Il calcolo per l'esperimento CUORE

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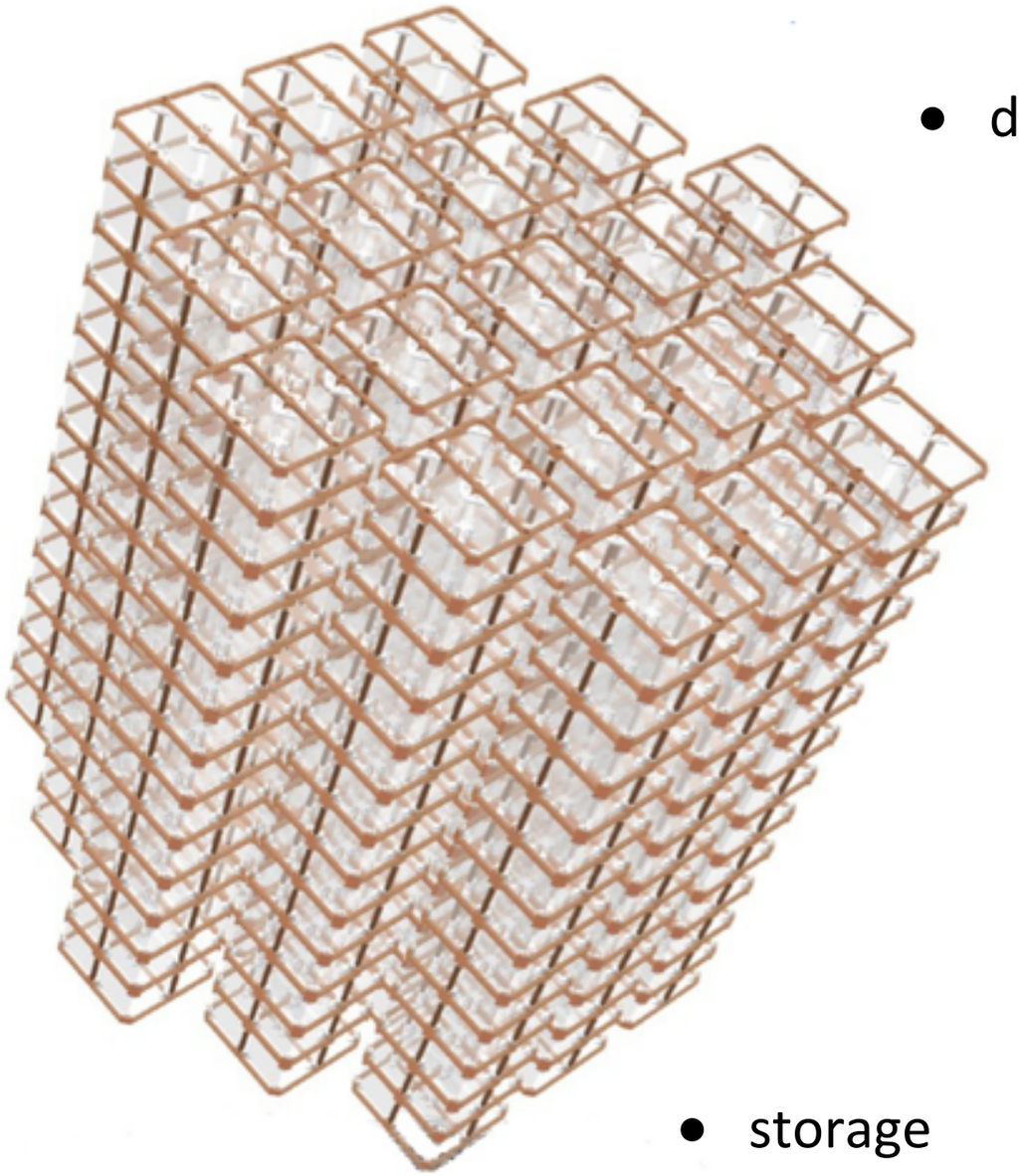
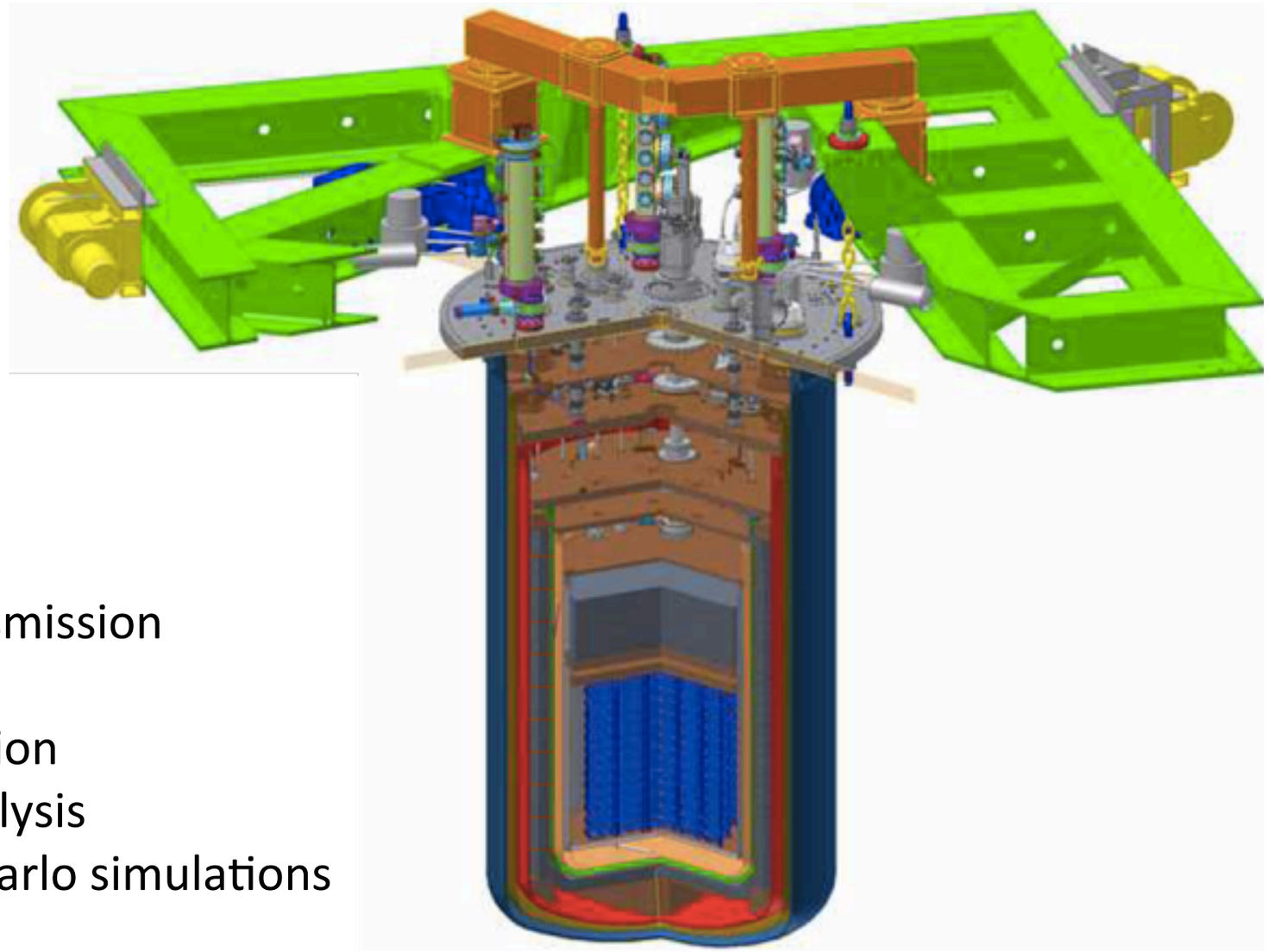
Workshop CCR: Il calcolo per gli esperimenti ai Laboratori Nazionali del Gran Sasso **LNGS 26 - 28 febbraio 2014**

Goal



- detector: 988 TeO2 bolometers
  - raw/triggered data

- complex system
  - informations (database)



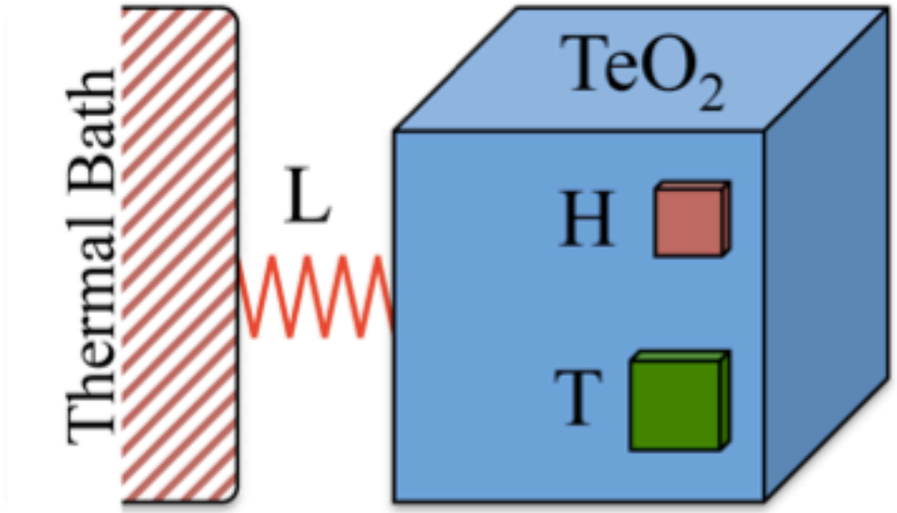
- storage
- access/transmission
- analysis
  - calibration
  - pre-analysis
  - montecarlo simulations

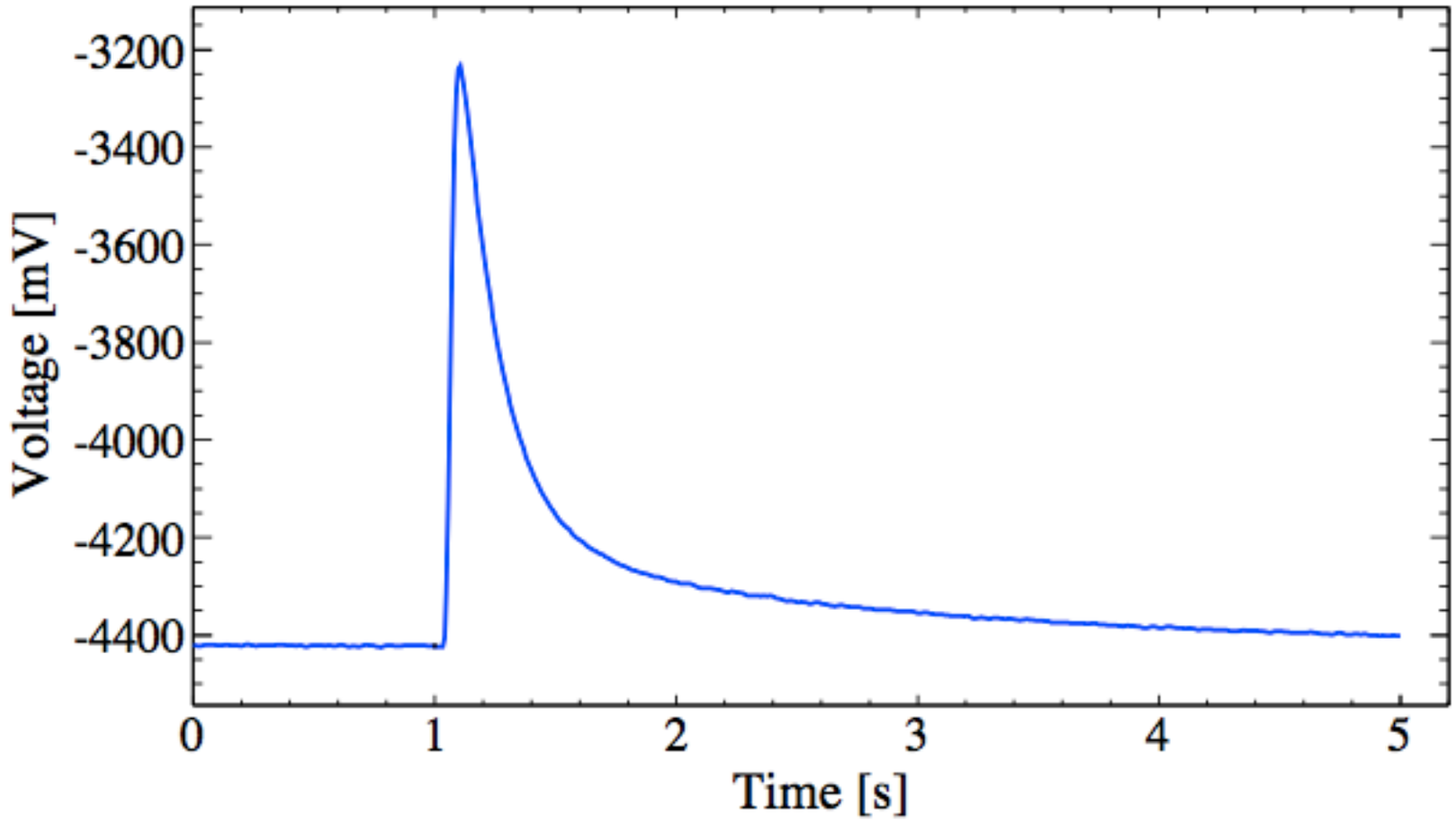
SW model

- based on/derived from BaBar framework
- developed on R&D systems and Cuoricino
- tested on R&D systems and CUORE-0
  - DAQ: Apollo
  - DA: Diana
  - Monitor: CORC/Slow Control

→ **CUORE(-0) cluster**

CUORE-0

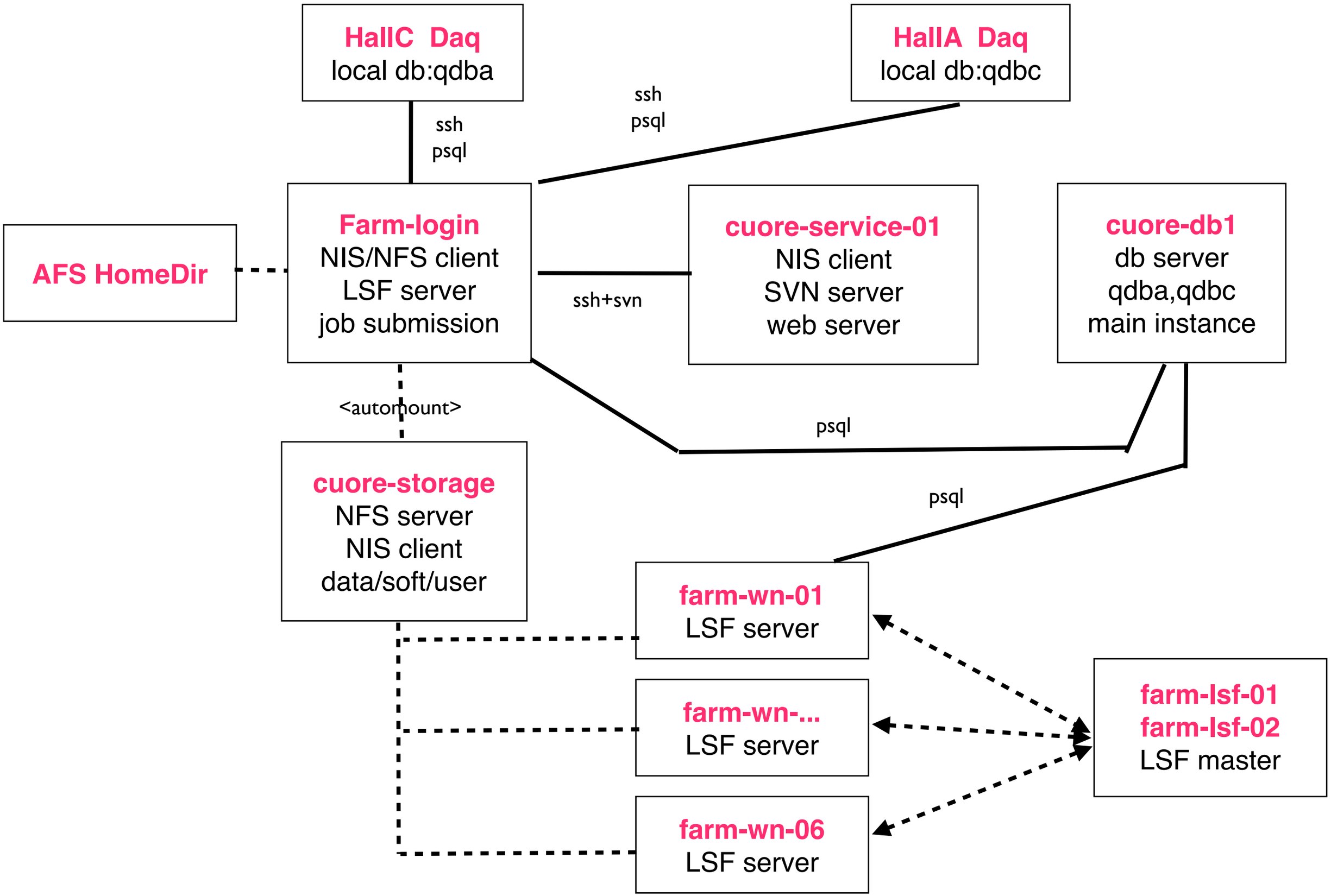

Thermal Bath
L
TeO_2
H
T


-3200
-3400
-3600
-3800
-4000
-4200
-4400
Voltage [mV]
0
1
2
3
4
5
Time [s]

CUORE cluster (presently in Rome)

- The Rome Cluster is the is the repository of both data and codes, and performs the following functions:
  - **data storage:** reference copies of data(continuum, triggered, processed, MC)
  - **svn server:** official svn repository of all CUORE codes and journal articles/notes
  - **web server:** Offline CORC, websvn, swdoc
  - **accounting**
  - **database:** the main instance of qdb and **db mirroring** with exp. halls
  - **data backup**
  - **bookkeeping**

Configuration



Configuration

- Two login hosts for batch submission, small interactive jobs run, export graphic session (root, GUI)
- One host for the DataBase: accessible from login-host and from batch jobs
- One host for the svn and web server
  - CORC: data dir not visible via NFS, copy data via ssh
- LSF
  - shared with other small experiments
  - normal queue: max 20 jobs/user, 40/group
  - fast queue: for compiling, max 8 jobs, 4/user 1/WN

```
HOST_NAME      type    model  cpuf ncpus maxmem maxswp server RESOURCES
farm-lsf-01 LINUX86    Twin1  47.0     1  1010M  1027M    Yes (mg)
farm-lsf-02 LINUX86    Twin2  43.0     1  1010M  1027M    Yes (mg)
farm-login- LINUX86    Twin1  47.0     2  3093M  2047M    Yes ()
farm-login- LINUX86    Twin2  43.0     1  3093M  2047M    Yes ()
farm-wn-01  LINUX86    Twin1  47.0     8 12169M 34975M    Yes ()
farm-wn-02  LINUX86    Twin1  47.0     8 12169M 34975M    Yes ()
farm-wn-03  LINUX86    Twin1  47.0     8 12169M 24003M    Yes ()
farm-wn-04  LINUX86    Twin1  47.0     8 12169M 24003M    Yes ()
farm-wn-05  LINUX86    Twin2  43.0     8 24361M 24003M    Yes ()
farm-wn-06  LINUX86    Twin3  53.0    12 24361M  8191M    Yes ()
```

Data management

- 9 TB Disk server in raid 6
- Three auto-mount partitions: 0.8 TB still available

	partition (TB)	used(%)	group write permission
/cuore/data	5	44	cuore_data
/cuore/soft	0.5	5	cuore_soft
/cuore/user	2.7	70	cuore

- /cuore/data: continuous/raw/processed/MC data + svn/db backup
- /cuore/soft: diana libraries, official MC and diana exe.
- cuore/user: users' NFS dirs

Data flow

- Perl scripts in cron jobs
- Check new data only when DAQ is OFF
  - New data: ended runs without dataset assignment
- Mirror the db
- Sync RDF and RDFC and organize them in dirs identified by run number
- Change data path to Diana list
- Perform bookkeeping
- Assign Dataset
  - done via an sql function
  - each calibration file belongs to 2 datasets, step of 3 between 2 adjacent datasets
  - after main stops/problems require user action

List of sw libraries/packages

- gsl
- boost libraries
- qt libraries
- svn
- root
- postgres client
- perl, perl/DBD, perl/php packages
- latex and related
- websvn
- MongoDB

On-site (LNGS) network and Farm

LAN:

- Router PC with two network cards, one visible from the outside one directed inside that creates the CUORE NAT or access the LNGS NAT (depends on the number of machines we will have).
- Router PC maintained together with the Lab staff.
  Use LNGS services to access services run on the NAT (db, www).

Farm:

- Estimated ~20 CPU Load (Multi-core or multi CPU)
- Use the LNGS u-lite system for storage

  180 Euro/TB, 100 TB/5y

- Backup → Berkeley and CNAF mirrors + LNGS tape.
- CPU's →

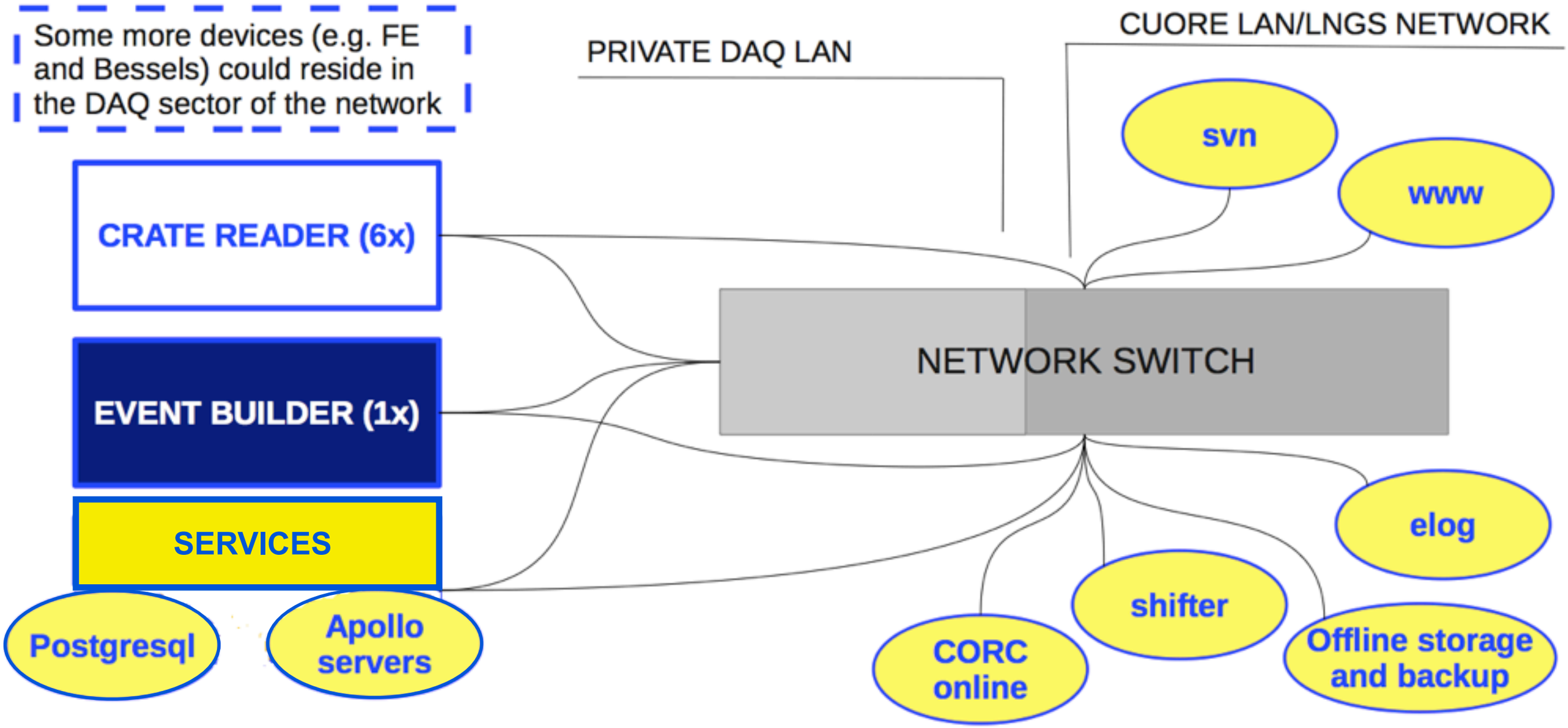
DAQ

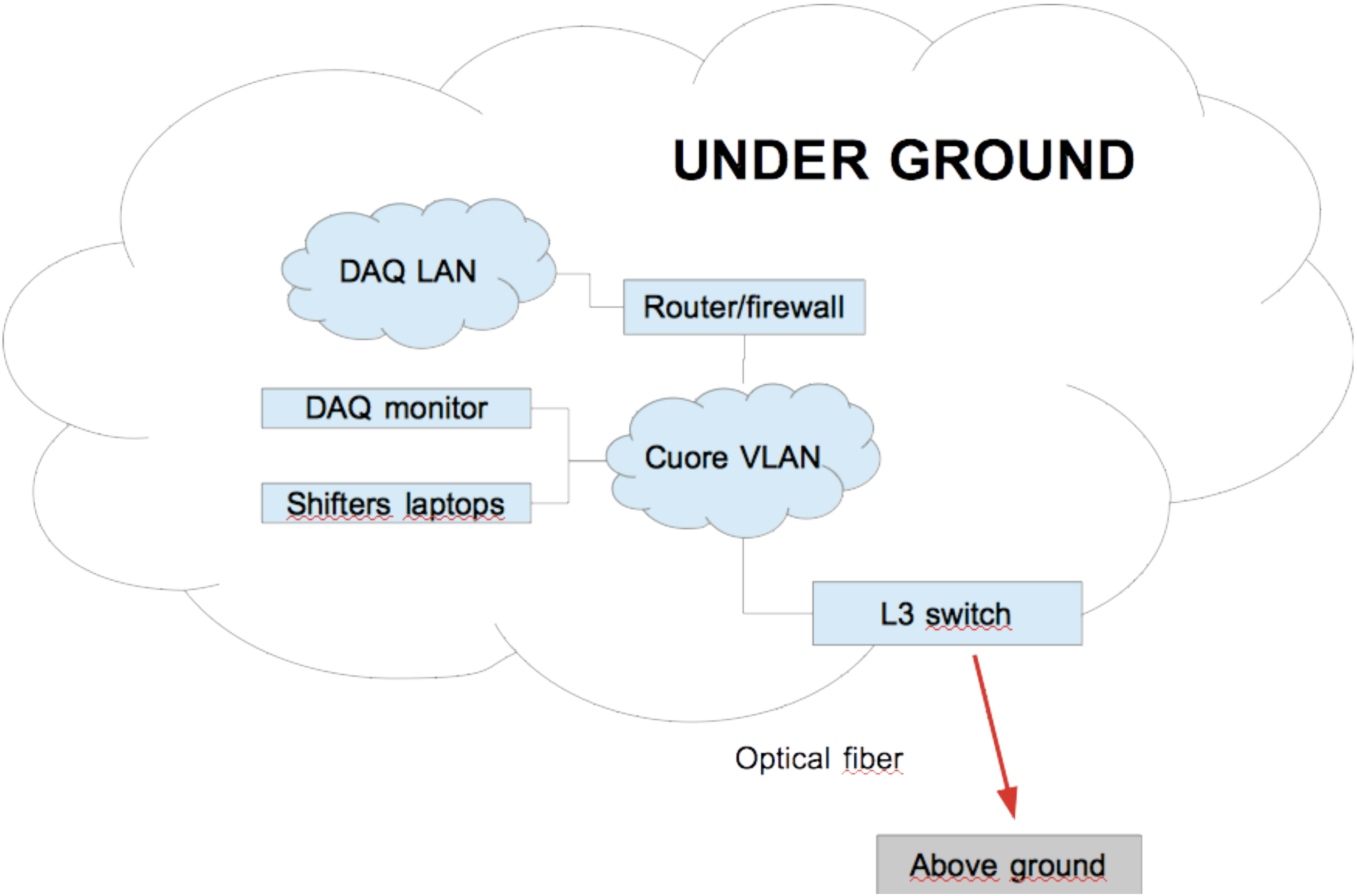
- 6 computers for signal readout, 1 computer for event building, 1 (or more?) computer for services.

  Each Daq computer will have 2 network interfaces

- Local storage: 20 TB/y or 50 GB/day (4*988*3.16x10^7/0.0128~10 TB/y)

  Lower priority interface for communication with the rest of the world




UNDER GROUND
DAQ LAN
Router/firewall
DAQ monitor
Shifters laptops
Cuore VLAN
L3 switch
Optical fiber
Above ground

Tape backup/archiving

LNGS border router

LNGS LAN

internet

Remote mirror

PC gateway
With NAT/PAT
Router / firewall
(AG)

db

www

Cloud
services

Storage server

Storage server bck

Fibre channel or iSCSI

Cuore VLAN

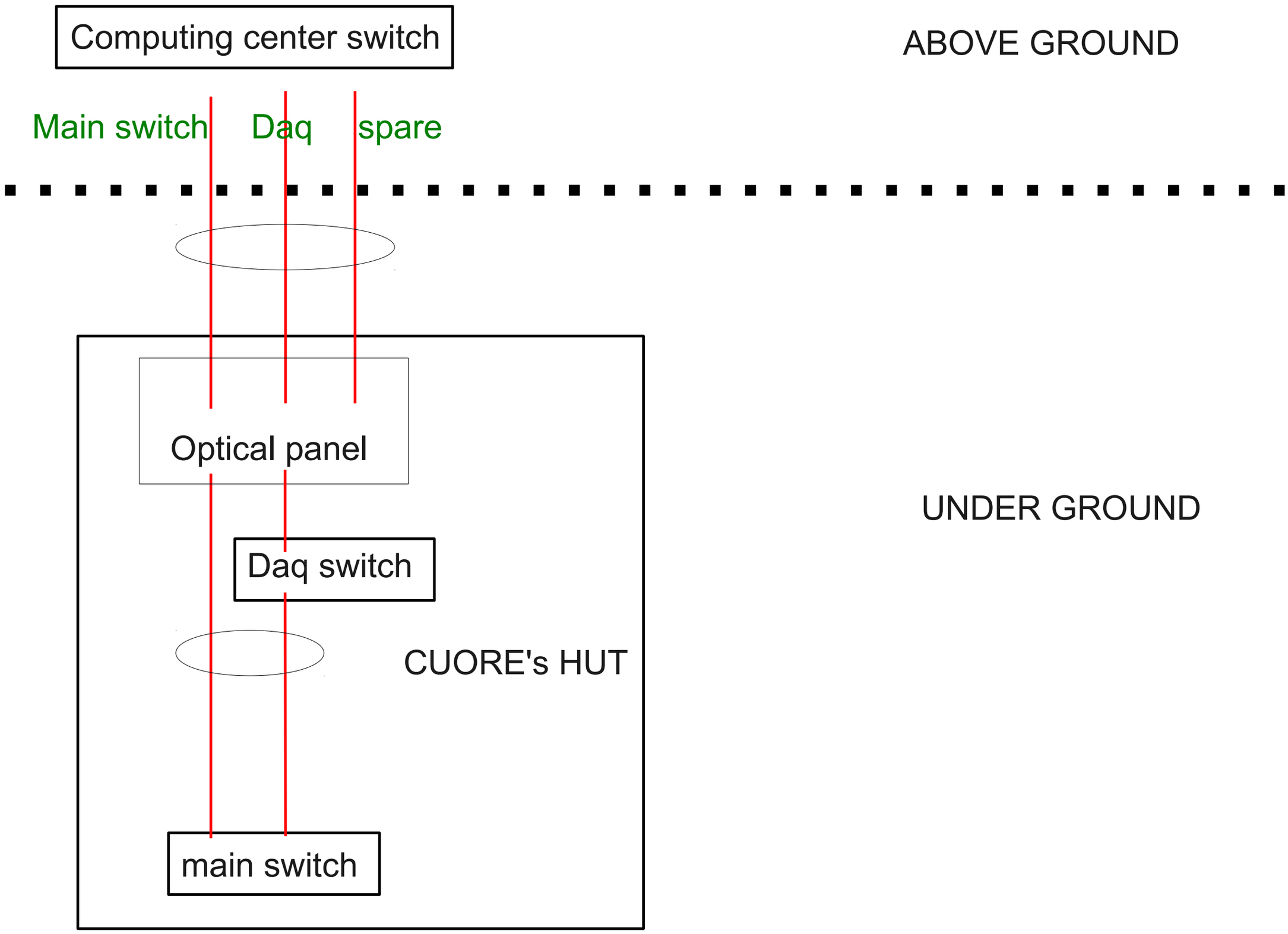
U-LITE storage

U-LITE
Computing
Cluster
(300 + CPUS)

switch

Optical fiber

ABOVE GROUND


Computing center switch
ABOVE GROUND
Main switch
Daq
spare
Optical panel
Daq switch
CUORE's HUT
UNDER GROUND
main switch

Data handling

- Two DAQ strategies: continuous and triggered

- More efficient way to access continuous data
  - Quick seek, ROOT or other non-proprietary format.

- More efficient way to handle triggered data:
  - Move side pulses from Apollo to Diana, and pick them from continuous data at run time.
  - Remove the triggered pulses from analyzed data.

- Move the trigger from Apollo to Diana? Define the amount of work to be estimated, before the end of November.

- Diana, parallel processing (by chan and by tower).

Conclusions

- 2 level computing model
  - signal processing, gain stabilization, calibration
    → std n-ple production
  - physical processes
- limited amount of data
- on-site needs:
  - DAQ
  - slow control
  - detector/measure monitor
  - storage (data master copy)
  - pre/local + on-site operator analysis (limited resources)
  - local network
- on/off site:
  - montecarlo simulations
  - extensive (physics) analysis (extensive resources)
- concerns: connectivity and compatibility/interoperability