CS3 Mesh

Global collaboration platform for Data Science, Education and Outreach

Jakub T. Mościcki, IT Storage, CERN

CERN

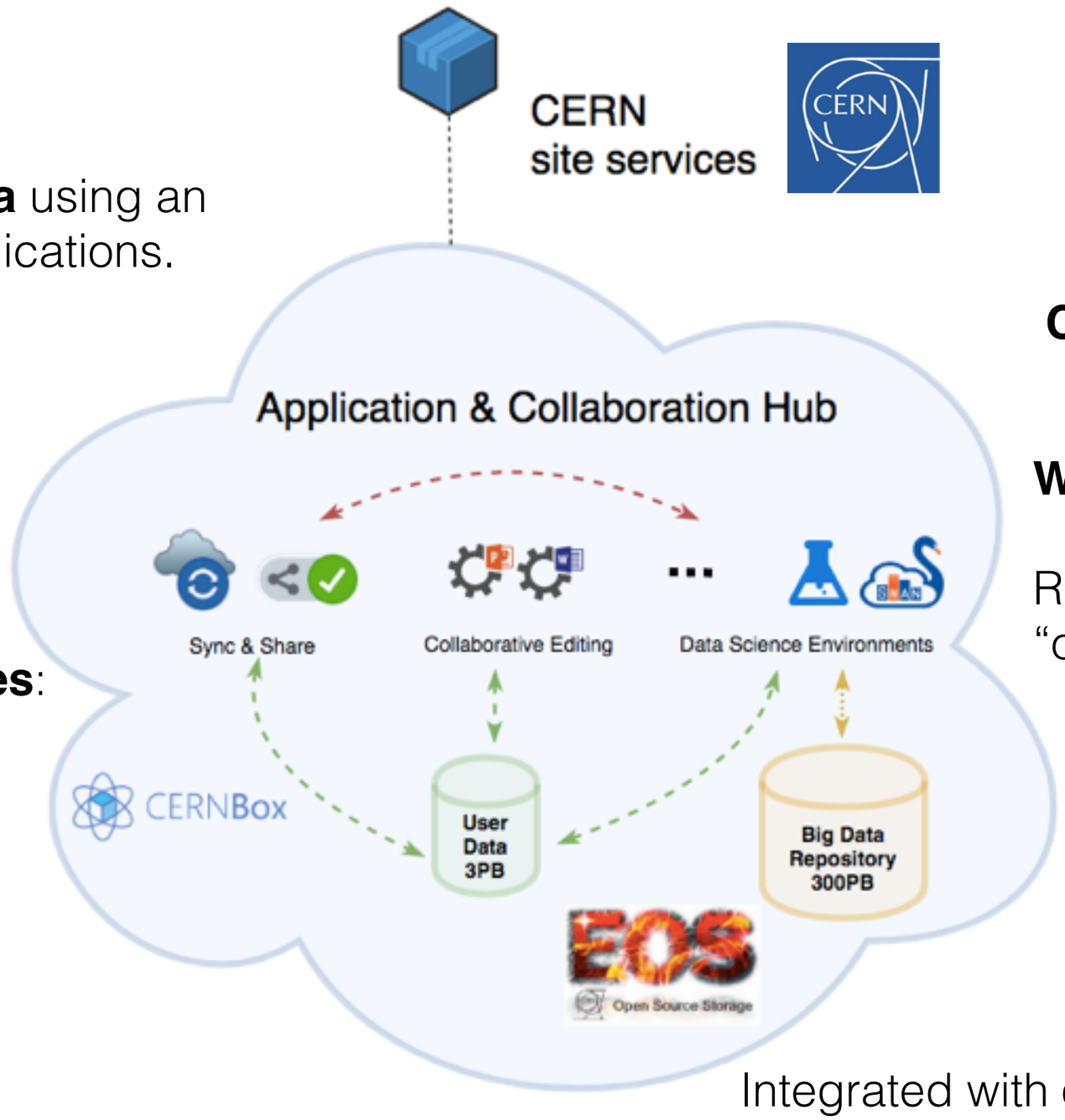
Integrated Service for Data Science

Users **collaborate on data** using an increasing number of applications.

16k users!
> 100k shares
1B files
7PB storge

Data available on **all devices**: mobile, laptops, desktops

Data easily **sharable** with individuals and groups



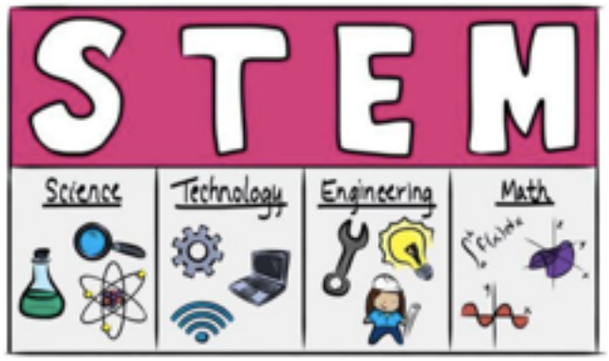
Concurrent editing

Web-based Analysis

Ready-to-go environment "one click away"

Integrated with **entire data repository**

Integrated Service for Data Science



Edu & Outreach

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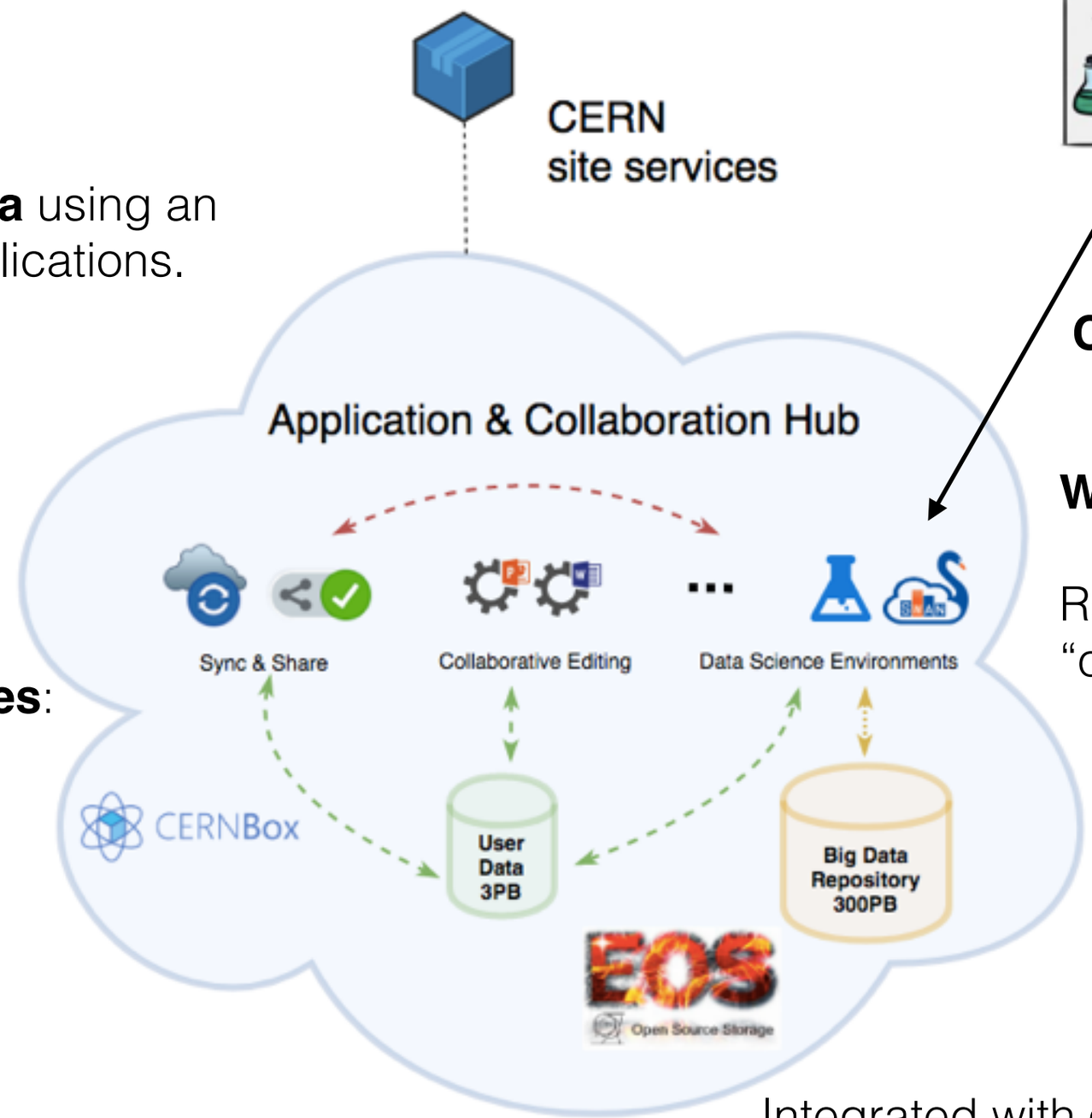

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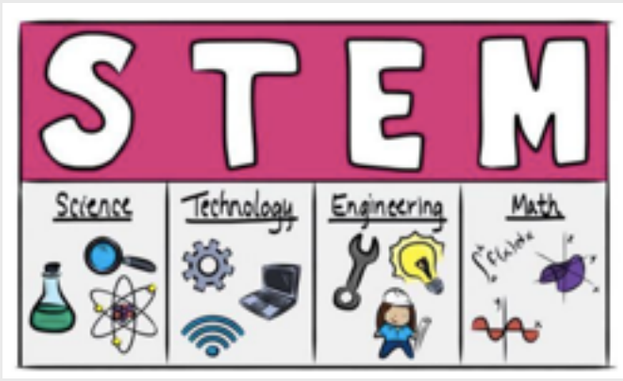
SWAN

Interactive Data Analysis, in the Cloud.

Edu & Outreach



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Basic | ROOT Primer | Accelerator Complex | FCC | Beam Dynamics | Machine Learning | Apache Spark | Outreach | LHC Signal Monitoring | AWAKE

Reach out with SWAN! This section collect a series of outreach efforts involving SWAN.

Particle open data teaching (Hiukkasfysiikan avoin data opetuksessa)

Esim-pseudorapiditeetti-mittatarkkuus (autosaved)

Control Panel | Logout

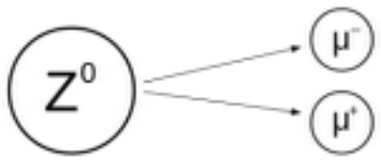
File Edit View Insert Cell Kernel Help | Python 2

Markdown | CellToolbar

Lähdetäänpä tutkimaan!

Lähdetään seuraavaksi tarkastelemaan, miten pseudorapiditeetin vaikutus mittatarkkuuteen voidaan havaita CMS-ilmaisimen keräämän oikean datan avulla. Käytetään CMS:n vuodelta 2011 kerättyä dataa [1], josta on valittu 10851 törmäystapahtumaa (events) tiedostoon "Zmumu_Run2011A_massoilla.csv". (Karsinta on suoritettu koodilla, joka on avoimesti saatavilla osoitteessa https://github.com/tpmccauley/dimuon-filter.)

Tiedostoon on valittu niitä törmäystapahtumia, joissa syntynyt Z-bosoni on hajonnut myoniksi μ^- ja antimyoniksi μ^+. Ilmaisin on havainnut nämä myonit ja mitannut niiden liikemäärät.



SWAN, the CERN Service for Web based ANalysis, is not only made for analysis of scientific data but also the ideal plat
(CMS) put together an introd
e result is great

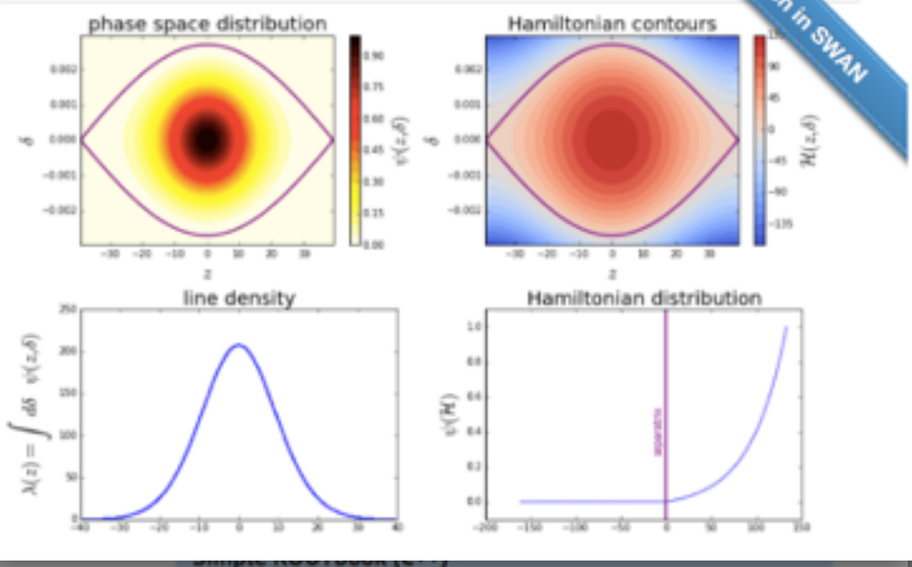
Open in SWAN

Github repository: https://gi

RF Bucket Matching

```
from PyHEADTAIL.particles.rfbucket_matching import ThermalDistribution
plot(ThermalDistribution);
```

Open in SWAN



This is a gallery of basic example notebooks: click on
repository!

Open in SWAN

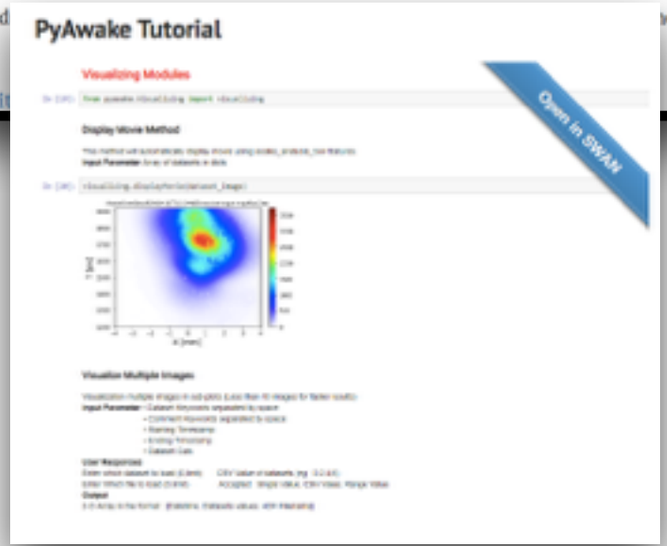
Many of the notebooks are ROOTbooks, based on the

Simple ROOTbook (Python)

Simple Fitting

Simple I/O

PyAwake Tutorial



SWAN Users' Workshop

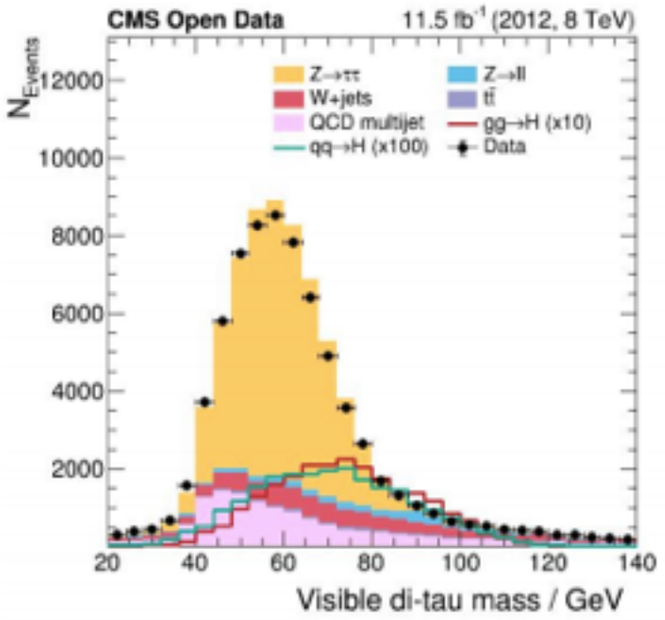
https://indico.cern.ch/event/834069

Outlook

- CERN Open Data portal is constantly growing
  - Data access policies of the ALICE, ATLAS, CMS and LHCb ensure vast amount of new data
- Ongoing effort to publish legacy CMS data in NanoAOD format
  - Reduced data format detached from experiment specific software
  - Suits a wide range of analyses
  - Allows for analyses with simple programming model

    → Bringing students and individuals close to real physics data from the LHC with minimal technical know-how

    → Example: ROOT RDataFrame
- **SWAN together with the Open Data portal would be the perfectly suited to bring HEP as close as possible to students and individuals**



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Stefan Wunsch

SWAN Users' Workshop

https://indico.cern.ch/event/834069

Conclusions

- For our education programs for teachers and students coming to CERN, we ideally want:
  - Computers without need for any local configuration besides one: a recent browser
  - Visually rich & interactive user-experience
  - Distribution of course material/versioning
  - Lightweight personal accounts for visitors

- => Cloud-based services like SWAN are capable to provide all of the above

"thin clients"

Fabian Bernstein
Oliver Michael Keller

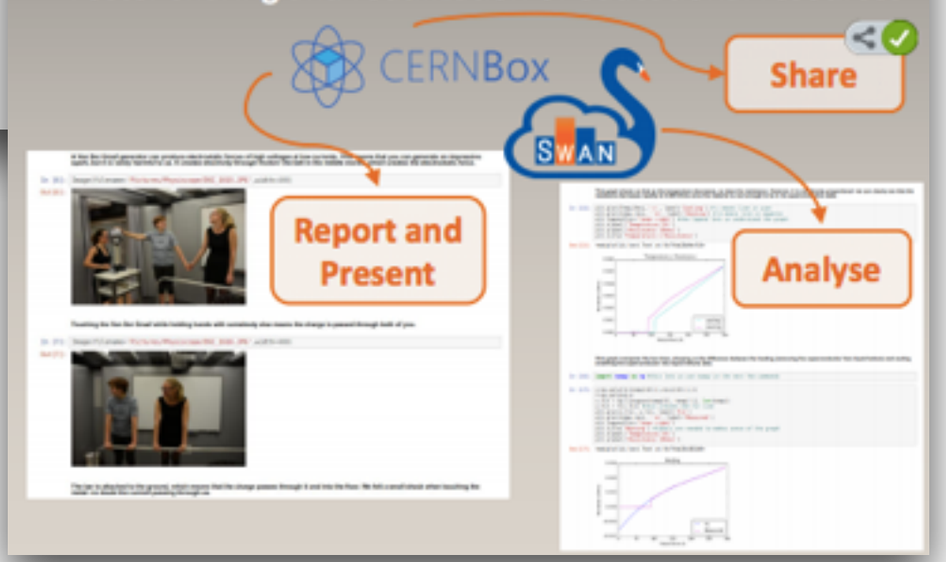
Up2U µExperiment – Work Programme

- Create a “reportage” from CERN visit with a focus on a particular physics subject and its relevance of High Energy Physics: ***superconductivity***

- Practical hands-on physics experiments will be carried out at Physiscope at UniGE
  - ✓ https://scienscope.unige.ch

Let Students Use Big Science Tools

- Students and teachers work using their browser
- Educational notebooks live in the CERNBox storage
- Foster sharing and reutilization of educational resources



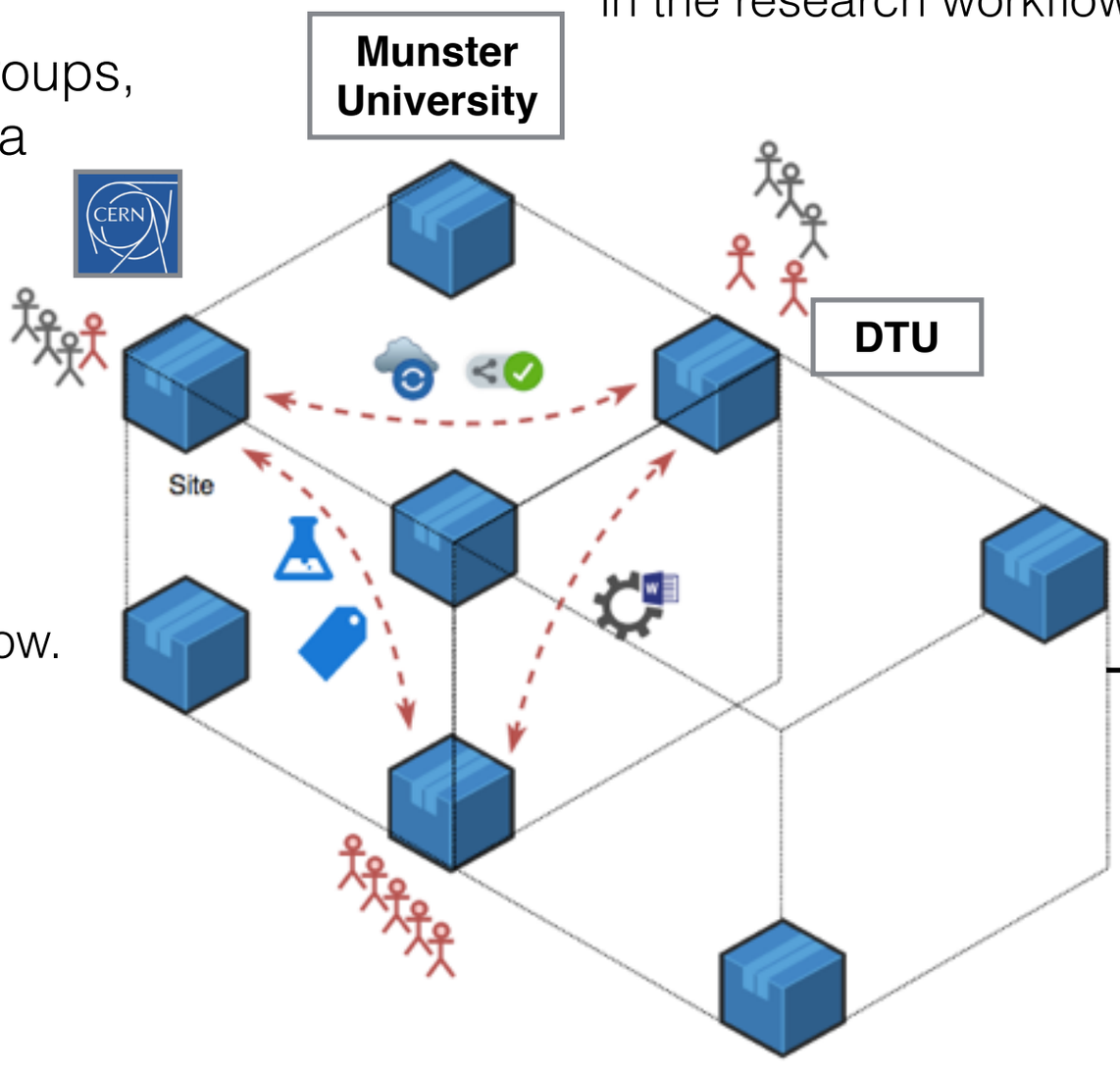
Going global

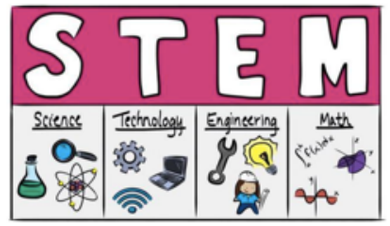
Future Federated Analysis Platform

Advancing state of the art

One-click to create user groups, share projects and data

Full metadata awareness in the research workflow.





Edu & Outreach

Domestic and remote users in the same collaborative workflow.

UP 2 U

https://up2university.eu

K12 - a few steps to higher education

Application&data workflow.

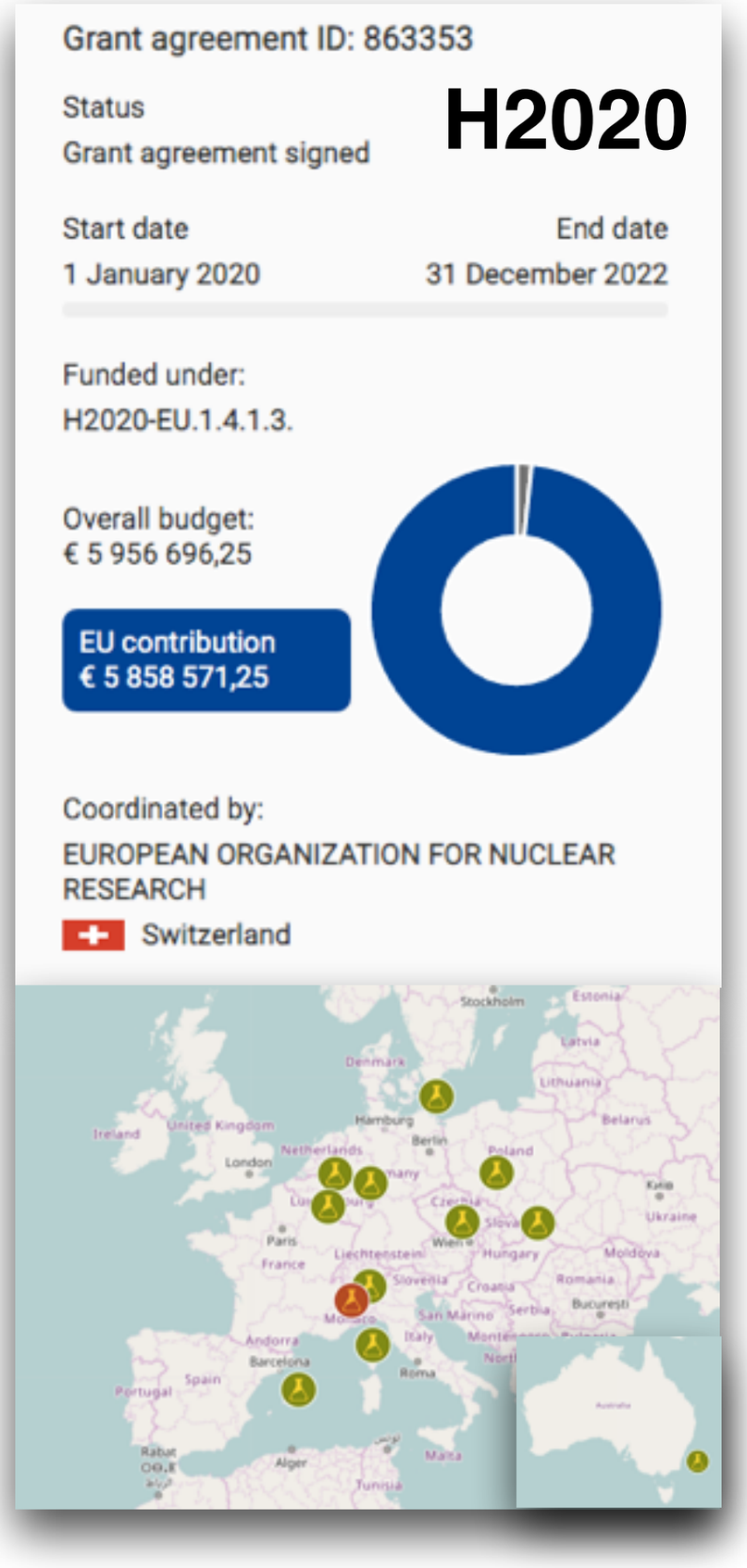
Callysto

https://callysto.ca

Multimodal learning program for grades 5-12 students in Canada

The Project: CS3 Mesh

- 12 partners to **create initial infrastructure**
  - connect existing, sustainable services
  - 200K+ existing users
- Deliver a **Global CS3 Collaboration Service** for researchers, educators, data curators, analysts, …
- **Provide an interoperable platform** to easily share and deploy applications and software components to extend functionality of the service.



Partners

Coordinator

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH — WLCG T0

Address: Route De Meyrin Cern 1211 Geneva 23, Switzerland

Activity type: Research Organisations

DANMARKS TEKNISKE UNIVERSITET — Denmark — UNI

SURFSARA BV — Netherlands — WLCG T1

INSTYTUT CHEMII BIOORGANICZNEJ POLSKIEJ AKADEMII NAUK — Poland — HPC

CESNET ZAJMOVE SDRUZENI PRAVNICKYCH OSOB — Czechia — NREN

AARNET PTY LTD — Australia — NREN

SWITCH — Switzerland — NREN

WESTFAELISCHE WILHELMS-UNIVERSITAET MUENSTER — Germany — UNI

AILLERON SA — Poland — TECH ENTERPRISE

CUBBIT SRL — Italy — TECH STARTUP

JRC -JOINT RESEARCH CENTRE- EUROPEAN COMMISSION — Belgium — EC

FUNDACION ESADE — Spain — BUSINESS SCHOOL

CS³ Mesh

EUROPEAN OPEN SCIENCE CLOUD

*The project delivers the core of a **scientific and educational** infrastructure for cloud storage services in Europe […]*

Work packages

WP	Title	Leader
1	**Project Management**	**CERN**
2	**Federated Infrastrcuture**	**SURFSARA**
3	**Technology & Foundation**	**CERN**
4	**Users & Applications**	**PSNC**
5	**Dissemination, exploitation & outreach**	**DTU**

Collaborative Workflows

Integrate existing experience and technology

Share, access, synchronize

Metadata&tagging, Open Data (OpenAIRE, Zenodo,…)

Data Science: Jupyter Notebooks (SWAN,…)

Concurrent editing

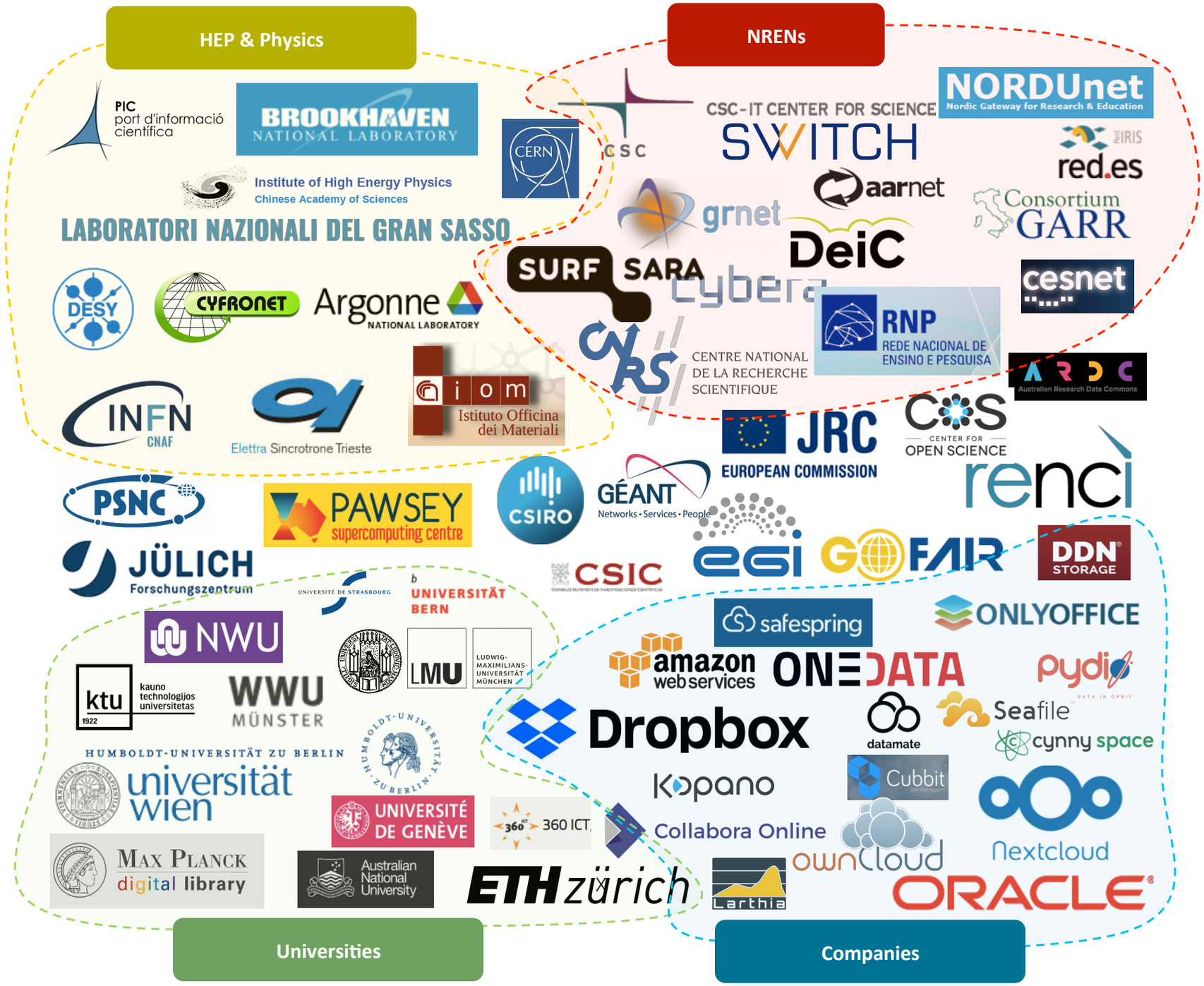
On-demand data transfers (Direct, FTS, DTN, Rucio …)

Interoperability

- Add thin layer on top of existing services
- Use existing fabric
- Use existing standards
  - Introduce new APIs only if needed
- ScienceBox
- Close collaboration with industry
- Integrate into upstream products

CS3 Community Service

cs3community.org



2019— Worldwide Community

- **147** participants
- **70** institutions
- **25** countries

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Project presentation and discussion

cs3.deic.dk