The life of LHC data

Simon/@drsm79

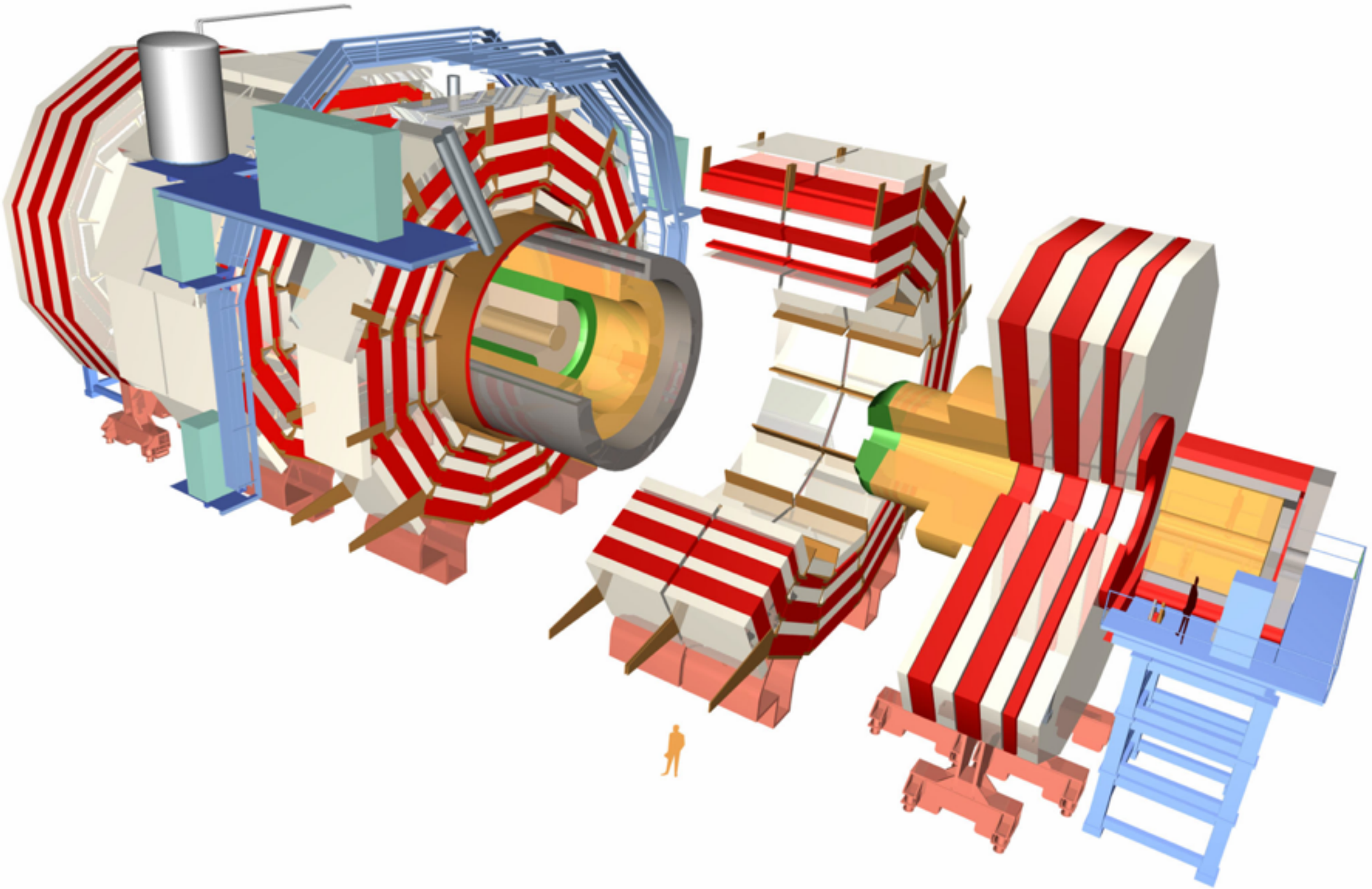
Hello!

Hello Geeks!

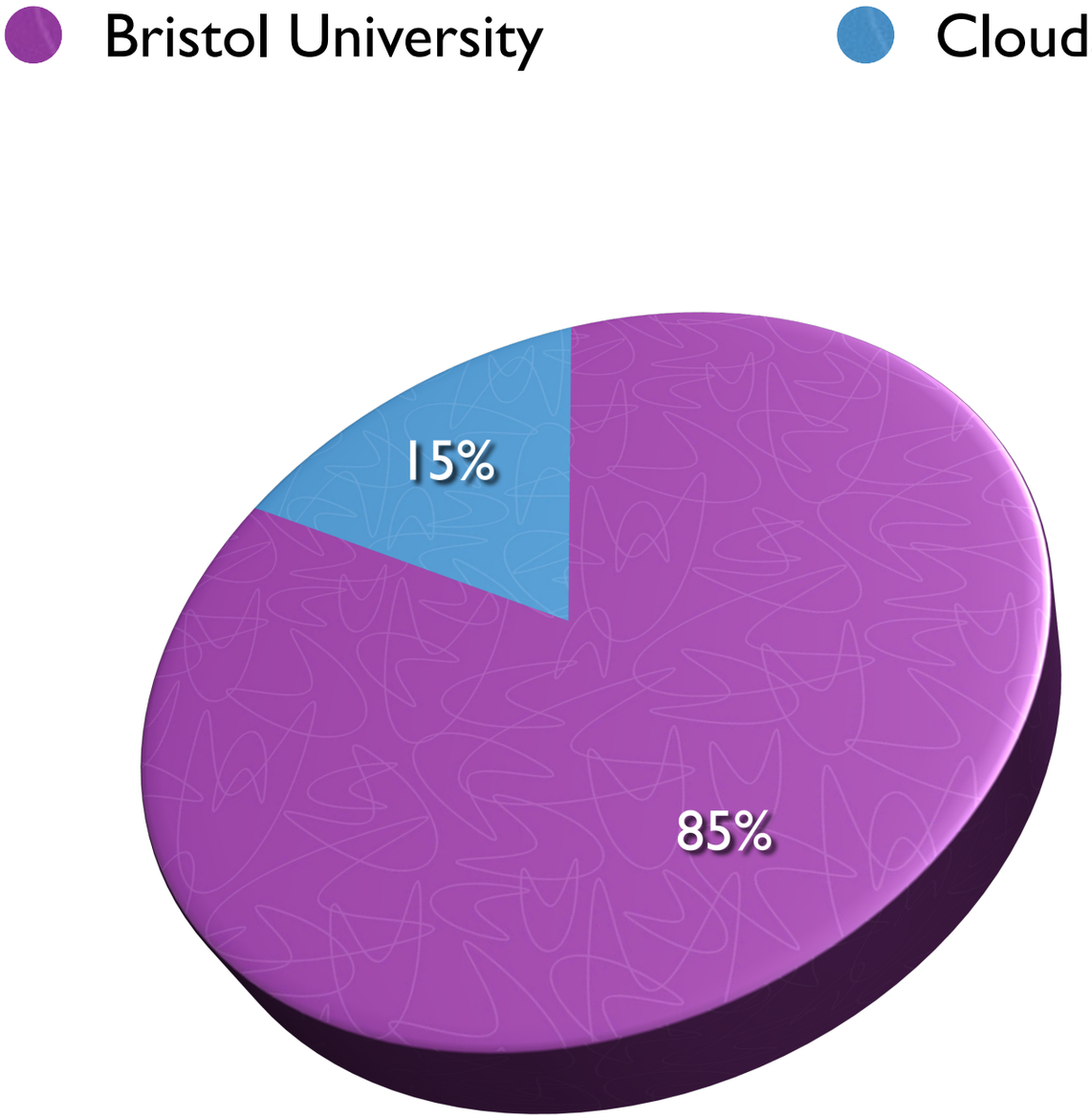
Hello Geeks in Oxford!

ALL YOUR
BASE
OXFORD UK | 18 OCT 2013
A DATABASE CONFERENCE
FOR WEB DEVELOPERS

CouchDB
relax



Time at places I've worked



CouchDB
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The life of LHC data

1. Detected by experiment
2. “Online” filtering (hardware and software)
3. Transferred to CERN main campus, archived & reconstructed
4. Transferred to T1 sites, archived, reconstructed & skimmed
5. Transferred to T2 sites, reconstructed, skimmed, filtered & analysed
6. Written into locally analysable files, put on laptops
7. Turned into a plot in a paper

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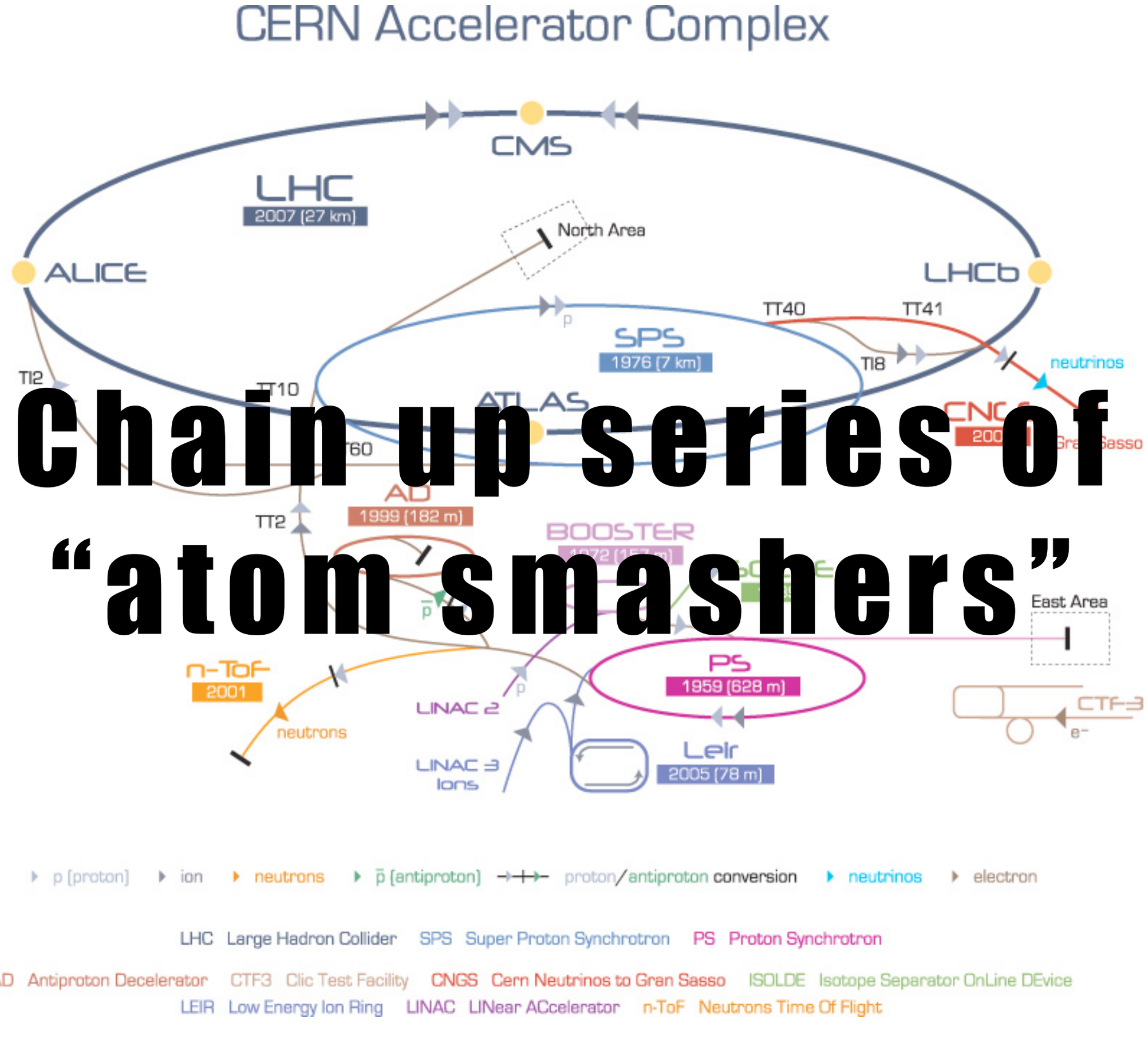
Dig big tunnels



Chain up series of “atom smashers”

Put sensitive cameras in awkward places

Record events

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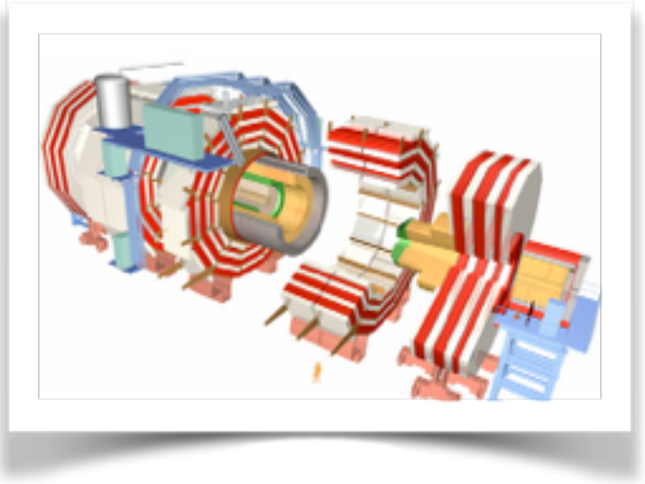
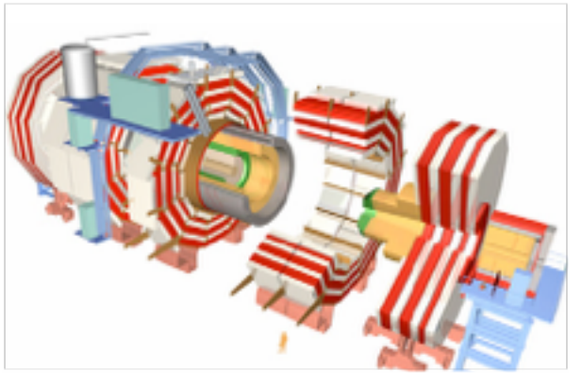
CMS online data flow



We have a big digital camera

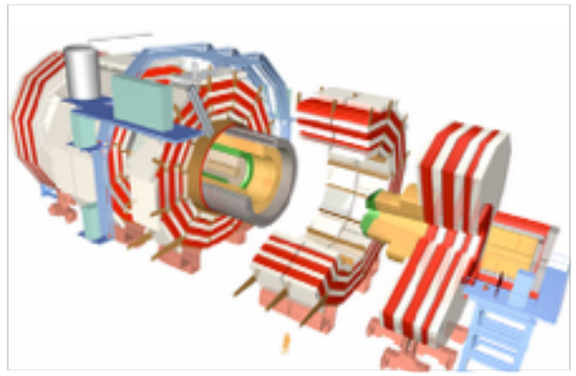
CMS online data flow



We have a big digital camera

Which goes into lots of computers (the HLT)

CMS online data flow



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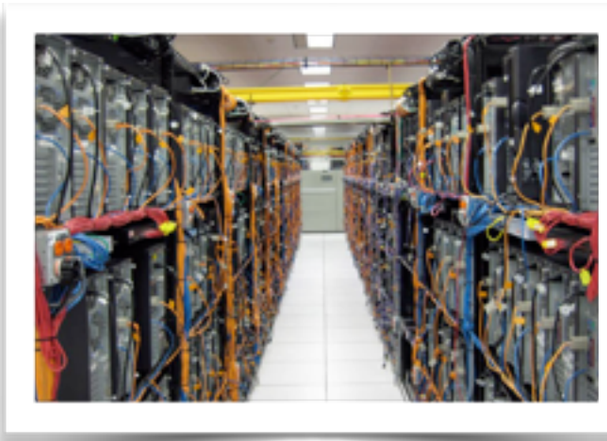
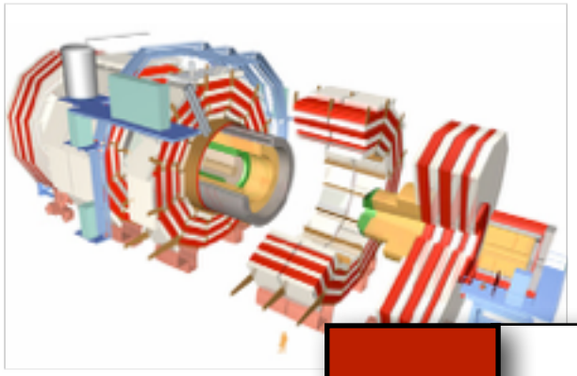


Which goes into lots of computers (the HLT)

Which goes into lots of disk (the Storage Manager)

CMS online data flow



We have a big digital camera

Write to HLT at ~200GB/s

Which goes into lots of computers (the HLT)

Write to Storage Manager at ~2GB/s

Which goes into lots of disk (the Storage Manager)

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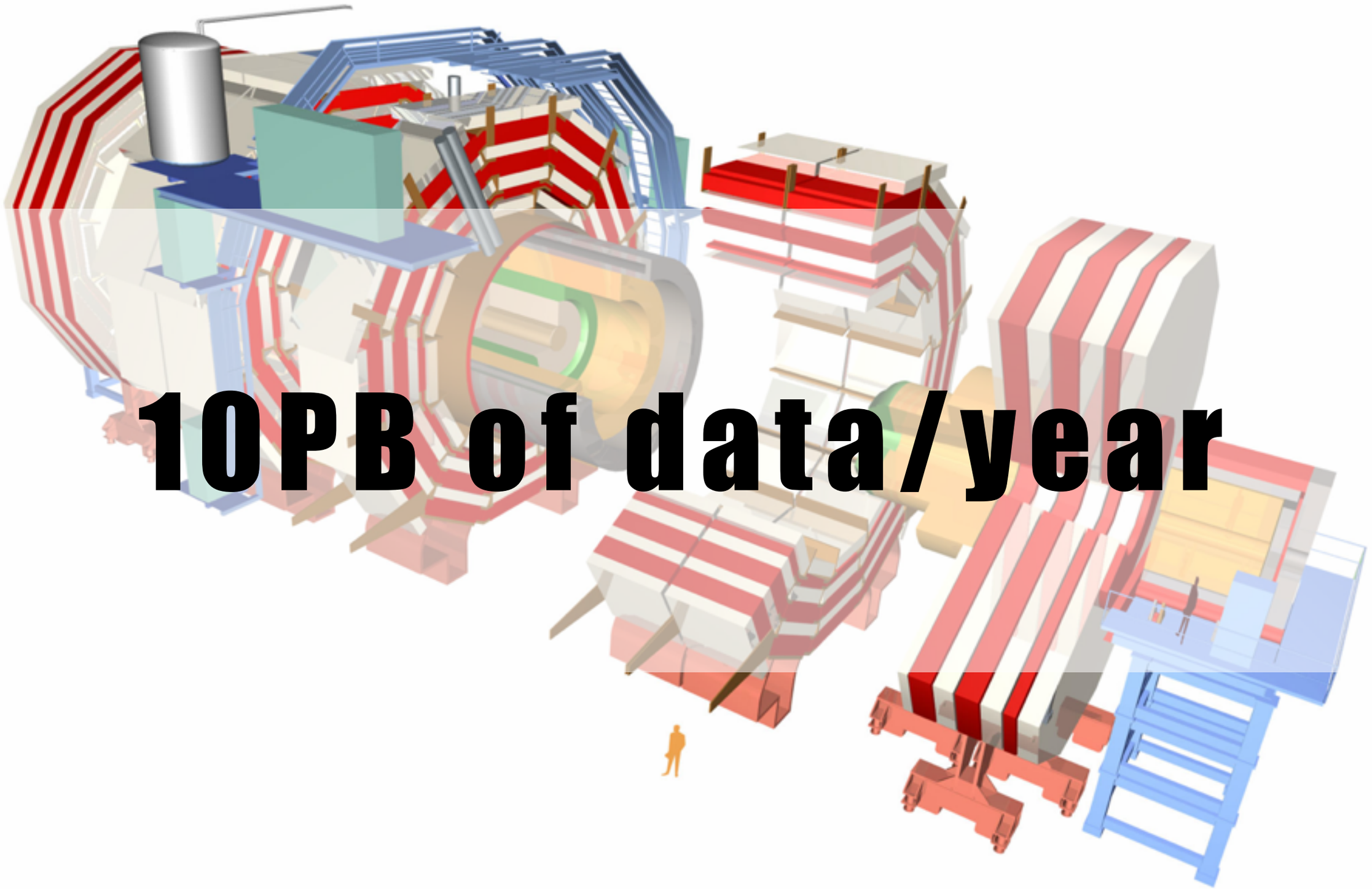

10PB of data/year

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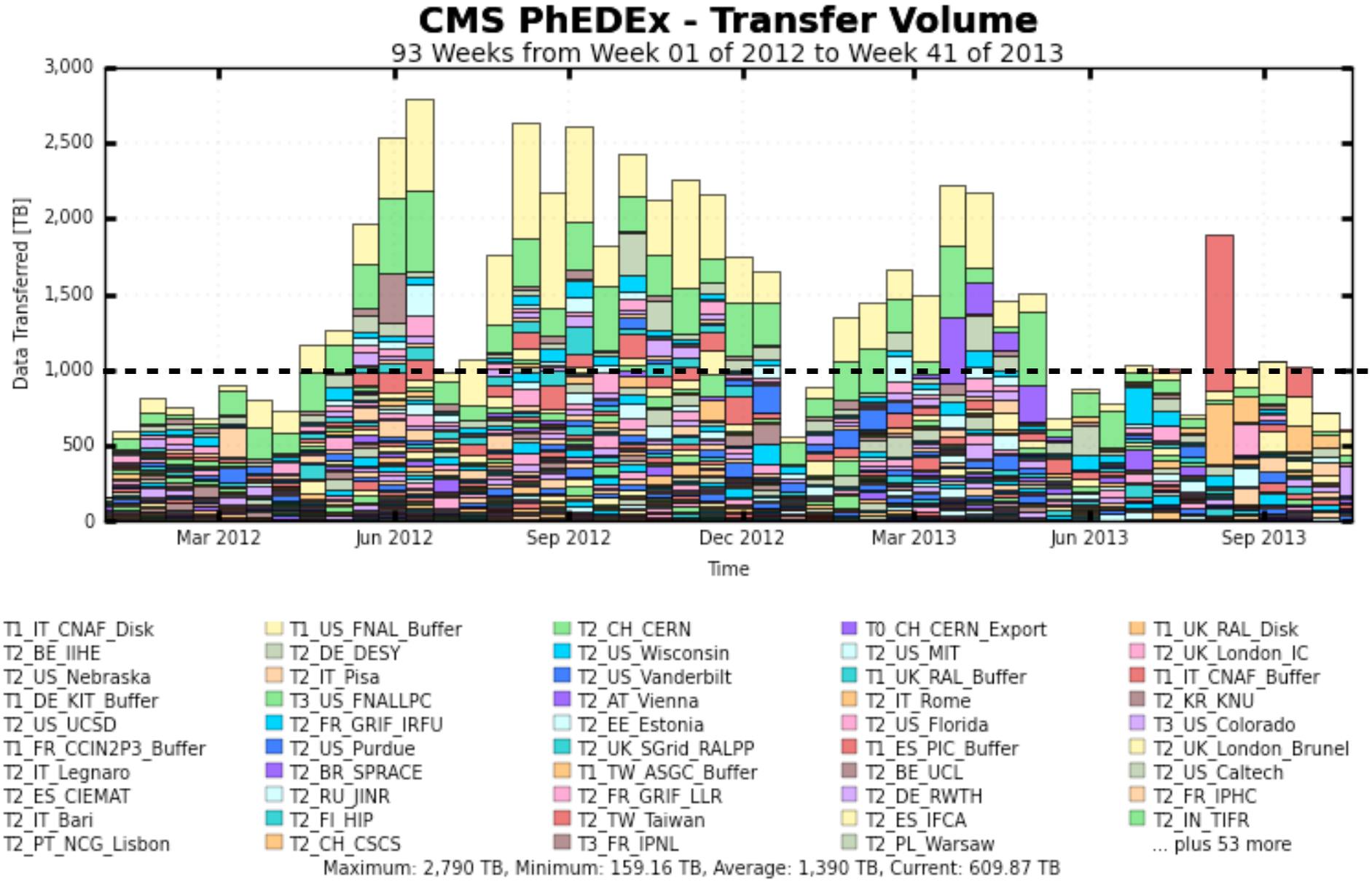
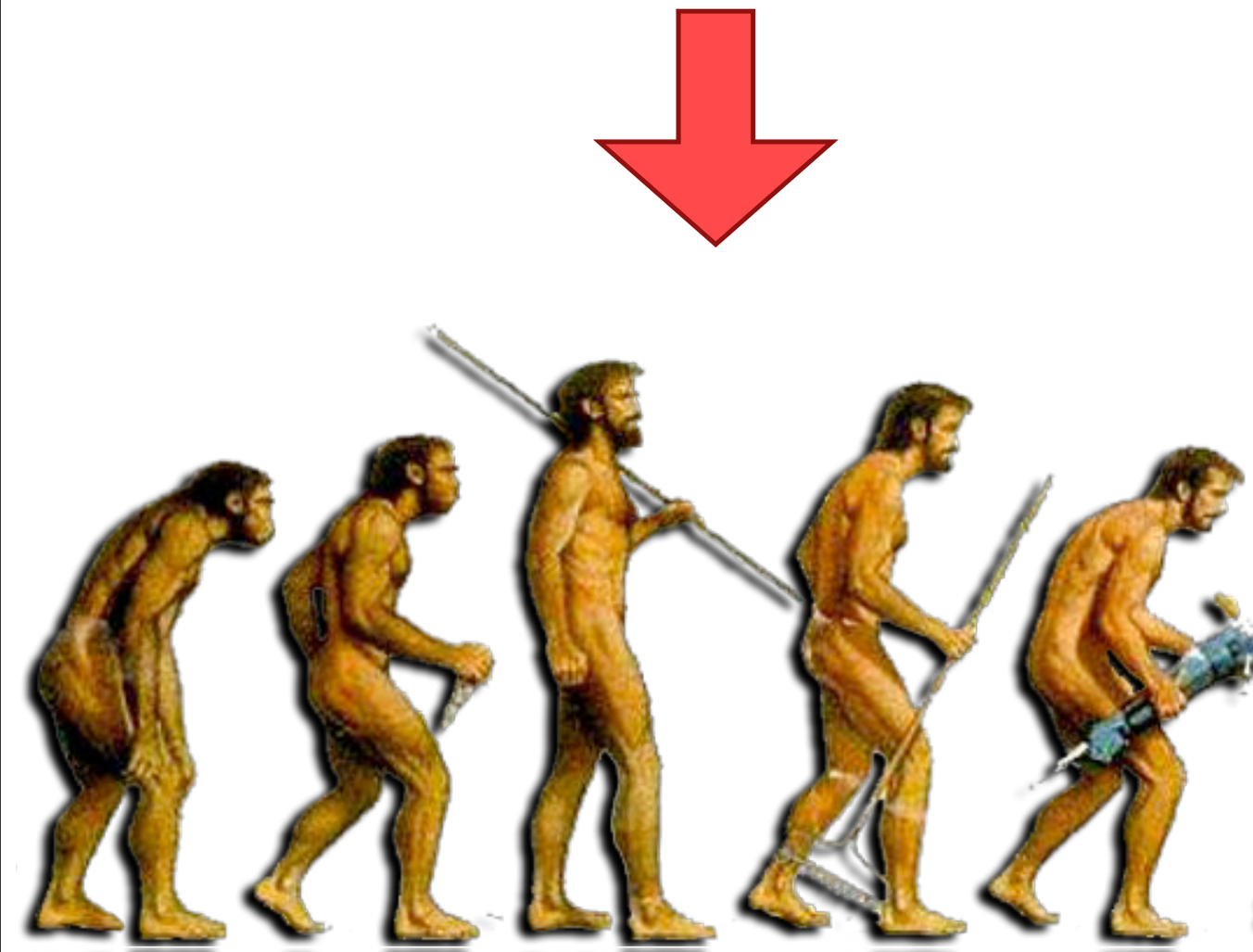
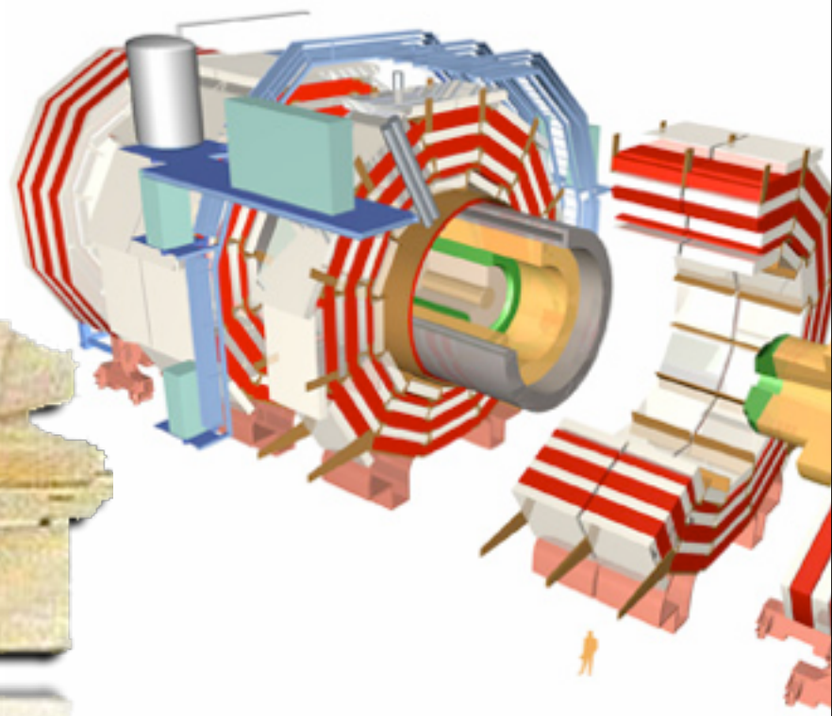

CMS PhEDEx - Transfer Volume
93 Weeks from Week 01 of 2012 to Week 41 of 2013
Data Transferred [TB]
3,000
2,500
2,000
1,500
1,000
500
0
Mar 2012
Jun 2012
Sep 2012
Dec 2012
Mar 2013
Jun 2013
Sep 2013
Time
T1_IT_CNAF_Disk
T1_US_FNAL_Buffer
T2_CH_CERN
T0_CH_CERN_Export
T1_UK_RAL_Disk
T2_BE_IIHE
T2_DE_DESY
T2_US_Wisconsin
T2_US_MIT
T2_UK_London_IC
T2_US_Nebraska
T2_IT_Pisa
T2_US_Vanderbilt
T1_UK_RAL_Buffer
T1_IT_CNAF_Buffer
T1_DE_KIT_Buffer
T3_US_FNALLPC
T2_AT_Vienna
T2_IT_Rome
T2_KR_KNU
T2_US_UCSD
T2_FR_GRIF_IRFU
T2_EE_Estonia
T2_US_Florida
T3_US_Colorado
T1_FR_CCIN2P3_Buffer
T2_US_Purdue
T2_UK_SGrid_RALPP
T1_ES_PIC_Buffer
T2_UK_London_Brunel
T2_IT_Legnaro
T2_BR_SPRACE
T1_TW_ASGC_Buffer
T2_BE_UCL
T2_US_Caltech
T2_ES_CIEMAT
T2_RU_JINR
T2_FR_GRIF_LLR
T2_DE_RWTH
T2_FR_IPHC
T2_IT_Bari
T2_FI_HIP
T2_TW_Taiwan
T2_ES_IFCA
T2_IN_TIFR
T2_PT_NCG_Lisbon
T2_CH_CSCS
T3_FR_IPNL
T2_PL_Warsaw
... plus 53 more
Maximum: 2,790 TB, Minimum: 159.16 TB, Average: 1,390 TB, Current: 609.87 TB

1PB/week

Why transfer so much data?

To process all the data taken in one year on one computer would take ~64,000 years





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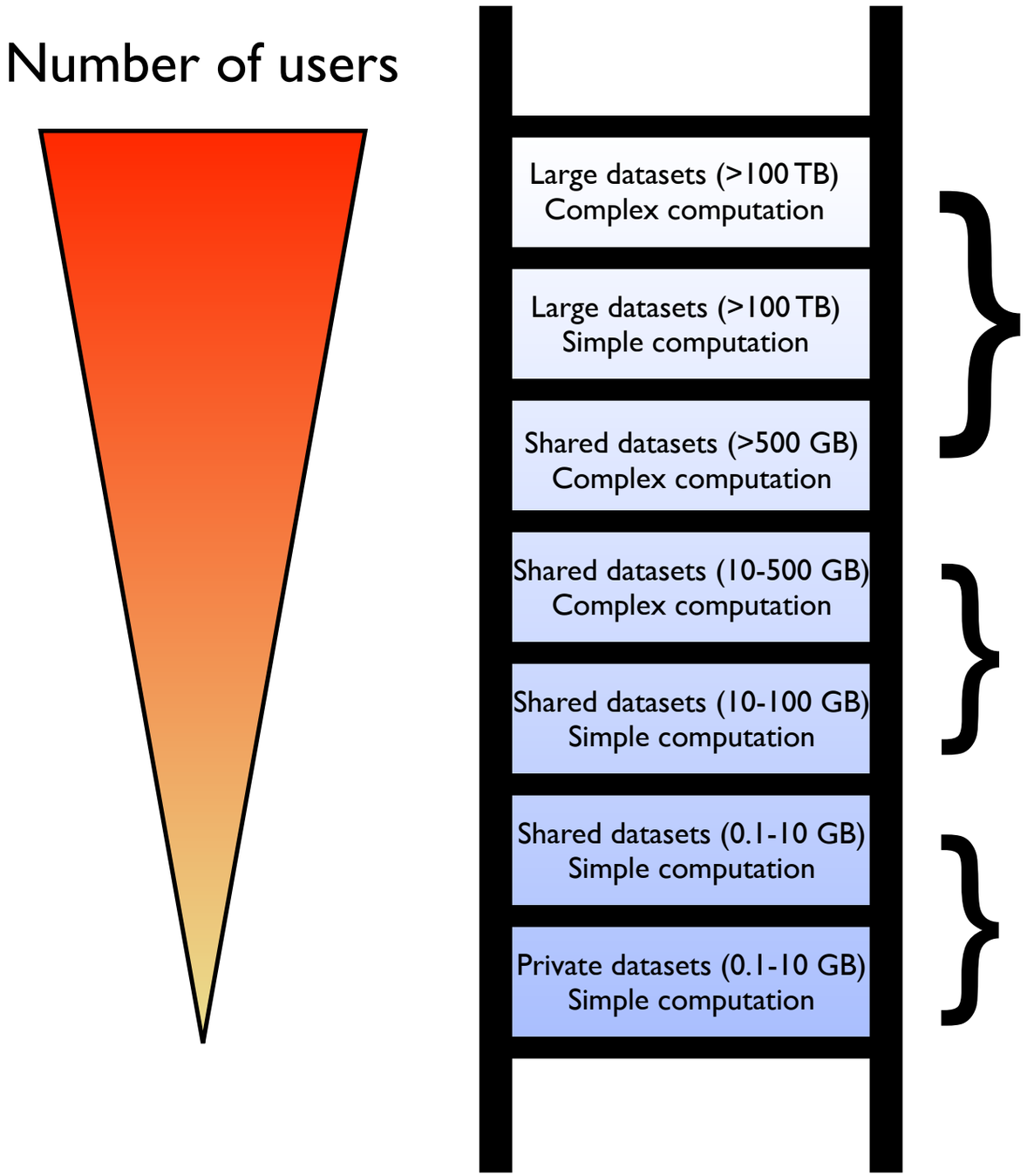
Analysis

- Each analysis is ~unique
- Query language is C++
- Runs on distributed system and local resources
- Series of “cut” selections to identify interesting events
- Data in the final plot may be substantially reduced from the original dataset

Workflow ladder



Use Grid compute and storage exclusively

Work on departmental resources, store resulting datasets to Grid storage

Work on laptop/desktop machine, store resulting datasets to Grid storage

The life of LHC simulated data

1. Simulated by experimentalists at T0/T1/T2 sites

2. Transferred to T1 sites, archived possibly reconstructed & skimmed

3. Transferred to T2 sites, reconstructed, skimmed, filtered & analysed

4. Written into locally analysable files, put on laptops

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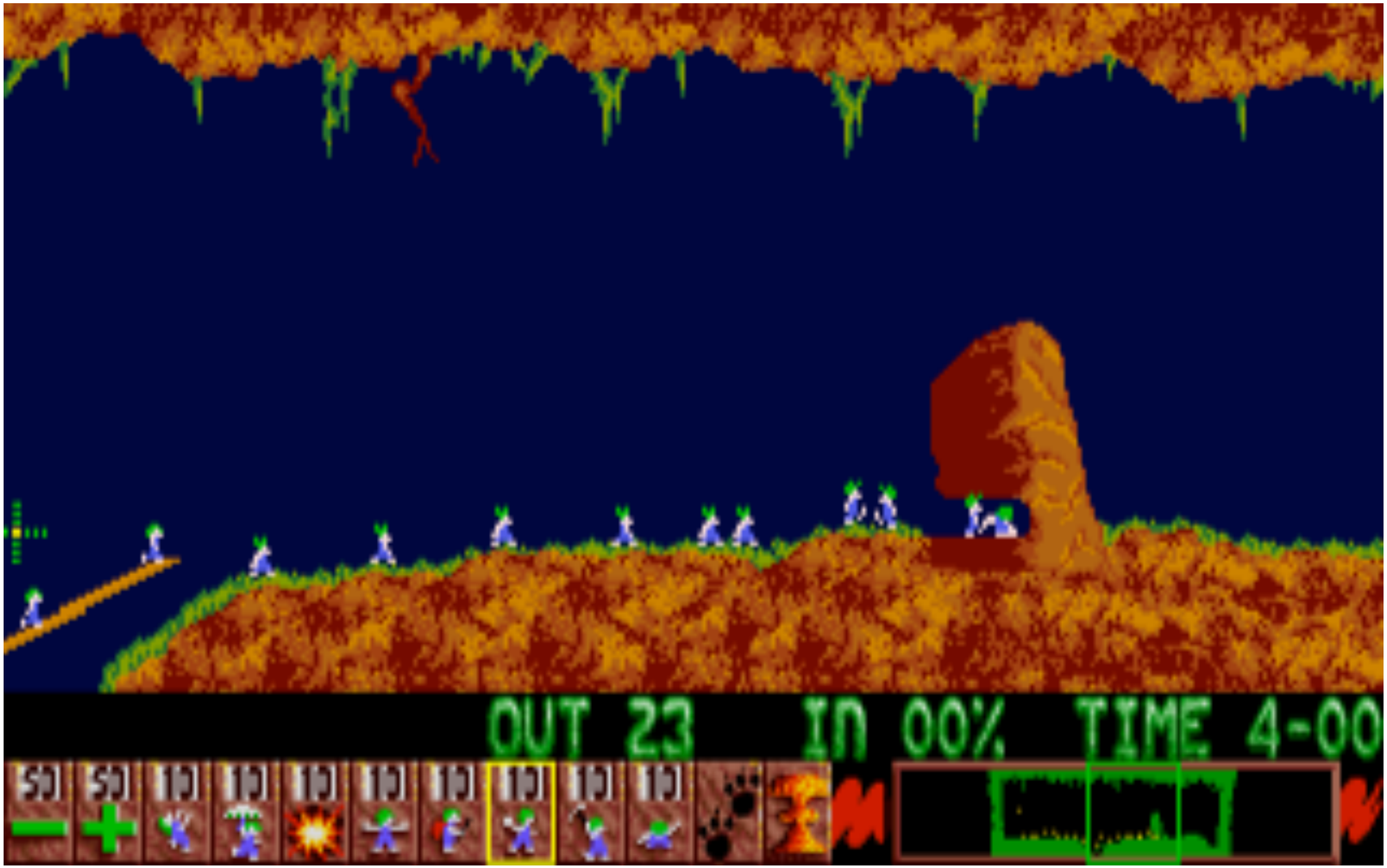
“We are going to die, and that makes us the lucky ones. Most people are never going to die because they are never going to be born.”

– Dawkins


OUT 23
IN 00%
TIME 4-00
50
50
10
10
10
10
10
10
10
10