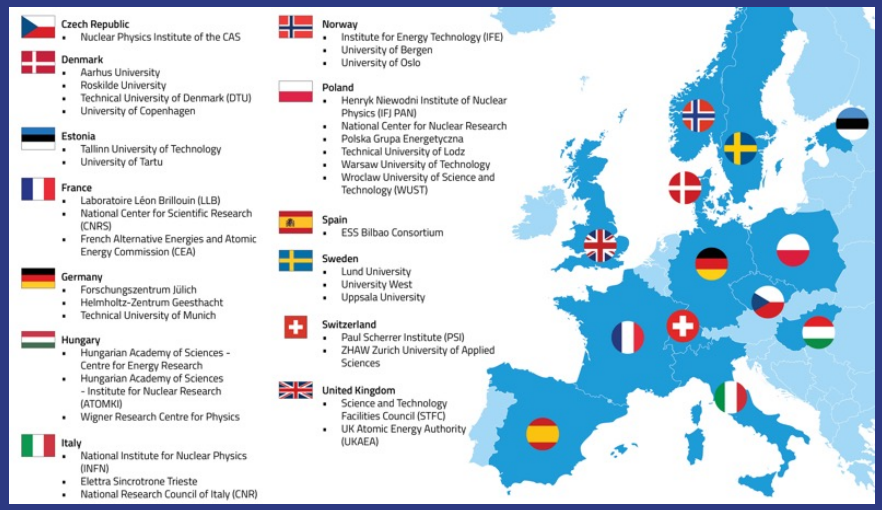
→ Continuous follow up from technical experts from In-Kind partner and ESS

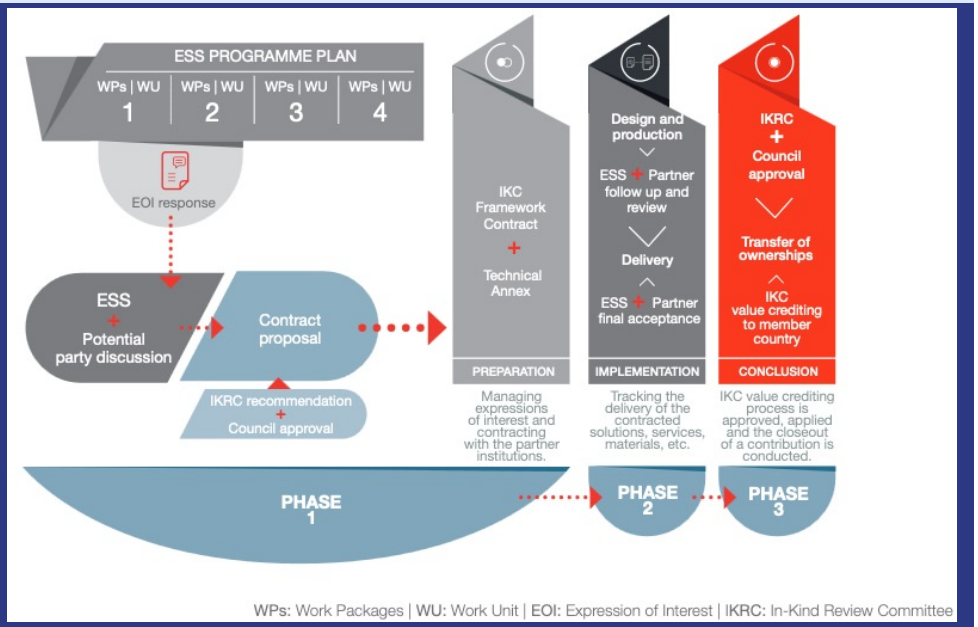
Research Infrastructure to develop community

Funded by the European Union

European Spallation Source established as ERIC* in 2015

*ERIC legal framework was created by the European Commission in 2009





→ESS Bilbao – SOCIO-ECONOMIC IMPACT

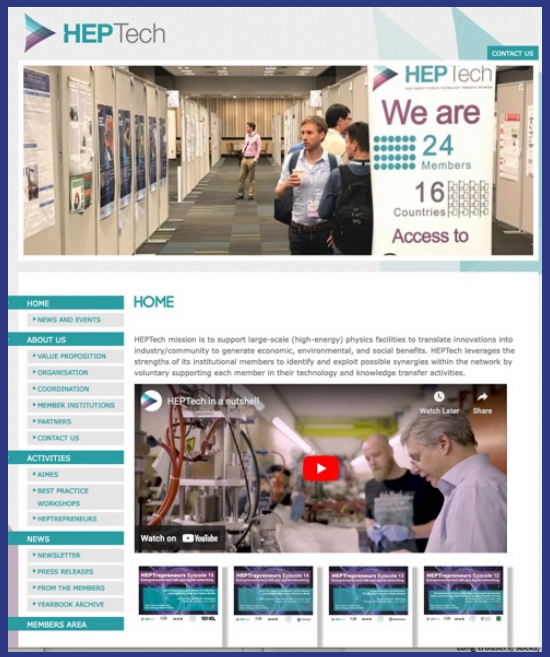
- Develop and maintain the **Member's industrial base**
- Boosts the professional and **social capital** of the member's scientists and engineers
- Enhanced **status** for their respective **national institutions** that are part of the **global communities**
- Distribution of the work to the Members is a major driver in fostering a **community of innovators**

"The European Research Infrastructure Consortium (ERIC) as governed by EU law and Swedish law: A study on a European Union legal form within the Swedish legal system", Ph.D. study by Arnljótur Astvaldsson : https://lnkd.in/dh5p6Xdc

More Networks for Global Research Initiative

Funded by the European Union

- In-Kind Committees, Boards & Reviews
- EC Grants (e.g. BrightNESS, ENRIIC)
- ERIC-Forum project
- Field Coordinators & In-Kind Network
- ILO & Big Science Forum
- HEPTech



In-Kind Contribution & Knowledge Transfer

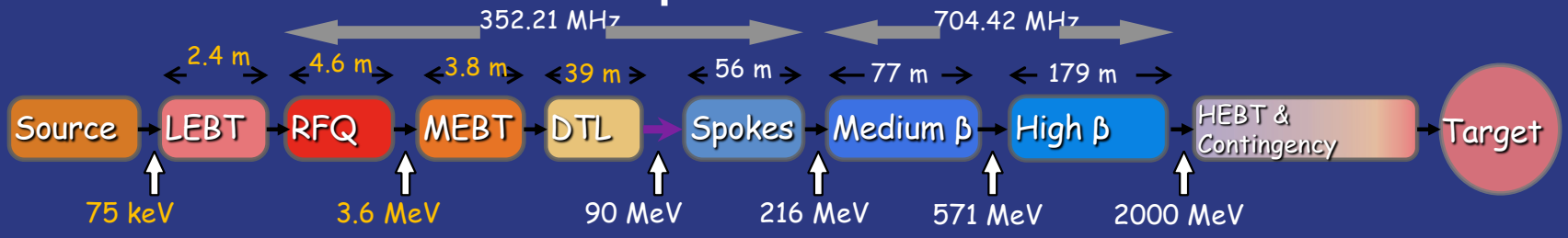
Funded by the European Union

Normal Conducting Super Conducting

Key parameters:

5 MW average beam power
2 GeV
62.5 mA peak
2.86 ms long pulses
14 Hz
4 % duty cycle

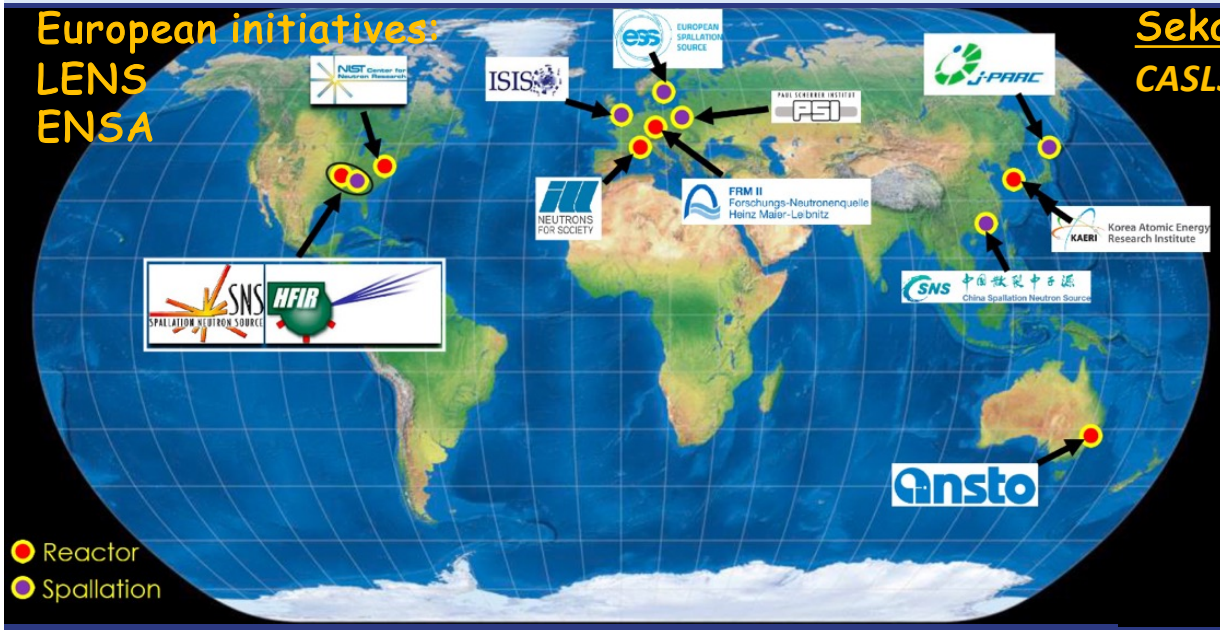
	Spoke	M-β	H-β
β	0.5	0.67	0.86
# CM	13	9	21
Cav. /CM	2	4	4
# Cav.	26	36	84
CM L [m]	2.9	6.6	6.6
L [m]	56	77	179

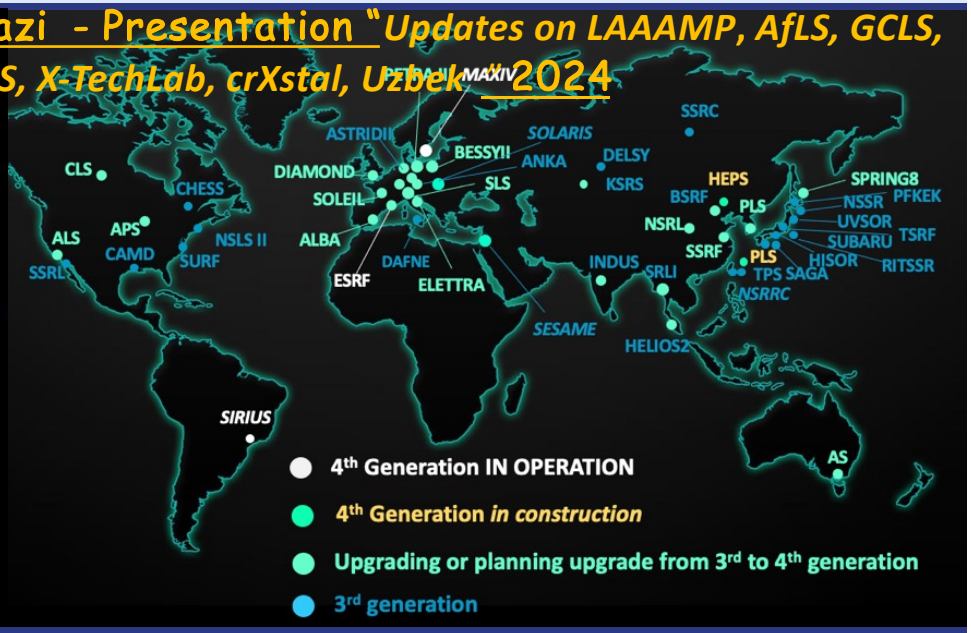


96% of acceleration will be provided by superconducting cavities supplied by dedicated high power RF sources

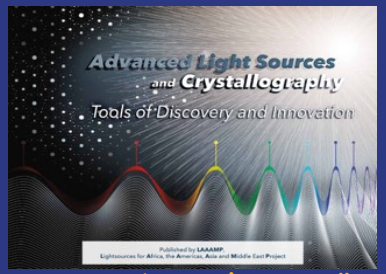
Common projects for Neutron, Photon and beyond

Funded by the European Union





NEPHEW (EU Grant)!
It brings together the LEAPS and LENS RI in a broad combined access programme for excellent curiosity driven science for the first time.



Approved upgrade projects in Europe:
- SLS2 (in execution; op: 2025)
- Elettra2 (in execution; op: 2026)
- Diamond2 (in execution; op: 2027)
- Soleil2 (in execution; op: 2028)

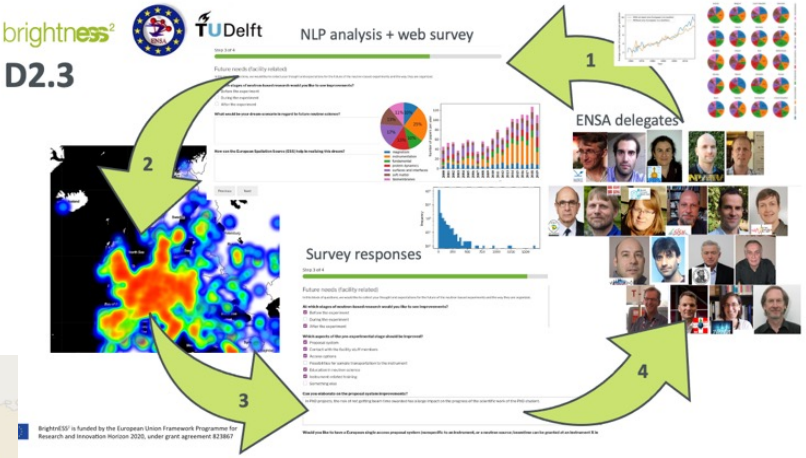
LAAAMP brochure: "*Advanced Light Sources and Crystallography: Tools of Discovery and Innovation*"

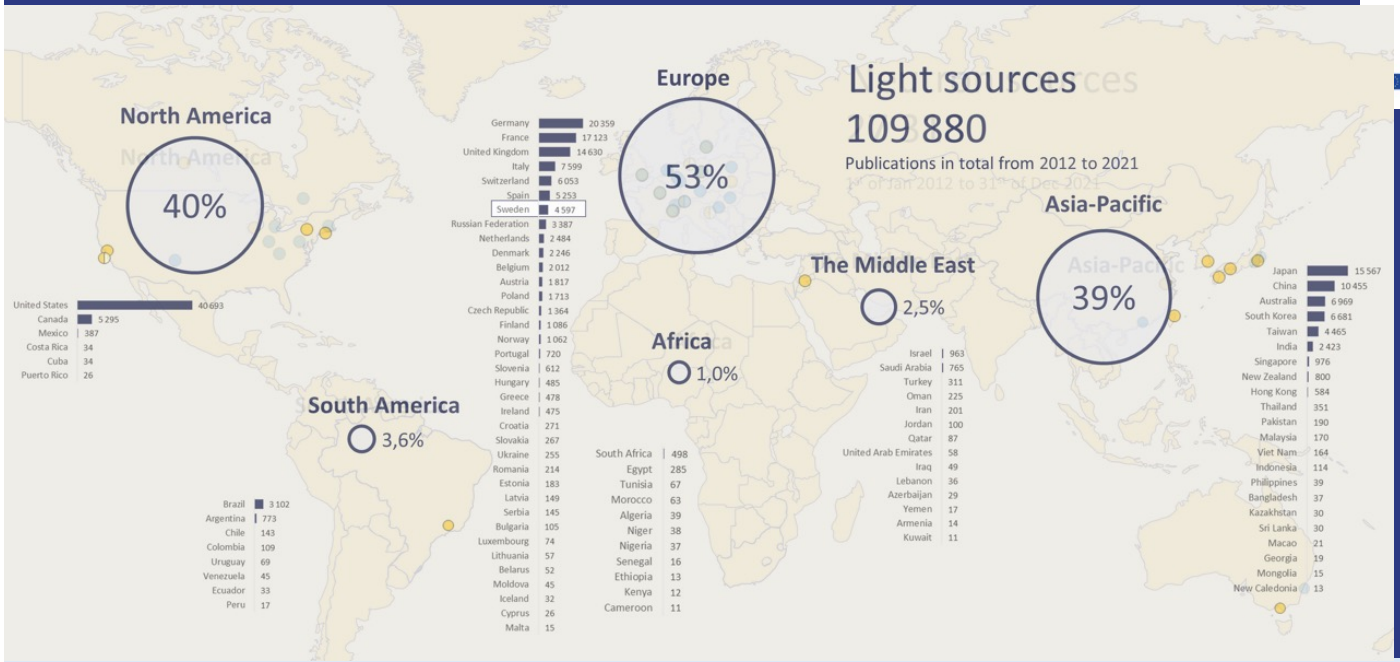
Tools for discoveries and tools to reach them !

Funded by the European Union

Natural Language Processing (NLP)

LENS Colloquium and BrightnESS² General Assembly
(2020, Feb. 11-12)





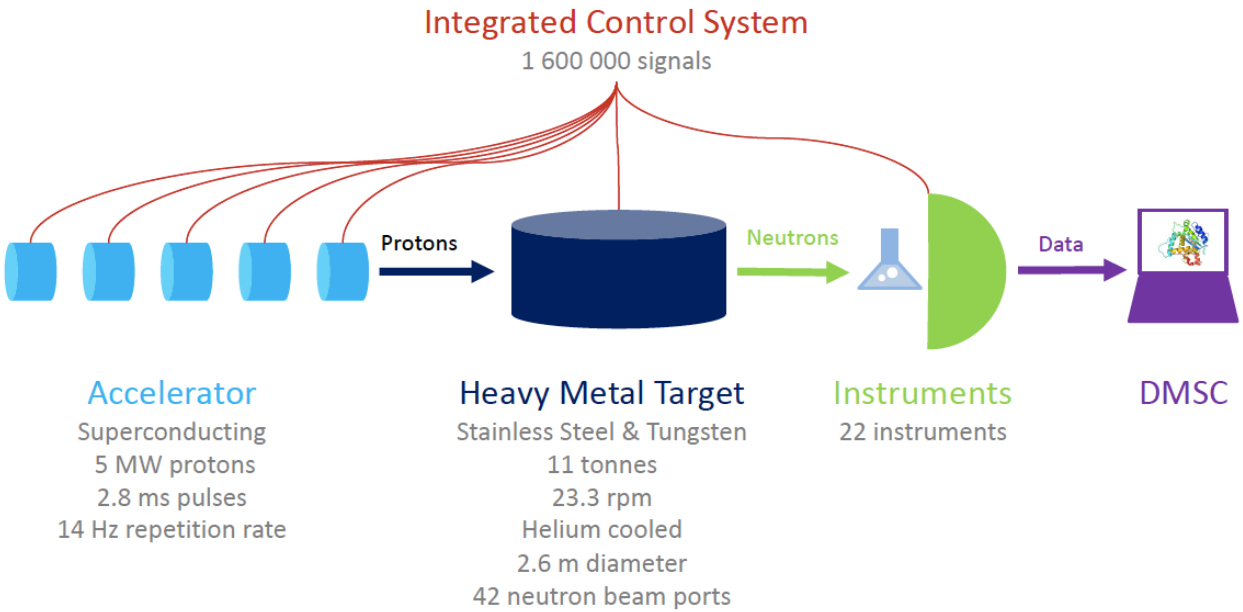
"What is the size of the global light- and neutron source research communities?"
by Martin Stankovski and Farhad A. P. Khotbehsara

Tools for EuPRAXIA?

Using Data as Tools

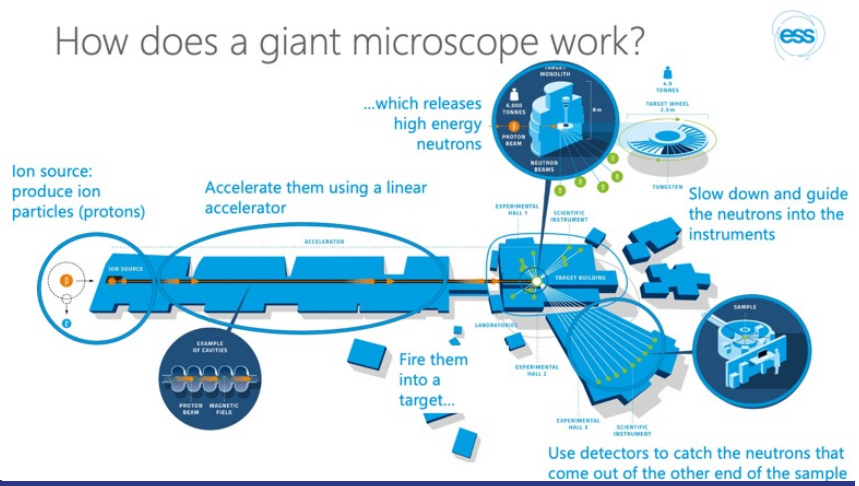
Funded by the European Union

ESS Data and Data Management and Software Centre (DMSC)



SciCAT

Manage and annotate your scientific data



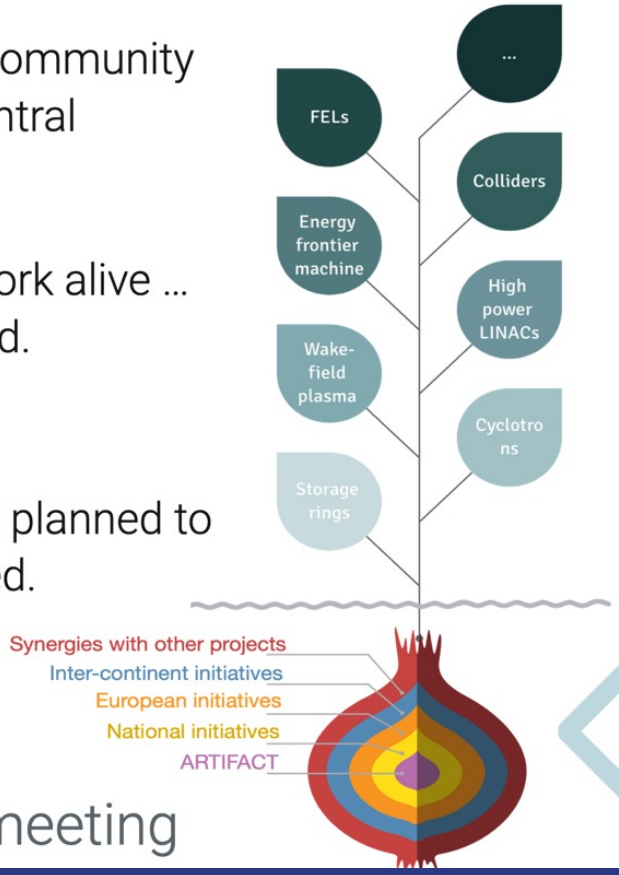
PaNOSC : Photon and Neutron Open Science Cluster is the Science Cluster representing European Research Infrastructures (RIs), developing and providing services for its scientific community and connecting these to the European Open Science Cloud (EOSC).

Using Data as Tools

Funded by the European Union

The seed is planted

- A large part of the European community is now organised around a central project.
- But we need to keep the network alive … even if ARTIFACT is not funded.
  - → Governance structure
- At the same time, clusters are planned to appear, as leafs out of the seed.
  - → Marie Curie exchange programs, ERC, national programs, …



TIARA meeting

artifact

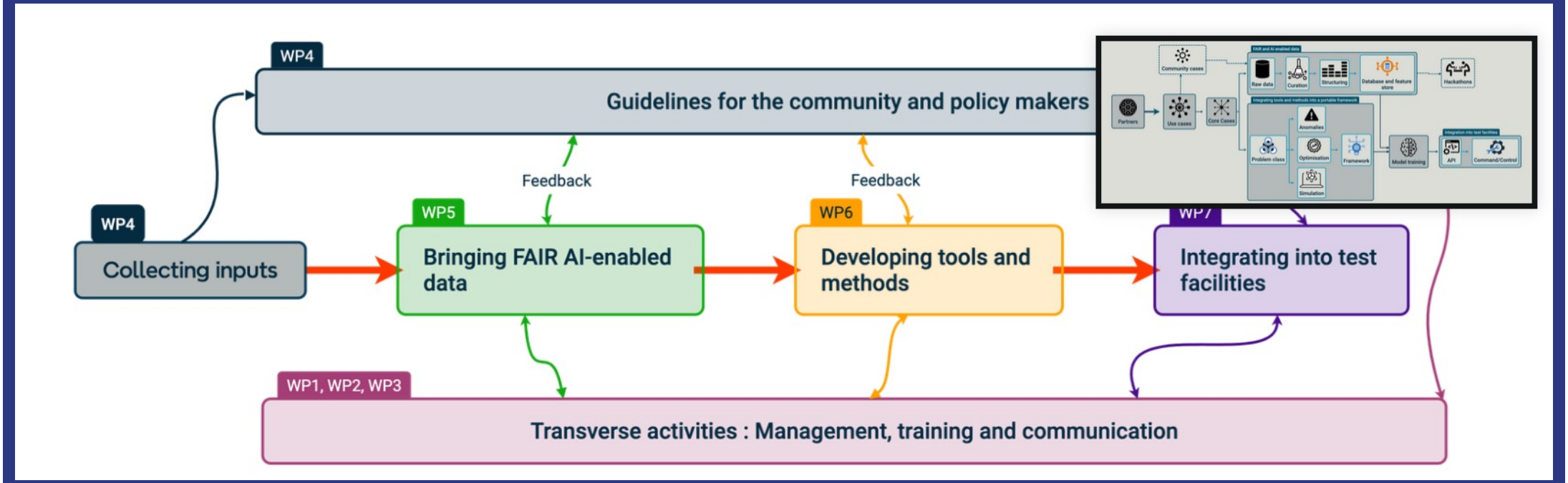
ARTifical Intelligence For Accelerators, user Communities and associated Technologies

See Slide presentation to TIARA (April 2024)

Using Data as Tools

Funded by the European Union

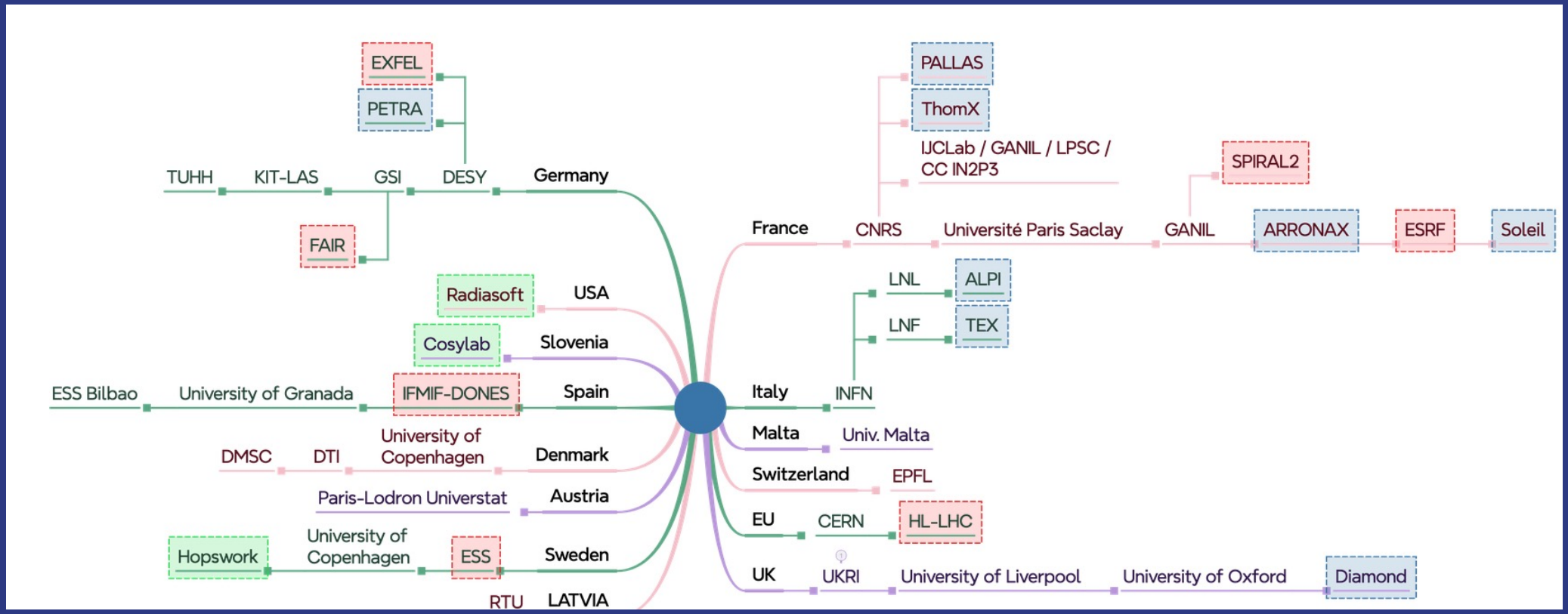
ARTIFACT Project Implementation



Using Data as Tools

Funded by the European Union

14 countries, 30 institutes,15 RI,7 ESFRI RI, 3 companies, many more people



Outline

- Research Infrastructure to develop community
  - The ESS case
  - Common projects for Neutrons, Photons and beyond
  - Using Data as Tools
- Research Initiatives for Developing Communities
  - IUPAP – WG14
  - Educational platforms: Schools; MOOCs
  - Communication w/o Borders !

Funded by the European Union

WG14: Accelerator Science - Mandate

Promote the exchange of information and views among the members of the international scientific community in the field of Accelerator Science including, but not limited to, the following:

- Education and training in Accelerator Physics and Technology
- Theory & experiments concerned with the nature and properties of particle accelerators and beam physics
- Improvement of international communication in Accelerator Science through the sponsorship of professional meetings
- The future of accelerator facilities for various fields that benefit science and society
- Industrial, medical, energy production and environmental applications of relevant accelerator technologies

More Accelerator Conferences via IUPAP

IUPAP – WG14

Funded by the European Union

Align with IUPAP Mission : "To assist in the worldwide development of physics, to foster international cooperation in physics, and to help in the application of physics toward solving problems of concern to humanity"

Physics outside academia

Development of Creative Commons licensed presentation materials

Areas identified:

- Applications of accelerators to environmental and societal challenges in line with the UN Sustainable Development Goals (SDGs)
- Particle beams for medical applications
- Accelerators from discovery to industry
- Future accelerators, including showcases on plasma physics and compact accelerators
- Accelerators as collaborative tools and enablers of peace

Training the future researchers

Funded by the European Union

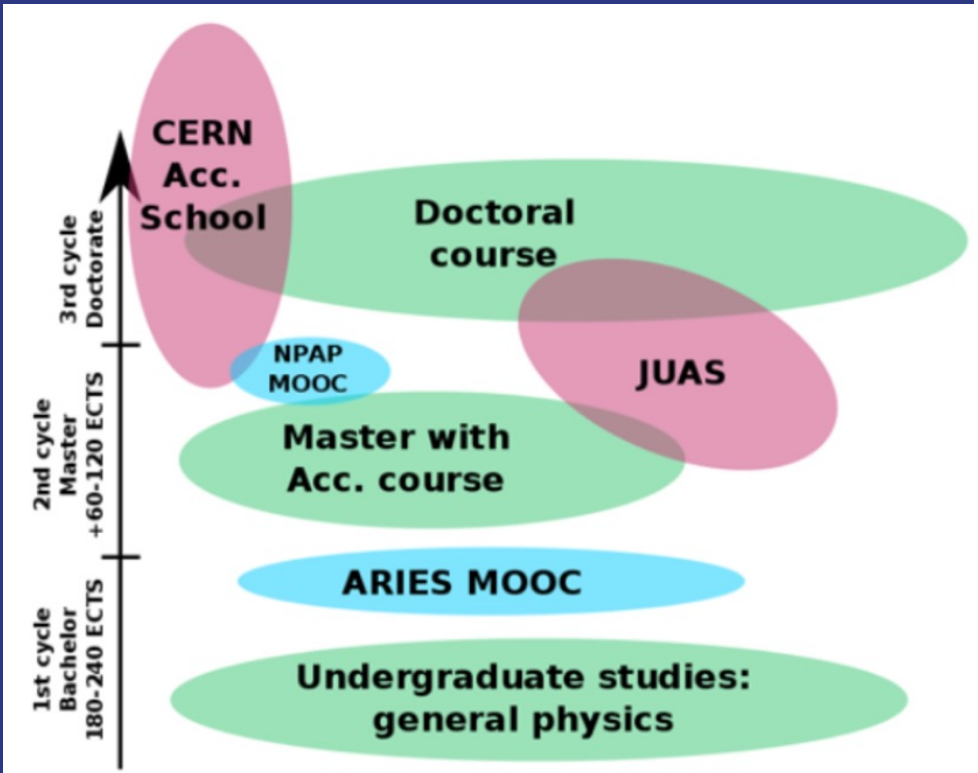
Existing educative platforms and programs for Particle Accelerators:

- Schools: JUAS, CAS, HASCO, USPAS, ACAS, ASP
- University programs (e.g. Aarhus, LU)
- EU-TIARA market surveys
- EU-ARIES and I.FAST

New Pedagogical tools for Accelerator science?

- School levels are typically advanced
- Domains/Field complementarity; User communities
- To provide sustainable and "users-friendly" tools

Sustanability training using Massive Open Online Courses (MOOC)



Training the future researchers

Funded by the European Union

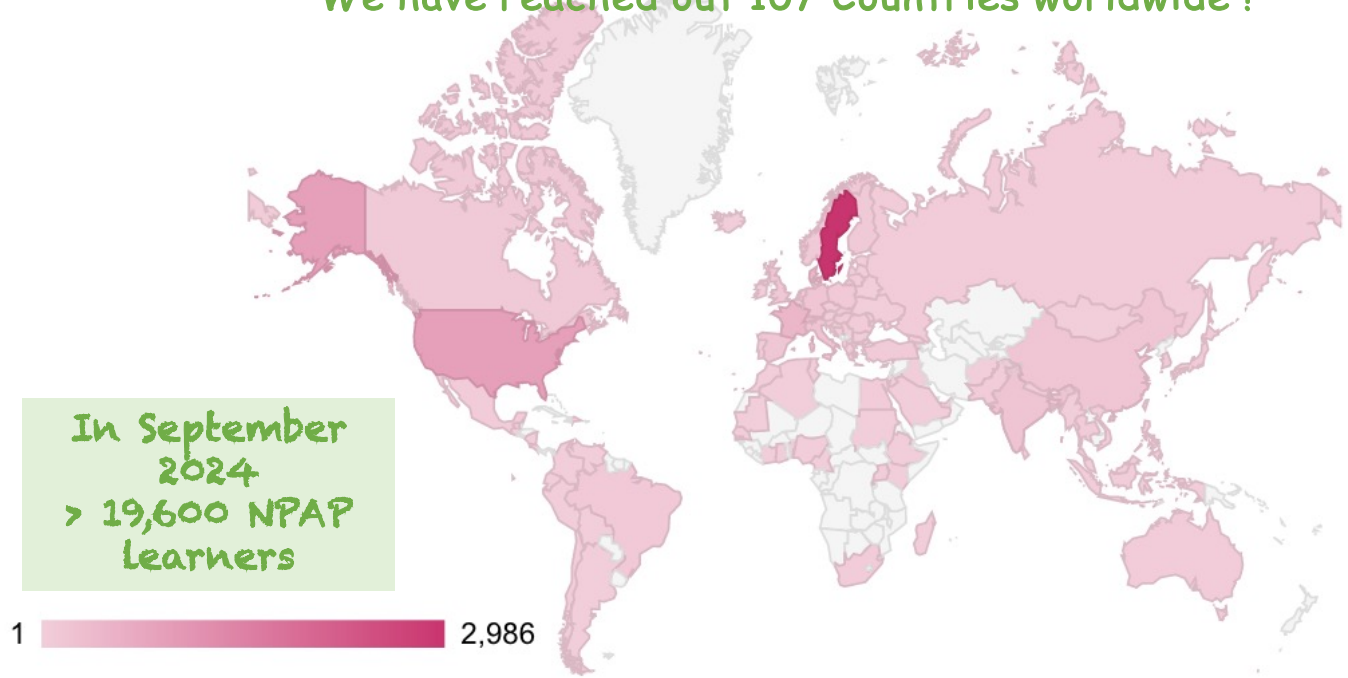
The Nordic Particle Accelerator Project (NPAP) to develop capacity in Northern Europe with emphasize on MAXIV and ESS

From proof of Concept w/ 2015 summer School to MOOC

EU Grant Strategic Partnership:

- Three Summer Schools
- 90 students
- Visit of MAXIV and ESS

We have reached out 107 Countries worldwide !

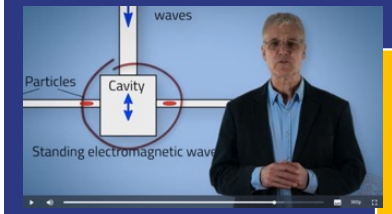


NPAP MOOC Topics

Funded by the European Union

MOOC1: Particle Accelerators introduction

→ Launched in August '19



100% online
Start instantly and learn at your own schedule.

Flexible deadlines
Reset deadlines in accordance to your schedule.

Intermediate Level
Basic physics at undergraduate level

Approx. 17 hours to complete
Suggested: 4 weeks of study with 5-8 hours/week

English
Subtitles: English

Accelerators for Synchrotron Light
Light and Light Sources
Accelerator to make light
The development of accelerators for synchrotron light

Photon light sources and MAXIV
Synchrotron radiation
Bending magnets, wigglers and undulators
Free Electron Lasers

Spallation source and ESS
Introduction and neutron science
European Spallation Source

Particles Colliders
Introduction to Particles Colliders
The LHC and its experiments
Linear Colliders
Future Circular Colliders

Plasma Wakefield (to be completed)

MOOC2: Fundamentals of accelerator technology

→ Launched in March '19

RF-System
Introduction to RF-systems
RF cavities
Waveguides
RF Amplifiers
More about cavities

Magnets technology for accelerators
Magnets part1/2/3

Beam Diagnostics
An overview
Beam intensity and position
Transverse Beam Profile
Longitudinal Beam Profile
Beam Loss Monitoring

Basics of Vacuum techniques
An overview and motivation
Residual gases and vacuum regions
Vacuum equipment
Other vacuum components

MOOC3: Medical Applications of Particle Accelerators

→ Launched in Nov. '18

Introduction to the course and radiotherapy
Introduction
Biological rational for radiotherapy
Intro. to the electron linac for radiation therapy

Electron Linacs for radiation therapy
The multi-energy electron Linac structure
Dose delivery to the patient

Proton therapy 1
Rationale of proton therapy
Accelerators for proton therapy
Treatment delivery of proton therapy

Proton therapy II and production of medical radionuclides
Heavy ion therapy
Challenges in pr. th. and heavy ion th.
Introduction to medical radionuclides
Production of medical radionuclides

MOOC for beginner – Accelerate your Teaching

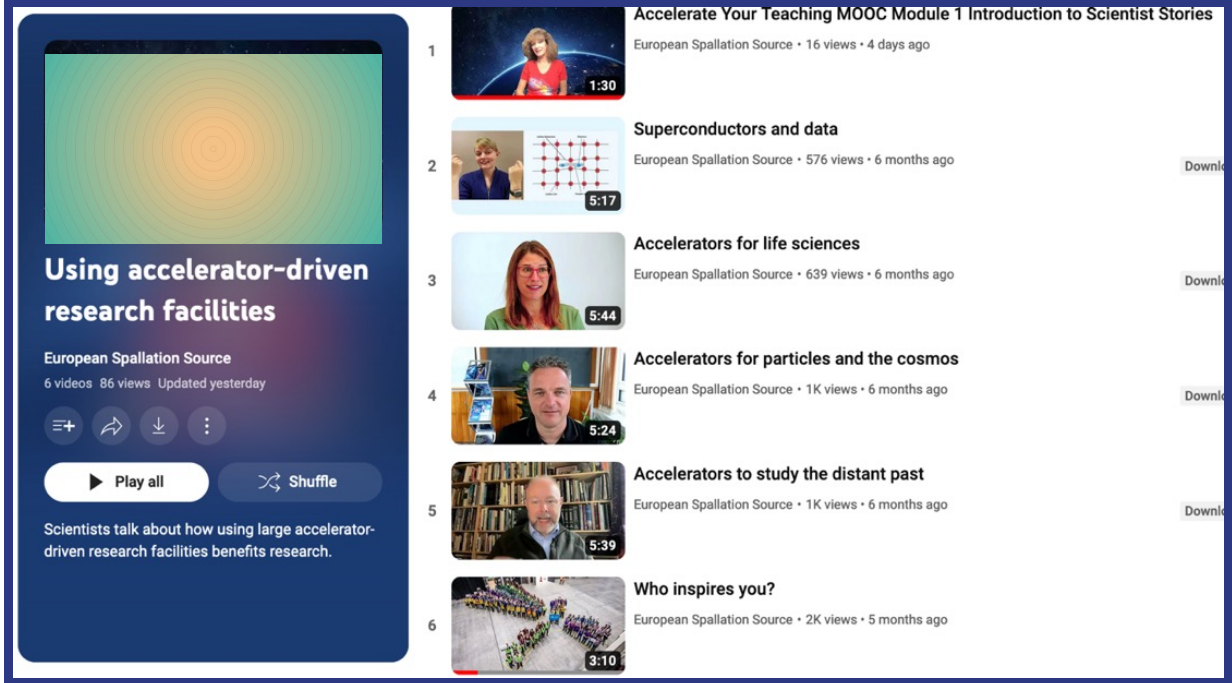
Funded by the European Union

Free pedagogical tools !

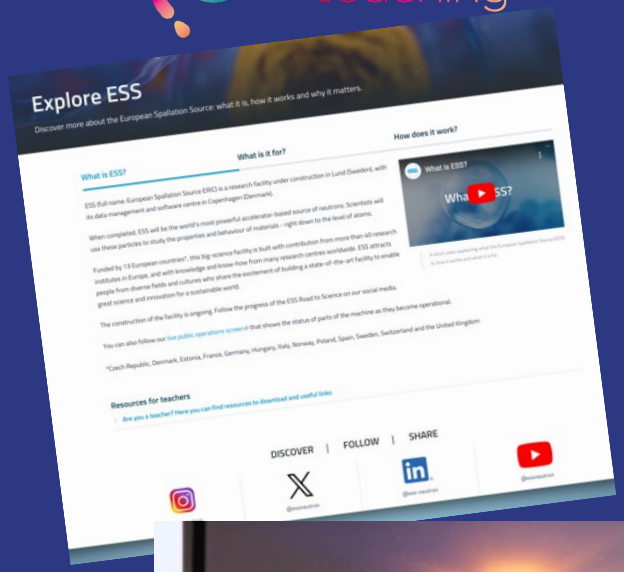
- Scientist Stories
- Race to Space
- Learning Scenarios

Short Videos of scientists

ess.eu/explore



accelerating teaching



African School of fundamental Physics and applications (ASP)

See Presentation by Mounia Laassiri

A non-profit organization established by a small group of worldwide scientists to stimulate and include more African talented physics students in the world scientific community

The aim of the school is to build capacity in African countries, to harvest, interpret, and exploit the results from physics experiments with particle accelerators, and to increase proficiency in related applications and technologies

- Student Program: (3)2-week intensive school
- High School Teachers Program: 1-week intensive workshop
- High School Learners Program: 1-week learners Outreach
- ASP Conference: (Introduced since 2016): 1-week International Conference
- ASP Forum: 1-day
- Mentorship program

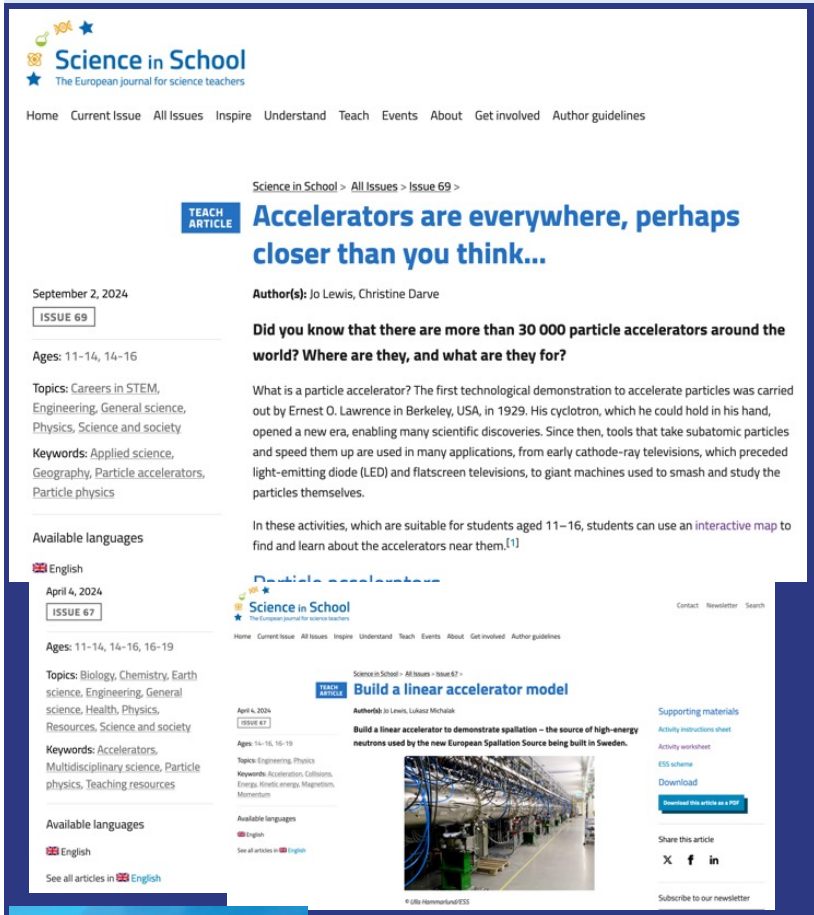
Communication w/o Borders !

Course High School: "Introduction to accelerator science: Activities and Lecture" (Part 2), (Part 1), Morocco, Apr. 15-17, '24

"ASP2024 Learners program - Summary Report", arXiv:2408.01464

Communication w/o Borders !

Funded by the European Union



"Accelerators are everywhere, perhaps closer than you think..."

- Int§ernational Atomic Energy Agency (IAEA) (e.g. interactive map)
- -e EPS and Societa Italiana di Fisica, SIF Prima Pagina
- APS and FIP Newsletters
- National Institute for Th. & Computational Sciences (NITheCS) (e.g. *online seminars)*
- https://lightsources.org/ (e.g. careers, selfies)
- Accelerating News

EIRO forum serving european science

https://www.eiroforum.org/

Communication w/o Borders !

Funded by the European Union

Forum on International Physics (FIP) @ 2024 APS meeting

APS FIP Sessions

Science Communication and International Public Impact

The Physics of Star Wars
Invited Speaker: Carsten P Welsch
Science as a common language for building bridges
Invited Speaker: Raïssa Malu
Why Physics Matters. and ..ppt
Invited Speaker: Christine Darve
Quark, Camera, Action! Bringing Science Communication to Social Media
Invited Speaker: Clara Nellist
CERN 70th anniversary and beyond… Movie only
Invited Speaker: Luciano Musa

Science Communication to Bridge Communities

Education to Bridge Communities

Partnership for Education Across Continents

Speaker Slides .pdf
Strengthening Pedagogical Content Knowledge of Science Teachers in Pakistan
Invited Speaker: Talat S Rahman
Building International partnership for Africa
Invited Speaker: Kétévi A Assamagan
Training South-American future scientists
Invited Speaker: Nathan J Berkovits
Ubuntu Science: Building International Collaborations with Africa
Invited Speaker: Sinead M Griffin
Education across continents: the NITheCS way
Invited Speaker: Francesco Petruccione

More initiative in developing community

Funded by the European Union

"An epic journey across the quantum landscape to the APS March Meeting"

2023 APS Meetings (DCMP, FECS, DPB and FPS)

March 2023 APS March meeting and slides

- IUPAP@100: Inter. Sc. in Changing Societal and Geopolitical Landscapes
- Large-scale Scientific Facilities and Diplomacy
- Inter. Perspective for Young Physicists from Particle to Materials

April 2023: APS April meeting and slides

- No Frontiers when Physics Matters
- Extending Frontiers in Physics
- Accelerate Solving Energy Crisis: From Fission to Fusion

SESAME

African Light Source (AfLS) Conceptual Design Report (CDR)

Next: The 7th African Light Source Conf., AfLS-2024 (18-24 Nov, SA)

More initiative in developing community

Funded by the European Union

What is ASFAP?

The African Strategy for Fundamental and Applied Physics (ASFAP) becomes essential for Africa, that should take its equal place as a co-leader in the global scientific process, along with all the consequent socio-economic benefits.

- **Develop a Strategy to increase African education and research capabilities**
- **Engage African scientists and the international community in the Strategy development;**
- African Strategy aims **to set the foundation and framework to draw the participation of African physicists**— with inputs from the international communities—in defining education and physics priorities most impactful for Africa;
- The process will take few years, to end with the release of the strategy report which will suggest the **direction, with actionable items for the next decade**. To be repeated periodically, every 7-10 years for the following decades with a review of the impact of previous Strategies.

Who will build these experiments? Who will do the physics?
→ **Crucial** to involve **young physicists** in this process, get their input, and educate the next generation of physicists.
→ This is a global conversation: international input highly welcomed.

The Perspectives of the Young Physicists Forum of the African Strategy for Fundamental and Applied Physics (ASFAP)

Mounia Laassiri

Helsinki Institute of Physics, University of Helsinki, Finland
Co-convener, Young Physicists Forum (YPF), ASFAP
mounia.laassiri@helsinki.fi

see file

APS-2023

PHYSICS MATTERS

Monthly online Life Colloquia series for development

- SESAME Light Source (members and observers) and developing communities
- Scientific Cases using Photon and Neutron Sources
- Particle Accelerators and large scale Research Infr
- Outreach & Education
- Organizations & Collaborations
- Forums and Topical Colloquia:
  - Environmental and Sustainable developments
  - Health & Life Science

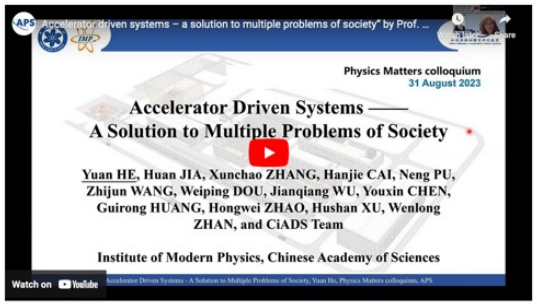
A way to reach out side APS community: no APS membership required, Open Zoom access provided!

- Presentation @2024 APS March meeting: **"Why Physics Matters!"**
- Article @EPS: "Facilitating Global Scientific Exchange: The Impact of PHYSICS MATTERS"
- Physics Matters Playlist

PHYSICS MATTERS Highlights

Funded by the European Union

Watch the latest PHYSICS MATTERS edition: "Accelerator driven systems – a solution to multiple problems of society" by Prof. Yuan He



Past PHYSICS MATTERS Colloquia Below

- August 2023: "Accelerator driven systems – a solution to multiple problems of society"
- July 2023: "More synchrotron light for Latin America in the Greater Caribbean?"
- June 2023: "Navigating the Complexity across the Peace-Sustainability-Climate security NEXUS"
- May 2023: "Entering the new century of IUPAP with a renovated vision"
- Apr 2023: "Role of large-scale facilities for battery research and innovation"

Sept 2022: Momentum grows for the African Light Source

Thursday, September 29, 2022

Mon July 2023: "More synchrotron light for Latin America in the Greater Caribbean?"

See

See

Des

Spe

Thursday, July 27, 2023

"More synchrotron light for Latin America in the Greater Caribbean?"

See Slides: [Slides_Leo_Violini_GCLS]

Speaker: Prof. Galileo Violini, Director Emérito CIF, Colombia

Nov 2022: "PHYSICS MATTERS to celebrate the 100 years of existence of the IUPAP"

Tuesday November 22, 2022

"PHYSICS MATTERS to celebrate the 100 years of existence of the IUPAP"

See Slides:

- [Slides_Michel_SPIRO]
- [Slides_Silvina_Ponce_Dawson]
- [Slides_Laura_Greene]
- [Slides_Monica_Pepe_Altarelli]

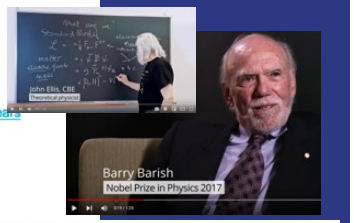
See Also: International Union of Pure and Applied Physics (IUPAP) has turned 100 years

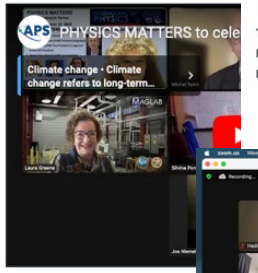
Description: [Description_IUPAP_SPIRO_DAWSON_GREENE_PEPEALTARELLI]

Speakers:

- **Michel SPIRO** IUPAP, CERN, IN2P3 & CEA (FR)
- **Silvina Ponce Dawson** University of Buenos Aires & IUPAP (AR)
- **Laura Greene** NHMFL, APS & IU
- **Monica Pepe-Altarelli** CERN & I

Trailer





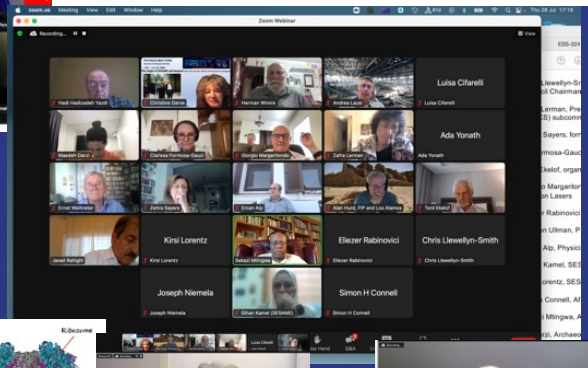
July 2022: FORUM to Celebrate "The Origin of SESAME and beyond" with Prof. Herman Winick

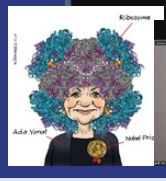
Thursday, July 28, 2022

FORUM to Celebrate "The Origin of SESAME and beyond" with Prof. Herman Winick

More Reading:

- The Wall-of-Ideas content, Important Archives, Memoires, Photos and Q&A to the Guests of Honor: "the Origin of SESAME and beyond" with Herman Winick
- Bio of the Guests of Honor
- Wall-of-Ideas





Oct. 24: "The accelerator BNCT System for Sustainable Quality of Life" by Dr. Kazuyo Igawa

REGISTER HERE

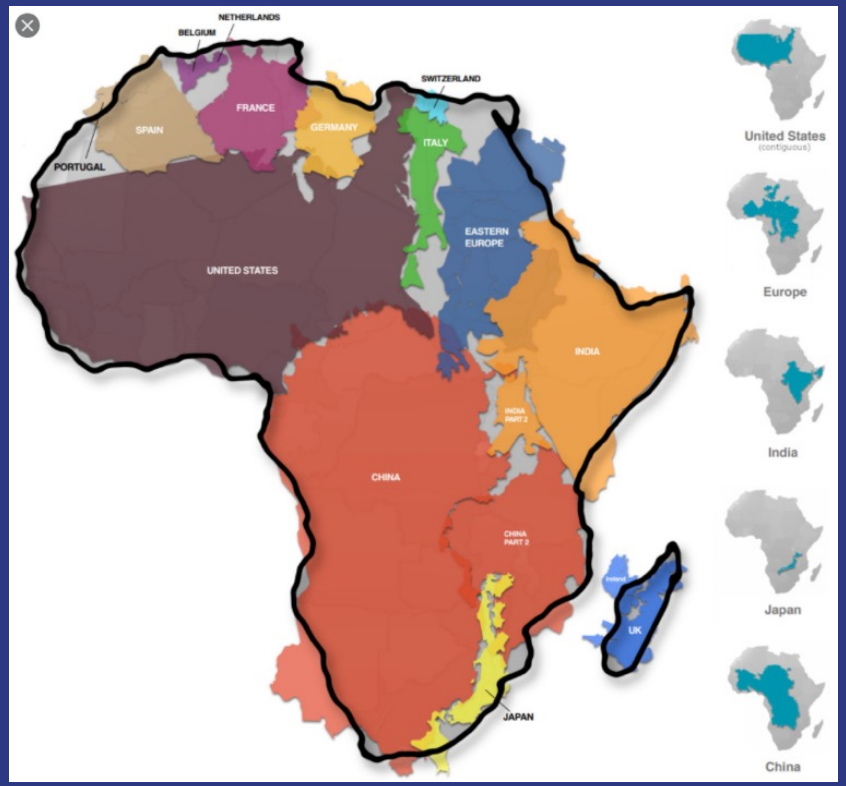
Subscribe/unsubscribe form

March 2024: "Strengthening Basic Sciences: Towards Sustainable Societies" by Prof. Amal Kasry (UNESCO)

Concluding comments

Funded by the European Union

- ✓Multidisciplinary roles of science & community partnership to develop community
- ✓Education to shape tomorrow societal challenges and transfer knowledge & technology
- ✓International organizations to build capacity w/o Borders !



Thank you for your attention!

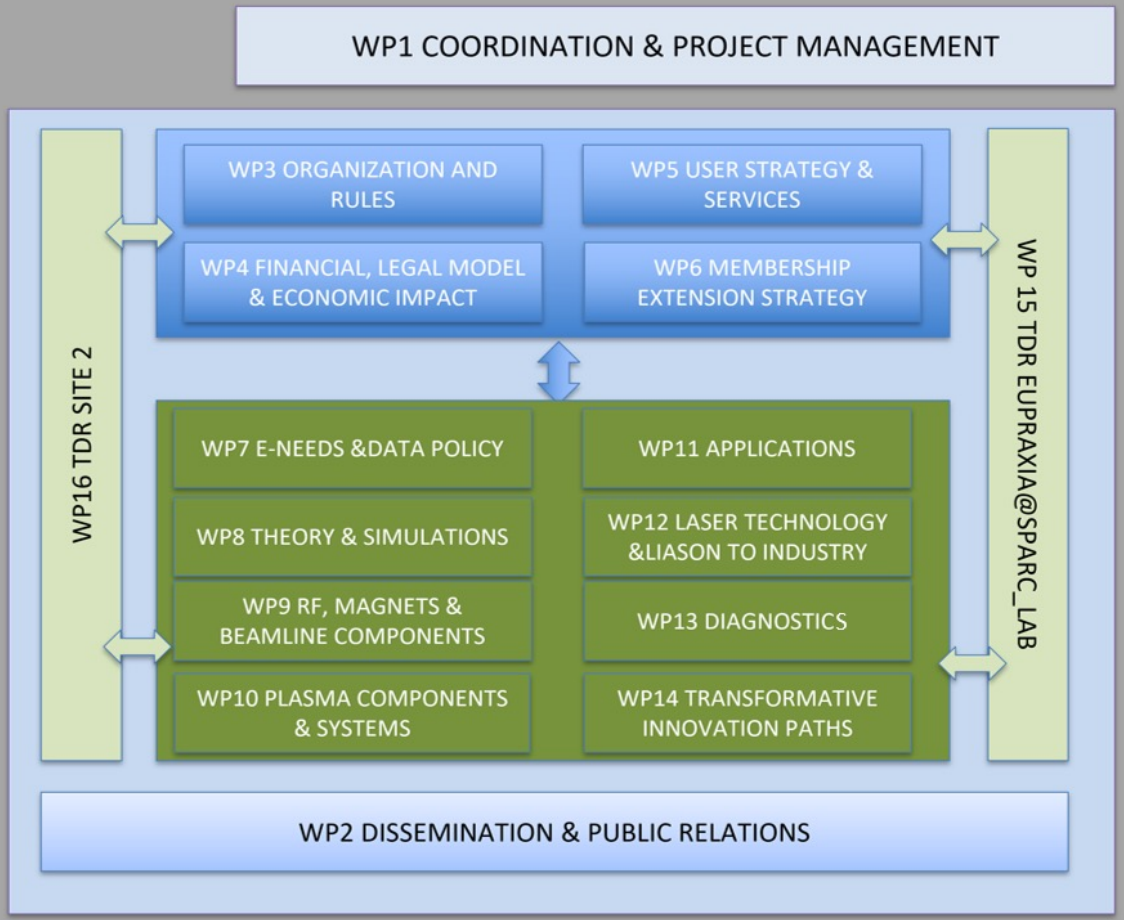
christine.darve@ess.eu
https://cdarve.web.cern.ch/

EuPRAXIA-PP Consortium

Funded by the European Union

EuPRAXIA-PP Structure

Funded by the European Union



Selected Committees and Boards

GOVERNING BOARD
(decision-making body, 1 representative per institute)

Steering Committee
(coordinator plus WP leaders plus experts)

Scientific/Technical Advisory Board
(external experts in user services, RI implement-tation, ESFRI aspects and technical themes)

Board of Financial Sponsors
(connection to decision makers and funding authorities)

Acknowledgements

- EuPRAXIA Preparatory Phase

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101079773. It is supported by in-kind contributions by its partners and by additional funding from UK and Switzerland.

- EuPRAXIA Doctoral Network

This project has received funding from the European Union´s Horizon Europe research and innovation programme under grant agreement no. 101073480 and the UKRI guarantee funds.

- EuAPS

This publication has been made with the co-funding of European Union Next Generation EU.