The LZ UK Data Centre

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What’s it all about?

- Extending the reach of HEP infrastructure to related fields:
  - Here: Astroparticle physics
- The stakeholders:
  - LZ
  - GridPP
- Technical details:
  - Setup of the data centre at Imperial College
  - User access
    - Production
    - Analysis
- Conclusions: It is the looks that matter
The LZ experiment

Dark Matter experiment located at Sanford Underground Research facility (~1.47 km underground).

Looking for WIMPs.

37 institutions, mainly in the US, UK and Portugal (plus South Korea and Russia).

Further reading: http://lz.lbl.gov/ http://lz.ac.uk/
GridPP collaboration

- A collaboration of 19 UK institutes providing Grid and Cloud based computing services to particle physics and other experiments.
- Hosts 69k job slots and 51 PB of storage.
- Imperial College is currently a WLCG Tier-2 site.
LZ computing model

Sanford Underground Research Facility, South Dakota at -1470 m

rq = reduced quantities (processed data)
Two data centre strategies

- **USDC**: Integrated into NERSC national lab:
  - Centralized computing model with large HPC clusters and shared file systems.
  - Hosts the primary data catalog and conditions database.

- **UKDC**:
  - Distributed/Grid computing model.
  - Data hosted on the Imperial College Grid SE.
  - CPU provided by various UK Grid sites.
LZ: Expected data and CPU requirements

Table 1: Planned storage (in TB) and processing power by U.S. fiscal year at the U.S. and U.K. data centers.

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<tbody>
<tr>
<td>Raw data</td>
<td></td>
<td></td>
<td></td>
<td>560</td>
<td>1680</td>
<td>2800</td>
<td>3920</td>
<td>5040</td>
<td>6160</td>
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<td>Calibration data</td>
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<td>480</td>
<td>800</td>
<td>1120</td>
<td>1440</td>
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<td>40</td>
<td>50</td>
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<td>213</td>
<td>292</td>
<td>371</td>
<td>451</td>
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<tr>
<td>Total data</td>
<td>80</td>
<td>160</td>
<td>160</td>
<td>200</td>
<td>200</td>
<td>1147</td>
<td>2810</td>
<td>4473</td>
<td>6136</td>
<td>7799</td>
<td>9463</td>
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<td>USDC: Disk space</td>
<td>40</td>
<td>220</td>
<td>220</td>
<td>220</td>
<td>220</td>
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<td>9360</td>
<td>11360</td>
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<tr>
<td>USDC: CPU cores</td>
<td></td>
<td></td>
<td>175</td>
<td>350</td>
<td>350</td>
<td>390</td>
<td>830</td>
<td>1270</td>
<td>1710</td>
<td>2150</td>
<td>2590</td>
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<tbody>
<tr>
<td>UKDC: Disk space</td>
<td>150</td>
<td>220</td>
<td>220</td>
<td>270</td>
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<td>1597</td>
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<td>6586</td>
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<td>9913</td>
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<tr>
<td>UKDC: CPU cores</td>
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<td>175</td>
<td>350</td>
<td>350</td>
<td>390</td>
<td>830</td>
<td>1270</td>
<td>1710</td>
<td>2150</td>
<td>2590</td>
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UKDC setup: Storage

- Data are hosted on the Imperial College Grid Storage Element:
  - dCache based
  - Data access via GridFTP or XRootD
  - Hosting 5 PB overall
  - Currently 650 TB for LZ in a dedicated pool group

- Data Transfers: NERSC↔Imperial College:
  - SPADE (by NERSC):
  - Currently being setup
UKDC setup: CPU

- CPU is provided by ~6 GridPP sites, including Imperial College:
  - Standard SL6 grid nodes
  - Some support for high memory jobs

- Jobs are distributed using the DIRAC (http://diracgrid.org/) middleware:
  - GridPP maintains a multi-VO DIRAC server
  - DIRAC also provides File Catalog
  - Once primary data catalogue is finalized, we will provide an interface to the DIRAC File Catalog
The LZ job submission system: Motivation

- Users don’t want to know about middleware.
- Or hardware.
- They shouldn’t have to.

- Customizing the ‘last mile’ yields huge returns in user acceptance of distributed computing.
- We provide an easy-to-use web portal designed for the specific needs of the LZ workflows.
Job submission interface

- Web Interface
  - User
    - submits request
  - Production Manager
    - approves request
- Request DB
- Job Monitor Daemon
- GridPP

LZ
- GitLab
- CernVM File system

Frontend

Backend

https://github.com/alexanderrichards/LZProduction
LZ Production Requests

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Sim Lead</th>
<th>Status</th>
<th>Request Date</th>
<th>Requester</th>
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<tbody>
<tr>
<td>380</td>
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<td>EK</td>
<td>Completed</td>
<td>18/08/2018</td>
<td>elena korolkova</td>
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<table>
<thead>
<tr>
<th>Macro</th>
<th>NJobs</th>
<th>NEvents</th>
<th>Seed</th>
<th>Output</th>
<th>Status</th>
<th>Progress</th>
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<td>Completed</td>
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<td>elena korolkova</td>
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</table>
New Request Form

Basic Information

Site:
ANY

Priority:
3

Sim Lead:
Sim Lead

Source type:

Detector components:

Description:
Enter a description of the request here.

Application Setup

Simulation Off/On

Select Application Type:
Application

Select Application Version:
Version

Simulation output LFN dir:

MCTruth output LFN dir:
Distributed computing is awesome

Mock Data Challenge 1 (June 2017): 132.77 TiB of data comprising 732288 files. About 90% of the data was produced in the allotted time frame (4 weeks).
Mock Data Challenge 2018

Running jobs by UserGroup
25 Weeks from Week 00 of 2018 to Week 25 of 2018

Max: 6,771, Min: 78.0, Average: 2,927, Current: 78.0
Initial focus was on MC production.

Now looking at Analysis:

- Data access via xrootd:
  - works in the UK
- All LZ users can access Grid resources via DIRAC, but so far other resources have been sufficient.
- Collaboration now pushes for analysis at the UKDC, have started working with users.

Working on web based event viewer to display data directly from the UKDC (XRootD + X509).
Conclusions

● The LZ UK data centre successfully runs on top of existing Grid infrastructure at Imperial College and GridPP:
  ○ This was straightforward to set up and requires little extra effort to maintain.
● LZ specific job submission interface allowed a single person to run large scale MC production:
  ○ Effort creating JSI & Production << Effort to run production by hand.
  ○ This made the Grid palatable to a collaboration used to centralised computing.
● Distributed computing is awesome :-)

Imperial College
London

The University Of Sheffield.

GridPP
UK Computing for Particle Physics