

Muons and GlobusOnline

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Overview

What do we do?

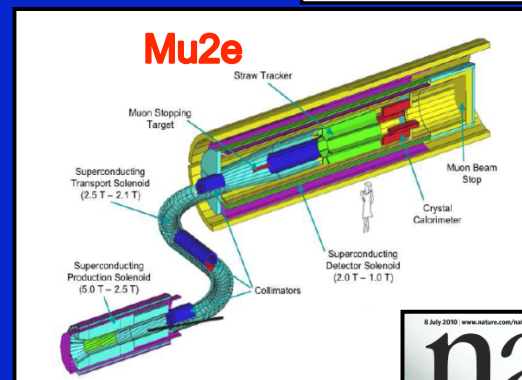
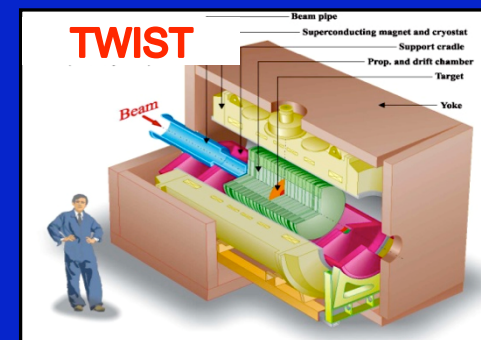
How does GlobusOnline help us?

The muon in a nutshell

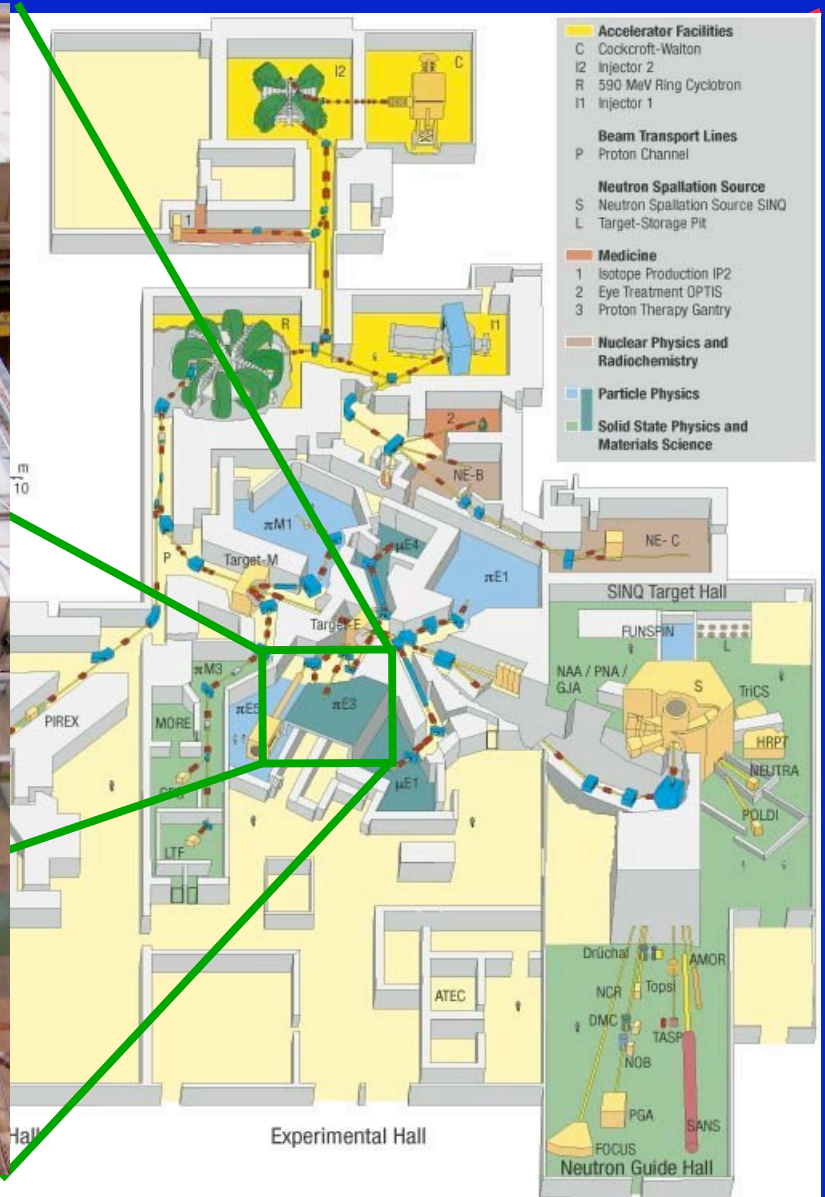
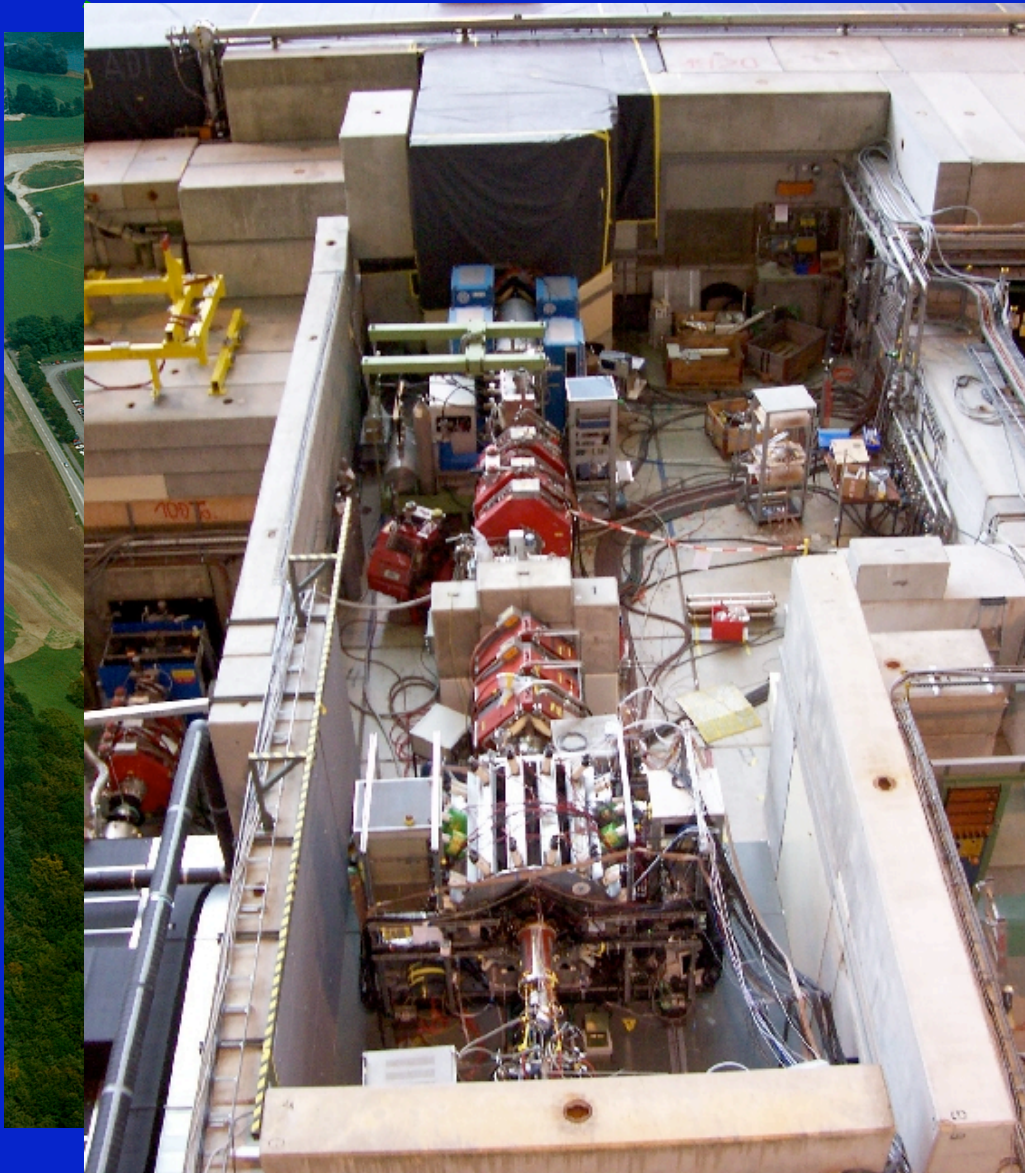
- Big brother of the electron, $207 \cdot m_e$
- "Long" lifetime $2.2 \mu\text{s}$: muon beams and probe
- Main decay $\mu \rightarrow e \nu_e \nu_\mu$
- Produced in accelerators like at Fermilab
- Hydrogen-like states (μ^-p)

Muon physics efforts worldwide

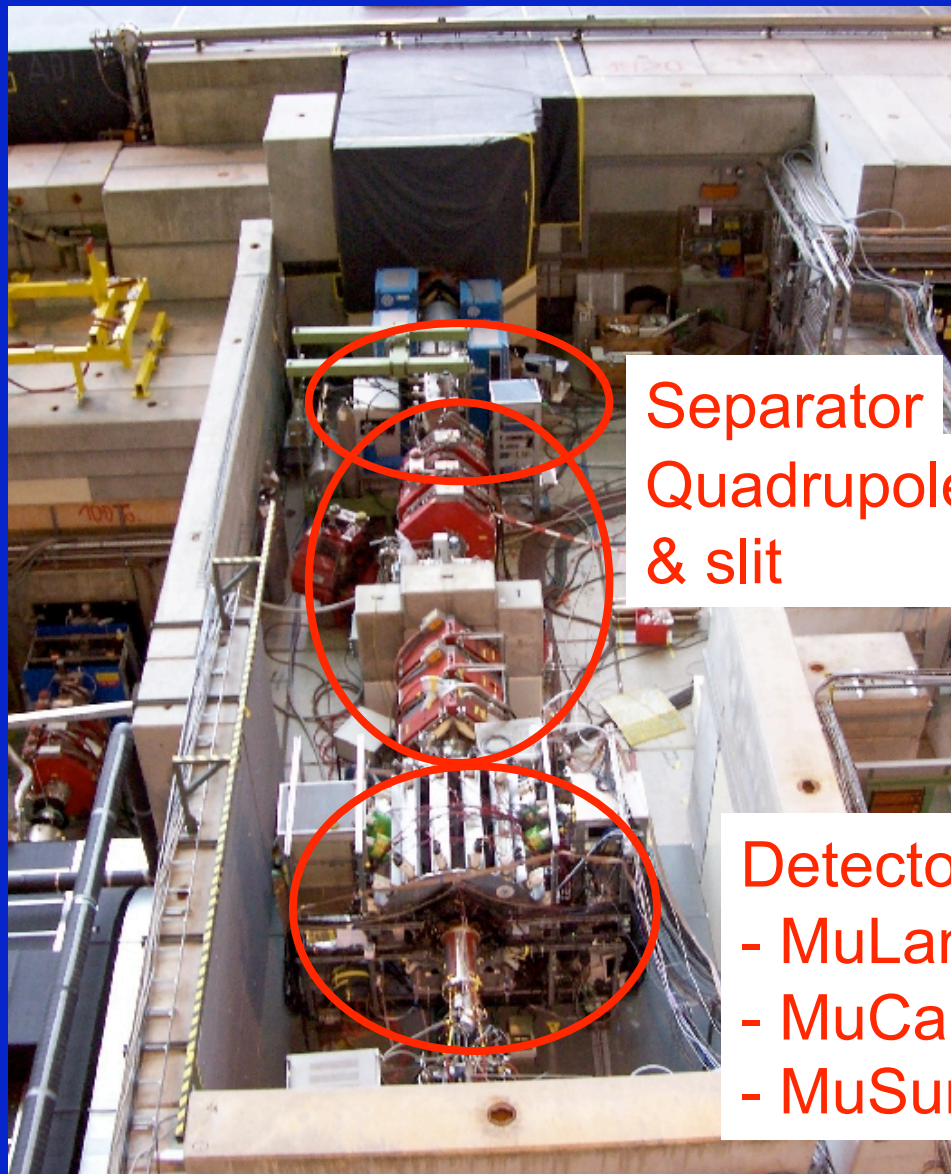
- Lifetime – Fermi constant
 - 2 “precision” experiments: MuLan & FAST
- Decay parameters
 - Michel – TWIST $\rho, \delta, \eta, P, \xi$
- Capture
 - MuCap: g_P , pseudoscalar coupling
 - MuSun: basic EW interaction in 2N system
- Anomalous magnetic moment (g-2)
 - New g-2 E989 experiment in planning
- Lepton Flavor Violation
 - $\mu \rightarrow e \gamma$ – MEG at PSI taking data now
 - μe conversion Mu2e at FNAL
 - COMET at JParc, Japan
 - $\mu 3e$ at PSI
- EDM
 - E821 PRD in prep $\sim 10^{-21}$ e cm
 - Modest efforts toward small dedicated ring at PSI
- Lorentz / CPT violation tests
 - E821 g-2 PRL 2007; precession vs. sidereal day
- Muonic Lamb shift (QED)
 - Proton charge radius puzzle



The facility: $\pi E3$ beamline at PSI



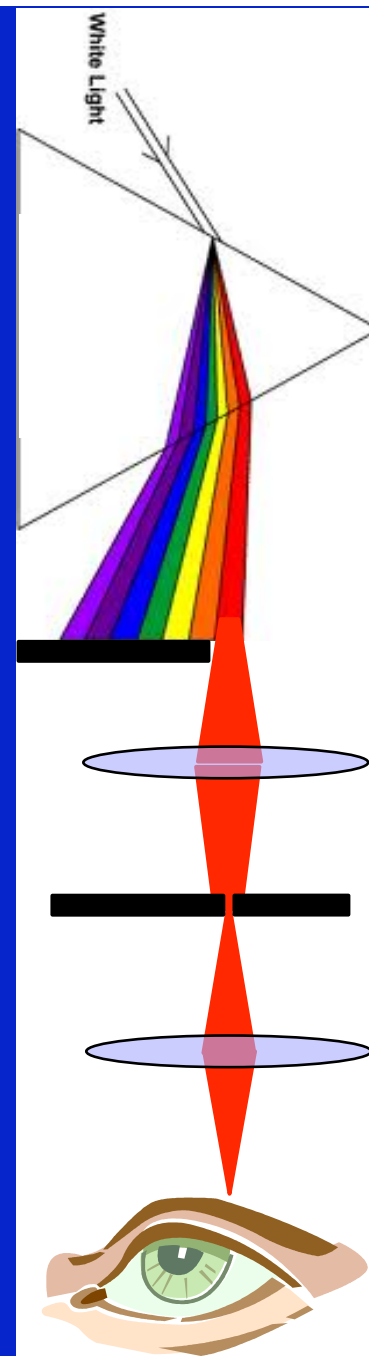
Beam line elements



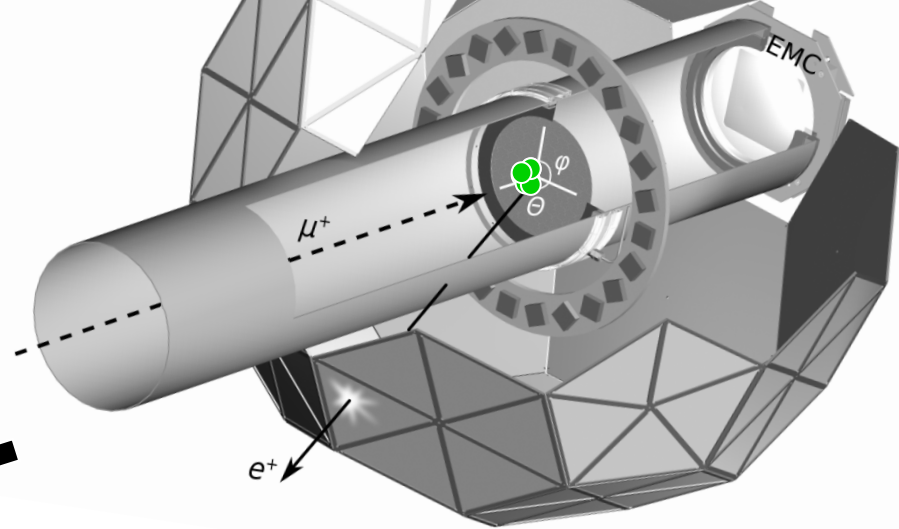
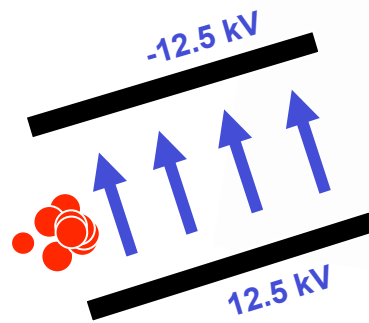
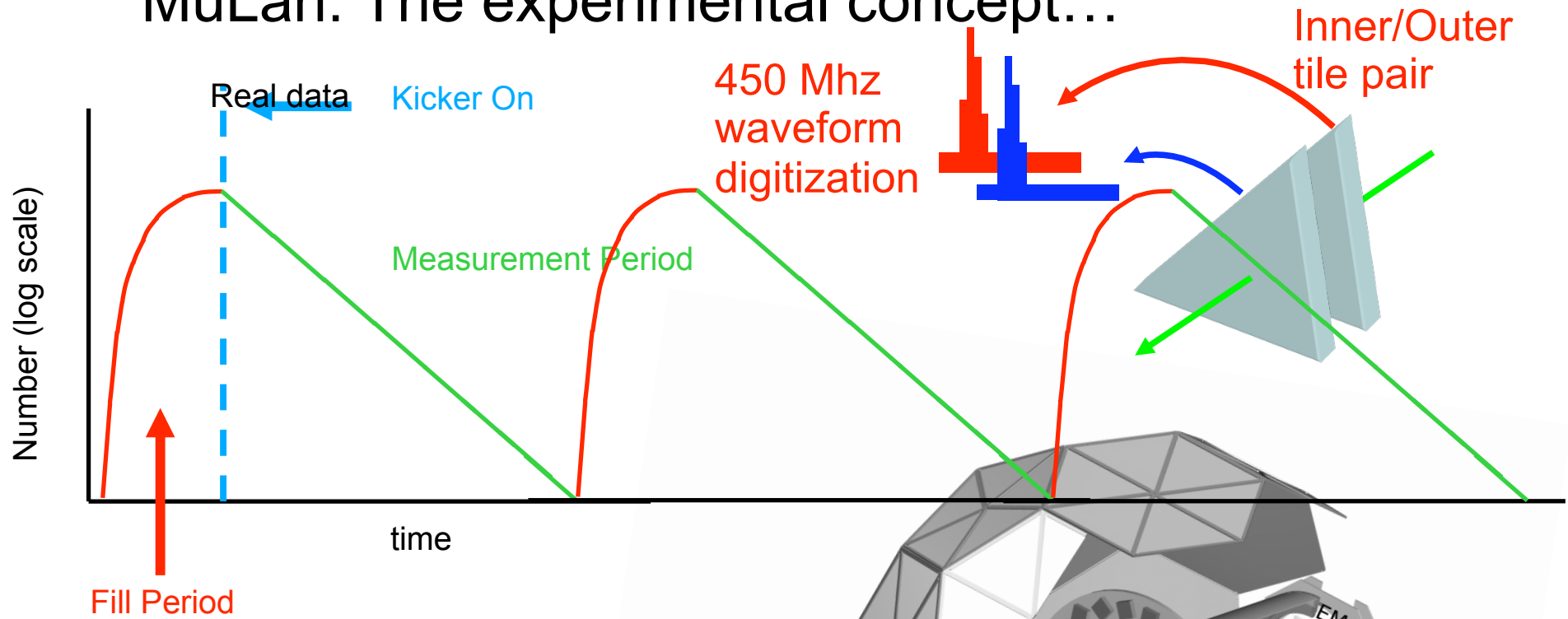
Separator
Quadrupoles
& slit

Detector
- MuLan
- MuCap
- MuSun

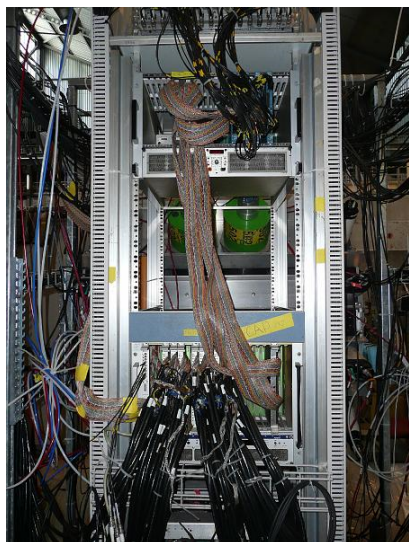
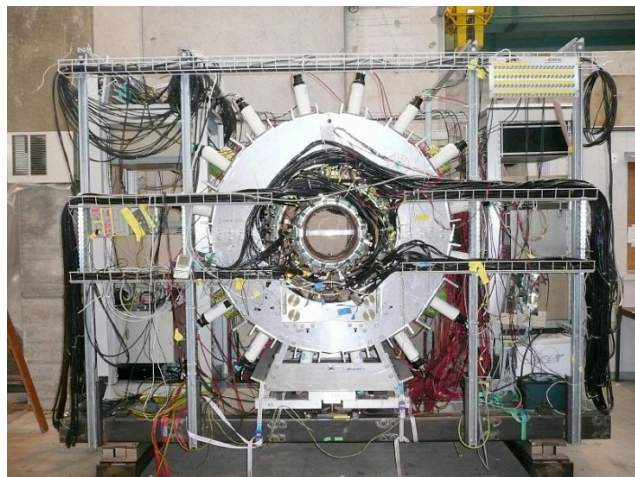
$E \times B$
separation
of electrons



MuLan: The experimental concept...



Mucap detector



Frontend electronics



Frontend PCs



Backend PC



Analysis cluster



Tape storage



PSI archive

But how much data do we have?



10^{12} waveforms sampling 24 times

Each sample is an 8-bit word

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

~ 100 TB compressed raw data

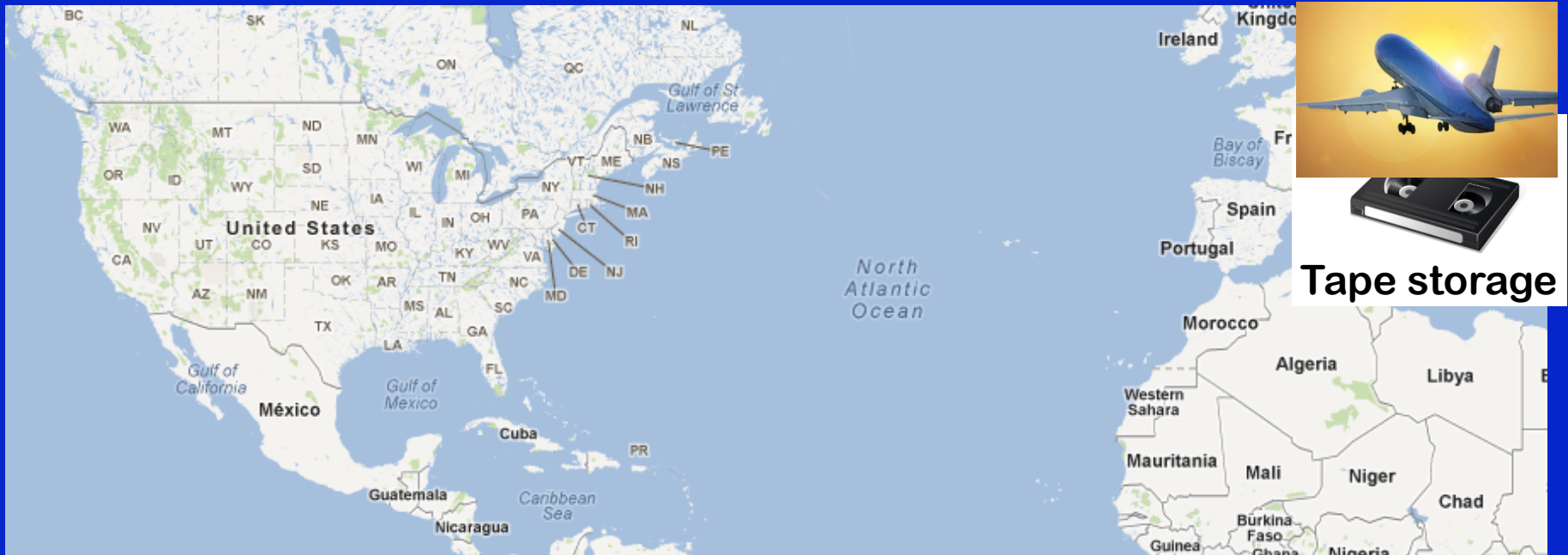
How to get to US quickly?

Collect all your data

Pack and put on airplane

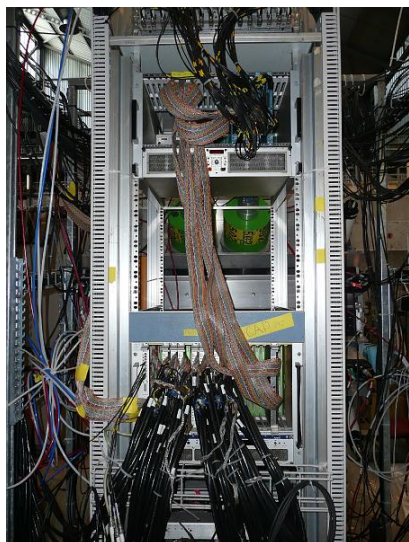
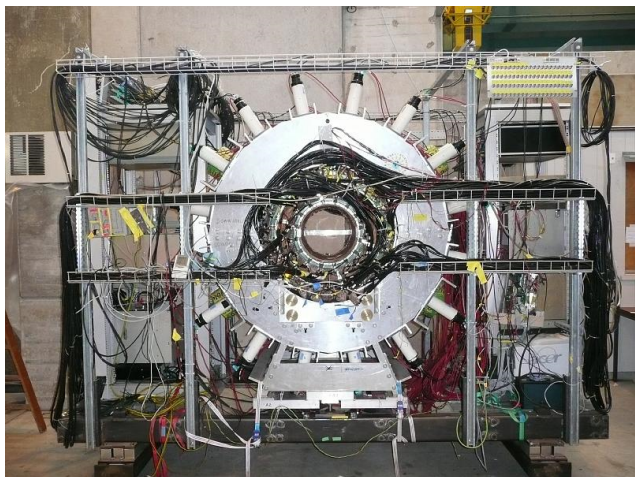
Ship to US and upload to super computer

Takes weeks after experiment until accesible



There must be a faster way...

Mucap detector



Frontend electronics



Frontend PCs



Backend PC



Analysis cluster

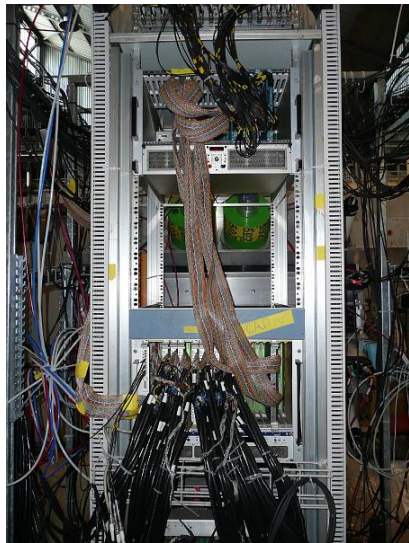
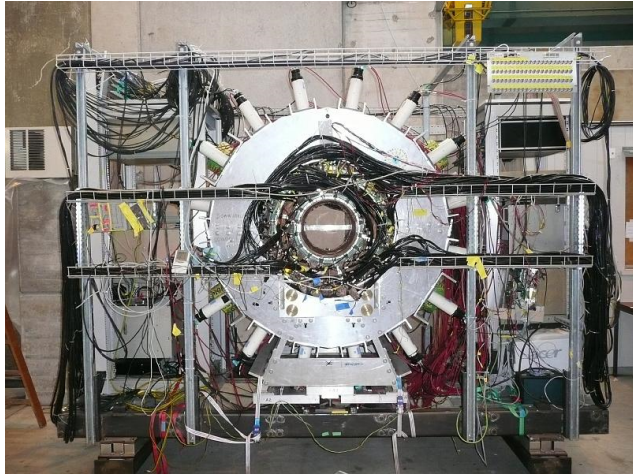


PSI archive



Tape storage

Mucap detector



Frontend electronics



Frontend PCs



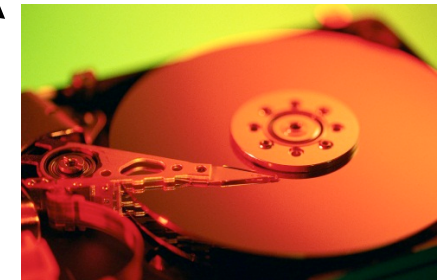
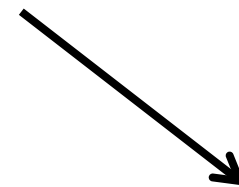
Backend PC



Analysis cluster



PSI archive



2 TB hard disk

Once hard disk is full, transfer...

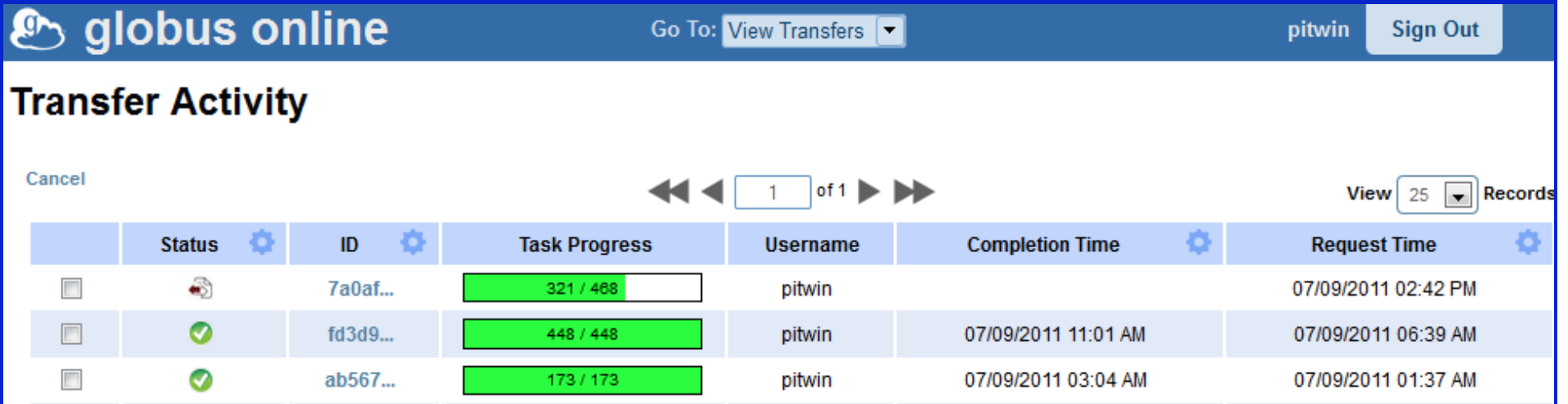
But we write ~1 TB / day!

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



The screenshot shows the Globus Online web interface. At the top, there is a navigation bar with the Globus Online logo, a "Go To:" dropdown menu set to "View Transfers", and a user profile for "pitwin" with a "Sign Out" button. Below the navigation bar is the "Transfer Activity" section. It features a "Cancel" button, a pagination control showing "1 of 1" records, and a "View" dropdown set to "25" records. The main content is a table with columns for Status, ID, Task Progress, Username, Completion Time, and Request Time. The table contains three rows of transfer data.

	Status	ID	Task Progress	Username	Completion Time	Request Time
<input type="checkbox"/>		7a0af...	<div style="width: 68%;"><div style="width: 68%;"></div></div> 321 / 468	pitwin		07/09/2011 02:42 PM
<input type="checkbox"/>		fd3d9...	<div style="width: 100%;"><div style="width: 100%;"></div></div> 448 / 448	pitwin	07/09/2011 11:01 AM	07/09/2011 06:39 AM
<input type="checkbox"/>		ab567...	<div style="width: 100%;"><div style="width: 100%;"></div></div> 173 / 173	pitwin	07/09/2011 03:04 AM	07/09/2011 01:37 AM

Let GlobusOnline handle failure...

	Status	ID	Task Progress	Username	Completion Time	Request Time
<input type="checkbox"/>	✓	ff149...	580 / 580	pitwin	07/22/2011 03:41 AM	07/21/2011 03:57 PM
<input type="checkbox"/>	!	0d258...	1 / 579 / 580	pitwin	07/19/2011 05:17 PM	07/19/2011 03:47 PM
<input type="checkbox"/>	!	fa5ae...	282 / 318 / 580	pitwin	07/19/2011 01:42 AM	07/18/2011 01:41 AM
<input type="checkbox"/>	✓	d5935...	400 / 400	pitwin	07/18/2011 12:33 AM	07/17/2011 04:30 PM
<input type="checkbox"/>	✓	a11bc...	453 / 453	pitwin	07/17/2011 03:04 PM	07/17/2011 06:55 AM

... 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!