# Data Analysis with PROOF, PQ2, Condor

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# Outline

- Dataset management with PQ2 tools.
- Data analysis at Wisconsin.
- Running PROOF and Condor at BNL.

# Introduction of PQ2 tools

- It's a local data management system using PROOF dataset management function.
- Users only deal with datasets instead of file lists.
- File information is stored locally on PROOF master. No database is needed.
- It can be used for both PROOF and Condor data analysis job submission.
- The files are pre-located and pre-validated. This will save lots of overhead for the PROOF sessions, especially for the large datasets. (One of our users was running a PROOF session with 60000 files, validation time is almost 15 minutes.)

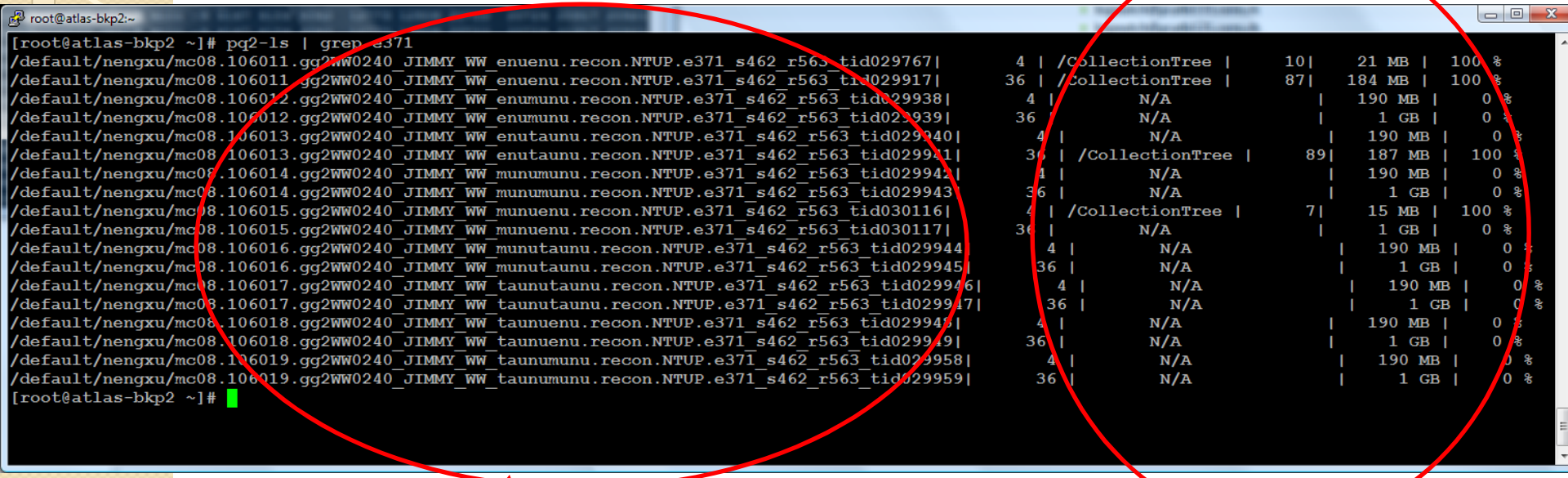
# How to PQ2 tools

- PQ2 is part of ROOT(newer than 5.24) now.
- http://root.cern.ch/drupal/content/pq2-tools
- It's in $ROOTSYS/etc/proof/util/pq2.
- To setup the environment:
  1. Setup the ROOT environment.
  2. export PATH= $ROOTSYS/etc/proof/util/pq2:$PATH
  3. export PROOFURL="userid@proof-redirector.xxx.xxx:1093"

# Basic Commands

- For system admin:
  - pq2-put (Register a dataset.)
  - pq2-verify (File location check and pre-validate.)
  - pq2-info-server (list all the storage nodes' information.)
  - pq2-ls-files-server (list all the files on one of the storage nodes.)
  - pq2-rm (remove datasets)
- For users:
  - pq2-ls (List the datasets.)
  - pq2-ls-files (List the file information of a dataset.)

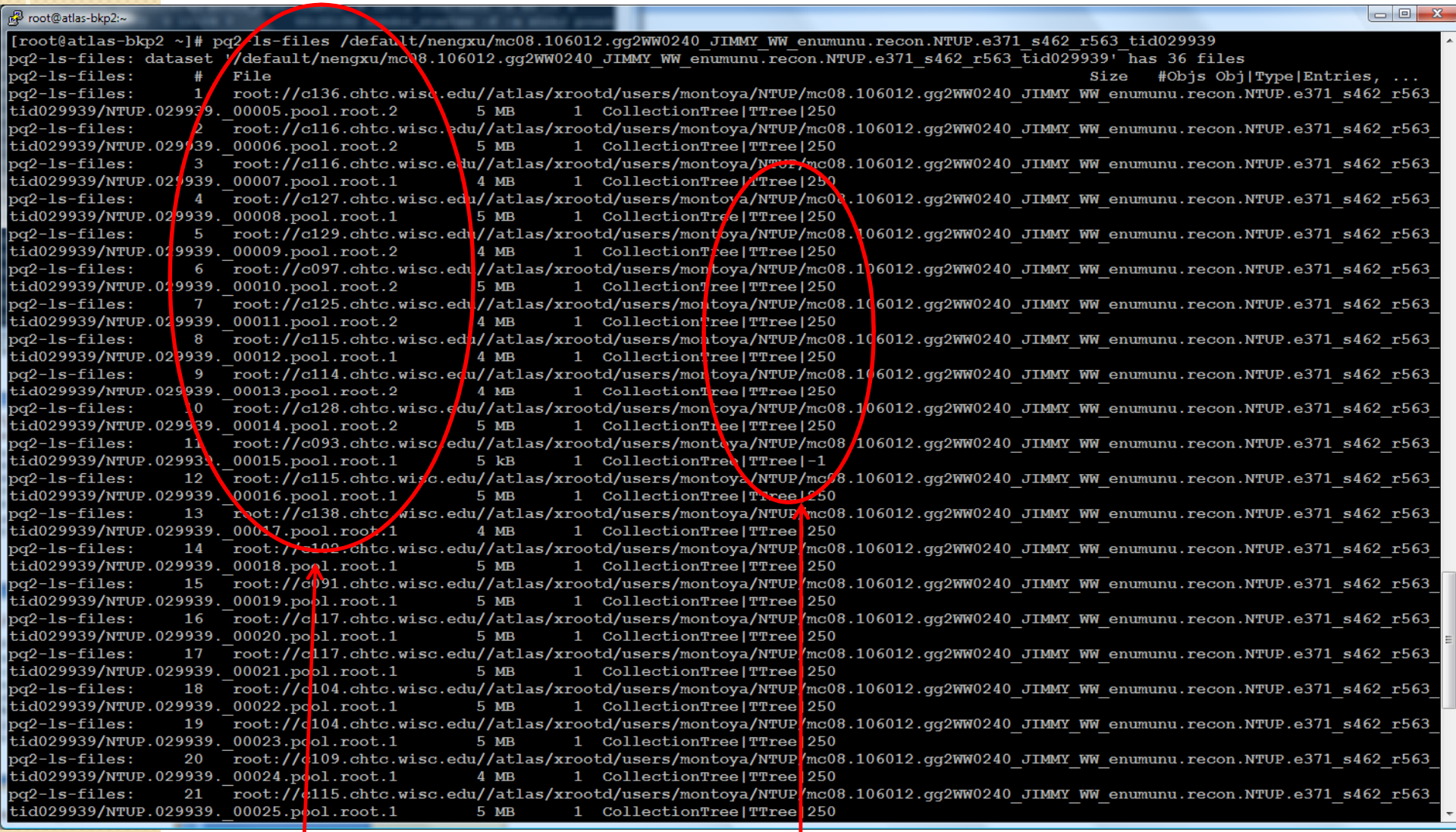
# Example of pq2-ls




Datasets information

Datasets information

# Example of pq2-ls-files




File location

Validation information

# How do users use PQ2 tools

- For PROOF users, they just need to put the name of the dataset like this:

```
p-> Process("/default/nengxu/mc08.109067.PythiaH190zz4l.merge.NTUP.e384_s462_r635_t53_tid056686",
            "CollectionTree.C+",options);
```

- For Condor-dagman users, they submit their analysis jobs like this:

```
python submit.py --initdir=/home/wguan/dag_pq2/test3 --parentScript=/home/wguan/dag_pq2/dump.sh --
    childScript=/home/wguan/dag_pq2/merge.sh --dataset=/default/nengxu/mc08.109999.PythiaQCDbb2l.fullsim.v14022303 --
    transferInput=/home/wguan/dag_pq2/input.tgz --jobsPerMachine=2
```

# Advantages of PQ2

- Easy to maintain.
- No database needed.
- Add/remove datasets is very simple.
- Fast access to the file information.
- Avoid some overhead of PROOF jobs.
- Easy to make load balance for the PROOF master.
- Not only work with Xrootd but also NFS, Dcache, CASTOR or even local files.
- …

# Our Tier3 Facility at Wisconsin

- We are using BestmanSrm + Xrootd for data transfer and storage.
- Our hardware is 50x(8core+16GB+8x750GB).
- Our network is 10Gb uplink and 1Gb to each node.
- We are using PATHENA, PROOF and Condor-dagman for data analysis.
- We run Xrootd and PROOF separately but on same storage pool.
- We are using PQ2 tools for local file management. Recently PQ2 need to work with XrootdFS to get the file list.
- All of our users are working from CERN

# Use PQ2 tools with DQ2/LFC in Wisconsin

- Since we are running DQ2 site service there. we wrote a script which reads out all the file information from DQ2/LFC and converts srm url of PFN to xrootd url.
- For each dataset, we create a simple text file.
- pq2-put command takes those text files as inputs and registers them into PROOF.

# Analysis with Condor-dagman

- The submit script talks with PQ2 server to get file location and define the Condor-dagman JDLs.
- Check the machine status before submit the jobs.
- Limit the number of jobs to each node.
- Multi-level collecting or merging the output files.
- Example script is here:

http://wisconsin.cern.ch/~wguan/dag_pq2_v2_bnl.tgz
http://wisconsin.cern.ch/~wguan/dag_pq2_v2_wisc.tgz

# Our Tier3 experience at BNL

- We are going to have some CPUs and storage at BNL. How to use them is our new project.
- We are working on two ways to run analysis jobs at BNL:
  - Using Condor to start a PROOF pool.
  - Using Condor-dagman to run analysis jobs.
- All the input files are in the Dcache. The PROOF jobs read via the Xrootd door and Condor-dagman jobs read directly from DCache.
- We registered the datasets we need to a PQ2.
- For PROOF jobs, we use SSH tunnel from CERN to BNL without login to BNL machines. Very convenient for users.

# Use PQ2 tools at BNL

- We can run dq2 command to get the datasets information and file SURL.
- We just simply create a text file with the xrootd url converted from SURL.
- pq2-put takes those text files to register the files into the PROOF redirector.
- Users can access the file information via SSH tunnel between CERN and BNL.

# Some performance problems at BNL

- Since PROOF reads the Dcache files via Xrootd door, the performance was limited by Xrootd door. The maximum speed is 8MB/s.
- PROOF developers are working on direct access Dcache files.
- We also don't want to overload the Dcache system at BNL because PROOF is very aggressive on I/O. There should be a way to limit maximum network traffic.

# Summary

- PQ2 works quite good for our local data management.
- If your Tier3 want to put machines at BNL or SLAC, the way we setup PROOF over Condor could be good example. It also works with other batch system like LSF, PBS.
- Condor-dagman is good for those users who don't want to modify their code. Multi-level merging can reduce the load on submit nodes.
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# Thanks to

- ROOT/PROOF team.
- Condor team.
- DDM team at BNL.
- SLAC Xrootd team.