

Data Preservation Activities at DESY.

Status Report of the HERA Data Preservation Group



David South (DESY)
on behalf of the DESY-DPHEP Group

6th DPHEP Workshop
CPPM, Marseille
19th November 2012



Contents

- > Introduction to the DESY-DPHEP Group
- > Data preservation strategies of the experiments and plans for archival storage of the HERA data
- > The Software Preservation System at DESY
- > Documentation efforts
- > Summary and future work



The DESY-DPHEP group

- DESY-DPHEP: group of about 15 people, meetings every other week
 - **DESY-IT:** D.Ozerov
 - **DESY-Library / INSPIRE:** Z. Akopov
 - **H1:** S. Baghdasaryan, V. Dodonov, B. Lobodzinski, J. Olsson, D. South, M. Steder
 - **HERMES:** E.Avetisyan, G.Schnell
 - **ZEUS:** A. Ausheva, V.Bokhonov, A.Geiser, J.Malka, K.Wichmann
- Conference presentations in 2012 by DESY-DPHEP (CHEP, ICHEP, IEEE)
- Many people employed on short term, dedicated data preservation contracts, requested in accordance with the DPHEP recommendations
 - We now try to secure the long term support needed
 - Only two names are permanent staff, and are not working exclusively DP

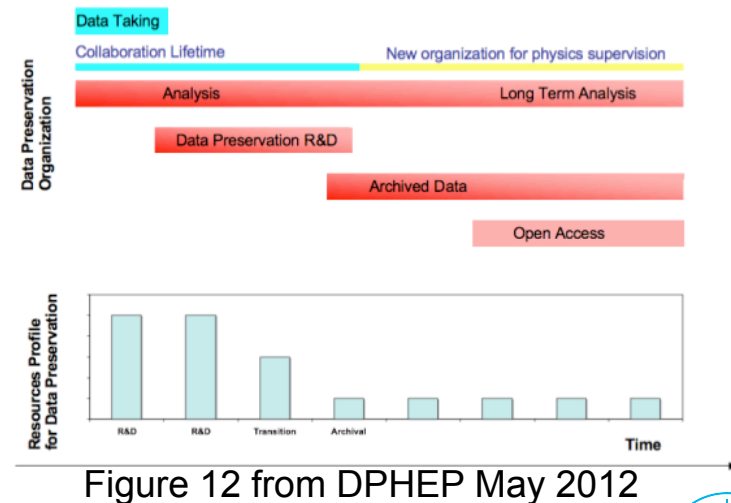
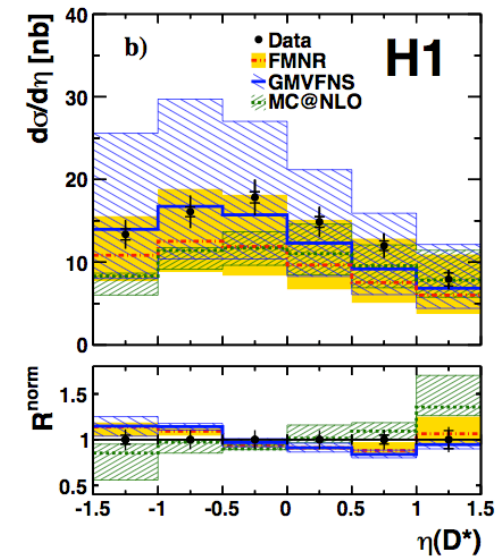
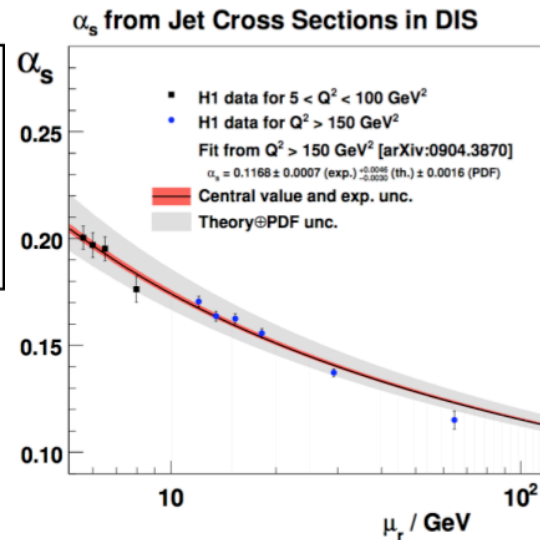
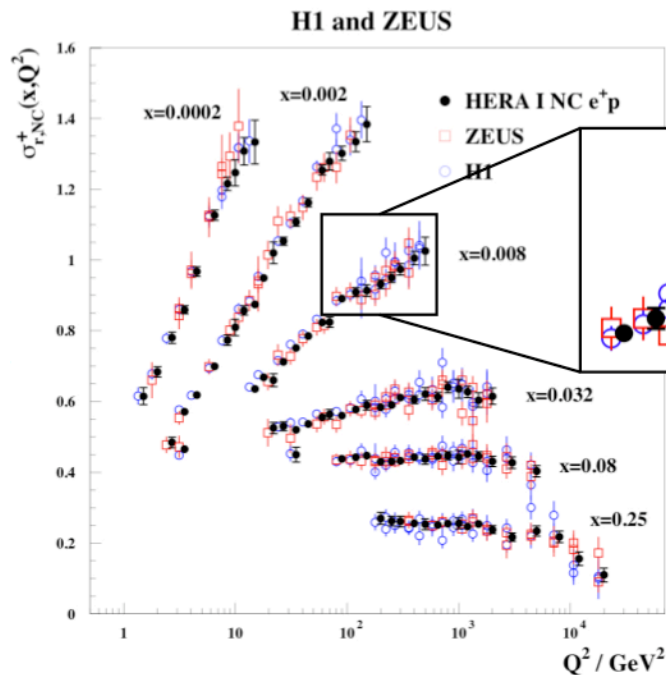


Figure 12 from DPHEP May 2012



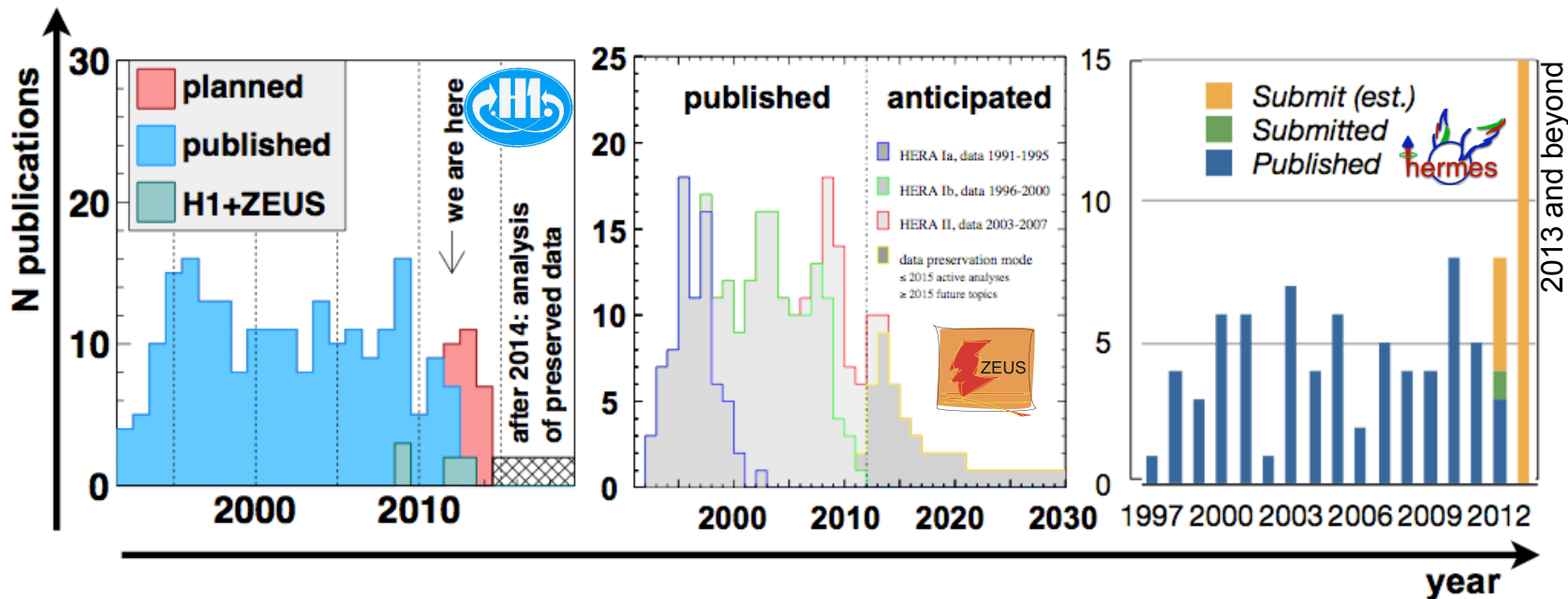
The ep collisions from HERA are unique..

- The HERA data are particularly unique, given there are no concrete plans for a new collider for $e^\pm p$ physics on the table
- Many physics cases can be built to support long term analysis
 - Including combinations, better theory available

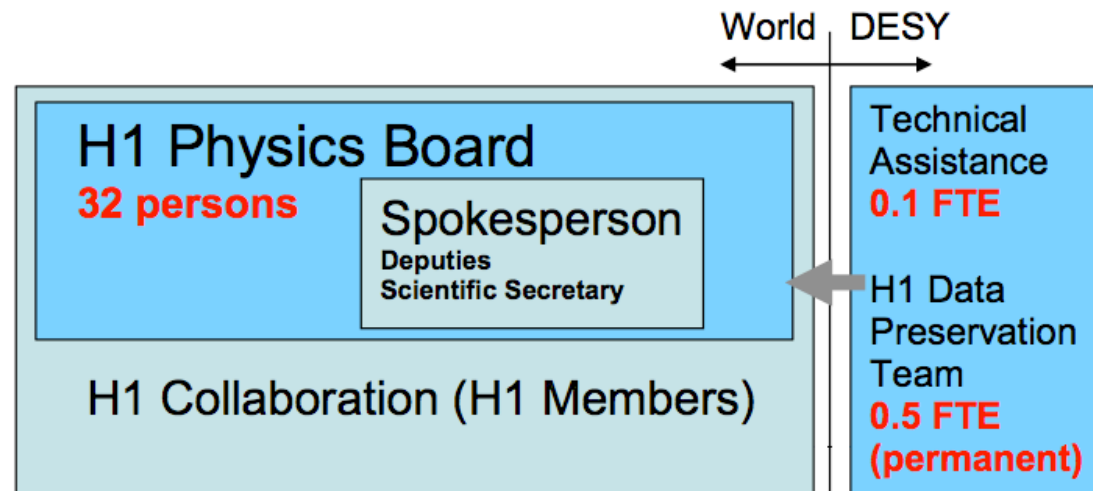


..and we are not done with them yet!

- Collaborations continue to publish at a significant rate, 5 years after data taking
 - As seen with LEP and predicted by BaBar
- Majority of remaining papers planned for next 2-3 years, but long tail expected
 - Key goal of DP project: ensure this is possible



Changing face of the HERA collaborations



- > H1 moved to a new collaboration management model in July 2012
 - Formation of **H1 Physics Board**, to replace Collaboration Board (institute based)
 - Future author list policies also set down in new constitution approved by collaboration
- > HERMES and ZEUS management teams retain same model as before, but similarly to H1 the collaborating institute layer is now removed
 - Remaining physics ZEUS working groups are now consolidated to a single physics group



Data preservation strategies of the HERA experiments

	Preservation Model	Use Case	
Increasing cost, complexity and benefits ↓	1	Provide additional documentation	Documentation
	2	Preserve the data in a simplified format	Outreach
	3	Preserve the analysis level software and data format	Technical Preservation Projects
	4	Preserve the reconstruction and simulation software as well as the basic level data	



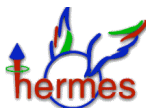
Preservation level 4

- Keep full chain from compilation of simulation, reconstruction and analysis code
- Retain the full flexibility in the future for data and MC production



Preservation level 3-4 (no compilation)

- Data and MC preserved in the form of ROOT-based Common Ntuples
- Maintain the ability to simulate small samples of new MC with existing executables



Preservation level 4

- ADAMO-based micro-DST files for data and MC
- Compilation of full analysis chain, production

All experiments also have level 1 documentation efforts – see *later*



HERA data for preservation



Final data reprocessing to mDST completed in 2009

- Basic preserved data format: ROOT based “Common Ntuples”
- Ultimately RAW, MDST data and MC removed from robots, keep only cNuptles
- Final production of data/MC cNuptles started, to be completed early 2013



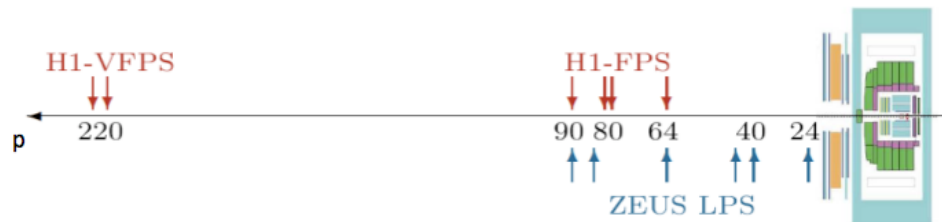
Final reprocessing (DST-7) of HERA II data in 2009, HERA I done in 2012

- Final version of common analysis software environment + files, H1OO also done
- Preserve RAW data, as well as DST-7 and H1OO 4.0 versions
- Large MC production of up $2 \cdot 10^9$ events / year, preserved MC sets to be decided



Final data and MC production completed in 2012

- Main format for analysis is the mDST, this is the one to be preserved
- Importantly for HERMES, all data/MC productions now moved to dCache



Dialogue begun with DESY machine group concerning their HERA data



Long term Archival Storage for the HERA data

- > Dedicated system too costly in both hardware and person-power
- > All collaborations now using dCache for mass storage, and this system will continue at DESY-IT for the LHC, photon-physics, others..
 - By using dCache this is completely transparent for user, relying on IT admin work
- > Ingredients to the proposed archival system:
 - Active check for the data consistency on disk level, tape copy only for the case if disk copy is corrupted; corresponding checks also on the tape (checksum)
 - For data which have no copy on disk: two copies on tapes (different technology old vs new, but both still readable), regular migration to new media
 - Data which should be archived, but not online all the time – re-pack into larger files
- > System properties also defined by which data needed “always online”

- Initial estimates:

~ 1 PB in total

- Different strategies clearly visible

	Online	Not online	Total
H1	~ 250 TB	~ 100 TB	~ 350 TB
ZEUS	~ 250 TB		~ 250 TB
HERMES	~ 40 TB	~ 350 TB	~ 390 TB
Total	~ 540 TB	~ 450 TB	~ 990 TB

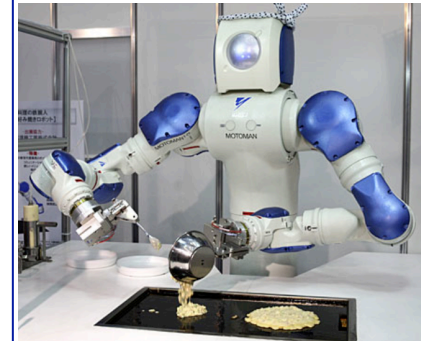


Pizza Preservation



- > Couple of days
 - Fridge
- > Couple of month
 - Deep freezer
- > Couple of years???
 - Preserve the recipe
 - Practice it often: You will not forget the recipe and you can detect variations in external dependencies

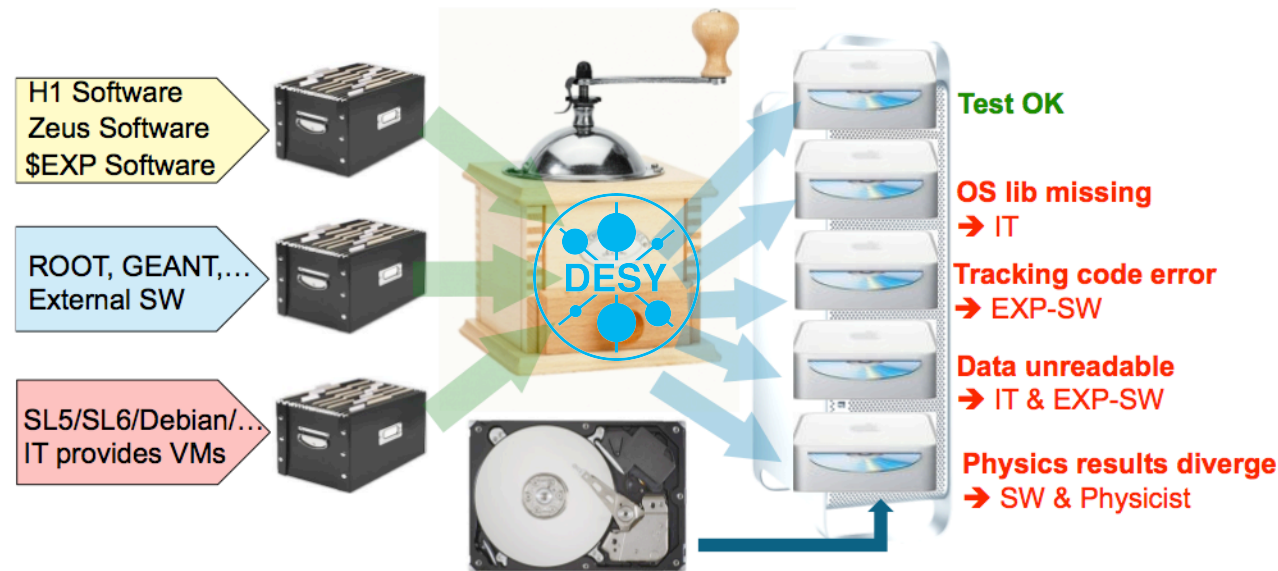
Y. Kemp, D. Ozerov,
CHEP 2012



- > Whilst freezing the software and environment is easy to do, long term use and correctness of the results not guaranteed
 - Naïve assumption virtualisation solves everything breaks down at the first security hole
- > Freezing software is OK if the timeline and scope are reduced, but if changes are needed this is more difficult the longer software is frozen
- > Better to cook the same recipe again and again (and maybe even allow it to be improved), validating the output *automatically*
 - Virtualisation can help here!



The Software Preservation System @ DESY



- > Automated validation system to facilitate future software and OS transitions
 - Uses virtualisation techniques to repeatedly run well defined tests
 - Perform checks of different and evolving environments (OS, s/ware configuration)
 - Stand alone system: No hidden dependencies or /afs access etc: rigorous testing
 - Automatically check these results against predefined, default values
 - Notify when test results differ from these values
 - Separate responsibilities of IT and the experiments



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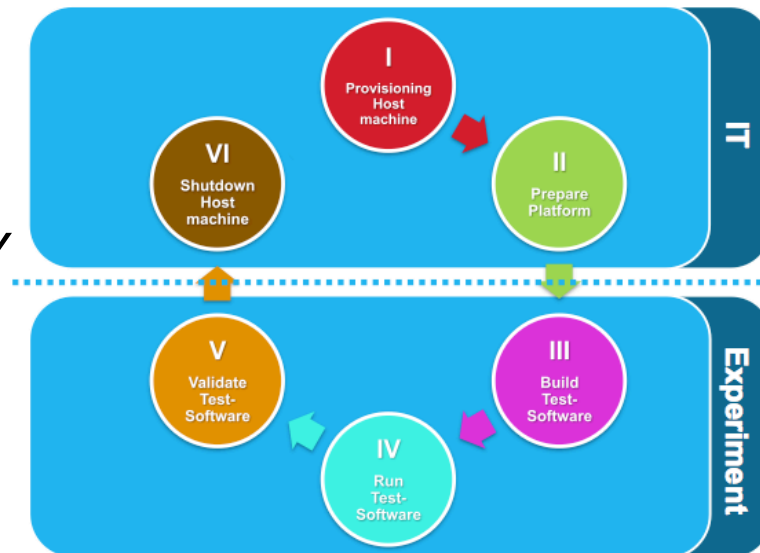
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The sp-system: Towards the full implementation

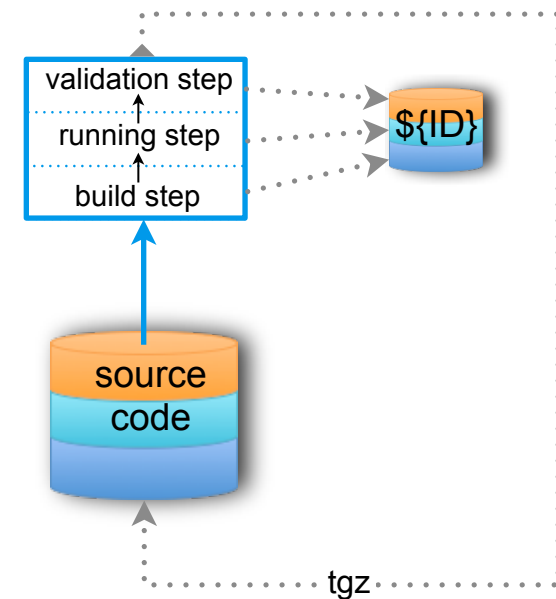
- > Pilot project at CHEP 2010
 - Single configuration, simple tests
- > Full implementation now installed at DESY
- > Common baseline of SLD5 / 32-bit achieved in 2011 by all experiments
 - Sound starting point for validation
- > Following OS configurations now available in sp-system:
 - **sl5.6/64**(gcc4.4), **sl5.7/32**(gcc4.4), **sl5.7/64**(gcc4.1), **sl5.7/32**(gcc4.1), **sl6.2/64**(gcc4.4)
- > In addition, to multiple ROOT versions
 - **5.26.00d**, **5.28.00c**, **5.30.05**, **5.32.00**, **5.34.01**
- > 64-bit systems a major step toward migrations to future OS and hardware
 - SL6 will only be supported in 64 bit variant at DESY
 - NFS4.1 technology, to be used in dCache, native only in SL6.2/64 or higher



Running jobs in the sp-system

> Initial step

- Compilation of analysis (level 3) and sim/rec (level 4) software
- **Or:** use tar-balls with pre-compiled software
- Provide access to software
 - Copy tar-balls to persistent storage
- All output kept in directory with unique name



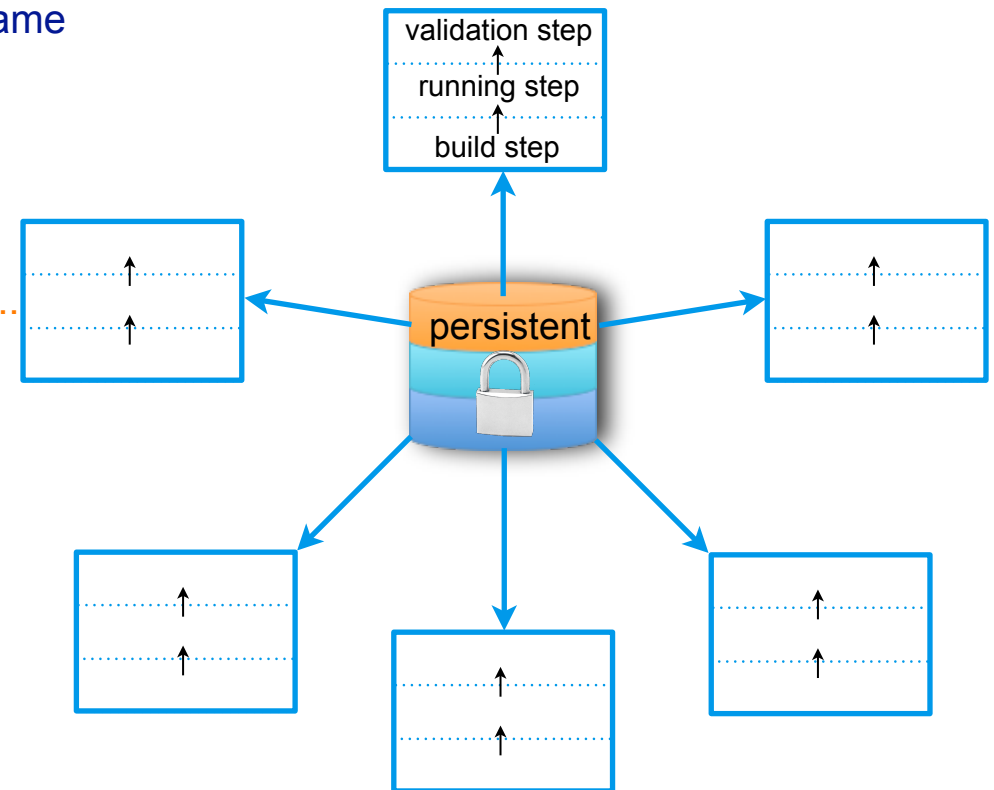
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> Run parallel tests

- Set up software environment
- Validate binaries with persistent input
 - e.g. event display, database access, ...



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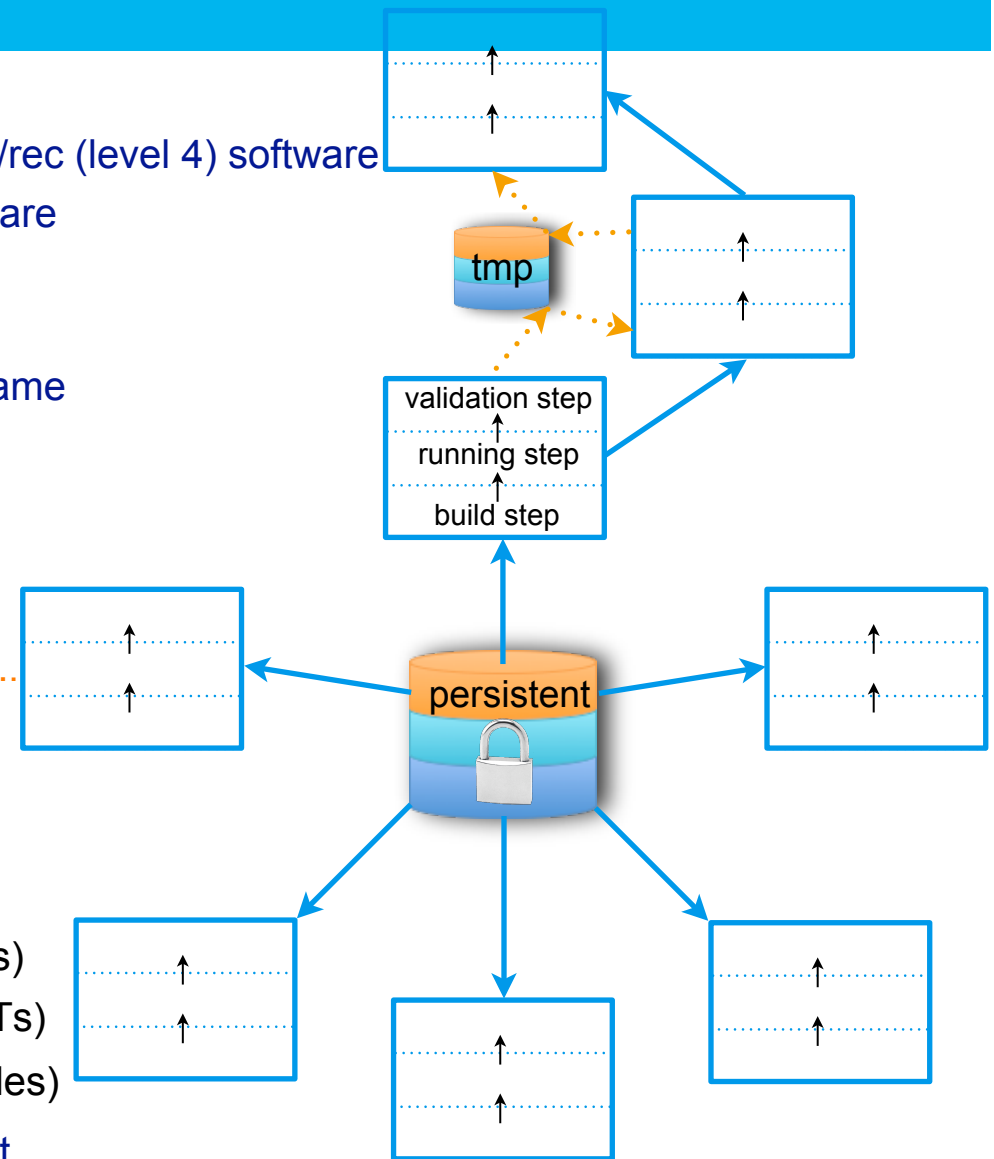
> Run parallel tests

- Set up software environment
- Validate binaries with persistent input
 - e.g. event display, database access, ...

> Run sequential tests

- Set up software environment
- Validate file production
 1. MC generation (produce gen files)
 2. Reconstruction (gen. files → DSTs)
 3. Analysis level (DSTs → ROOT files)
- Tests use output of previous test as input

> Results remain accessible or can be reproduced with identical results



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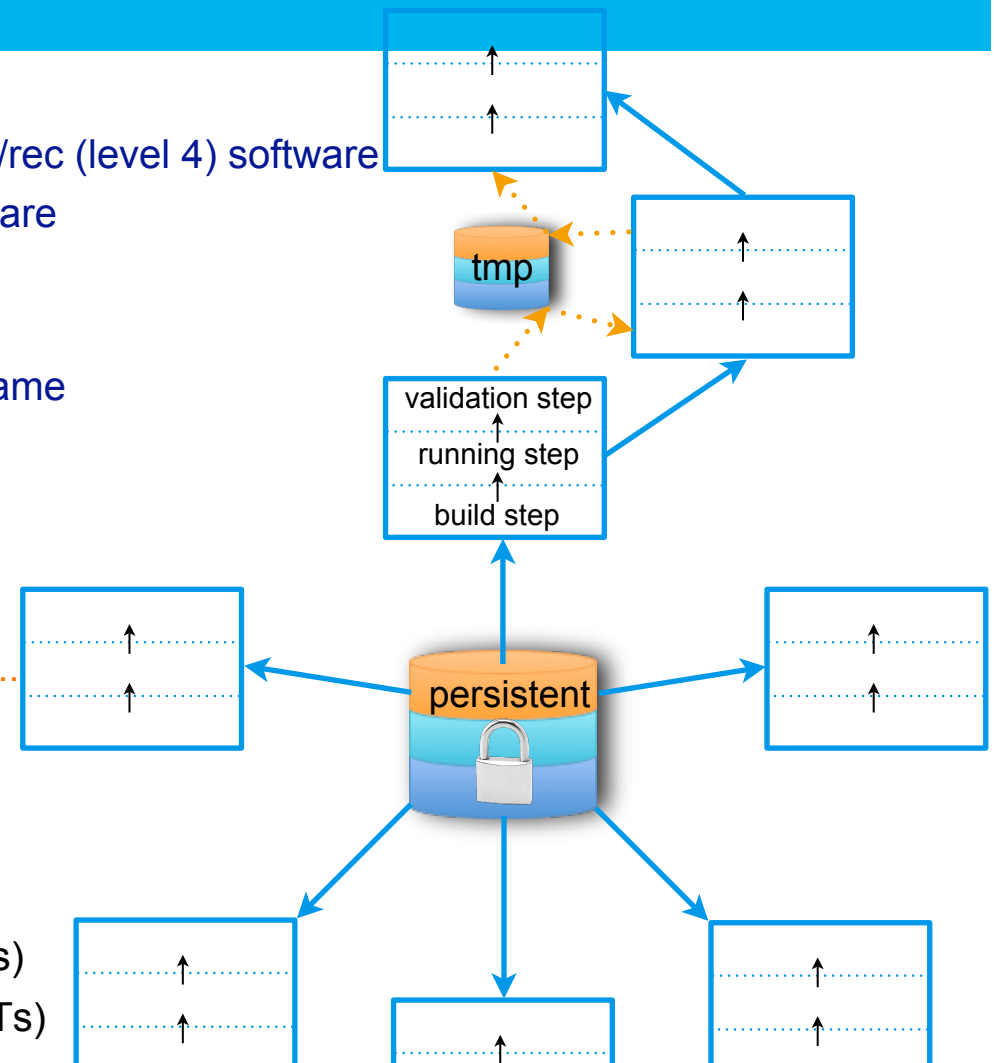
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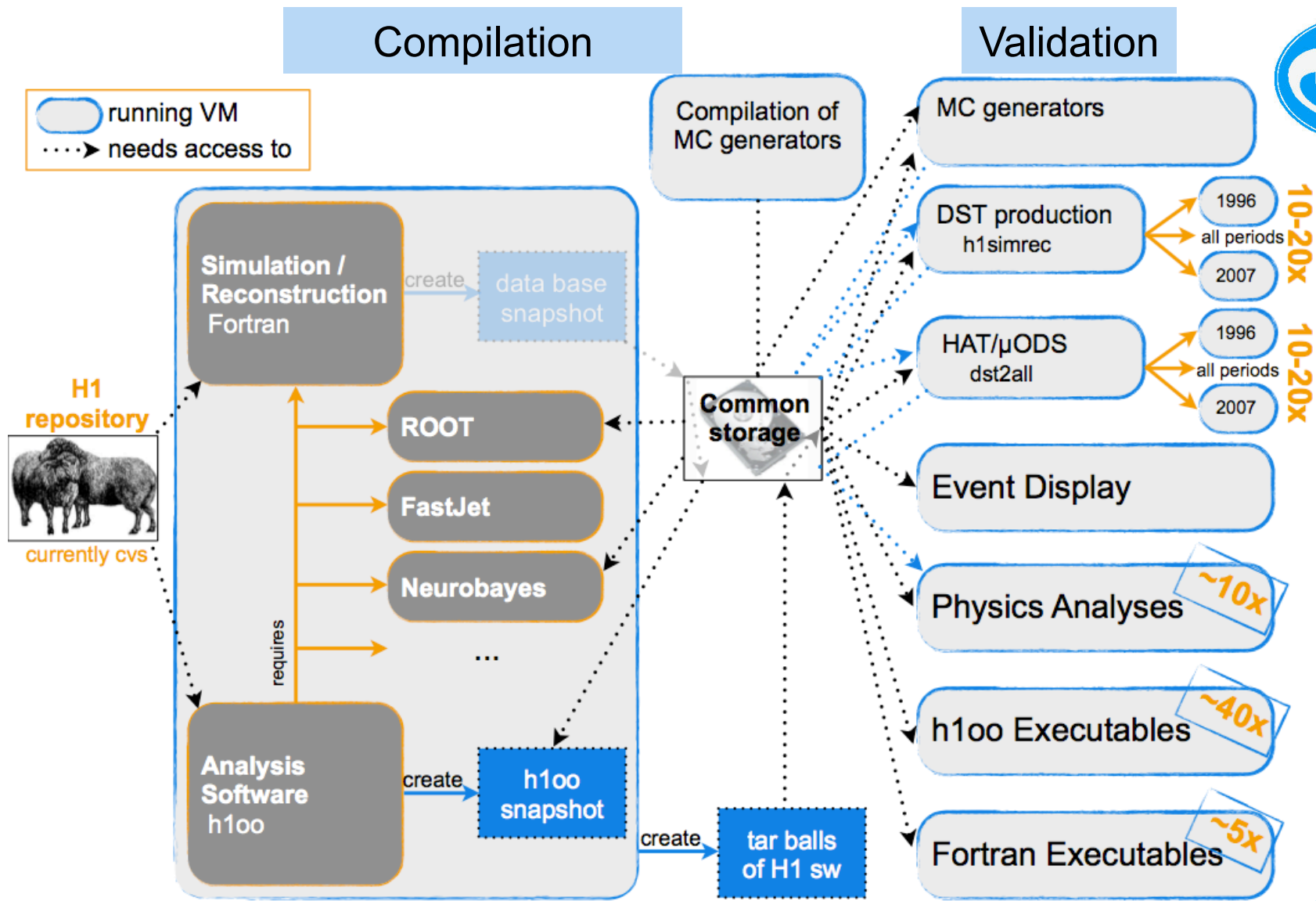
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 3. Analysis level (DSTs → ROC)
- Tests use output of previous test as

> Results remain accessible or can



→ It is essential to have robust definition of complete set of experimental tests
The nature and number dependent on desired preservation level

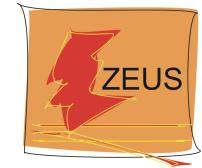
Example structure of experimental tests: H1 (Level 4)



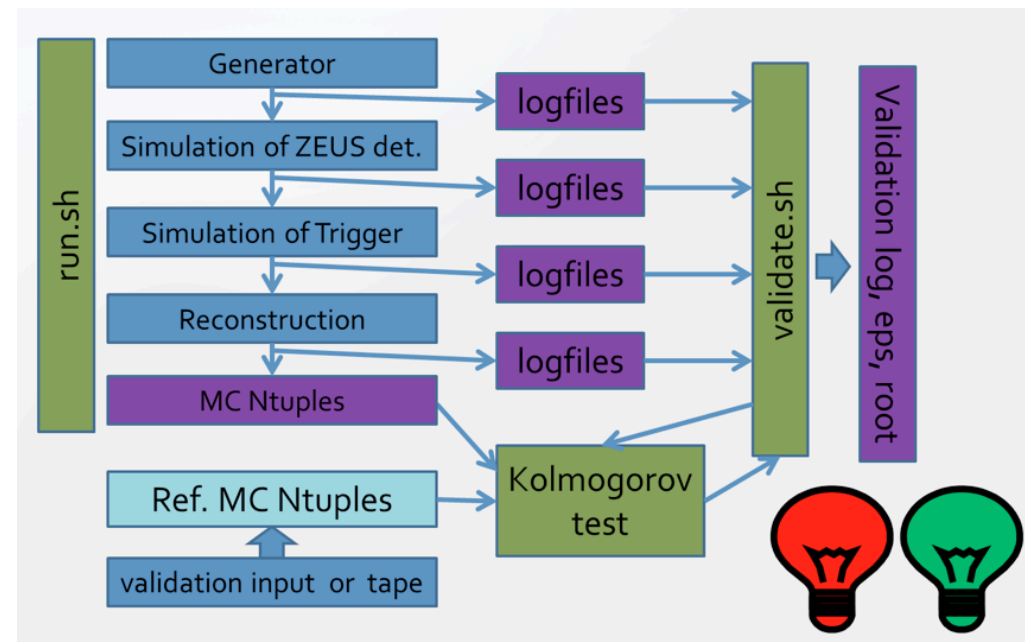
Including compilation of individual packages: about 250 tests planned by H1



Example structure of experiment tests: ZEUS (Level 3 + MC chain)

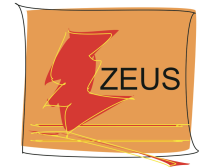


- > ZEUS strategy: use ROOT based analysis level Common Ntuples as data format for preservation – DPHEP level 3
- > Only external dependence is ROOT
 - Validation of new ROOT versions included as analysis level tests in the sp-system
- > However, the MC production chain pre-compiled executables will also be preserved as a standalone package
 - Remaining ZEUS SL3 executables continue to work on the SL6/64 OS
- > In addition, an interface for new generators is developed, which is also included in the validation system



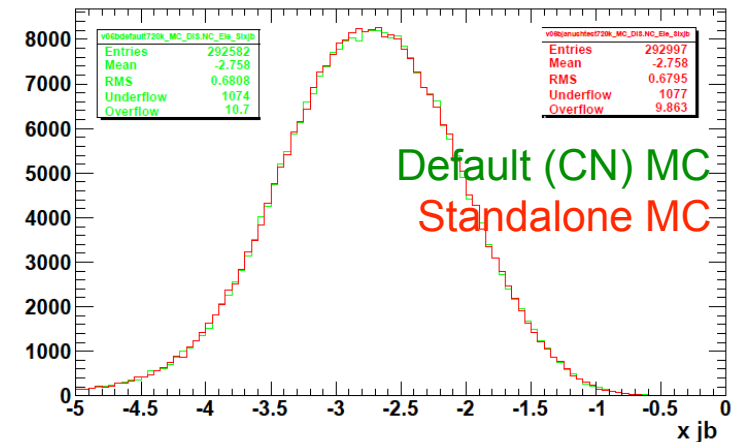
HEP MC interface and standalone MC production

- > Work on interface between HepMC and ZEUS ADAMO on going, very preliminary version is ready
 - The HepMC format C++ classes and Fortran formoza compile to one executable
 - Event record from HepMC ASCII file is converted to HEPEVENT common block and passed to formoza to fill the ZEUS ADAMO
 - Still need testing: events record flow, different version of HepMC format, different OS,..





- > Several options where to run the standalone MC production

- **Powerful work group server:** no significant differences observed with respect to standard Common Ntuples
- **Stand alone work group sever:** Output looks reasonable, some checks still needed
- Use of distributed computing for future MC production not planned (only small samples are foreseen, where small $\sim 1M$ events)

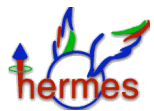


Putting it all together

Process	Operating System	SL5 32bit				SL5 64bit					SL6 64bit
		External Dependencies				Cernlib		Fastjet	Neuro-bayes		
		5.26	5.28	5.30	5.32	2005	2006	2.3.3	2008 0312	3.3.0	
 Accessing cNtuples (Data/MC)											
Creating cNtuples (Data/MC)											
ZMCSP (simulate/reconstruct MC)						No dependence					
Validation											
Compilation of s/w											
Generating MC files											
 Producing DST files (Data/MC)											
Producing h1oo files (Data/MC)											
Accessing h1oo files (Data/MC)											
Accessing ndb snapshot											
Validation											
Compilation of s/w											
Accessing uDST (precompiled s/w)											
Reconstruction (precompiled s/w)								No dependence			
Producing uDST (precompiled s/w)											
Validation											

Full chain, including compilation of all H1 software, from MC generation, through to validation of analysis level (e.g. high Q^2 neutral current) histograms now in place within the sp-system

Putting it all together



Process	Operating System	SL5 32bit				SL5 64bit					SL6 64bit	
		External Dependencies	ROOT 5.26	ROOT 5.28	ROOT 5.30	ROOT 5.32	Cernlib 2005	Cernlib 2006	Fastjet 2.3.3	Neuro-bayes 2008 0312		Neuro-bayes 3.3.0
Accessing cNtuples (Data/MC)												
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Validation												
Compilation of s/w												
Accessing uDST (precompiled s/w)												
Reconstruction (precompiled s/w)									No dependence			
Producing uDST (precompiled s/w)												
Validation												

Here a much finer granularity needed for displaying the results !

Digesting the validation results

- Display the results of the validation in a comprehensible way: web based interface
- The test determines the nature of the results
 - Could be simple yes/no, plots, ROOT files, text-files with keywords or length, ...


H1 Validation Results

List of available validation runs: success error(s) work to be done not in list

- [H1_64bit_VT79_4.0.21](#)

Description of used software version:
H1_64bit_VT79_4.0.21

	12:23 17.01. 2012	17:38 30.01. 2012	08:06 04.02. 2012
cernlibs			
fastjet			
neurobayes			
h1unix			
h1icefp			
hos			
...			

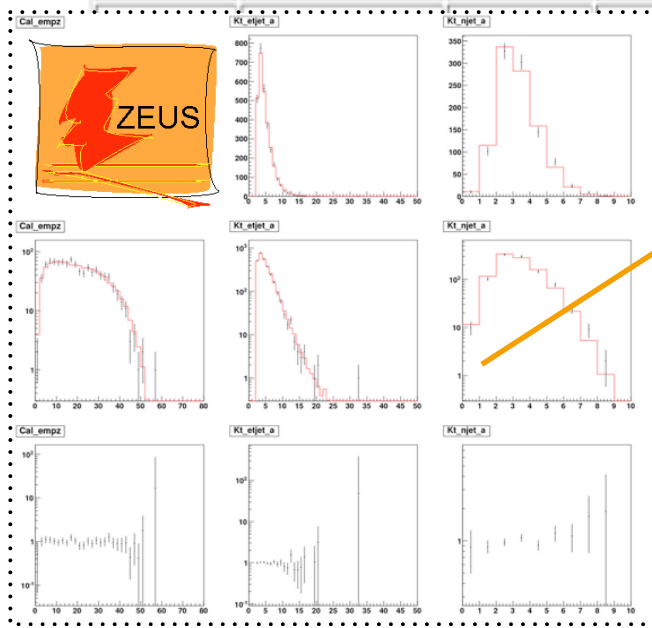


test number	operating system	root version	staus	std output file	error file	plots	root file
58	s15.6_64	5.28.00c	OK	out	err	plots	root
						plots	root
						plots	root
						plots	root
						plots	root
						plots	root
						plots	root
						plots	root

Results of Tests

Tests run with software version:
H1_64bit_VT79_4.0.21
created on: 04.02.2012 (08:06)

	HERA I					HERA II					
	no specific year	1996	1997	1998	1999	2000	2003	2004	2005	2006	2007
dst2all											
dumpHATvariables											
jpsi_mods											
ndbint											
...											



Opening ZEUSMC.HFIX627.F15419.4B70.TEEST.Z01.root

You have chosen to open

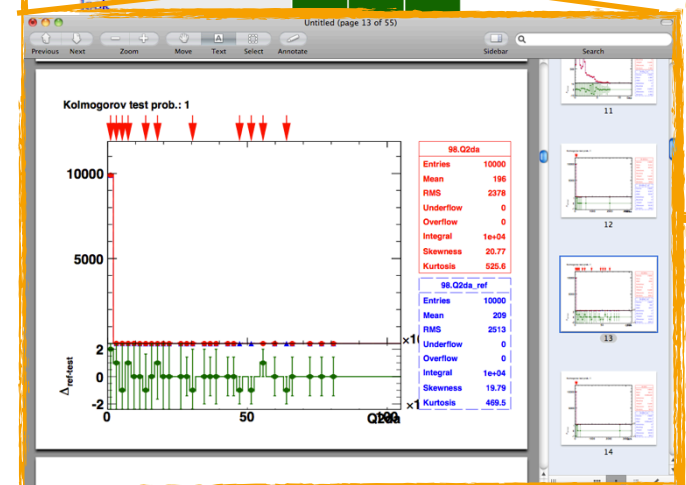
ZEUSMC.HFIX627.F15419.4B70.TEEST.Z01.root
which is a: root File (40.7 MB)
from: <http://www-zeus.desy.de>

What should Firefox do with this file?

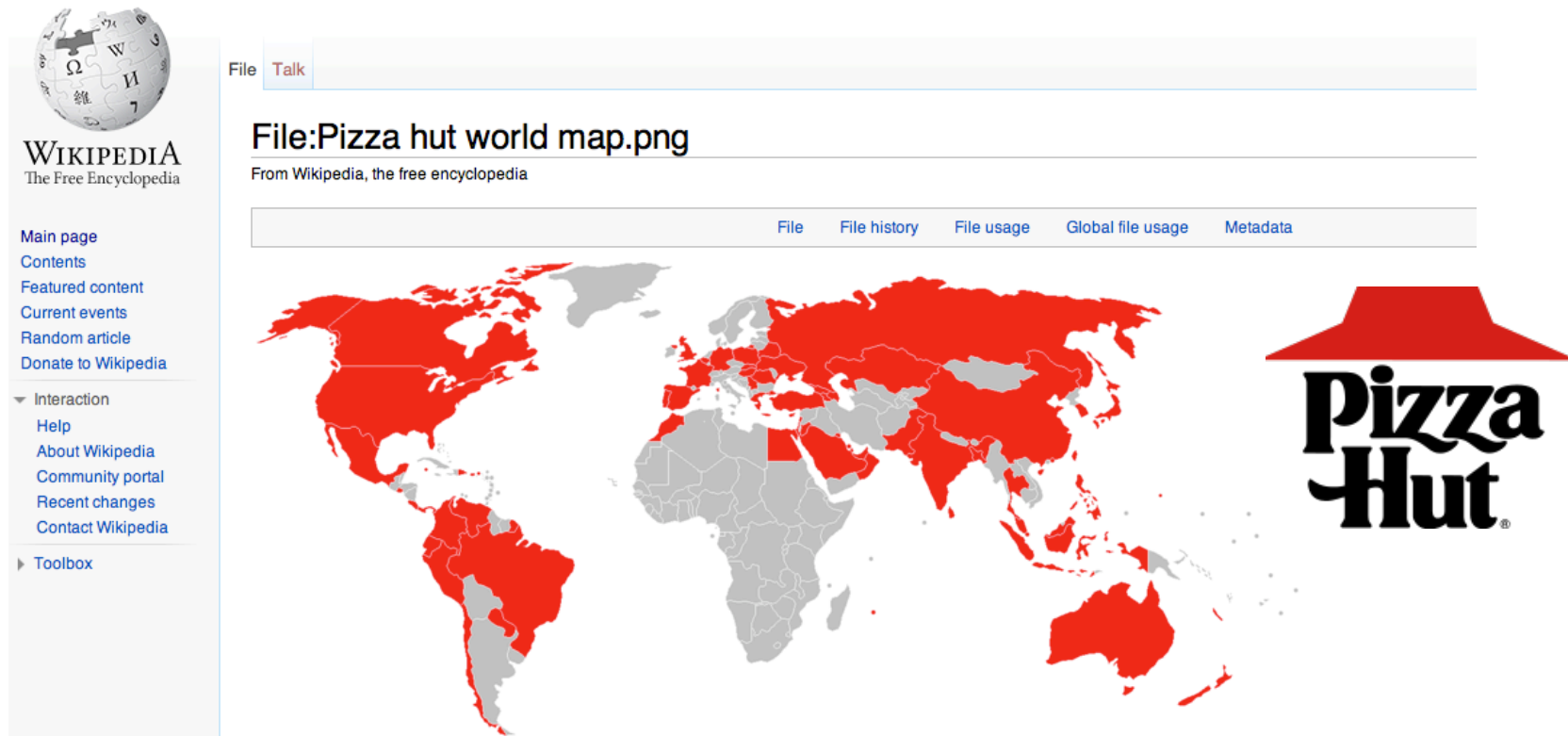
Open with

Save File

Do this automatically for files like this from now on.



Deployment



- The whole point of the `sp-system` is **not** to provide a future resource for the experiments, but rather to provide a recipe which can be deployed
 - At DESY, this means for example exploring alternative resources such as the local BIRD cluster, the National Analysis Facility (dedicated to LHC, unlikely) or the Grid



Future analysis model

> H1 model illustrated on the left for post-2014 period

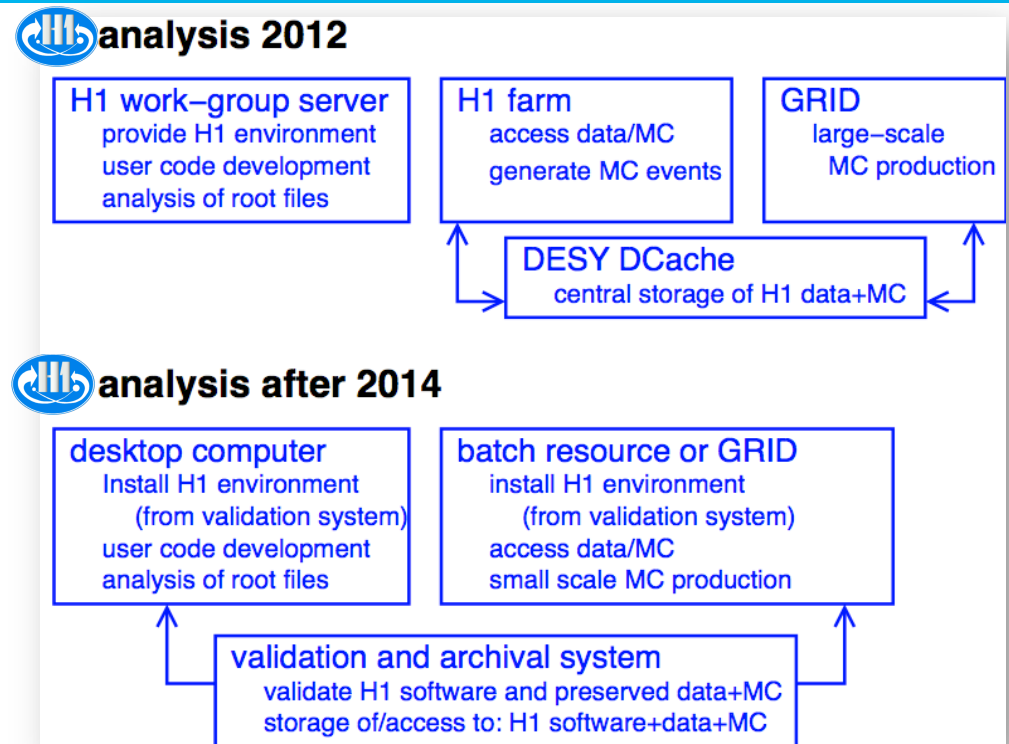
- Existing infrastructure replaced by alternative future resources
- SL5/64 sp-system recipe already successfully deployed on bare wgs

> HERMES situation more urgent, current infrastructure now very old and unsupported

- Already mentioned the move of their data to the central dCache within DESY-IT
- Many user jobs running on BIRD cluster, allowing retirement of much-maligned hardware

> ZEUS standalone MC production likely to run on single machine

- Analysis resources to be used where available (preserved data only needs ROOT)



Documentation



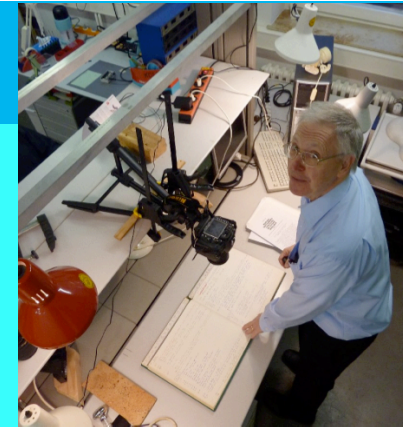
Dedicated storage for the HERA experiments in the basement of DESY Library

Non digital documentation

- Much material exists from pre-web days
- Requires quite some management, cataloguing and new archives
- Non-digital documentation safely stored in a dedicated library archive
- Some parts of non-digital documentation digitised, including theses, talks, minutes, log books, internal notes,...

H1 Virtual Archive

- [Physical Location of the H1 Archive](#)
- [Plenary Meetings](#)
- [Physics Meetings](#)
- [Thursday Weekly Meetings](#)
- [Collaboration Board \(CB\), Executive Committee \(EC\) Meetings](#)
- [Physics Working Groups](#)
- [Trigger Meetings](#)
- [H1 Detector](#)
 - [General Documents \(LoI, Proposal, Progress Reports...\)](#)
 - [H1 Operation Meeting](#)
 - [H1 CDAQ Logbooks](#)
 - [H1 and HERA Startup](#) (Various internal documents)
- [Meetings of various DESY committees: Minutes, talks, documents](#)
 - [PRC, Physics Research Committee](#)
 - [ESC and WA: Extended Scientific Council, Wissenschaftliches](#)



Status DPHEP-5: May 2011



Status DPHEP-6: November 2012

H1: now an additional third row added



• 1984

• H1 Collaboration Meeting 5-6 Nov. 1984

Letter from Spokesman G.Weber, 16.11.1984

Copies of transparencies of Reports of the Regional Groups

- | | |
|--|--------------------------------------|
| a) <u>D0 Tests</u> | D.Brick (Brown Univ.) |
| b) <u>SLD Tests</u> | R.K.Yamamoto (MIT) |
| c) <u>Dipole vs. Solenoid fields</u> | J.Feltesse (Saclay) |
| d) <u>Small vs. Large Coil</u>
<u>including report of UK group on coil size</u> | A.B.Clegg |
| e) <u>Track detection in the presence of high background</u> | J.Heintze (contained in WG 2 report) |
| f) <u>Detector design problems</u> | F.Brasse |

List of the 8 Working Groups

Date and Main Subjects of future H1 Collaboration Plenary Meetings

Reports of the Working Groups

- | | |
|---|---|
| WG 1 <u>Interaction Region</u> | W.Bartel |
| WG 2 <u>Tracking Devices + TRD: Agenda and Participants list</u>

<u>Design for FWD Tracking</u>
<u>A Thin Jet-chamber as Forward Detector for a HERA-Experiment</u>
<u>("Radial Wire Jet-chamber")</u>
<u>Proposition for a Transition Radiation Detector at HERA</u>
<u>A small, high precision Tracking Device</u>
<u>Some preliminary Thoughts!</u>
<u>High Rate, High Precision Chamber</u>
<u>CELLO 'Stereo Wire Chamber' for HERA?</u>
<u>Track Detector</u> | R.Marshall
P.Steffen

W.Struczinski
H.McCann

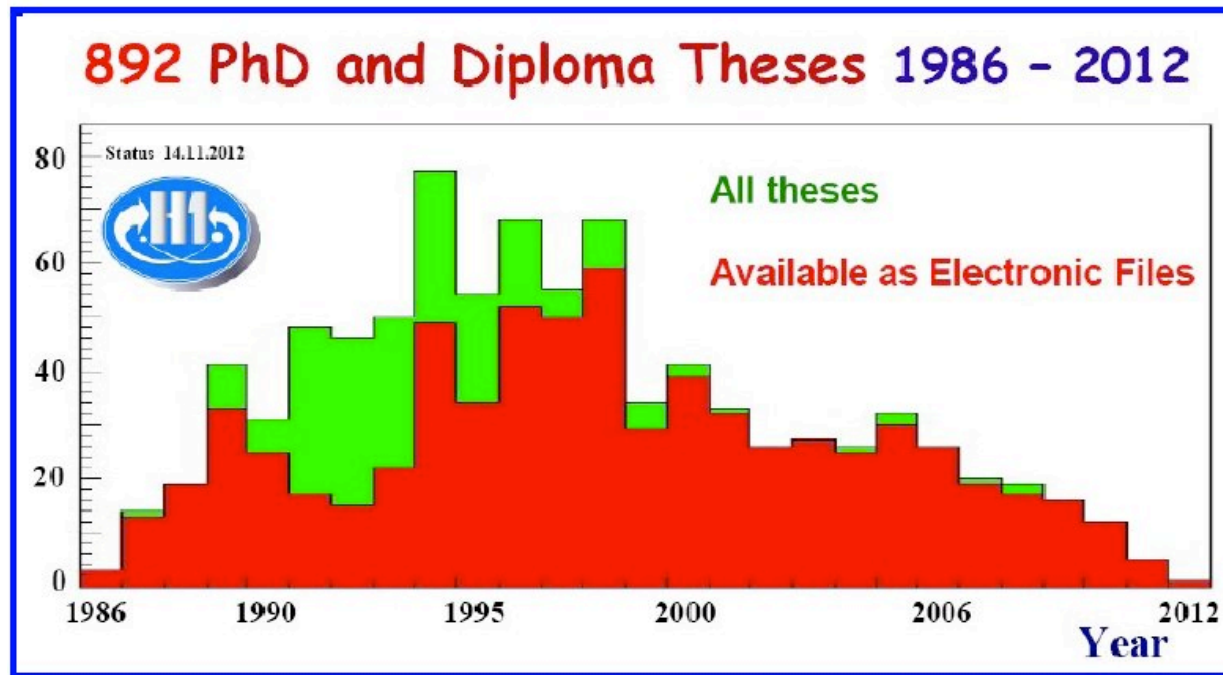
A.H.Walenta
L.Criegee
J.Heintze |
| WG 3 <u>Detector Simulation</u>
<u>Calorimeter Studies</u>
<u>WG3 List of participants</u> | H.-U.Martyn
G.Lindstroem |
| WG 4-7 Remark "no transparencies" | |
| WG 8 <u>Physics and Event Simulation</u> | B.Stella |

List of Participating Institutes (as of 12.11.1984)

Document "Design Principles for HERA-detectors" F.Eisele and D.Wegener (18.01.1984)

H1 Theses

- > Since October 2010, **106** H1 theses discovered not previously known to the collaboration; **18** since this summer, latest ones only last week
- > Scanning and linking these to the official H1 pages is given high priority



- > Currently, of the 892 known H1 theses 197 are not available in electronic form: ~ 22% not available to the H1 community!



DESY-DPHEP projects with INSPIRE

- > Successful collaboration with INSPIRE and the DESY Library
- > ALL HERA collaboration internal notes now on INSPIRE
 - In the case of ZEUS, this is over 1800 new records!
 - Also completed for HERMES and H1
- > Work on going in further projects
 - List of theses available now
 - Upload of additional theses
 - ZEUS explore putting their preliminary results on INSPIRE too
- > Collaboration curator accounts now installed for all experiments
 - Self management of material



A screenshot of the INSPIRE website search interface. At the top, there is a navigation bar with links for HEP, HEPNAMES, INSTITUTIONS, CONFERENCES, JOBS, EXPERIMENTS, and HELP. Below this is a search bar with a "Search" button and a link to "Advanced Search". The search results show "ZEUS Internal Notes" with 1,807 records found. The first two results are listed: 1. Inelastic J/psi helicity analysis: a comparison between the ZEUS and the H1 results. A. Bertolin. ZEUS-IN-10-001. 2. Inclusive-jet production in NC DIS with HERA II. J. Terron C. Glasman. ZEUS-IN-10-002. A red arrow points from the "1,807 records" text to the search bar. A small orange box with a lightning bolt and the word "ZEUS" is also visible on the right side of the screenshot.

More on INSPIRE in Sunje's talk this afternoon



Collaboration web pages

> All HERA collaborations have now moved their web pages to a new host in the DESY-IT virtual environment

- Removing the need for dedicated hardware in the future

> ZEUS are migrating their pages to a more future-proof, simplified version with a flat html structure

- Thorough survey of all content, consolidation different material from different sources
- Removal of databases, php and other specialities, importing from /afs directories
- New management system considered for meetings, likely indicio

> Improvements taking place in other areas such as storage of theses, conference talks and proceedings

- In many cases, these are additional candidates for storage on INSPIRE



Summary and Future Work

- > DESY Data Preservation Group continues to be very active and visible
 - Successful collaboration between the experiments, DESY Library, INSPIRE and DESY-IT
- > Final versions of HERA data and MC for preservation now almost complete
- > `sp-system` development continues by IT and experiments
 - Full installation expected in 2013, along with dCache based archival system
- > Documentation consolidation including landmark projects with INSPIRE
- > Discussions still in progress about person-power for the longer term

