MicroBooNE on the Grid

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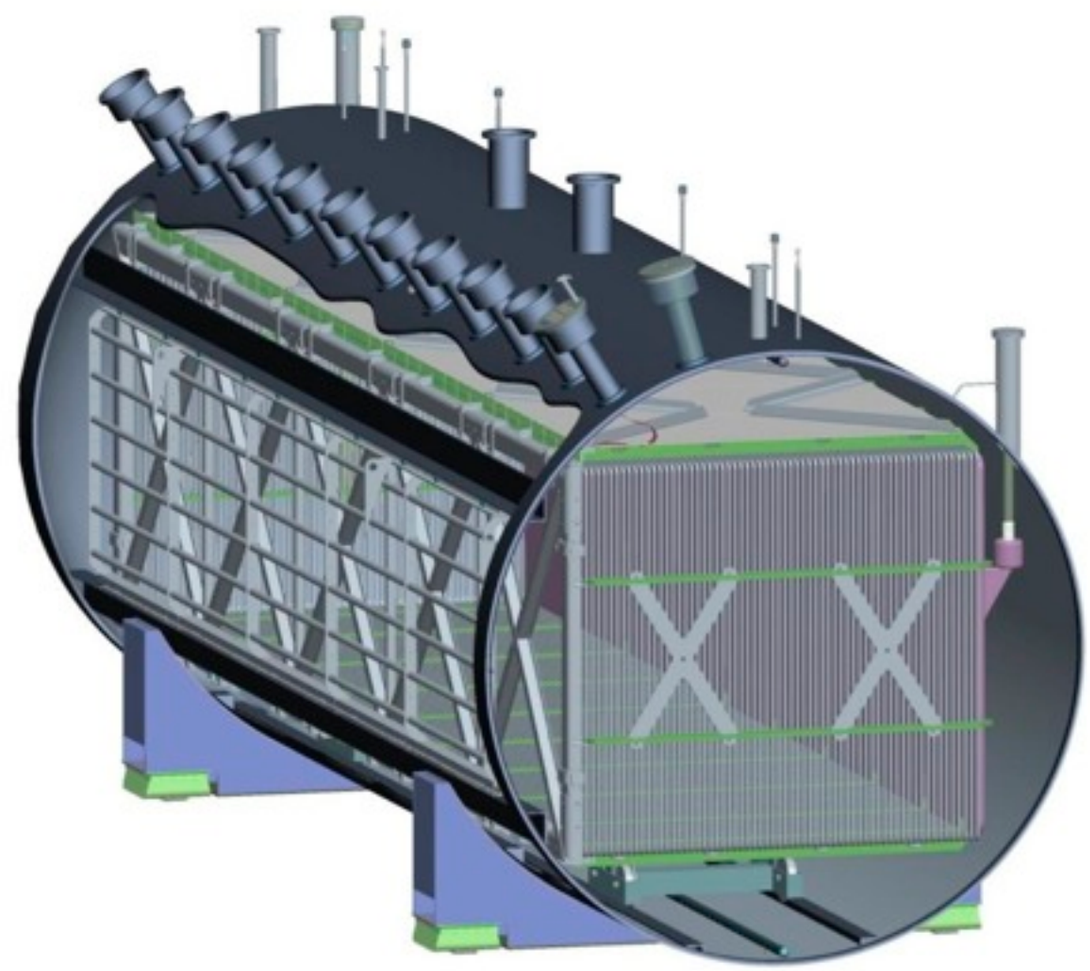
MicroBooNE

- Short-baseline neutrino experiment
- Explores low-energy neutrino phenomena:
  - Low energy excess measured at MiniBooNE
  - Sterile neutrino oscillation
- Uses the Booster neutrino beam at Fermilab
- Detector: Liquid argon Time Projection Chamber

- Detector commissioning: Sept.-Oct. 2014
- Data-taking: ~Jan. 2015



Software: LArSoft

- LArSoft: an *art*-based framework for the liquid argon experiments
  - *art*: an event-processing framework (C++11), used by the intensity frontier experiments at Fermilab
  - shared by MicroBooNE, LBNE, ArgoNeuT, and LArIAT
- Each individual experiment has its own specific package, such as uboonecode, lbnecode

MC Challenge 4

MC Generation: Genie, CRY (Cosmic)

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Geant4 Simulation

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Detector Response Simulation

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2-D Reconstruction

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3-D Reconstruction

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Merge Files, Write to Tape

Job Submission

- Distributed through the BlueArc service
- Fermilab UPS packing to get versioned software to worker nodes
- Jobs submitted to Fermigrid
  - Scripts to automate job submission
  - File management using "IF Data Handling Client Tools" (ifdhc)
    - Input files copied from BlueArc to local scratch space
    - Output files copied back to BlueArc

MC Samples

- Booster neutrino beam samples:

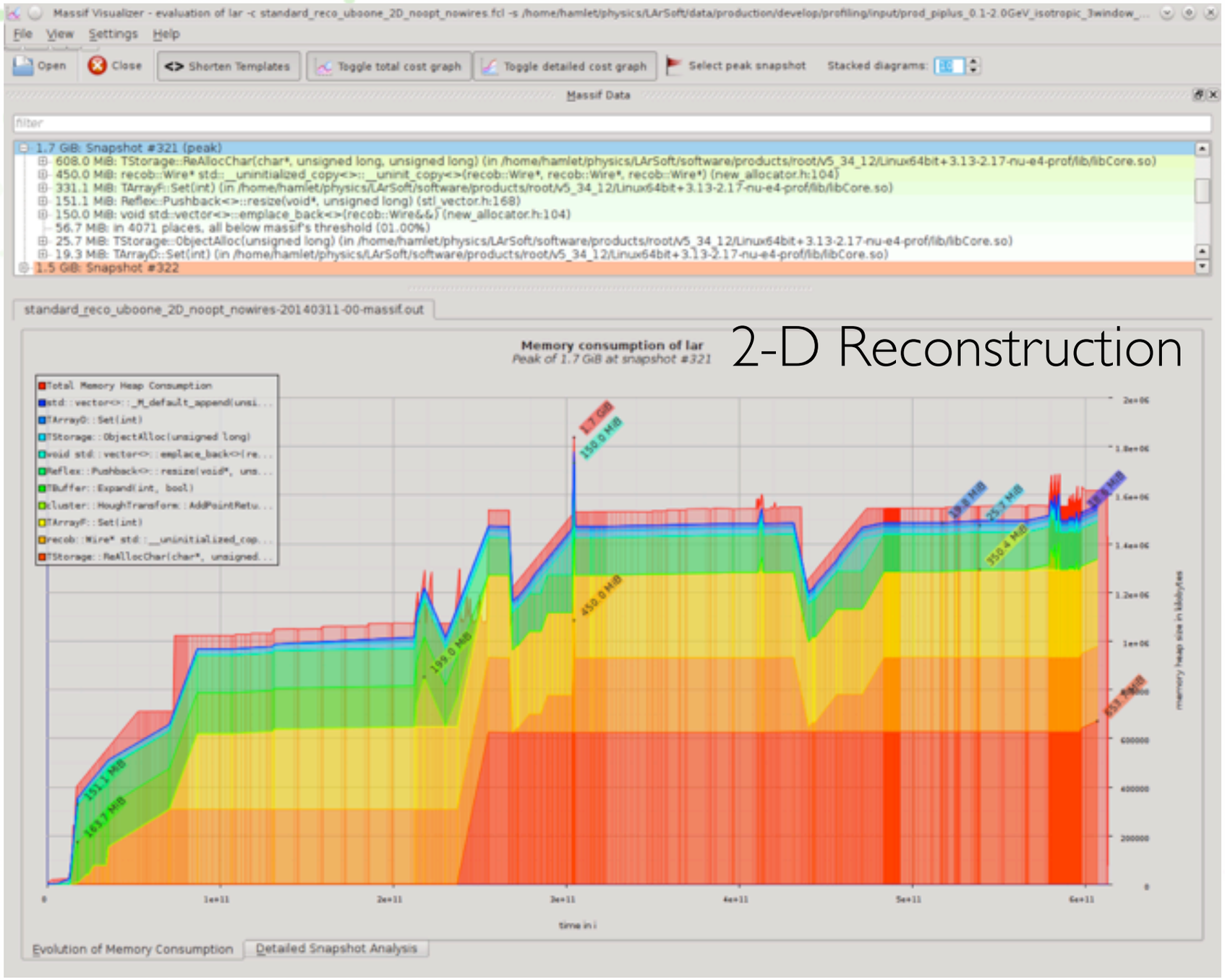
	ν_μ flux	ν_e oscillation
w/o cosmics	Some crashed	Some crashed
w/ cosmics	Some crashed	Most crashed

- Cosmic samples: Some crashed
- Single particle samples:
  - μ^+, μ^-, e^+, e^-, π^+, π^-, π^0, γ, p
  - Most of them are good
- 10,000 events for each sample

Memory Issues

- MCC 4 jobs crashed mainly due to memory issues
  - Memory leak at Geant4, detection simulation, 2-D reconstruction, etc.
  - Large memory usage (>4G), e.g. optical simulation (photon library)
- Other minor issues: Singular matrix, etc.
- All the successful samples ~1.6TB

Memory Profiling



2-D Reconstruction

Plot courtesy of Gianluca Petrillo

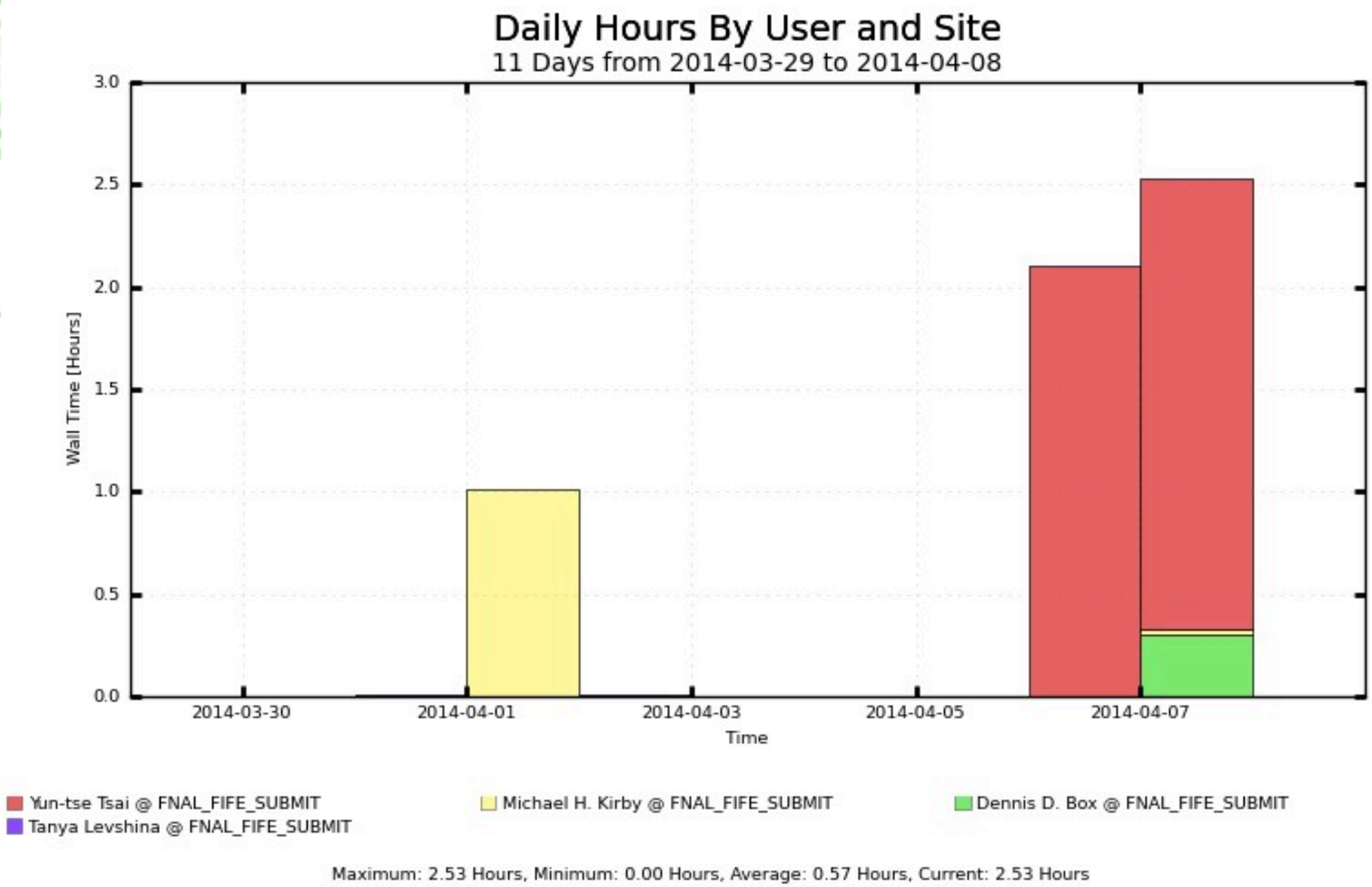
Open Scientific Grid

- Distributed through the OASIS CVMFS service
- Fermilab UPS packing to get versioned software to worker nodes
- Uses the new Fermilab infrastructure, fifebatch, to submit jobs
- Available sites: UCSD, Nebraska, SLAC

OSG Status

- Automated submission scripts ready
- Infrastructure configuration ready
- Succeeded to run a MicroBooNE test job (MC generation) yesterday
  - A production job
  - Need the configuration
    ifdh cp --force=expgridftp -r dir1 dir2
- The Nebraska nodes don't work
  - A X11 library is missing

MicroBooNE Gratia Plots



Plot courtesy of Tanya Levshina

OSG Plans

- Continue testing the MCC 4 jobs
- Provide wrapper scripts
- Test analysis or development jobs
  - e.g. tarball the working area and copy it to the worker node
- Fix the issue on the Nebraska nodes
- Prepare to run MC Challenge 5 on OSG!

LBNE Status (Tanya)

- Long-baseline neutrino experiment
  - CP-violation in lepton sector, neutrino mass hierarchy
- The infrastructure used for MicroBooNE is also utilized for LBNE
- Samples: Single muons in the geometry of the 35-ton prototype
- Run on 17 sites with CVMFS service
  - Failed on 6 sites

Summary & Outlook

- Succeeded running the first MicroBooNE job on OSG yesterday (on a SLAC node)
  - 3 OSG sites: UCSD, Nebraska, and SLAC
- Will continue testing both production and development jobs
- Will prepare to run MC Challenge 5 on OSG
- The same infrastructure is also used for LBNE (17 sites)

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  - Wei Yang

Backup Slides