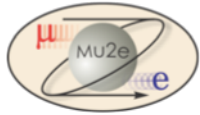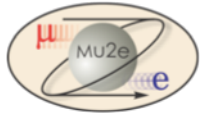# Mu2e and Muon g-2:
FIFE Plans and Issues

Rob Kutschke and Adam Lyon

FIFE Workshop

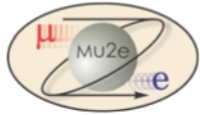June 15, 2013

Mu2e and Muon g-2

- I am speaking for Mu2e
- Presenting some slides on behalf of Adam Lyon for Muon g-2.
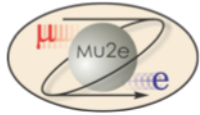
Most Important Slide

- Thanks to the FIFE team and related service providers for all of their hard work.
  - We have used lots of resources.
  - We have received lots of help and advice, some of it on a rush basis.
  - In most cases we have very good communication.
- We very much appreciate all of it.
- There is a lot more work to do …
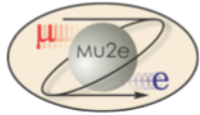
Mu2e Timeline

- We are in the P5 plan in all scenarios!
  - Some stretch-out possible
- CD-2/3 Director's Readiness Review: July 8-11
  - Internal deadline this week!
- CD-2/3 DOE Review: August 19-21
  - No disruptive changes until after the DOE review
  - CD 3 only for selected subsystems
  - Other subsystems: CD-3 mini review over ~1 year
  - Continue heavy simulations through this period
- Projected construction start this fall
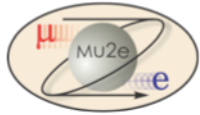- Projected engineering runs ~2019

Grid Usage - 1

- **GPGrid and CDFgrid**
  - Average ~1000 slots active at any time
  - Peaks to > 4000 slots
  - Likely to continue for at least a year (but see next page …)
- **Two major classes of jobs**
  - CPU heavy, little IO
  - IO dominated
    - Dominated by "wait for lock" to access bluearc
    - Stage in O(10 GB) and compute for only 1 or 2 hours
    - Often hundreds of processes waiting to stage in files
    - Expect that dcache will help a lot – testing now
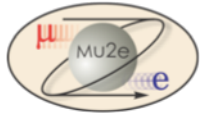- **Expect fraction of IO dominated jobs to increase**

Grid Usage - 2

- A new need has arisen.
- Known weak points in cosmic ray veto coverage
  - Over the river; off the expressway; through the window; off the scoreboard; nothin' but net.
- Need to simulate at least 10 x the live time of the experiment with targeted simulations
  - ~4,000,000 cpu hours over 6 months+
  - (= 1000 cores for ~5.6 months)
- Learning to use offsite OSG will be important
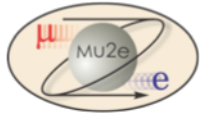 - We will initiate this in the next weeks

Grid Issues

- Intermittent problem: jobs that die for reasons we do not understand – O(1%).
  - Hundreds of processes in one cluster will complete successfully and a few will die seconds after starting.
  - Current ticket: INC000000418734

- Mu2e processes sit idle when there are thousands of free slots on both CDF Grid and GP Grid

- Wait-for-lock issue from page 5 – hopefully dcache and/or xrootd is enough mitigation.

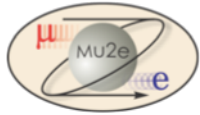- Have not yet tried client-server jobsub.

FermiCloud

- One important use case: making pre-mixed background overlays
  - IO limited 1000 x [O(8 GB) in O(8 GB) out]
  - Enough additional degrees of freedom to safely oversample many times.
  - Needs a machine with about 8 GB peak virtual size
  - Because of IO limitations we can only use a few such machines at one time.
  - Fermicloud has been a great solution
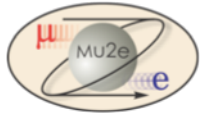- This will be an intermittent but ongoing need.

Disk - 1

- Bluearc: 82 TB data, 1.4 TB app - full
- Recently started to use dcache scratch
  - SCD response was fast
  - Some glitches but we are working through them
  - Some feature requests in the ifdh queue
- We are gambling that we can use dcache scratch as a safe place to stash files for a few more weeks until we have our SAM instance configured.
- Migrating our high IO jobs to stage-in large files from dcache, not from bluearc.
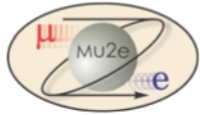 - Will also test drive at xrootd.

Disk – 2

- We renew our request for individual bluearc quotas
- For now, only a group quota
- We would like to be able to control individual quotas ourselves, ie without a service desk ticket
- Under normal operating conditions we have a few spare TB of bluearc disk space
  - Not all should be written to tape – in fact most of it should not.
  - It's easy for someone who is not paying attention to use it all and cause everyone else's work to fail.
  - Expect this to get worse as more people join
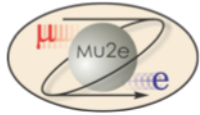 - dcache can help but it is not really the complete answer

SAM

- We have had the initial meetings to set up SAM

- On our plate:
  - Decide on file families, meta-data and policy for what gets written to tape.
  - Ray Culbertson has prepared a draft plan
  - Expect to make decisions O(<= 1 week)

- I understand that we can be up and running O(1 week) after that.

- Decision was made a few weeks ago that new files will be written to T10000 tapes.

- Then we will need to adapt scripts O(1 week) including debugging in the field.
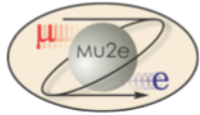
Software Enviornment

- **Relocatable UPS**
  - Our own instance plus products/common
  - Everything except our own code.

- **Code management**
  - cvs on cdcvs
  - plan to change to git on redmine

- **Build system: scons (no plans to change soon)**

- **Still use expwww and are ramping up redmine wiki.**

- **Use our own G4 interface (do not use artG4)**

- **SLF5/6 only.**
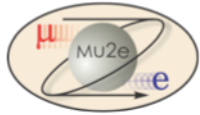 - Want to test-drive Mac OS when we have the people-cycles

art

- Overall very happy with art.
- About bug-fix and feature requests.
  - Things that are both important and easy to do are usually dealt with quickly.
  - In recent months NOvA has had priority so other work has been delayed (understandably so)
  - There is a large and growing backlog of requests, including many Mu2e requests.
  - The client base is growing
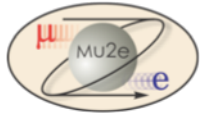 - The art team needs to grow or it will not be able to keep up.

jobsub

- We have our own submit scripts that live on top of jobsub
  - mu2eart
  - mu2eg4bl
  - mu2emars
- So far only use GP and CDF grids
- Good response on jobsub feature requests
- Have not yet exercised client server jobsub. Will do so as soon as well can post TDR.
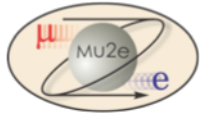
ifdh

- We use it and in general works well.
- Periodic issues and good response.
- We have an issue open now regarding stage-in from mixed sources (both bluearc and dcache).
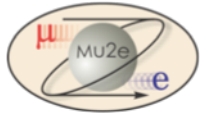
Conditions Databases

- Three needs:
  - Fall 2014: DBs for travellers for construction project
    - DB's will be O(a few GB?)
  - ~2015-2016?: conditions DB for prototyping the conditions system and learning to do alignment
    - Guess that scale is O(100 GB)?
  - ??: Test beam conditions data
    - Guess that the scale is < O(1 GB)
- GUI's for data entry for the traveller DBs.
  - Historically done by postdocs/grad students (aka free labor) on project but Mu2e is too far from data to have many of these
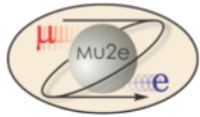 - Is this availabled within FIFE? Elsewhere in SCD?

Other

- OASIS/CVMFS
  - We know that we need it to enable offsite running.
  - On our list so deploy soon.
- ELOG
  - We have an instance but it is not heavily used.
  - Expect use to grow as testbeam starts
  - Not clear yet if construction projects will use it
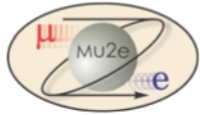
Not Sure If this is the Right Venue …

- The Mu2e collaboration asked for a discussion forum technology ~2 years ago.
  - I understand that a prototype is being designed in Sharepoint 2013 but I have not yet heard when it might be available to test.

- Our outside collaborators have urged me to talk about this in the strongest possible terms – they are already telling their colleagues that FNAL CS just does not care.
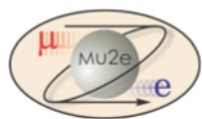
FIFE & Muon g-2

Adam Lyon for the Muon g-2 collaboration
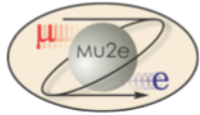
What we use now

- We're a big user, supporter, and cheerleader for the art framework
    - Simulation and offline code is under development in art
    - Our ArtG4 is now supported by the SCD Simulation group
- Our development environment has become "mrb", in use by LArSoft and others
- We've had new users go through the art workbook and they like it
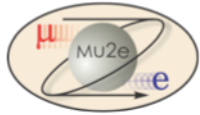
What we use now

- We rely on Redmine and git
  (writing the conceptual and technical design reports
  were managed by git – even the spokespersons
  learned git [though not happily])

- We use CMake for builds (same as art itself)

- We deliver applications/libraries with CVMFS
  (including to our mac laptops; Cornell U and
  U Washington groups use OASIS to get releases on
  their interactive nodes)

A glaring omission

- Several collaborators want to use their Windows Laptops (including a spokesperson)
  - The lab basically does not support kerberos on non-lab owned windows laptops. There is no good free kerberos Windows solution
  - Installing and using kerberos via Cygwin is painful
  - Some people don't appreciate being told to buy a Mac (but of course that's the right thing to do ☺)
- Our solution:
  - Windows user installs VirtualBox (free virtualization system - easy)
  - Download and install our specially prepared SLF6 Vbox Image file
  - This gives the user a virtual SLF6 machine that comes with Kerberos, ssh, git, LaTeX, X-windows, and CVMFS Oasis automounted – all installed and instantly ready to go. Files can be shared with the Windows side.
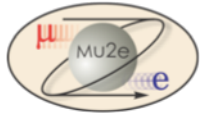 - This solution has worked nicely, but wish we didn't have to do this

Plans for this summer

- Adopt SAM/IFDH/dCache
  - Right now we're still using Bluearc via jobsub's nice copyback mechanism (uses IFDH)
  - Plan to put important simulations on tape and use the scratch cache
  - SAM is already set up and is waiting for us
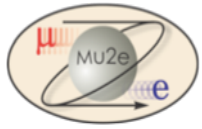- Try new JobSub
- Try Build Facility

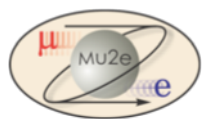Going slowly because people are busy with work on TDR/reviews.

Plans

- By fall we'll be a fully on-boarded OSG experiment using SAM, dCache, etc

- Thanks for everyone's hard work and help!
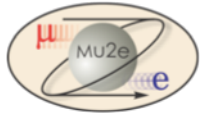
Backup Slides

Computing Projections

- Continue current CPU and IO load for about another year to finalize the design
  - Background rates as we modify details of shielding.
    - Shielding for system A can increase rates in system B!
  - Weak points in cosmic ray veto system.
  - Improve robustness of reco algorithms in higher background scenarios.
  - Calibrate-out some some effects that are modeled in the simulation but not yet in reco

Mu2e Background Model

- 1 Event = 3.1×10^7 protons on target
- ~3,000 hits in the tracker during the live gate
- Simulate one proton at a time
  - Done 6 stages: 4 simulation + premix + reco/analysis
    - The last 2 are IO heavy
    - Premixing requires 8 GB peak virtual size
  - Some stages resample the output of previous stage many times
  - Lots of knobs and dials to increase the effective statistics so that we can have effective statistics of many millions of events.
  - Form samples of pre-mixed background to overlay on signal events