



DAQ for FLASH operations and experiments

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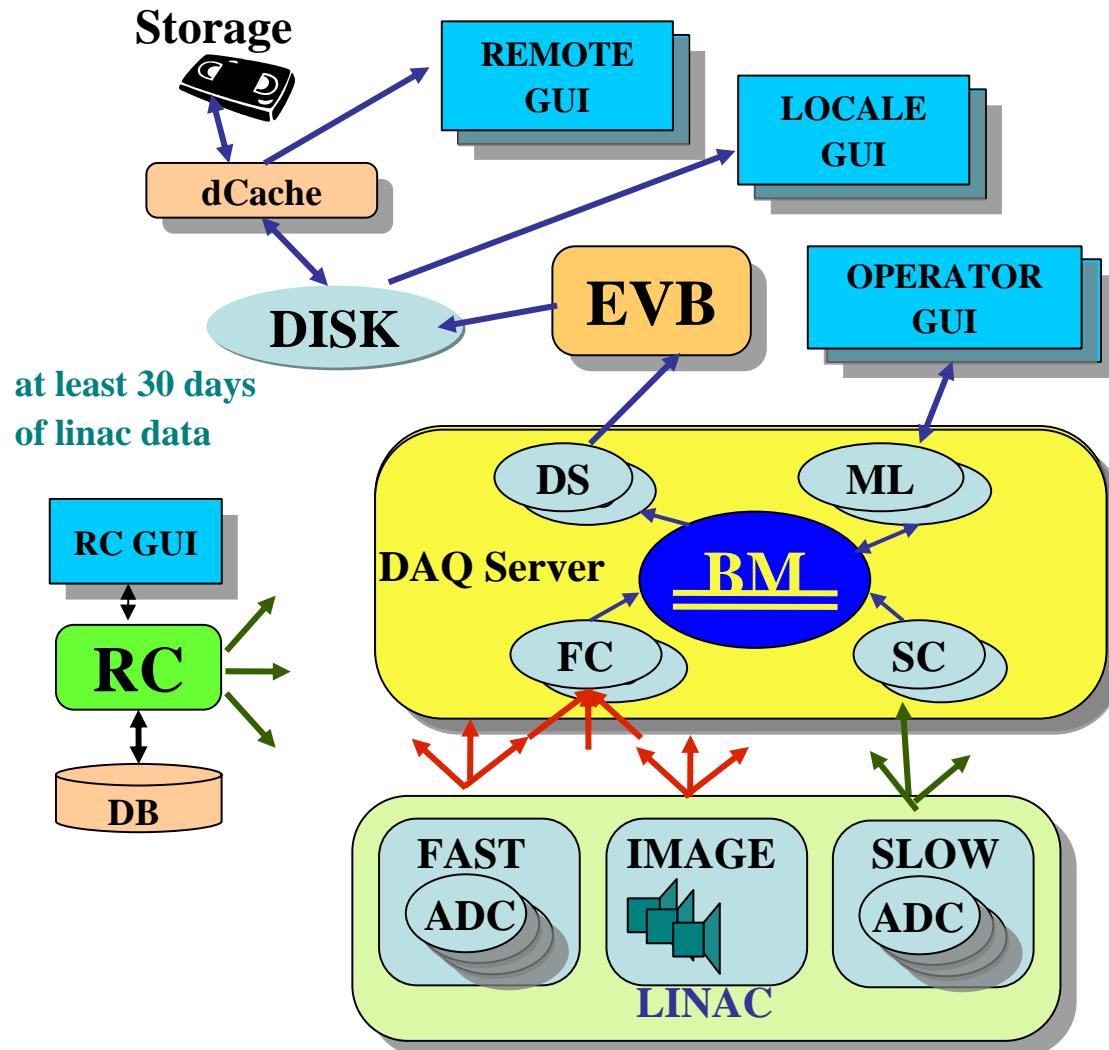
Outline

- **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

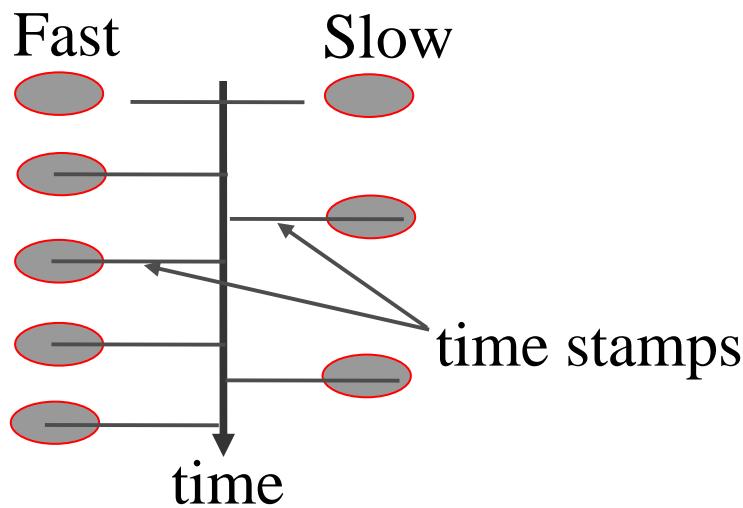
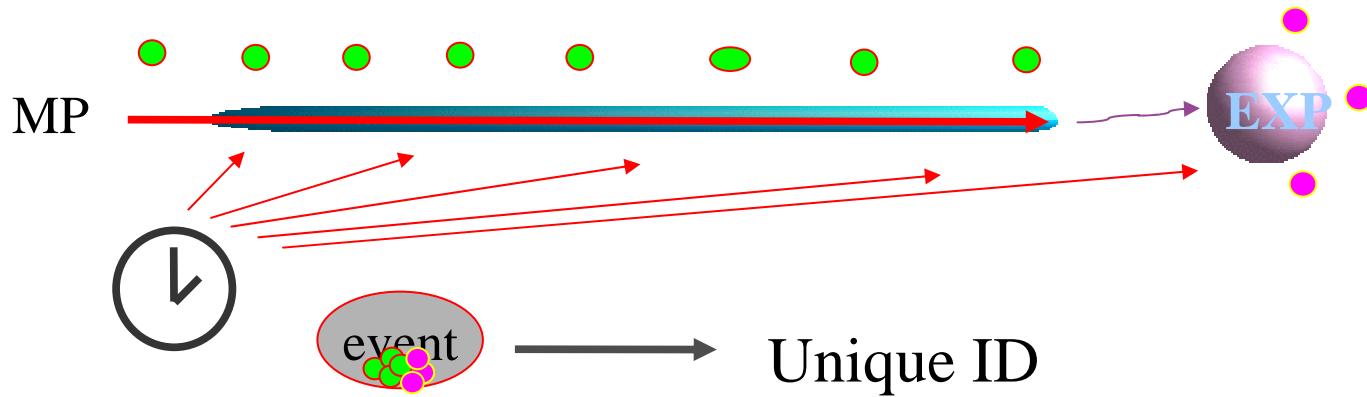


multicast ↪

Fast data (every micropulse)
Beam relevant info:
ADCs (BPM, BLM, TOR, etc)
CAMERAs

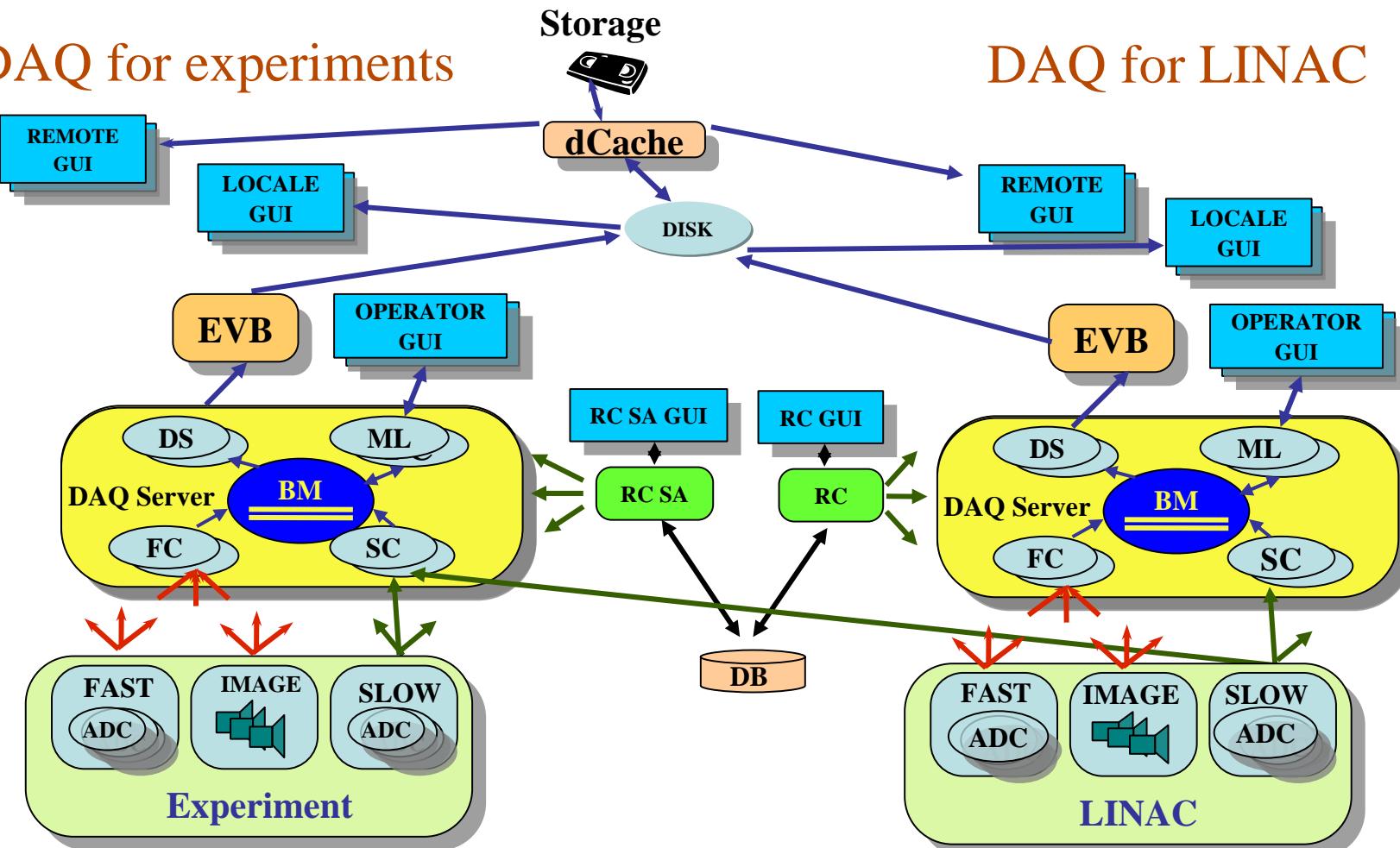
DOOCS ↪
(TINE)
Slow data (max 1Hz)
Data from slow ADCs
(MAG, V, etc.)
DOOCS channels
(Masks, params, etc.)

Events



Architecture

DAQ for experiments



The main DAQ server



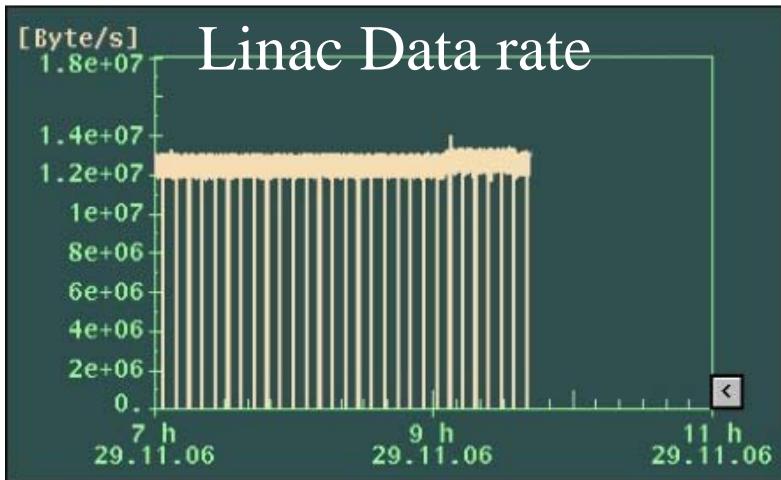
- **8 double core SPARC CPUs**
- **32 GB common memory**
- **4 x 1Gbit Ethernet**
- **1.7 TB local storage**
- **fully redundant fan, PS, ...**

- 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

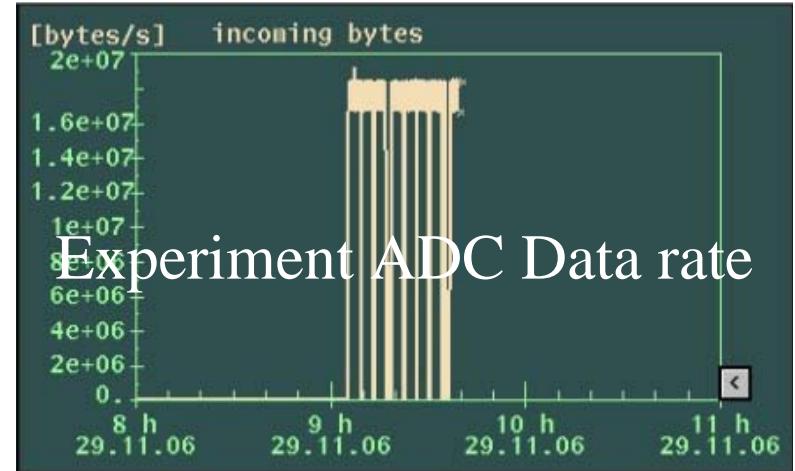


Data volumes/rates

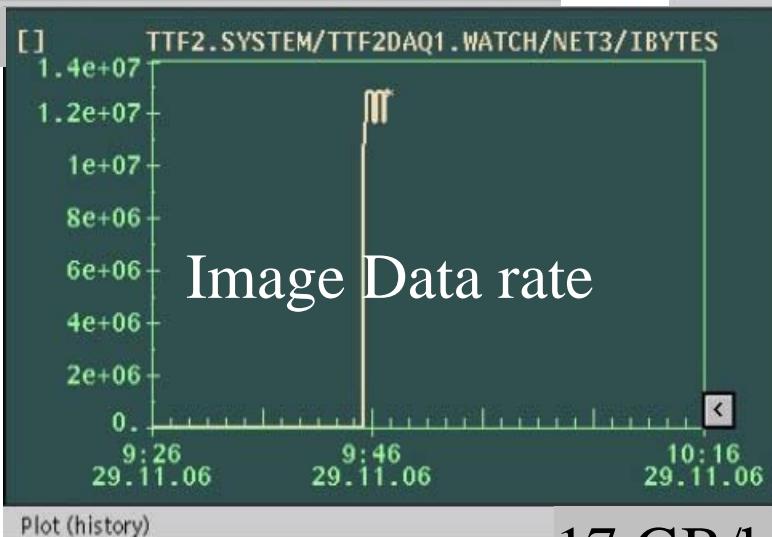
Data rates



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

Information about data

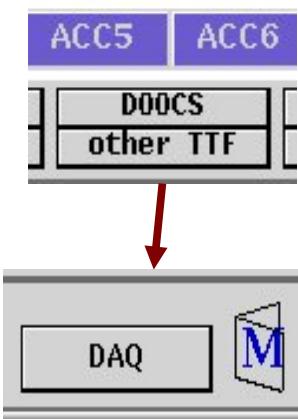
http://ttfinfo.desy.de/ttf_apps/DAQ/showDAQ.jsp

http://ttfinfo.desy.de/ttf_apps/DAQ/show_xml.jsp?file=/daq/ttf2/admtemp/2006/linac/main/run1554/linac_main_run1554 Chan Dscr.xml

Type	DOOCS Name	DAQ Name		
TTF2.DAQ/LLRF.ML/OUT09/CHAN_NAME	LLRF.ML/ACCS_AMPL			
TTF2.DAQ/LLRF.ML/OUT08/CHAN_NAME	LLRF.ML/ACCS_PHASE			
TTF2.DAQ/LLRF.ML/OUT07/CHAN_NAME	LLRF.ML/ACC4_AMPL			
TTF2.DAQ/LLRF.ML/OUT00/CHAN_NAME	LLRF.ML/ACC1_PHASE			
TTF2.DAQ/LLRF.ML/OUT01/CHAN_NAME	LLRF.ML/ACC1_AMPL			
TTF2.DAQ/LLRF.ML/OUT02/CHAN_NAME	LLRF.ML/ACC2_PHASE			
TTF2.DAQ/LLRF.ML/OUT03/CHAN_NAME	LLRF.ML/ACC2_AMPL			
TTF2.DAQ/LLRF.ML/OUT04/CHAN_NAME	LLRF.ML/ACC3_PHASE			
TTF2.DAQ/LLRF.ML/OUT05/CHAN_NAME	LLRF.ML/ACC3_AMPL			
TTF2.DAQ/LLRF.ML/OUT10/CHAN_NAME	LLRF.ML/GUNPFOR_PHASE			
TTF2.DAQ/LLRF.ML/OUT11/CHAN_NAME	LLRF.ML/GUNPFOR_AMPL			
TTF2.DAQ/LLRF.ML/OUT12/CHAN_NAME	LLRF.ML/GUNPREFL_PHASE			
TTF2.DAQ/LLRF.ML/OUT13/CHAN_NAME	LLRF.ML/GUNPREFL_AMPL			
TTF2.DAQ/LLRF.ML/OUT14/CHAN_NAME	LLRF.ML/ACC23_AMPL			
TTF2.DAQ/LLRF.ML/OUT15/CHAN_NAME	LLRF.ML/ACC23_PHASE			
TTF2.DAQ/LLRF.ML/OUT16/CHAN_NAME	LLRF.ML/ACC45_AMPL			
TTF2.DAQ/LLRF.ML/OUT17/CHAN_NAME	LLRF.ML/ACC45_PHASE			
TTF2.DAQ/LLRF.ML/OUT18/CHAN_NAME	LLRF.ML/FLASH_AMPL			
TTF2.DAQ/LLRF.ML/OUT19/CHAN_NAME	LLRF.ML/FLASH_PHASE			
TTF2.DAQ/LLRF.ML/OUT0	Type	Devices	Channels	HASE
TTF2.DAQ/ENERGY.DOGLE				E_SPECT
TTF2.UTIL/LASER.CONTR				GUN
TTF2.RF/CPL.ADC/C8.AC	Slow	-500	-500	2
TTF2.RF/CPL.ADC/C7.AC	Fast	-350	-800	2
TTF2.RF/CPL.ADC/C6.AC				2
TTF2.RF/CPL.ADC/C5.AC				2
TTF2.RF/CPL.ADC/C4.AC				2
TTF2.RF/CPL.ADC/C3.AC				2
TTF2.RF/CPL.ADC/C2.AC	Total	-870	-1320	2
TTF2.RF.CPL.ADC/C1.ACC2/DAQ_CHANNEL	CPL.ADC/C1.ACC2			
TTF2.RF.CPL.ADC/C8.ACC1/DAQ_CHANNEL	CPL.ADC/C8.ACC1			
TTF2.RF.CPL.ADC/C7.ACC1/DAQ_CHANNEL	CPL.ADC/C7.ACC1			
TTF2.RF.CPL.ADC/C6.ACC1/DAQ_CHANNEL	CPL.ADC/C6.ACC1			
TTF2.RF.CPL.ADC/C5.ACC1/DAQ_CHANNEL	CPL.ADC/C5.ACC1			
TTF2.RF.CPL.ADC/C4.ACC1/DAQ_CHANNEL	CPL.ADC/C4.ACC1			
TTF2.RF.CPL.ADC/C3.ACC1/DAQ_CHANNEL	CPL.ADC/C3.ACC1			
TTF2.RF.CPL.ADC/C2.ACC1/DAQ_CHANNEL	CPL.ADC/C2.ACC1			
TTF2.RF.CPL.ADC/C1.ACC1/DAQ_CHANNEL	CPL.ADC/C1.ACC1			
TTF2.RF.CPL.ADC/C8.ACC4/DAQ_CHANNEL	CPL.ADC/C8.ACC4			
TTF2.RF.CPL.ADC/C7.ACC4/DAQ_CHANNEL	CPL.ADC/C7.ACC4			
TTF2.RF.CPL.ADC/C6.ACC4/DAQ_CHANNEL	CPL.ADC/C6.ACC4			
TTF2.RF.CPL.ADC/C5.ACC4/DAQ_CHANNEL	CPL.ADC/C5.ACC4			
TTF2.RF.CPL.ADC/C4.ACC4/DAQ_CHANNEL	CPL.ADC/C4.ACC4			
TTF2.RF.CPL.ADC/C3.ACC4/DAQ_CHANNEL	CPL.ADC/C3.ACC4			



DAQ Run Control GUI



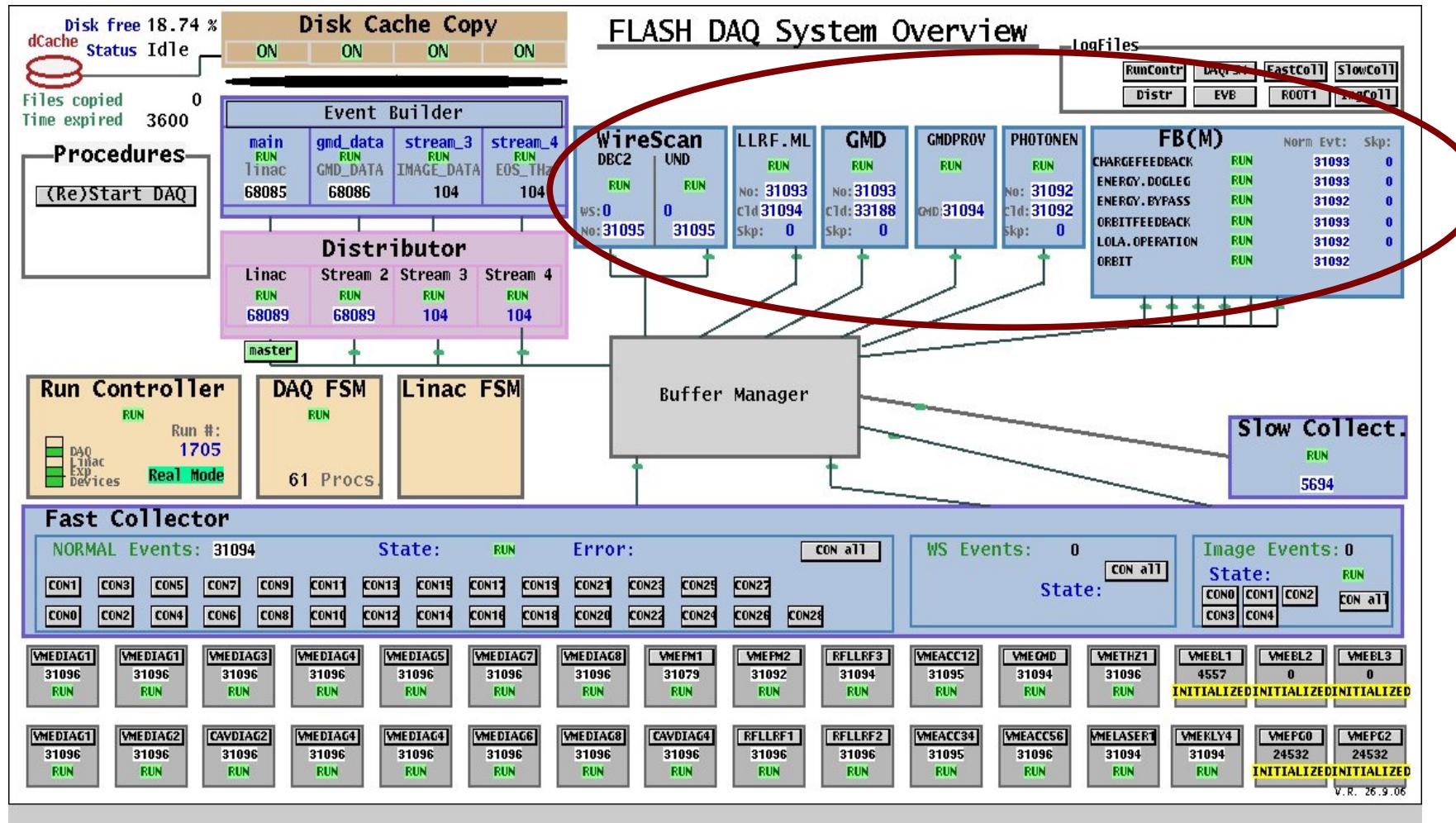
For operators



For experiments



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:

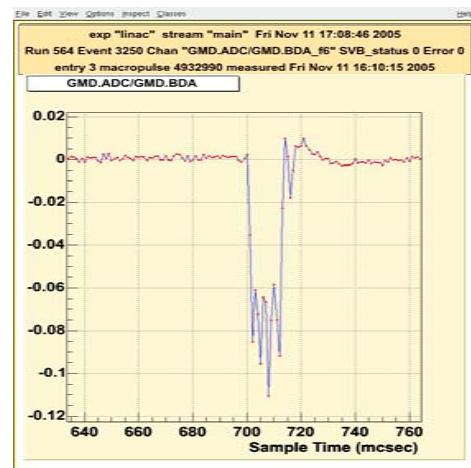
- DDD panels (Energy server, LLRF ML, etc)
- MATLAB GUI (GMD tool)

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

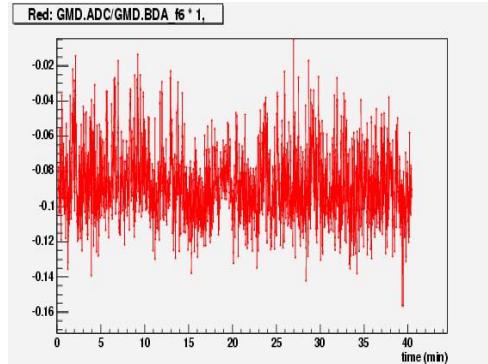
DAQ data analysis tools

ROOT GUI



Spectrum

POT



ROOT
GUI

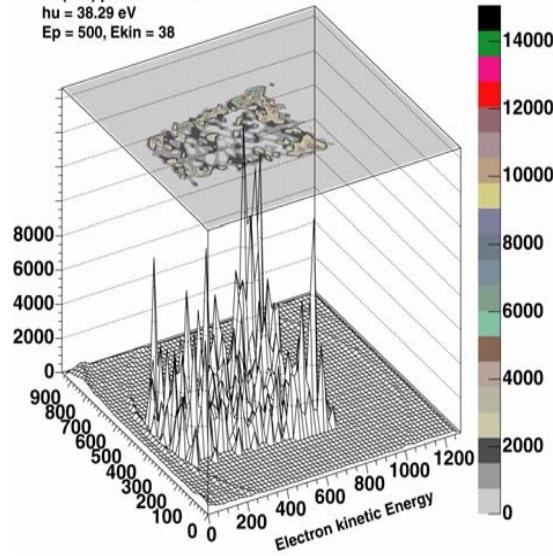
User callback
Image

User
code

out

exp "HASVUV_PG2" stream "stream_2" Fri Sep 16 12:10:00 2005
Run 215 Event 198 Entry 87 Obj 0 Macropulse 5 Error 0
nframe 88 time of measurement Sat Aug 20 20:54:51 2005

Cu(100) photoemission
 $h\nu = 38.29$ eV
 $E_p = 500$, $E_{kin} = 38$



GMD reader – reduced version of ROOT GUI

© Alexander Föhlisch, Uni Hamburg



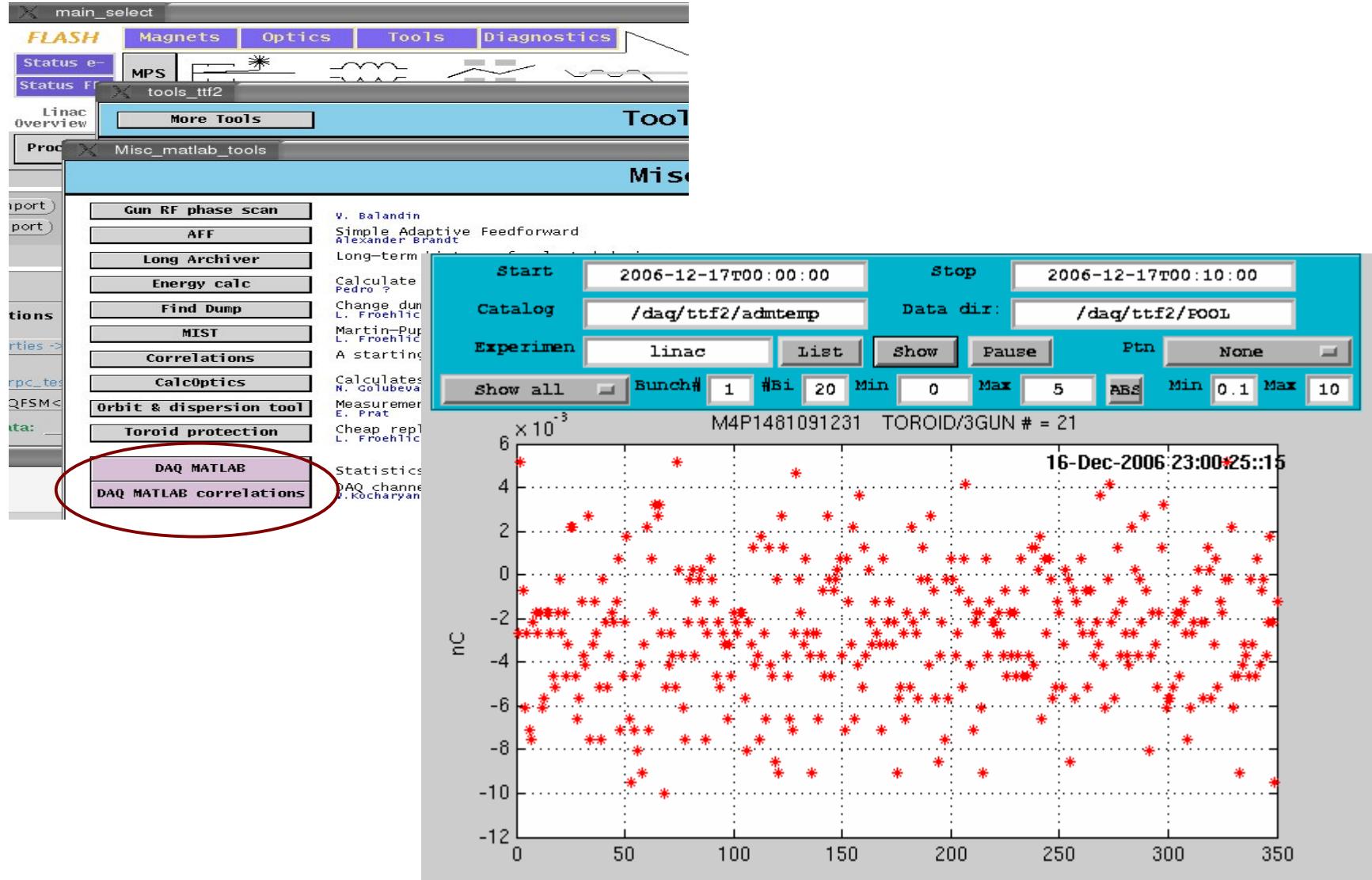
DAQ data analysis tools

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