Muons and GlobusOnline

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Overview

What do we do?

How does GlobusOnline help us?
The muon in a nutshell

• Big brother of the electron, $207 \cdot m_e$
• "Long" lifetime $2.2 \mu s$: muon beams and probe
• Main decay $\mu \rightarrow e \nu_e \nu_\mu$
• Produced in accelerators like at Fermilab
• Hydrogen-like states ($\mu^-p$)
Muonic Lamb shift (QED)
- Proton charge radius puzzle
The facility: $\pi$E3 beamline at PSI
Beam line elements

E x B separation of electrons

Separator

Quadrupoles & slit

Detector
- MuLan
- MuCap
- MuSun
MuLan: The experimental concept...

- Real data
- Kicker On
- Measurement Period
- 450 MHz waveform digitization
- Inner/Outer tile pair

Graph showing:
- Number (log scale) vs. time
- Fill Period
- -12.5 kV
- 12.5 kV

Real data curve and digitization process.
But how much data do we have?

$10^{12}$ waveforms sampling 24 times

Each sample is an 8-bit word

$10^{12} \times 24 \times 8 \text{ bit} = 200 \text{ TB}

\approx 100 \text{ TB compressed raw data}
How to get to US quickly?

Collect all your data
Pack and put on airplane
Ship to US and upload to super computer
Takes weeks after experiment until accessible

Tape storage

There must be a faster way...
Mucap detector

Frontend electronics

Frontend PCs

Backend PC

Analysis cluster

PSI archive

2 TB hard disk
Once hard disk is full, transfer...

But we write ~1 TB / day!

*What's fast enough to keep up?*

- HPNssh
- `globus-url-copy` with `gridFTP-Lite`
- `GlobusOnline`
GlobusOnline most easy to use...

1. If disk is full, mount on a separate computer

2. Use GlobusOnline to copy entire disk to US

3. Monitor progress

Transfer Activity

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<th>ID</th>
<th>Task Progress</th>
<th>Username</th>
<th>Completion Time</th>
<th>Request Time</th>
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Let GlobusOnline handle failure...

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</table>

... by using the directory synchronization afterwards

```
$ echo "go#ep1/share/godata/ go#ep2/~/ -r -s 1" | ssh lcc@cli.globusonline.org
transfer
Task ID: 609b53fc-ebff-11df-aa30-1231350018b1
Created transfer task with 1 file(s)
```

GlobusOnline managed to copy 26 TB PSI to the US when we collected 34 TB total!

Also used it to transfer ~40 TB from NCSA to Ranch!