Investing in Curation

A **Shared** Path to Sustainability

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Data Preservation in HEP (DPHEP)

Outline

1. Pick 2 of the messages from the roadmap & comment
   - I could comment on all – but not in 10’

1. What (+ve) impact has 4C already had on us?
   - Avoiding overlap with the above

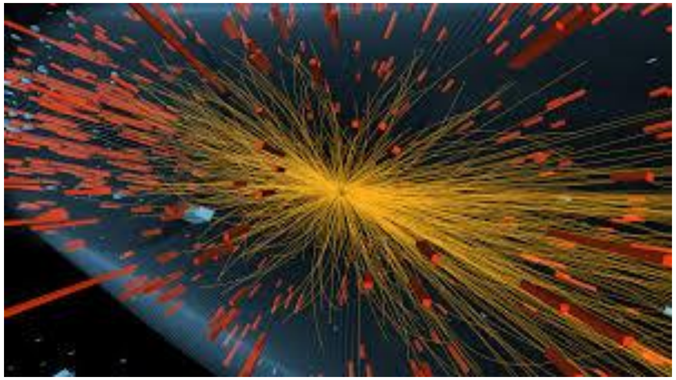
1. A point for discussion – shared responsiblity / action

THE MESSAGES

The 4C Roadmap Messages

1. Identify the value of digital assets and make choices
2. Demand and choose more efficient systems
3. Develop scalable services and infrastructure
4. Design digital curation as a sustainable service
5. Make funding dependent on costing digital assets across the whole lifecycle
6. Be collaborative and transparent to drive down costs

IMPACT OF 4C ON DPHEP

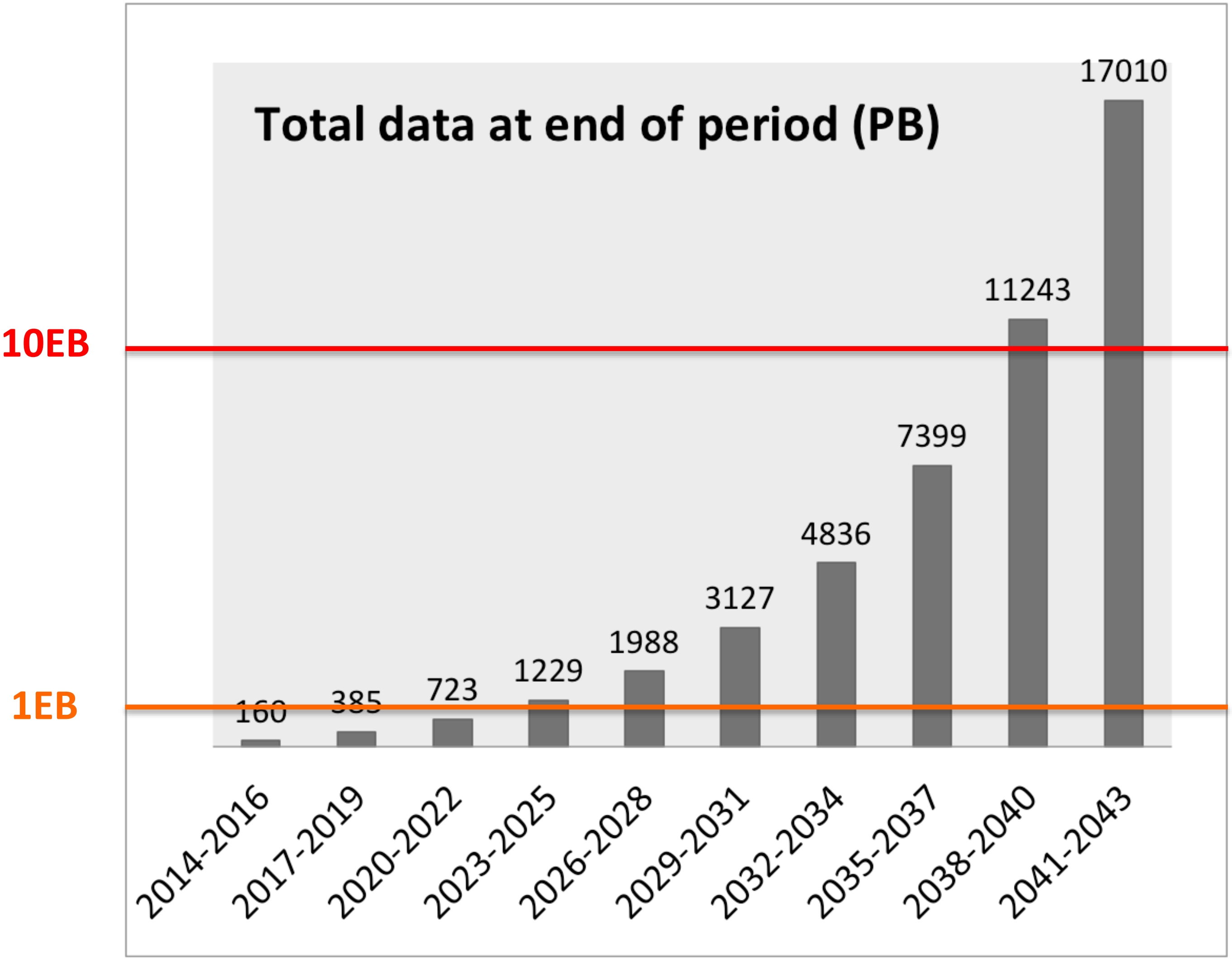


DPHEP

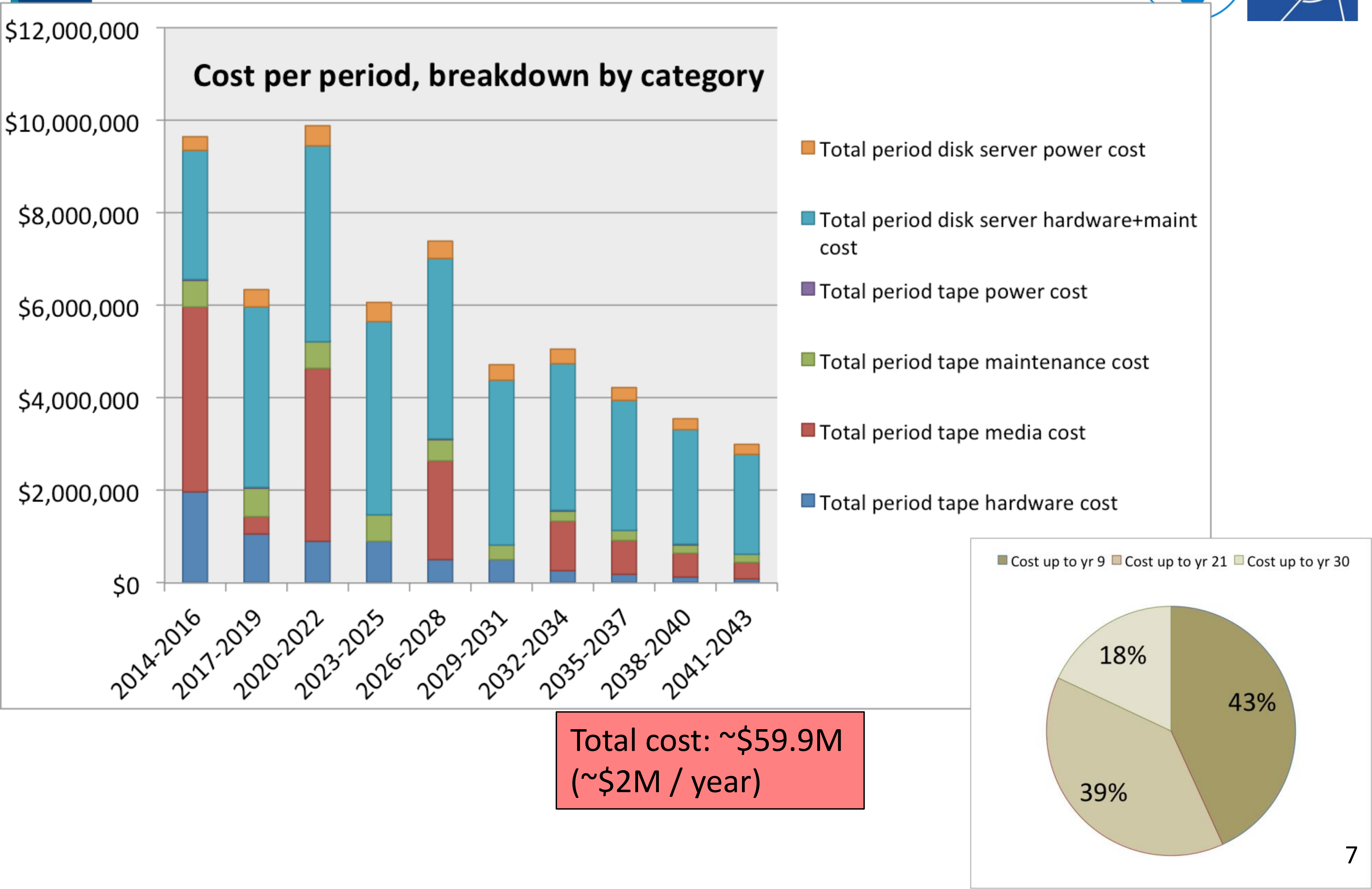
International Collaboration for Data Preservation and
Long Term Analysis in High Energy Physics

“LHC Cost Model” (simplified)

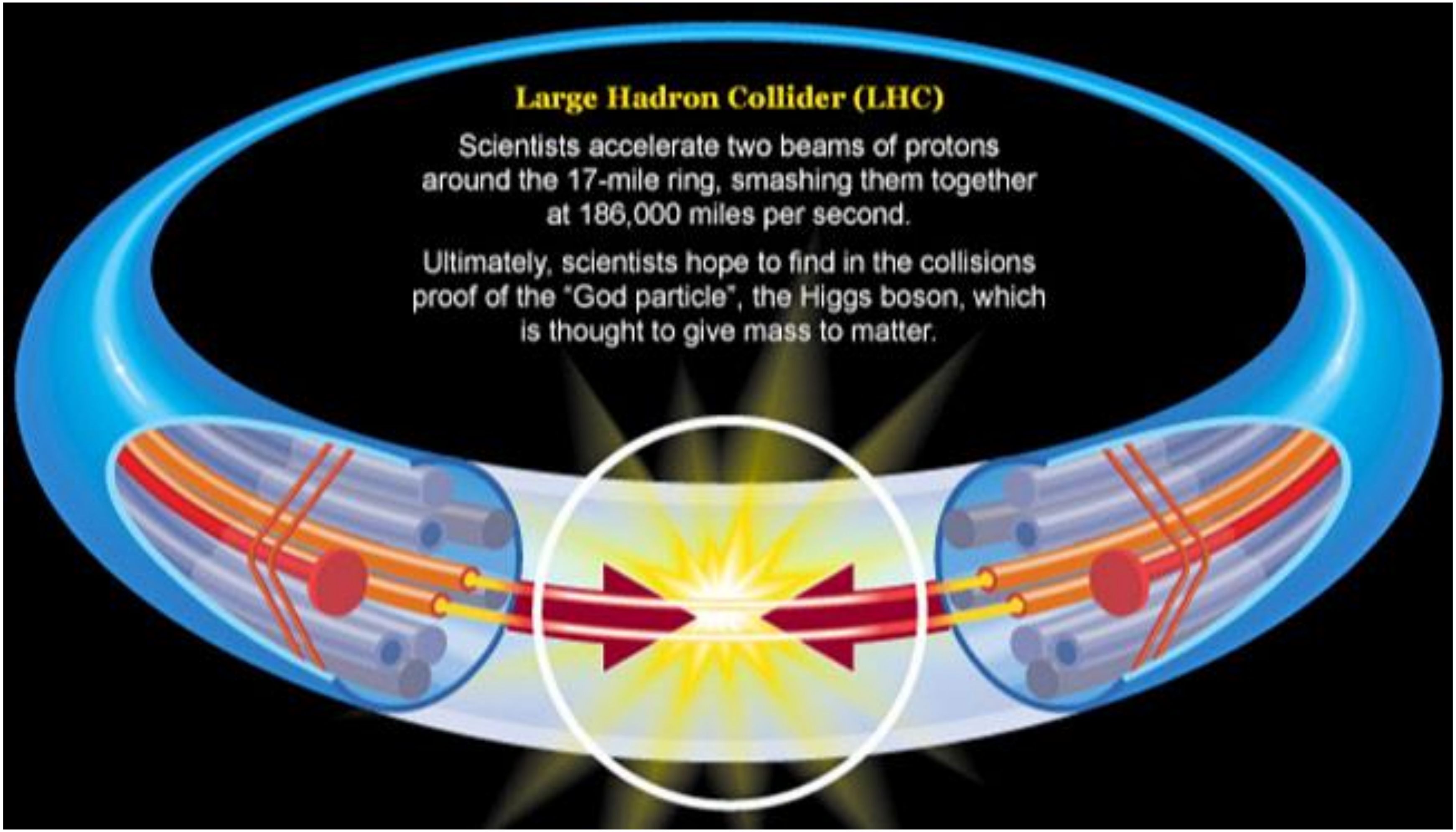
Start with 10PB, then +50PB/year, then +50% every 3y (or +15% / year)



Case B) increasing archive growth



Total cost: ~$59.9M
(~$2M / year)



Large Hadron Collider (LHC)

Scientists accelerate two beams of protons around the 17-mile ring, smashing them together at 186,000 miles per second.

Ultimately, scientists hope to find in the collisions proof of the "God particle", the Higgs boson, which is thought to give mass to matter.

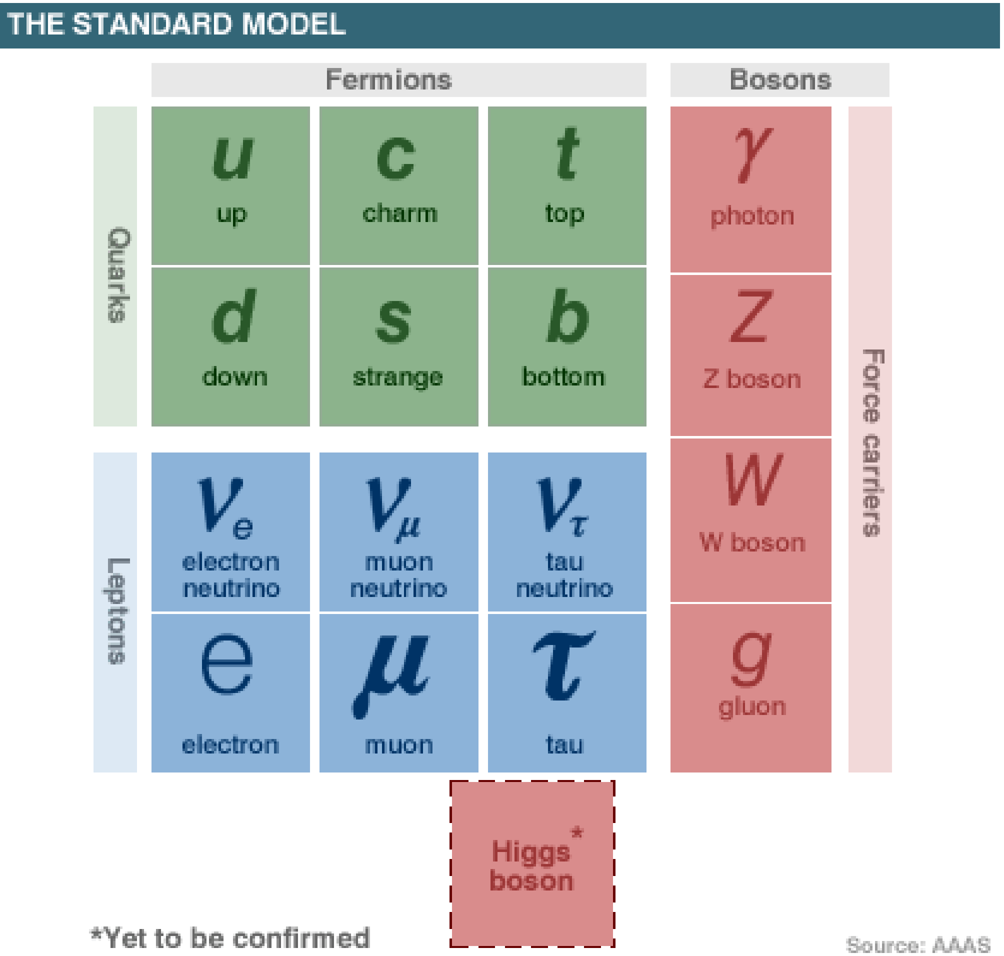
1. Identify the value of digital assets and make choices

- Today, significant volumes of HEP data are thrown away "at birth" – i.e. via very strict filters (aka triggers) B4 writing to storage

➢ **To 1st approximation ALL remaining data needs to be kept for a few decades**

- "Value" can be measured in a number of ways:
  - Scientific publications / results;
  - Educational / cultural impact;
  - "Spin-offs" – e.g. superconductivity, ICT, vacuum technology.

Why build an LHC?



THE STANDARD MODEL

	Fermions			Bosons	
Quarks	u up	c charm	t top	γ photon	Force carriers
	d down	s strange	b bottom	Z Z boson	
Leptons	ν_e electron neutrino	ν_μ muon neutrino	ν_τ tau neutrino	W W boson	
	e electron	μ muon	τ tau	g gluon	
			Higgs boson*		

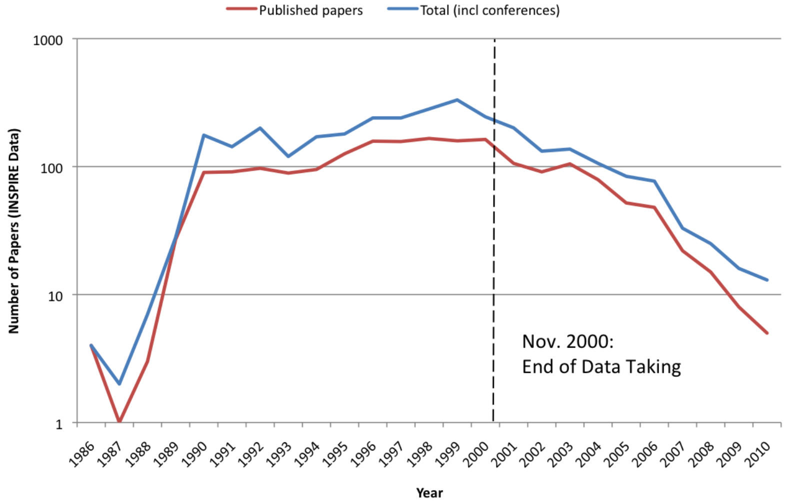
*Yet to be confirmed

Source: AAAS

ALICE
CMS
ATLAS
LHCb

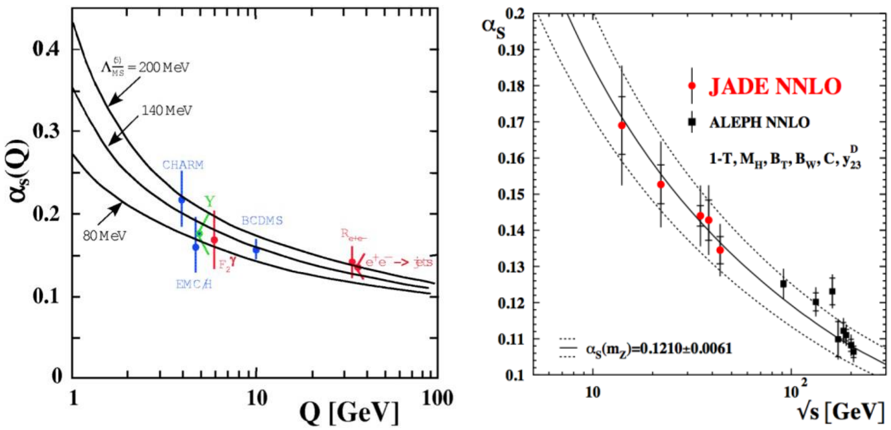
BEFORE!

1 – Long Tail of Papers



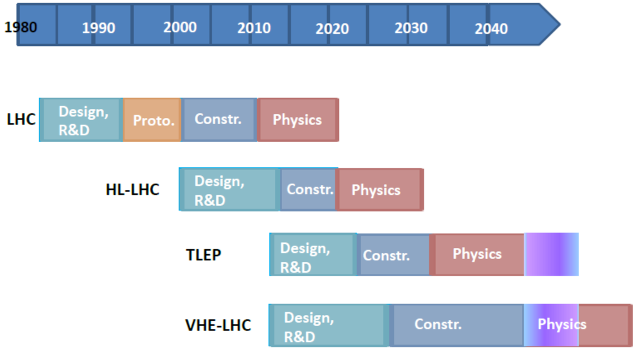
Nov. 2000:
End of Data Taking

2 – New Theoretical Insights



3 – "Discovery" to "Precision"

possible long-term time line



Zimmermann

Use Case Summary

1. Keep data usable for ~1 decade
2. Keep data usable for ~2 decades
3. Keep data usable for ~3 decades

Volume: 100PB + ~50PB/year (+400PB/year from 2020)

Balance sheet – Tevatron@FNAL

• 20 year investment in Tevatron			**~ $4B**
• Students	$4B	}	**~ $50B total**
• Magnets and MRI	$5-10B		
• **Computing**	**$40B**		

Very rough calculation – but confirms our gut feeling that investment in fundamental science pays off

I think there is an opportunity for someone to repeat this exercise more rigorously

cf. STFC study of SRS Impact

http://www.stfc.ac.uk/2428.aspx

Science & Technology
Facilities Council

2. Demand and choose more efficient systems

- From my point of view, we can divide the services into two areas:
  - **Generic, potentially “shared” infrastructure**
  - **Discipline oriented services, addressing specific Use Cases of communities, using common components (VREs)**
- “Bit preservation” falls into the former – and is harder than many people thing – particularly at scale (PB, EB, ZB, YB, …)

Suppose these guys can build / share the most cost effective, scalable and reliable federated storage services, e.g. for peta- / exa- / zetta- scale bit preservation?

Can we ignore them?

The answer today is often yes – Something I am convinced we need to overcome, if we really care about:

1. Efficiency;
2. Sustainability;
3. Cost effectiveness

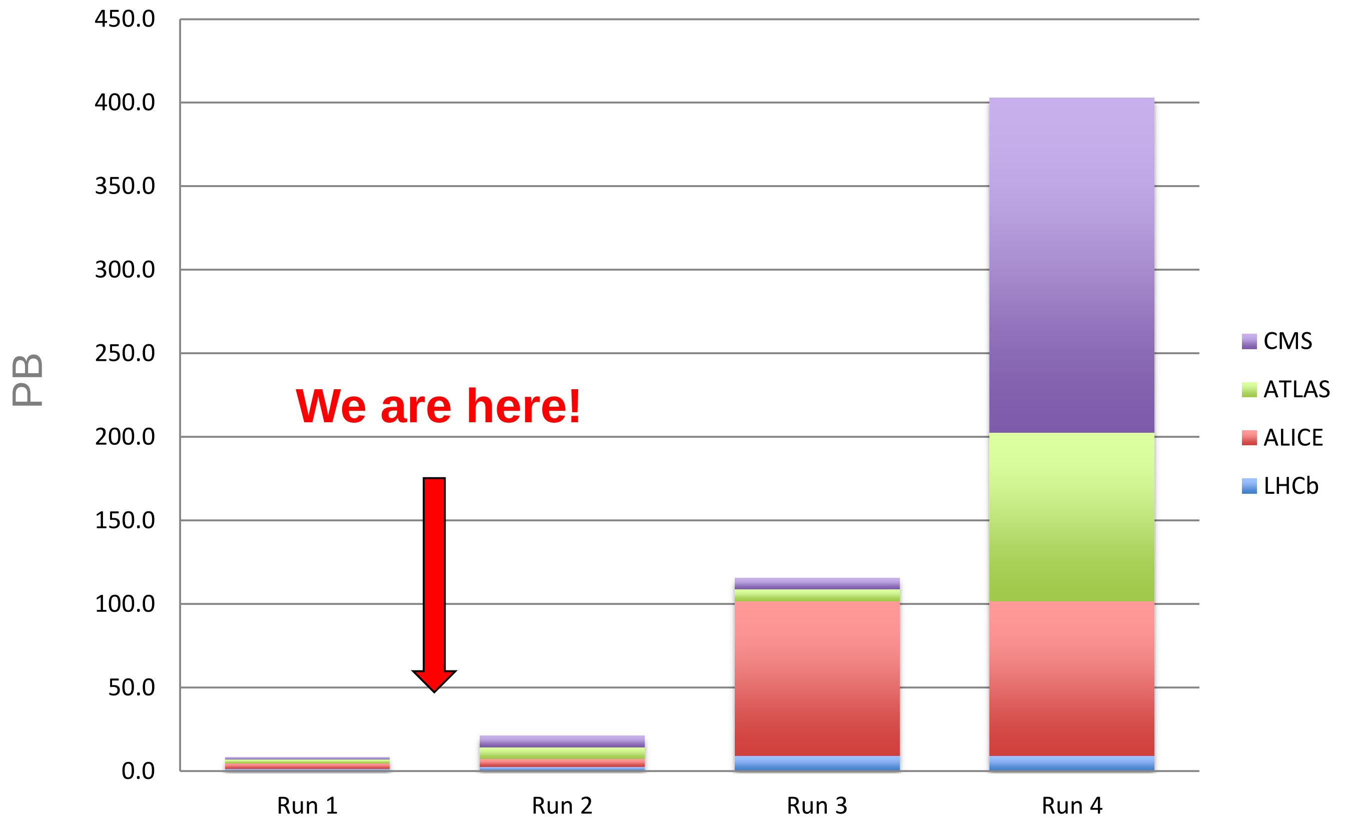
3. Develop scalable services and infrastructure

- What do we mean by “scalable”?

- **Linear scaling with “capacity” is not a realistic option: increased “capacity” with constant {budget; effort} over a long period (decades) is a more “realistic” target**

- And – the WLCG experience shows – constant service improvement is also possible

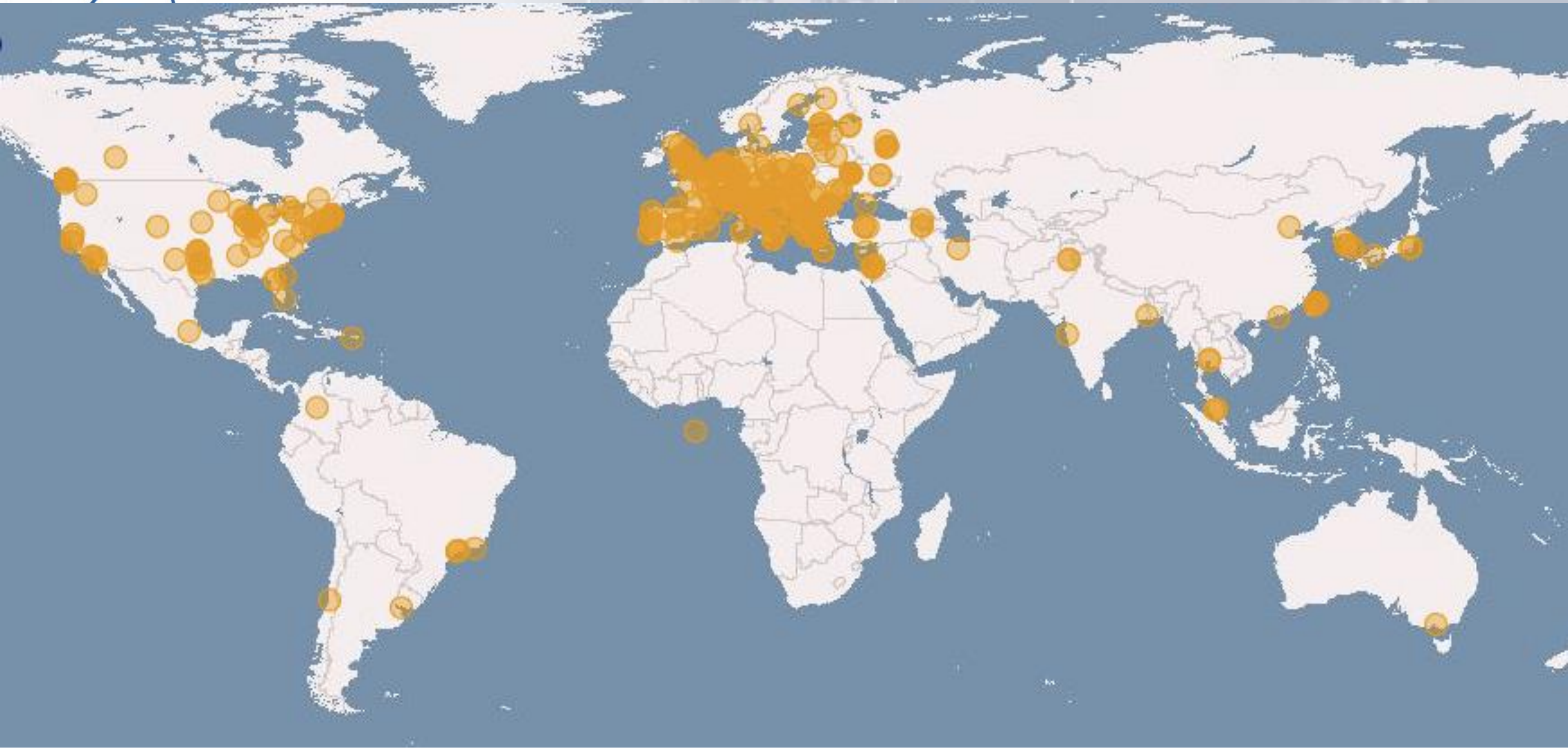
Data: Outlook for HL-LHC



- Very rough estimate of a new RAW data per year of running using a simple extrapolation of current data volume scaled by the output rates.
  - To be added: derived data (ESD, AOD), simulation, user data…

➢ **At least 0.5 EB / year (x 10 years of data taking)**

WLCG Collaboration Today



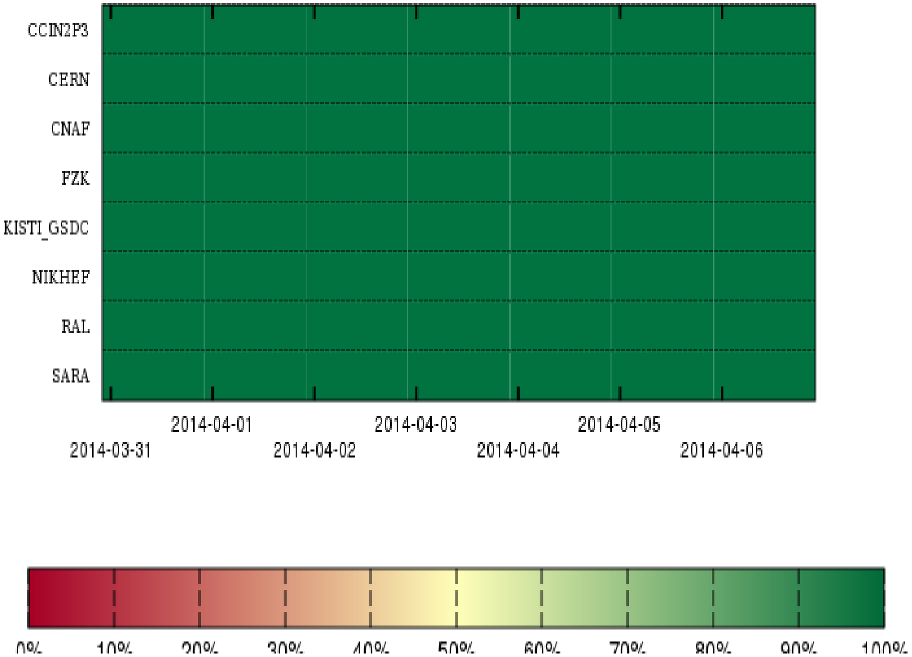
- Distributed infrastructure of 150 computing centers in 40 countries
- 300+ k CPU cores (~ 2M HEP-SPEC-06)
- The biggest site with ~50k CPU cores, 12 T2 with 2-30k CPU cores
- Distributed data, services and operation infrastructure

WLCG Collaboration Tomorrow

- How will this evolve to HL-LHC needs?
- To what extent is it applicable to other comparable scale projects?
- **Already evolving, most significantly during Long Shutdowns, but also during data taking!**

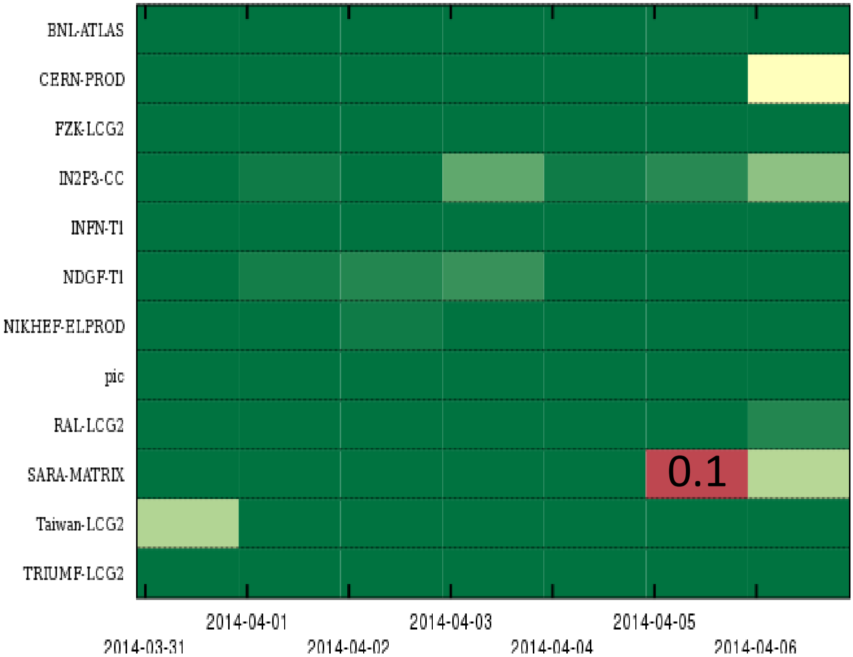
Site reliability using ALICE_CRITICAL

168 hours from 2014-03-31 00:00 to 2014-04-07 00:00



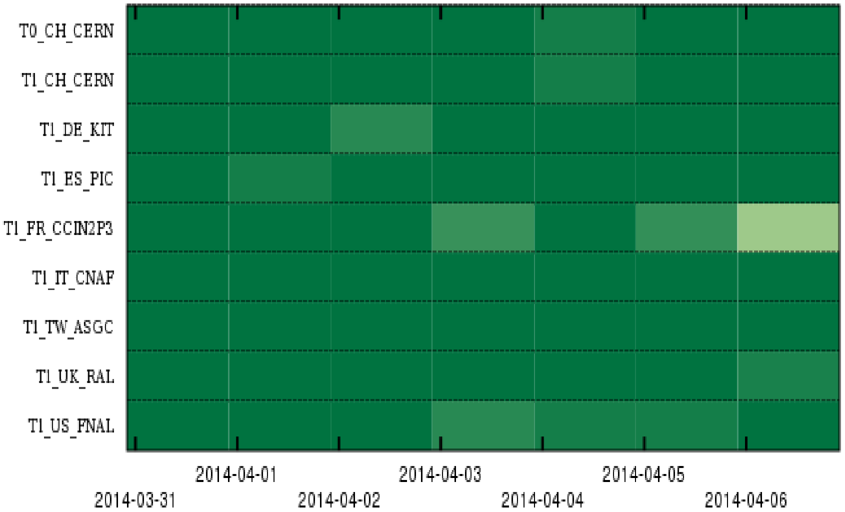
Site reliability using ATLAS_CRITICAL

168 hours from 2014-03-31 00:00 to 2014-04-07 00:00



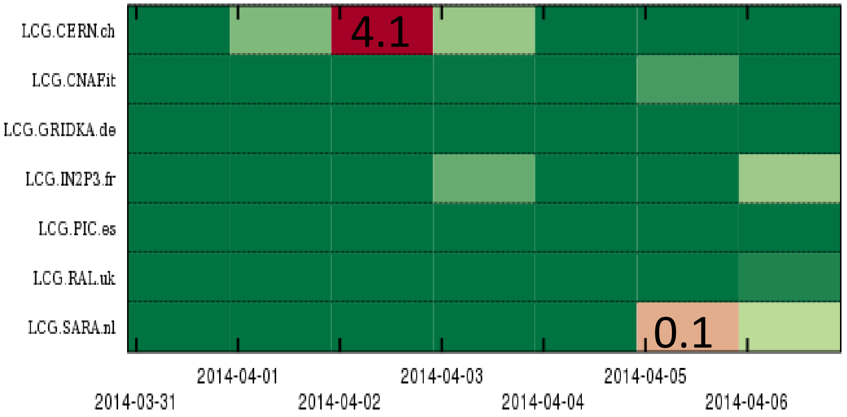
Site reliability using CMS_CRITICAL_FULL

168 hours from 2014-03-31 00:00 to 2014-04-07 00:00



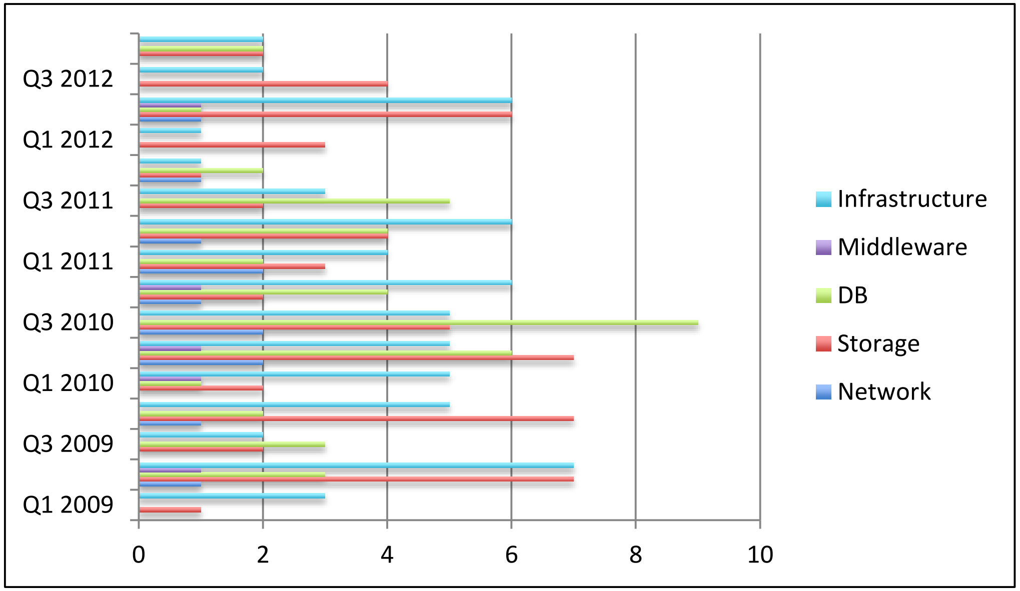
Site reliability using LHCb_CRITICAL

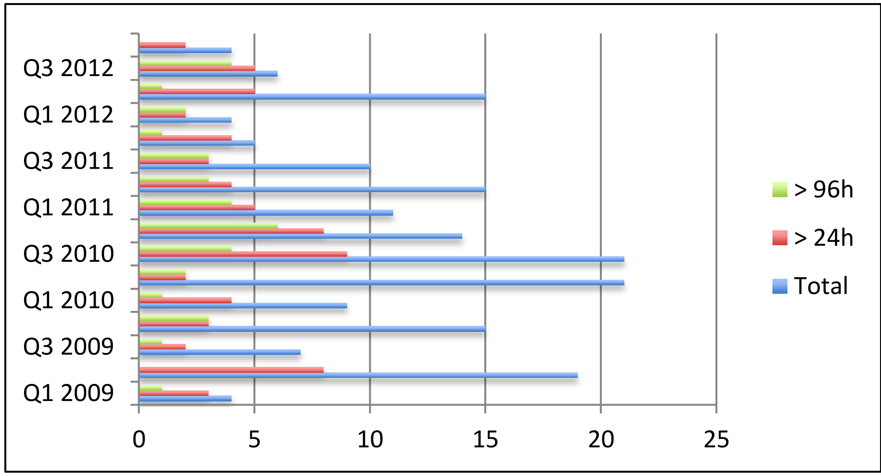
168 hours from 2014-03-31 00:00 to 2014-04-07 00:00



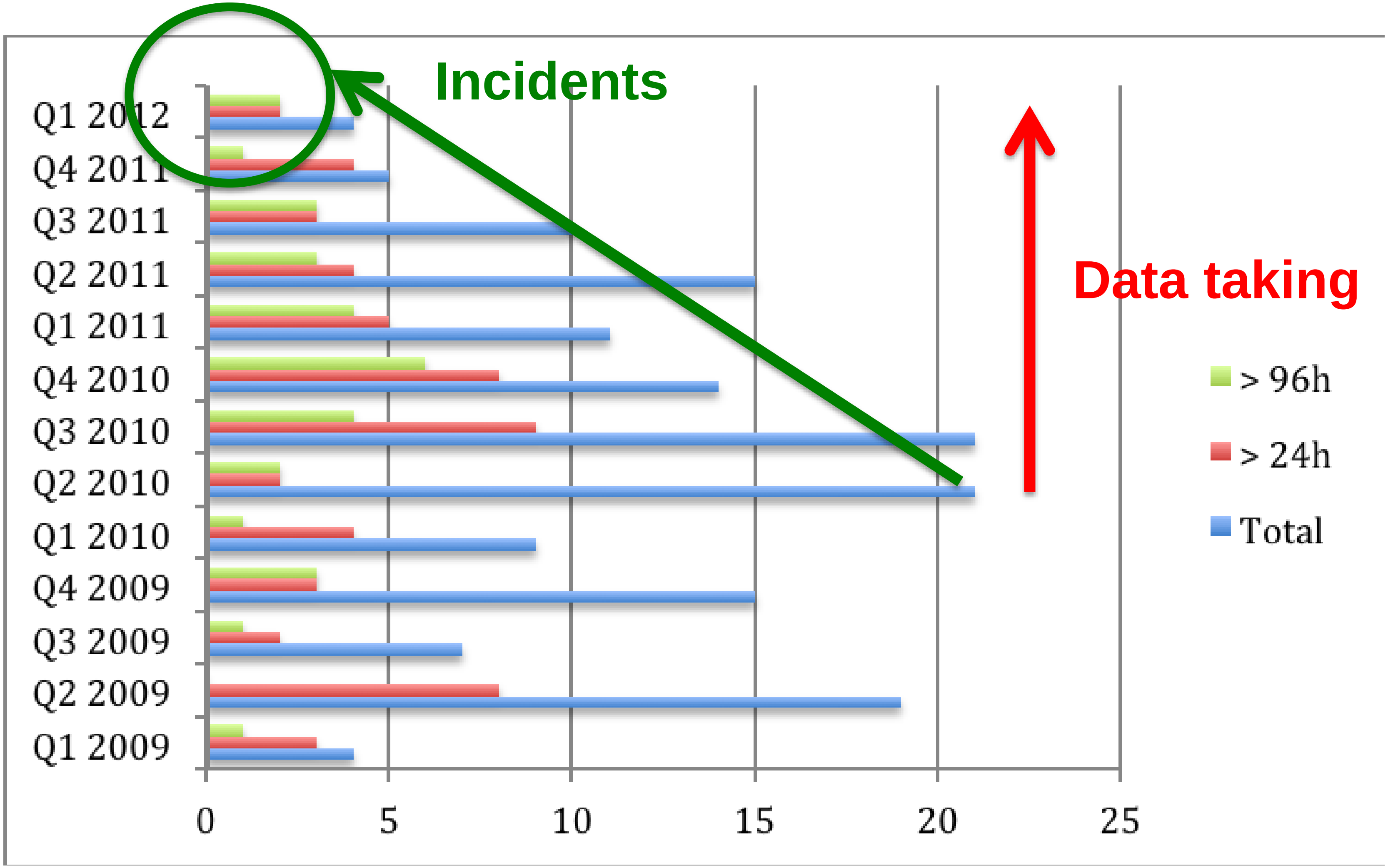
WLCG Service Incidents

- Aka "post-mortems"





Resolution of Incidents



4. Design digital curation as a sustainable service

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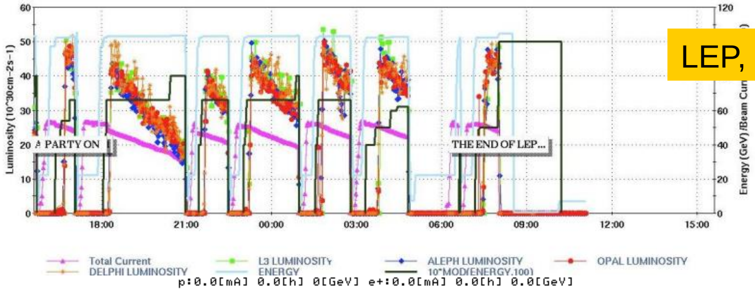
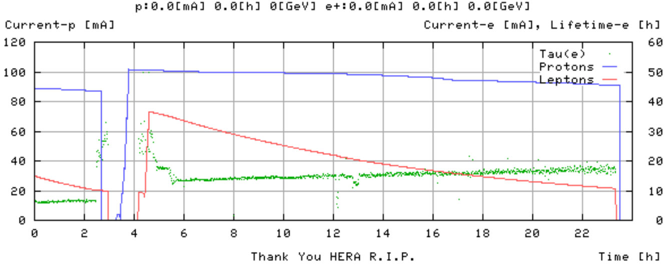
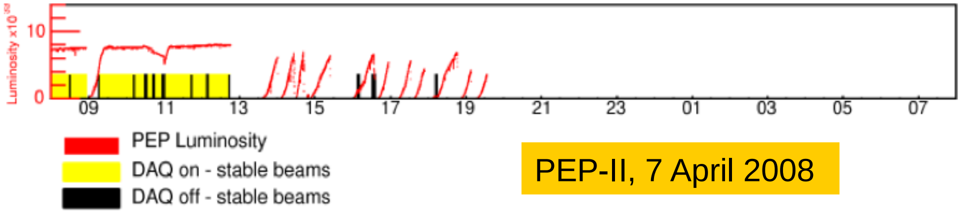
The last years have seen the end of several experiments



LEP, 2 November 2000



HERA, 30 June 2007

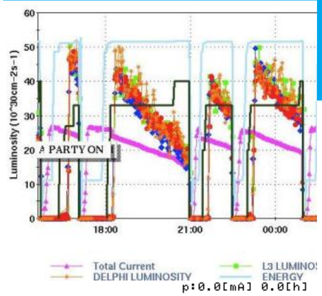


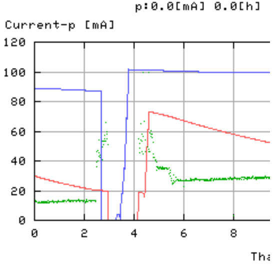
Mon Apr 7
04:34h (19.0%) Stable Beams
04:15h (93.1%) DAQ on
84.6/pb Recorded Lumi
1.3% Deadtime
18s DCH paused (# 4)

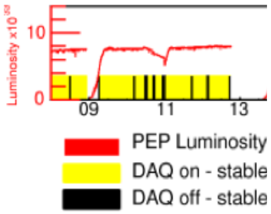
PEP-II, 7 April 2008

4. Design digital curation as a sustainable service

The last years have seen the end of several experiments

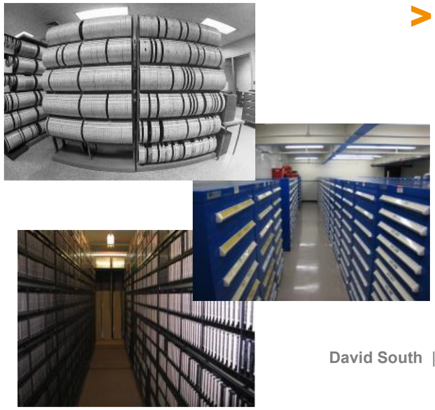






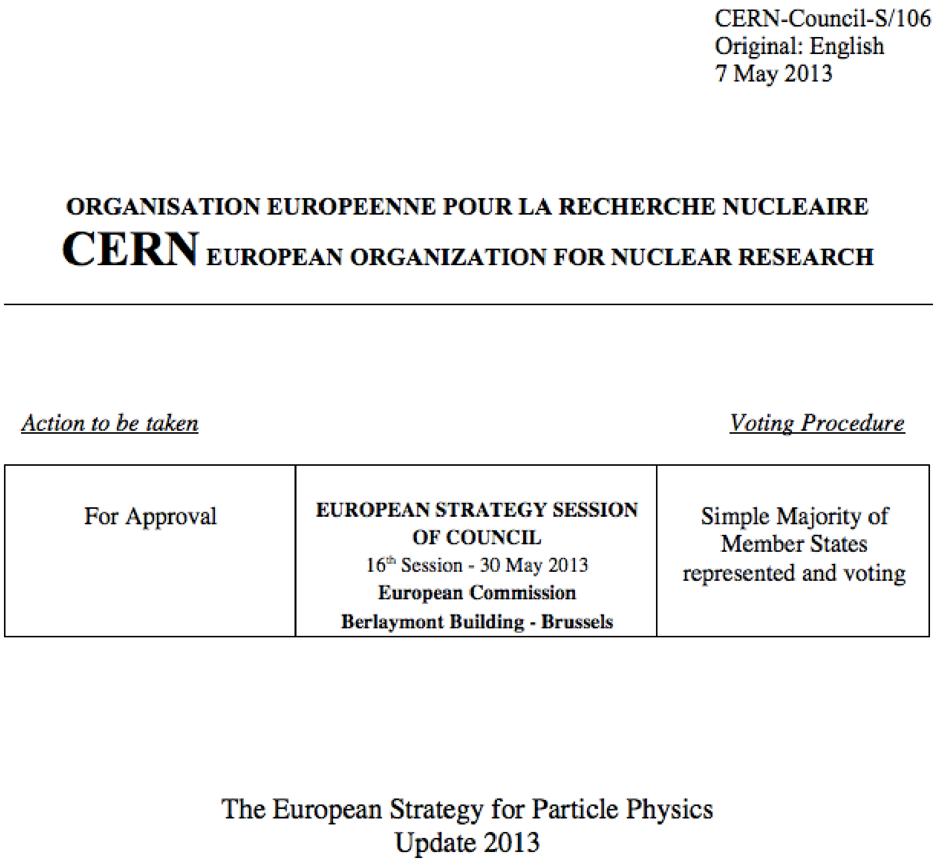
After the collisions have stopped

- Finish the analyses! But then what do you do with the data?
  - Until recently, there was no clear policy on this in the HEP community
  - It’s possible that older HEP experiments have in fact simply lost the data
- Data preservation, including long term access, is generally not part of the planning, software design or budget of an experiment
  - So far, HEP data preservation initiatives have been in the main not planned by the original collaborations, but rather the effort a few knowledgeable people



- The conservation of tapes is not equivalent to data preservation!
  - *“We cannot ensure data is stored in file formats appropriate for long term preservation”*
  - *“The software for exploiting the data is under the control of the experiments”*
  - *“We are sure most of the data are not easily accessible!”*

4. Design digital curation as a sustainable service



CERN-Council-S/106
Original: English
7 May 2013

ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE
CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Action to be taken *Voting Procedure*

For Approval	**EUROPEAN STRATEGY SESSION OF COUNCIL** 16th Session - 30 May 2013 **European Commission** **Berlaymont Building - Brussels**	Simple Majority of Member States represented and voting

The European Strategy for Particle Physics
Update 2013

ments

do with the data?

the HEP community

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4.

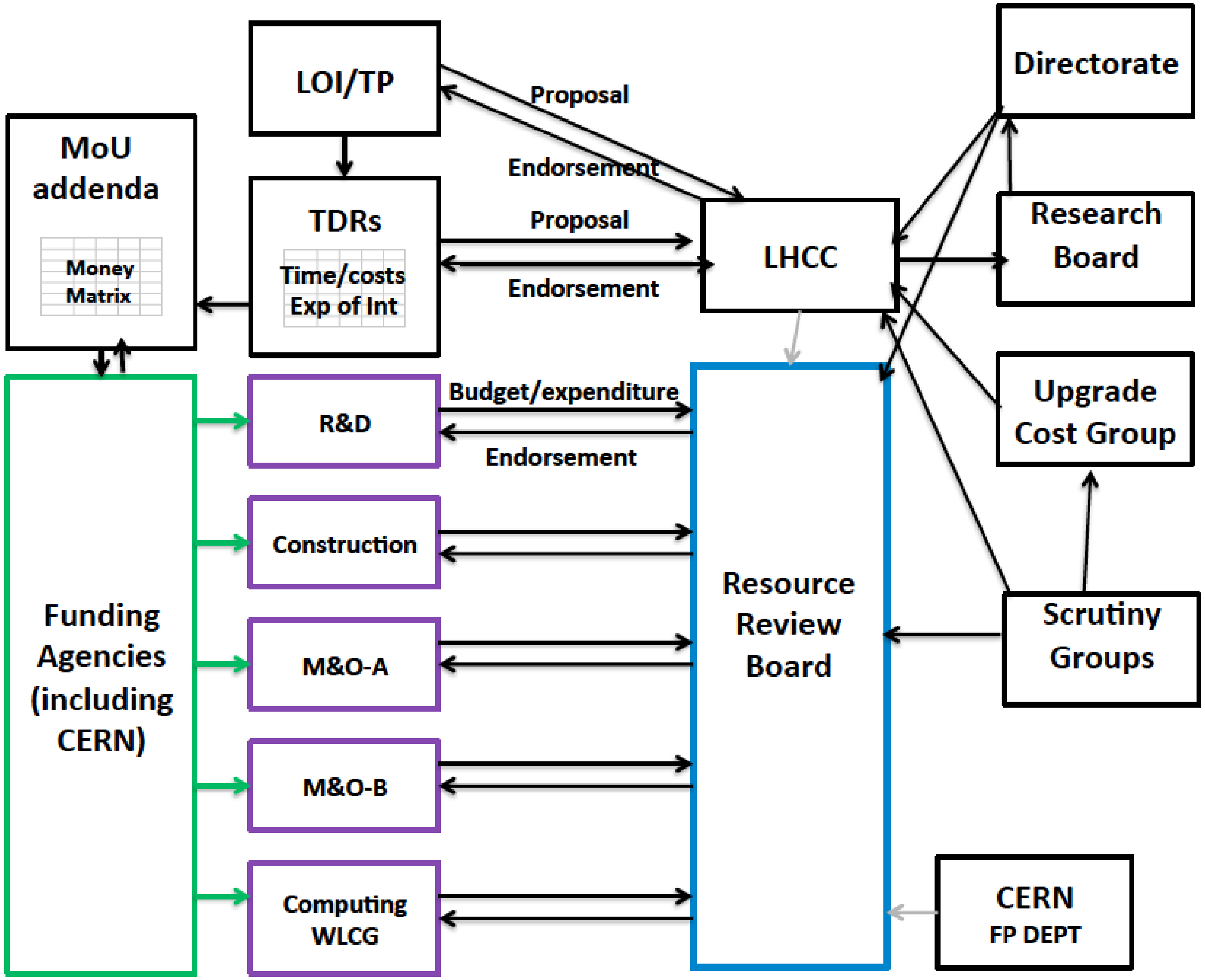
ORGANISATION EUI

CERN EUROPE

Action to be taken

For Approval

Experiment approval and monitoring process



LOI/TP

Proposal

Endorsement

MoU addenda

Money Matrix

TDRs

Time/costs Exp of Int

Proposal

Endorsement

LHCC

Directorate

Research Board

Upgrade Cost Group

Funding Agencies (including CERN)

R&D

Budget/expenditure

Endorsement

Construction

M&O-A

M&O-B

Computing WLCG

Resource Review Board

Scrutiny Groups

CERN FP DEPT

i) The success of particle physics experiments, such as those required for the high-luminosity LHC, relies on innovative instrumentation, state-of-the-art infrastructures and large-scale data-intensive computing. *Detector R&D programmes should be supported strongly at CERN, national institutes, laboratories and universities. Infrastructure and engineering capabilities for the R&D programme and construction of large detectors, as well as infrastructures for data analysis, data preservation and distributed data-intensive computing should be maintained and further developed.*

5. Make funding dependent on costing digital assets across the whole lifecycle

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http://science.energy.gov/funding-opportunities/digital-data-management/

- *"The focus of this statement is sharing and preservation of digital research data"*

- **All proposals submitted to the Office of Science (after 1 October 2014) for research funding must include a Data Management Plan (DMP) that addresses the following requirements:**

1. **DMPs should describe whether and how data generated in the course of the proposed research will be shared and preserved.**

   If the plan is not to share and/or preserve certain data, then the plan must explain the basis of the decision (for example, cost/benefit considerations, other parameters of feasibility, scientific appropriateness, or limitations discussed in #4).

   At a minimum, DMPs must describe how data sharing and preservation will enable validation of results, or how results could be validated if data are not shared or preserved.

U.S. DEPARTMENT OF ENERGY | Office of Science

ALICE Data Preservation plans

- The ALICE collaboration is committed to develop a long term program for Data Preservation to serve the triple purpose of
  i. preserving data, software and know-how inside the Collaboration,
  ii. sharing data and associated software and documentation with the larger scientific community, and
  iii. give access to reduced data sets and associated software and documentation to the general public for educational and outreach activities.

ALICE Data Preservation plans

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The goal is to require the reproducibility of analysis in such virtualized environments as a prerequisite for publishing results.

and

iii. give access t
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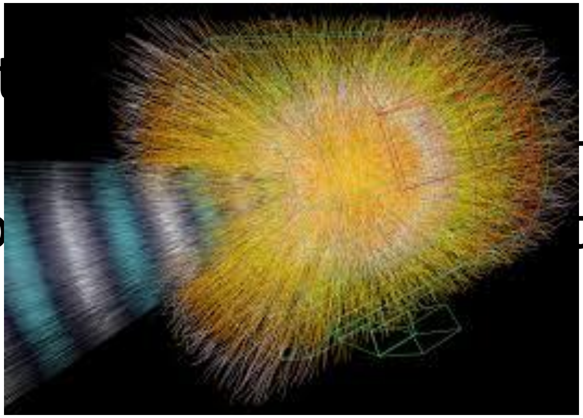

6. Be collaborative and transparent to drive down costs

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2020 Vision for LT DP in HEP

- ***Long-term – e.g. FCC timescales:*** ***disruptive change***
  - By 2020, all **archived data** – e.g. that described in DPHEP Blueprint, including LHC data – easily **findable**, fully **usable** by **designated communities** with clear (Open) access policies and possibilities to annotate further
  - Best practices, tools and services well run-in, fully documented and sustainable; built in common with **other disciplines**, based on standards
  - **DPHEP portal**, through which data / tools accessed
    - **"HEP FAIRport": Findable, Accessible, Interoperable, Re-usable**

- **Agree with Funding Agencies clear targets & metrics**

6. Be collaborative and transparent to drive down costs

Collaboration – Benefits

- In terms of 2020 vision, collaboration with other projects has arguably advanced us (in terms of implementation of the vision) by several years
- **I typically quote 3-5 years and don't think that I am exaggerating**
- **Concrete examples include "Full Costs of Curation", as well as proposed "Data Seal of Approval+"**
- With or without project funding, we should continue – and even strengthen – this collaboration
  - APA events, iDCC, iPRES etc. + joint workshops around RDA
- **The HEP "gene pool" is closed and actually quite small – we tend to recycle the same ideas and "new ones" sometimes needed**

- ***Long-***
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  - **DP**

➢ **Agree**

6. Be collaborative and transparent to drive down costs

- *Long-*

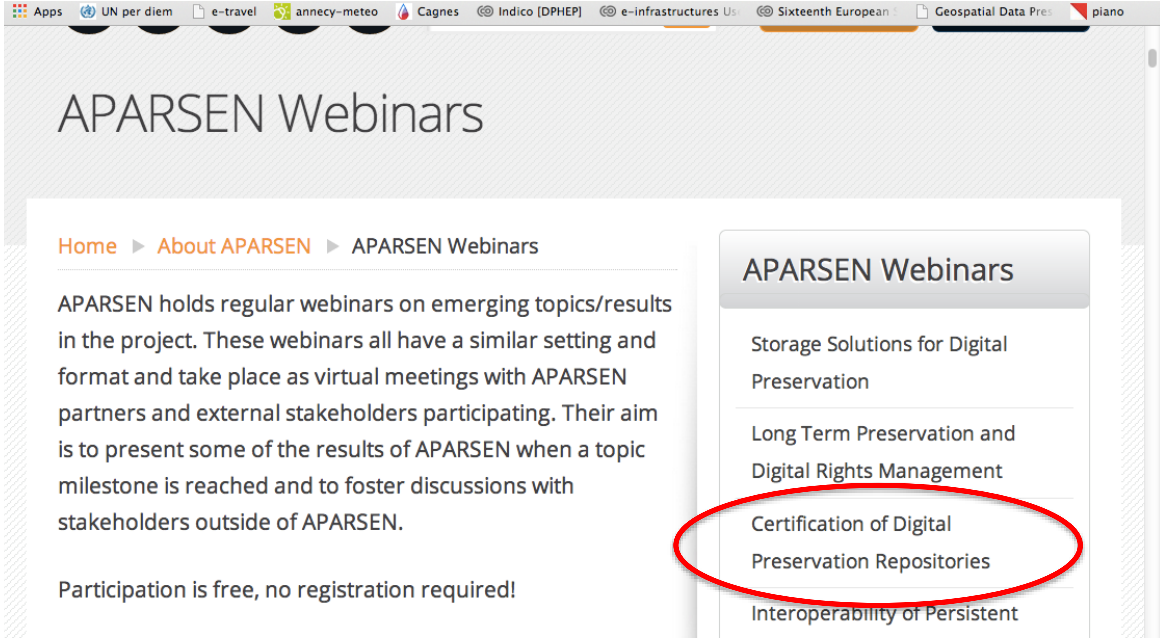
  – By inc **co** an

  – Be su sta

  – **DP**

➢ **Agree**

APARSEN Training & Knowledge Base



APARSEN Webinars

Home ▸ About APARSEN ▸ APARSEN Webinars

APARSEN holds regular webinars on emerging topics/results in the project. These webinars all have a similar setting and format and take place as virtual meetings with APARSEN partners and external stakeholders participating. Their aim is to present some of the results of APARSEN when a topic milestone is reached and to foster discussions with stakeholders outside of APARSEN.

Participation is free, no registration required!

APARSEN Webinars

- Storage Solutions for Digital Preservation
- Long Term Preservation and Digital Rights Management
- Certification of Digital Preservation Repositories
- Interoperability of Persistent

POINT FOR DISCUSSION

http://science.energy.gov/funding-opportunities/digital-data-management/

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U.S. DEPARTMENT OF ENERGY | Office of Science http://science.energy.gov/funding-opportunities/digital-data-management/

User Communities & Virtual Research Environments

- *“Th arch da*

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(International) Funding Agencies

Service Providers (e-infrastructures)

ENERGY | Science

http://science.energy.gov/funding-opportunities/digital-data-management/

User Communities & Virtual Research Environments

- *“Th… …earch dat…*
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TRAINING
terminology plus extension and OAIS concepts
Business case
Business Model
Value
Preservation
Usability
Services
TOOLS
COSTS
GOVERNANCE
SELECTION
RIGHTS
AUTHENTICITY
INGEST
STORE
PLAN
REP. INFORMATION
TRANSFORM
HAND OVER
Dispose
Create
Use
Audit

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(International) Funding Agencies

Service Providers (e-infrastructures)

ENERGY | Science

Summary

- Thanks to stimulation from and interactions with the 4C project, we have developed a simple “cost model” for LHC data (“bit preservation”)
- This has been input to the CERN Resource Review Board (LHC machine, experiments, computing) – a sustainable funding scheme for decades
- A portal will help us inform people of the current state, including the implementation of DMPs and access to the preserved data (HEP FAIRport)