DAQ for FLASH operations and experiments

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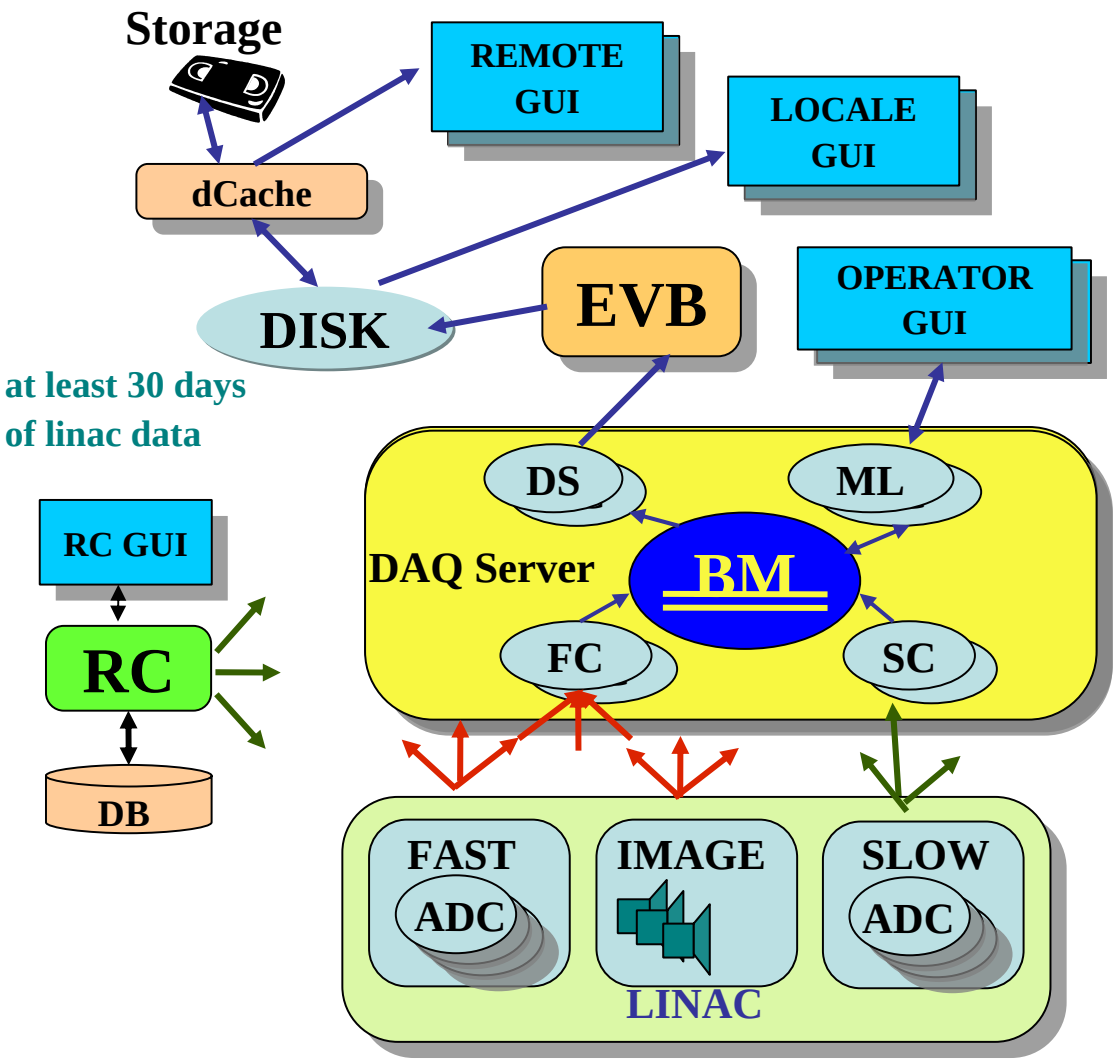
Outline

- **Goals**
- **Architecture**
- **Data volumes/rates**
- **Control GUI for DAQ**
- **ML servers in DAQ**
- **DAQ data analysis tools**
- **Status**
- **Plans**

Goals

- **Store all beam relevant data of the linac (with bunch resolution)**
- **Improve, better understand, and maintain the linac**
  1. *Error statistics: find reasons of faults, improve reliability*
  2. *Operation optimization, find best parameters*
  3. *Allow experiments to correlate measurements with the machine*
- **Central data store for middle layer services (e.g. feedback)**
- **Store the data of the experiments**
- **Provide the tools to analyze the stored data for local and remote users**

Architecture



multicast

Fast data (every micropulse)

Beam relevant info:

ADCs (BPM, BLM, TOR, etc)

CAMERAs

DOOCS (TINE)

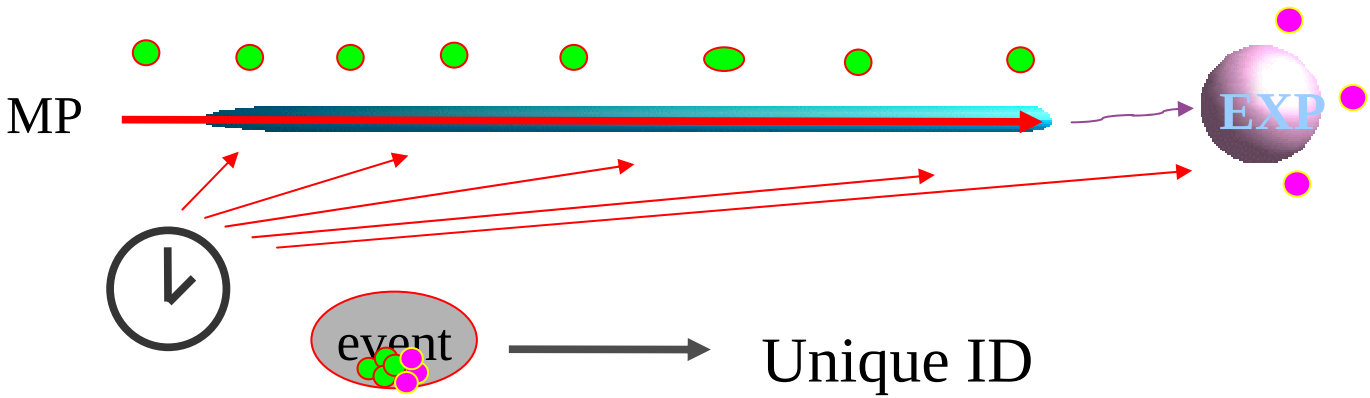
Slow data (max 1Hz)

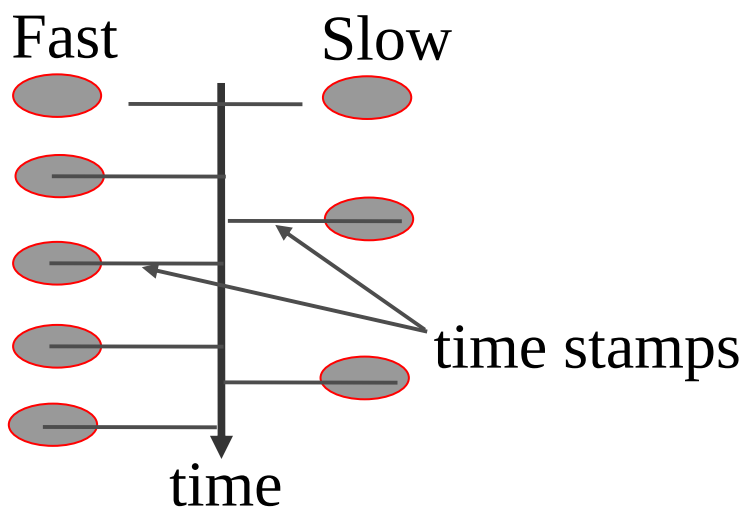
Data from slow ADCs (MAG, V, etc.)

DOOCS channels (Masks, params, etc.)

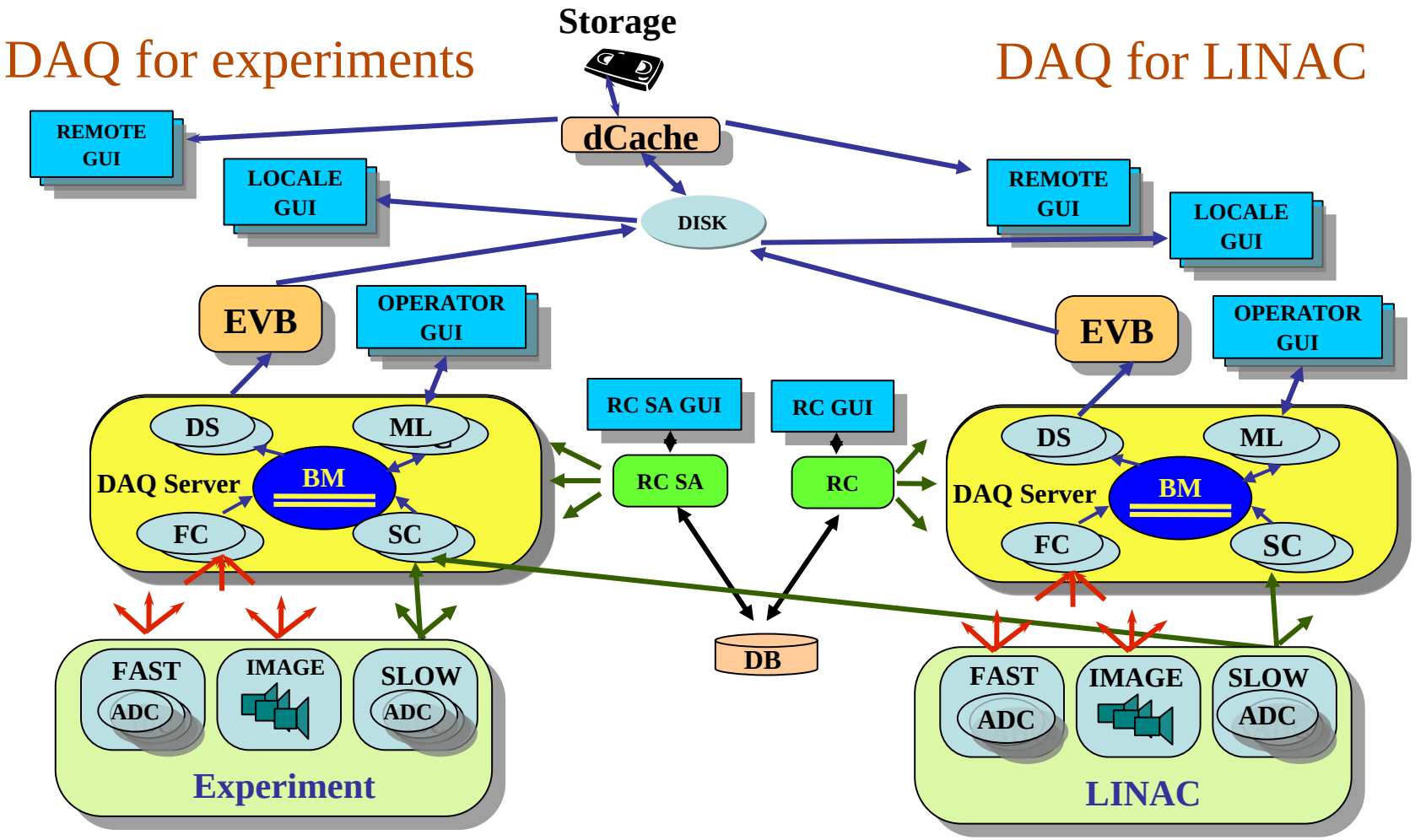
Architecture

Events





Architecture



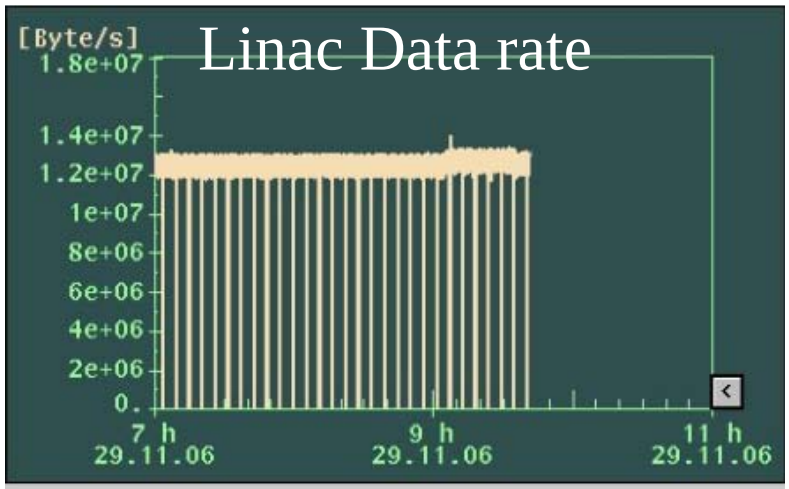
The main DAQ server

- **8 double core SPARC CPUs**
- **32 GB common memory**
- 4 x 1Gbit Ethernet
- 1.7 TB local storage
- fully redundant fan, PS, …

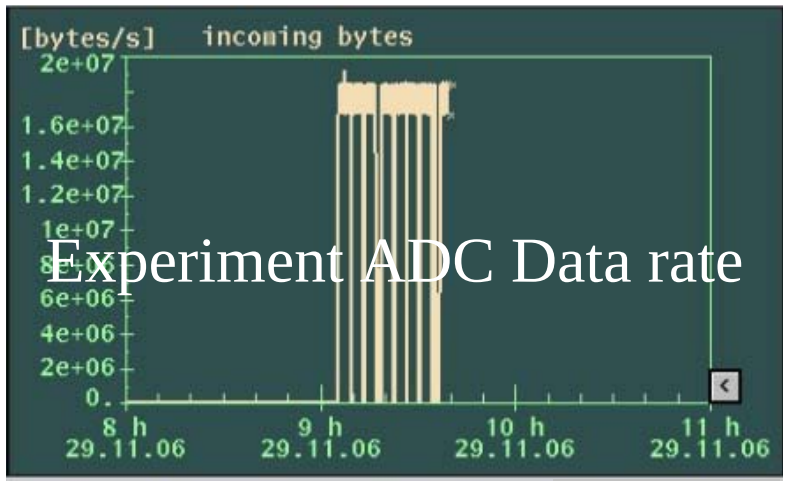
- 2 dual-core AMD Opteron processors 2.6 GHz
- 16 GB common memory
- **24 TB local storage; 48 SATA HDD**
- 4 x 1Gbit Ethernet
- 1 GBps from disks to network
- 2 GBps from disk to memory

Data volumes/rates

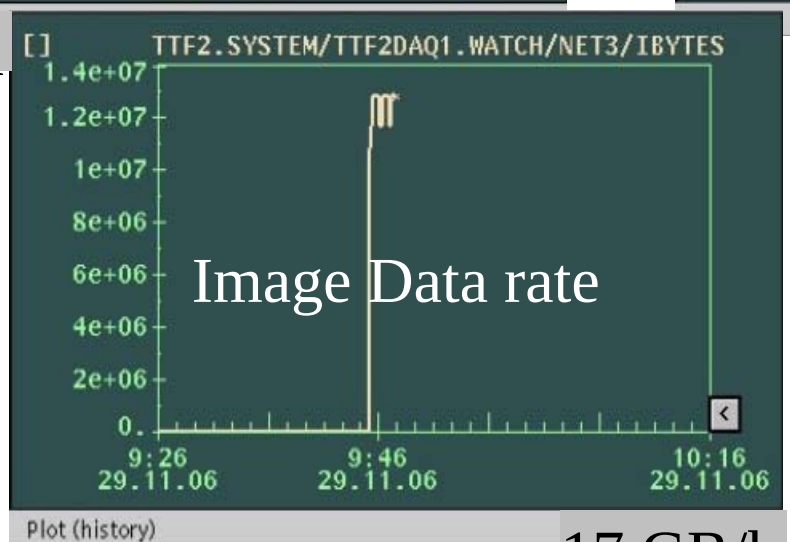
Data rates



18 GB/h



15 GB/h



17 GB/h

Last experiments (25.11 -11.12 2006):

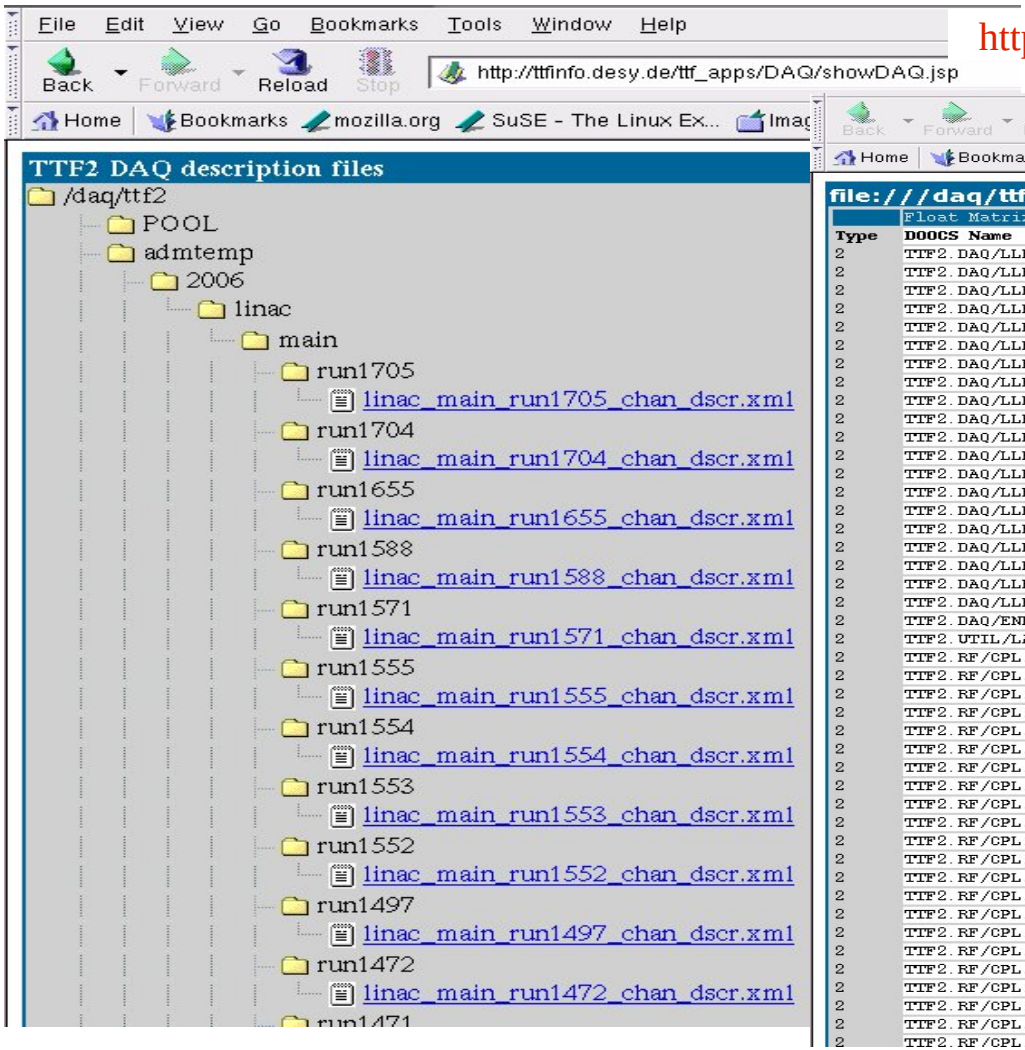
PG2 – 212 runs (8100 files,~ 1.6 TB)

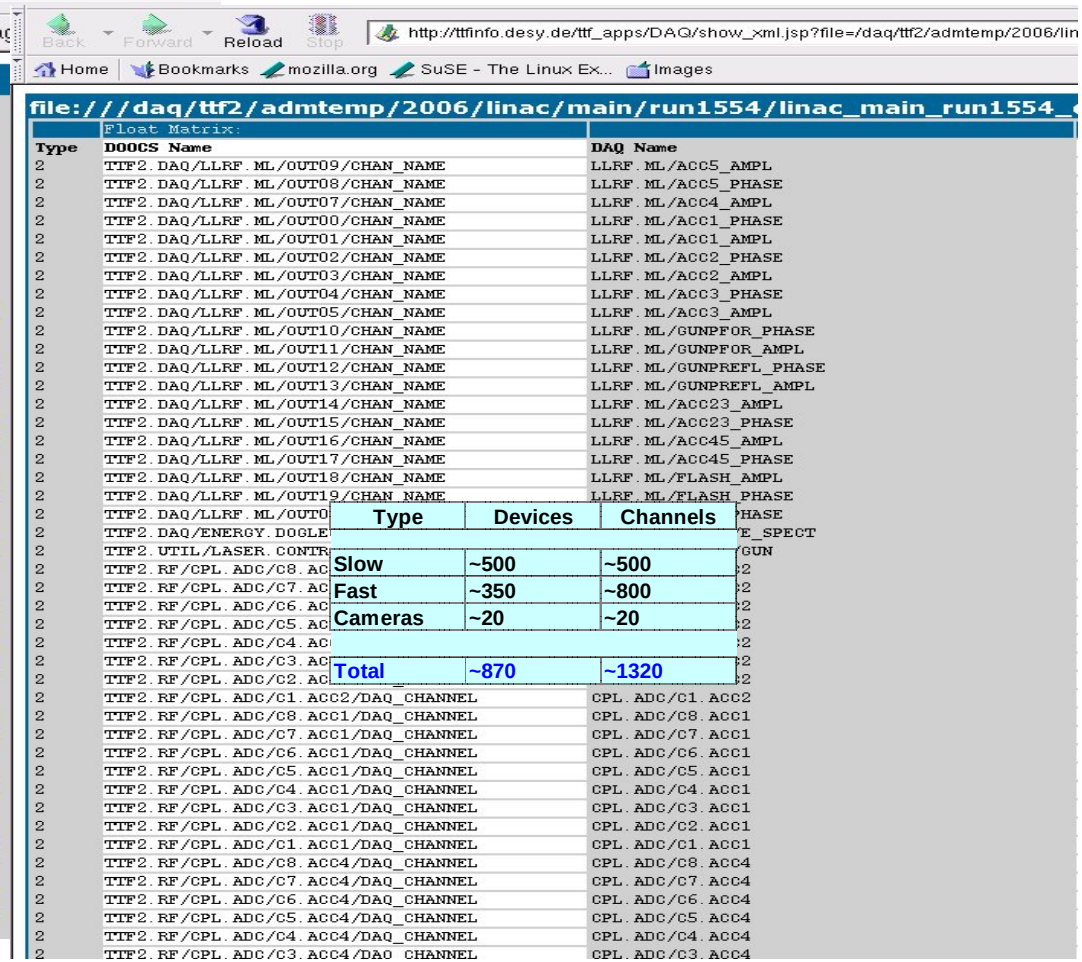
BL1 – 108 runs (1950 files,~390 GB)

Data volumes/rates

Information about data

http://ttfinfo.desy.de/ttf_apps/DAQ/showDAQ.jsp

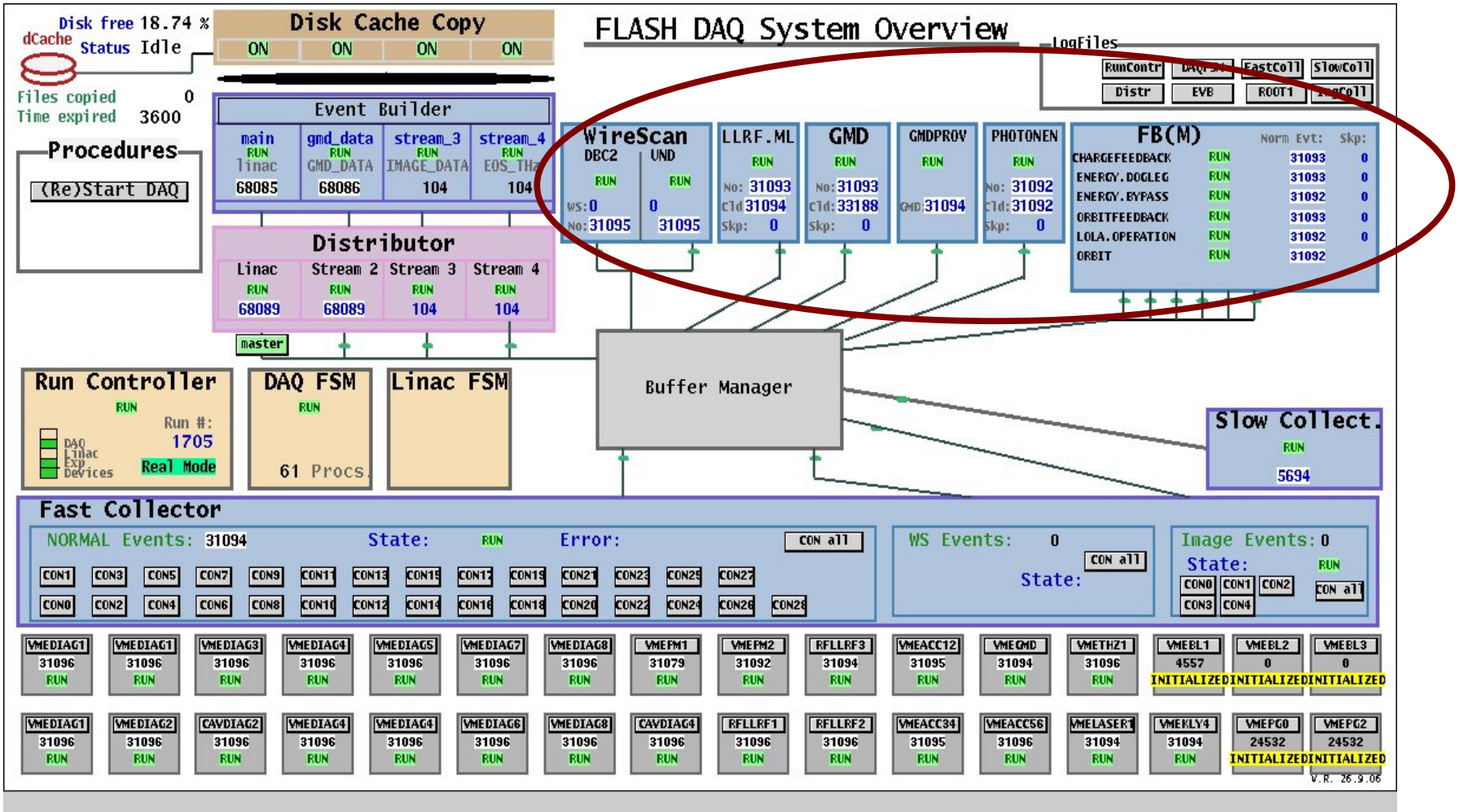




Type	Devices	Channels
Slow	~500	~500
Fast	~350	~800
Cameras	~20	~20
Total	~870	~1320

DAQ Run Control GUI

DAQ status (DDD)



DAQ ML servers motivation

- Reduce load on front ends (using central DAQ BM)
- Easy access to synchronized data
- Control and operate Feed-Back servers from DOOCS
  - Avoid *wildly* running FBs
  - Have one common interface for FBs
- Benefit from standard DOOCS features (histories, …)

DAQ ML servers status

- Generic skeleton for high level software applications (C++, MATLAB)
- Have common exception handling
  - e.g. bunch pattern generation, mean value calculation...
- Calculated result can be stored by DAQ together with LINAC data
- details:
  - see R. Kammering talk
    - at FLASH seminar
    - PCaPAC2006 "*DAQ based high level software applications using MATLAB*"

DAQ ML servers status

Middle layer servers using the FBM API:

- *Acqiris* data compression (Exp, C++)
- Calibration server for FEL experiments (Exp, C++)
- Charge FB (Op, Matlab)
- Energy monitor (Op, Matlab)
- Gas Monitor Detector (Op, Exp, C++)
- LLRF monitor (Diag, C++)
- Orbit FB (Diag, Matlab)
- Orbit server (Diag, C++)
- Photon energy monitor (Exp, Op, C++)
- Data Scan server (Test)

DAQ data analysis tools

Online:

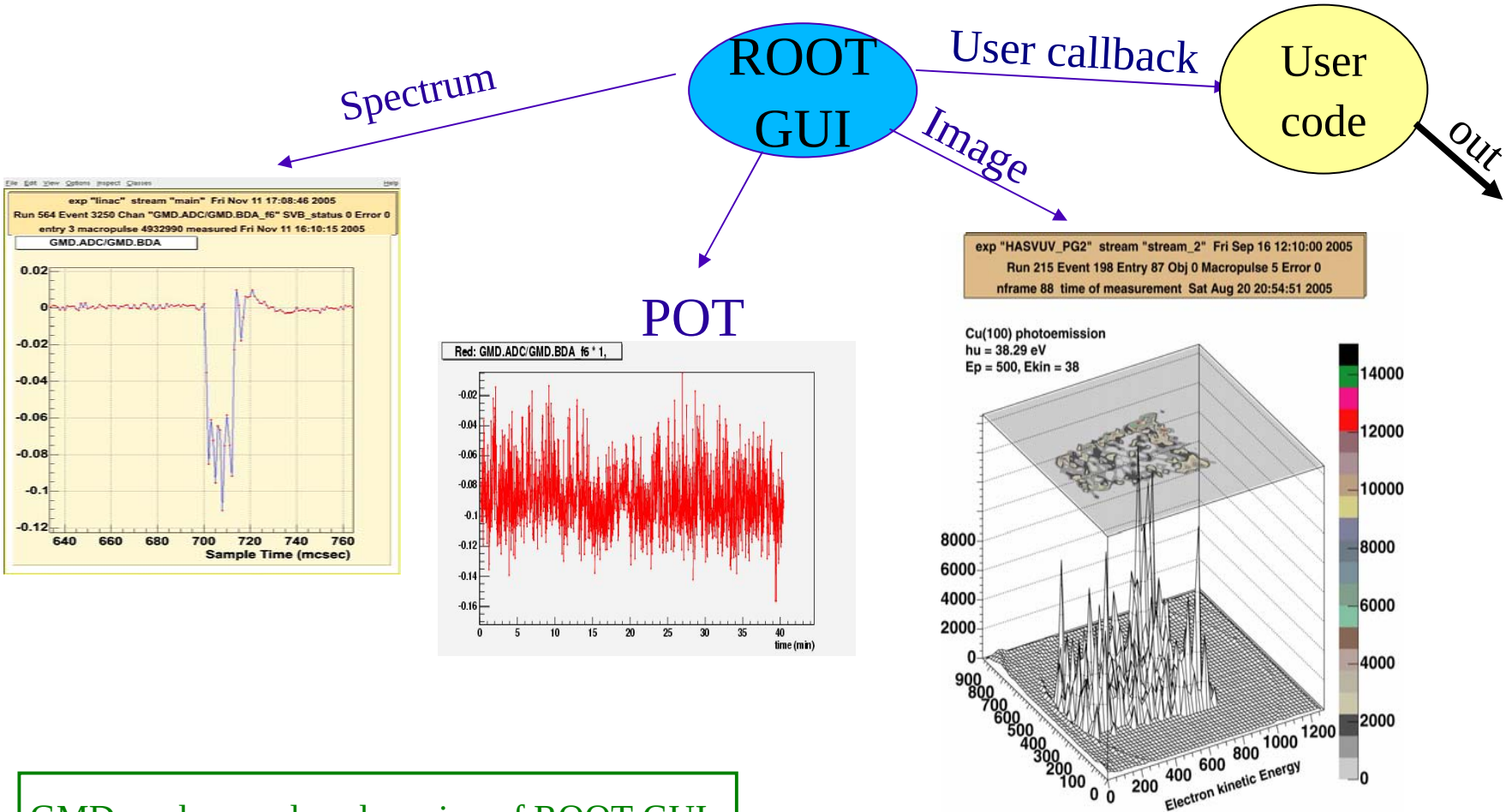
- DDD panels (Energy server, LLRF ML, etc)
- MATLAB GUI (GMD tool)

Offline:

Name	Environment	Input info	Output format	Usage
ROOT GUI	ROOT	via GUI	GUI, User defined	Experiments
GMD reader	ROOT	Fixed	ASCII	HASYLAB, Experiments
RootReader2Matlab	C++, Matlab	config. File	Matlab	EOS, TEO
DAQ MATLAB	Matlab	via GUI, config. file	GUI	Under preparation
DAQ MATLAB API	Matlab	config. File	User defined	Under preparation

DAQ data analysis tools

ROOT GUI



GMD reader – reduced version of ROOT GUI

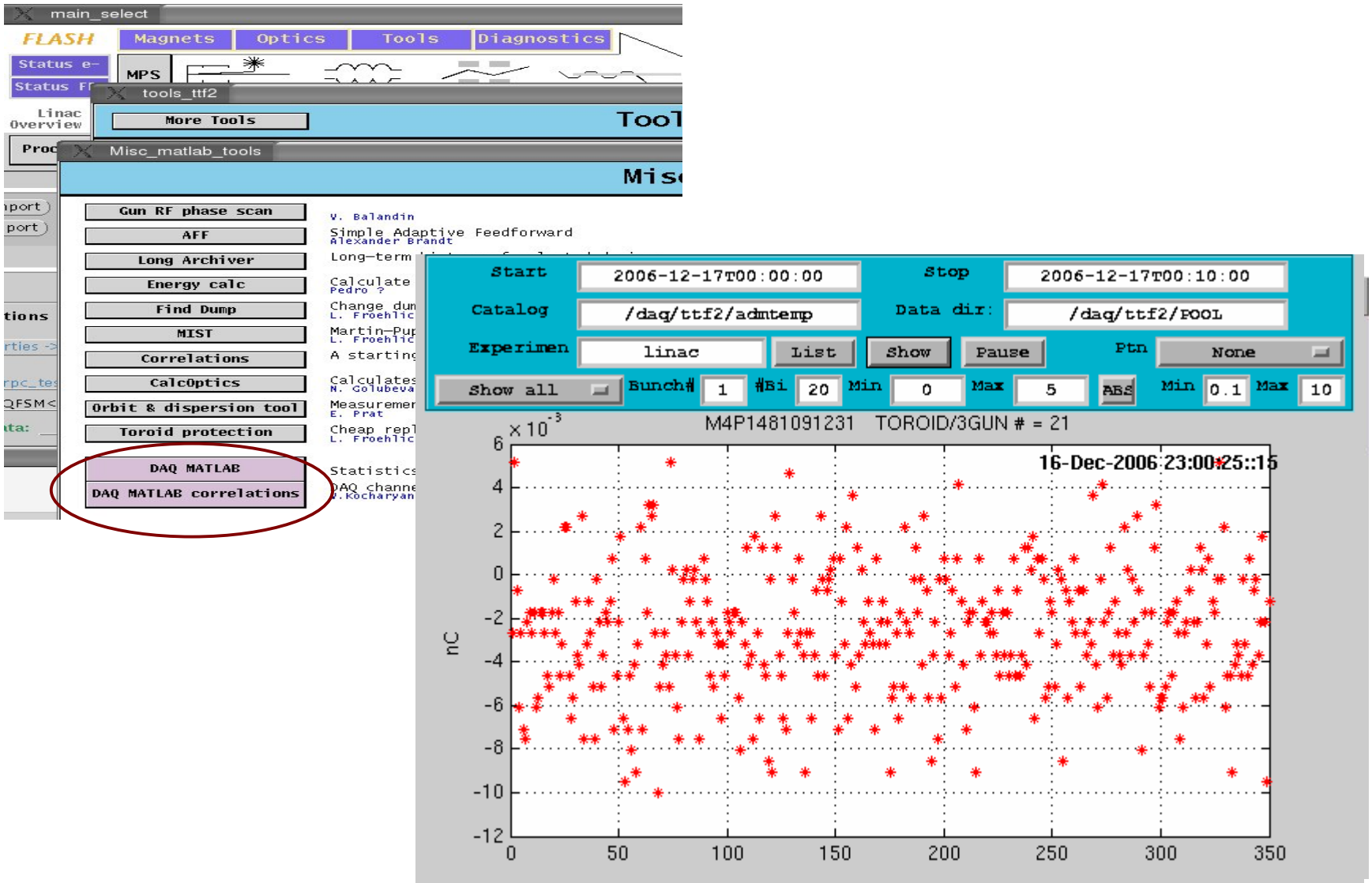
DAQ data analysis tools

RootReader2Matlab (command line tool)

```
-start 2006-12-13T04:50:00
-end 2006-12-13T05:00:00
-exp linac
-lead TOROID/7MATCH
#
-mlfile my_file
-chan BPM/2TCOL:0;2TCOL
-chan BPM/8TCOL:0;8TCOL
-chan BPM/3ECOL:0;3ECOL
-pattern  TOROID/7MATCH:0.05;4
-fchan TTF2.MAGNETS/QUAD/Q2TCOL/PS.RBV:-5.51;Q2TCOL
-fchan TTF2.MAGNETS/STEERER/H4TCOL/PS.RBV:-0.006;H4TCOL
-fchan TTF2.MAGNETS/QUAD/Q8TCOL/PS.RBV:35.90;Q8TCOL
-fchan TTF2.MAGNETS/STEERER/H9TCOL/PS.RBV:0.034;H9TCOL
-fchan TTF2.MAGNETS/DIPOLE/D1ECOL/PS.RBV:78.10;D1ECOL
-fchan TTF2.MAGNETS/STEERER/H2ECOL/PS.RBV:0.09;H2ECOL
-param STAT_LOOP_END:10;INT
-param STAT_SAMPLE:1;INT
-param CALC_ENERGY:1;INT
-param LAMBDA_MEAN_MANUAL:32.0;FLOAT
-param DEBUG:2;INT
```

Additional parameters to test ML server code

DAQ data analysis tools



Status

- DAQ (SA) run most of time smoothly
- Gained a lot of experience
- Lots of debugging done
- ML are in use (some for standard operations)
- TBs of experiment data on tape
- Analysis:
  - ROOT based analysis tools in use (experiments)
  - Access from MATLAB in preparation

Plans

- More ML servers (BLM server, improved Orbit server, ...)
- Improve offline analysis tools
- DAQ auto configuration according to Linac mode
- Switching to new timing system (individual event Id)
- DAQ ML server data in SA DAQ

Thanks for your attention

Looking forward to see DAQ extensively used by operators both online and offline

Proposals on new channels to collect by DAQ are welcome

30 days of:

- *FAST*
  - BPM
  - TOROID
  - LLRF
  - CPL
  - BLM
  - PHASE_MON
  - GMD
  - MCP
  - Special diag. (EOS, TEO, THZ)
- *Slow*
  - Magnets
  - Vac
  - ...

http://ttfinfo.desy.de/ttf_apps/DAQ/showDAQ.jsp