FLASH DAQ Data Management and Access Tools

Data flow, Data Management, Data Access Tools, Performance

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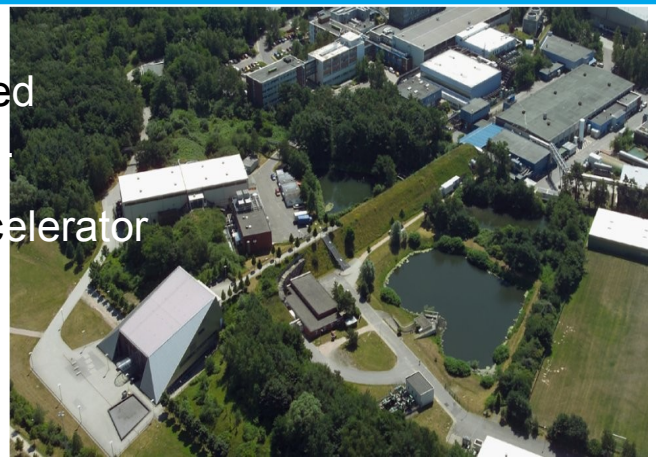
FLASH DAQ Data Management and Access Tools
PCaPAC2010
Saskatoon, 10/08/2010

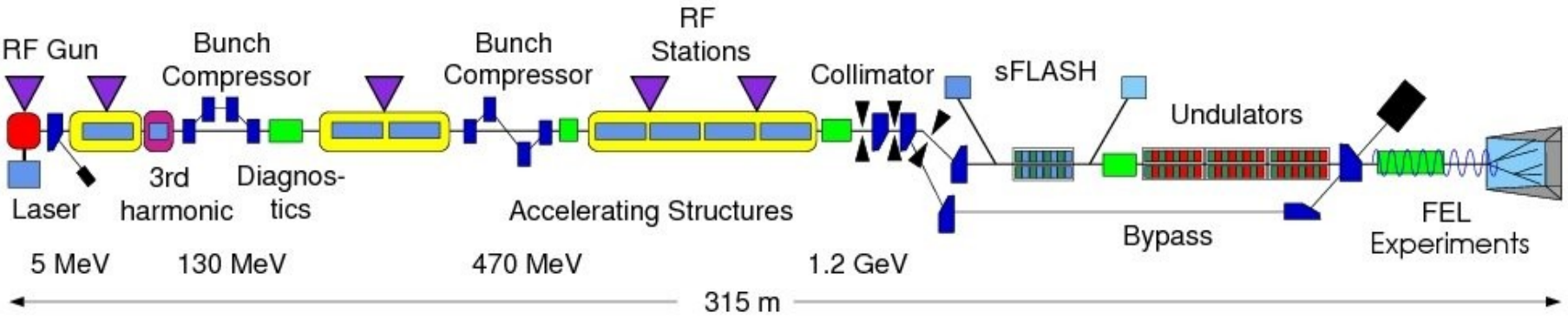
HELMHOLTZ ASSOCIATION

DESY

Free-Electron Laser at Hamburg (FLASH)

- User facility for photon science community providing a pulsed light source in the extreme ultraviolet and soft X-ray regime..
- Test bed for exploring and testing new superconducting accelerator technologies for the European XFEL and ILC.
- Upgraded 2009 - 2010.

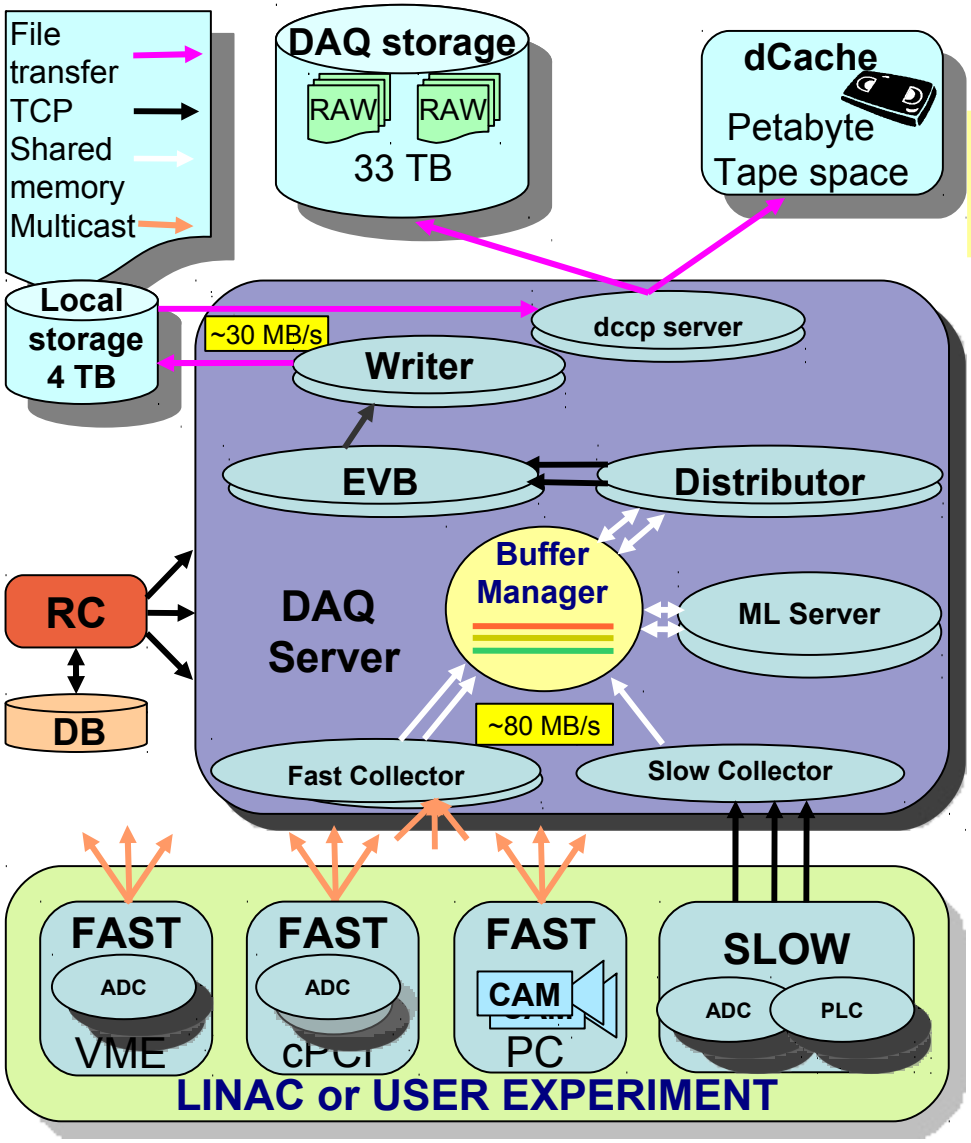




Electron Energy: 0.4 … 1.2 GeV
Photon wavelength: 4.5 … 47 nm
Bunch charge: … 3 nC

Bunch repetition rate: 10 Hz
Bunch frequency: 1 … 3 MHz
Bunch train length: 800 us

FLASH DAQ Architecture



Launched in Summer 2004

- Collect and store LINAC beam relevant data in real time
- Provide data to feed-back and monitoring tools
- Collect data for FLASH user experiments

PCaPAC2005

WEB1 Data Acquisition System for a VUV-FEL Linac

WEB2 Orbit Data Processing Using the Data Acquisition System (DAQ) at the TTF VUV-FEL

WEP10 Application of Oracle Database for the VUV-FEL DAQ System

PCaPAC2008

TUP010 Buffer Manager Implementation for the FLASH Data Acquisition System

ICALEPC 2005

TU4A.2-5O Integrating a Fast Data Acquisition System into the DOOCS Control System

ICALEPC 2007

WPPA21 DOOCS Camera System

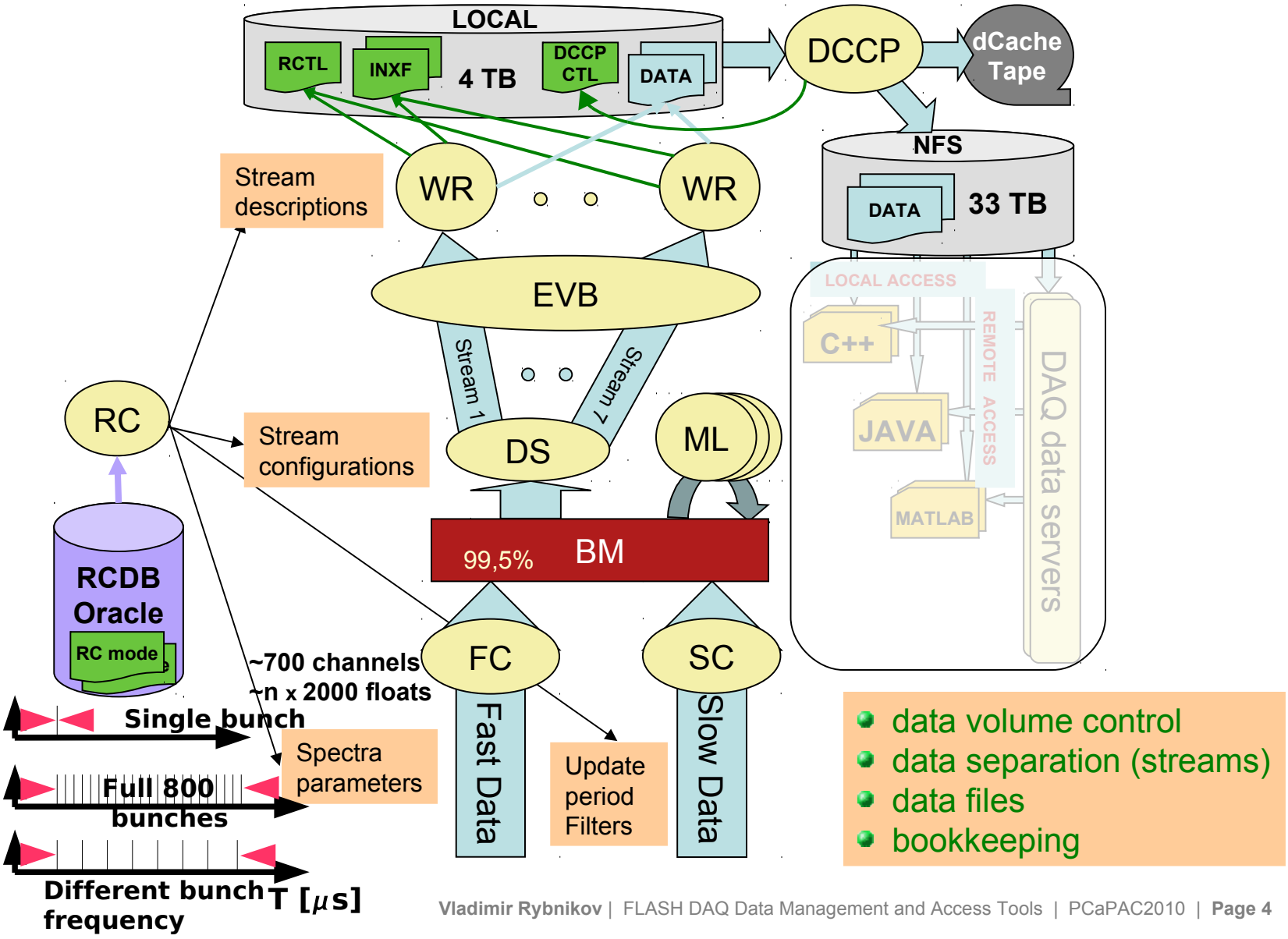
RPPA25 The Data Acquisition System (DAQ) of the FLASH Facility

ICALEPC 2009

MOD004 Evolution of the FLASH DAQ System

THP086 A "Pluggable" API for High Level Software Applications Based on the FLASH DAQ System

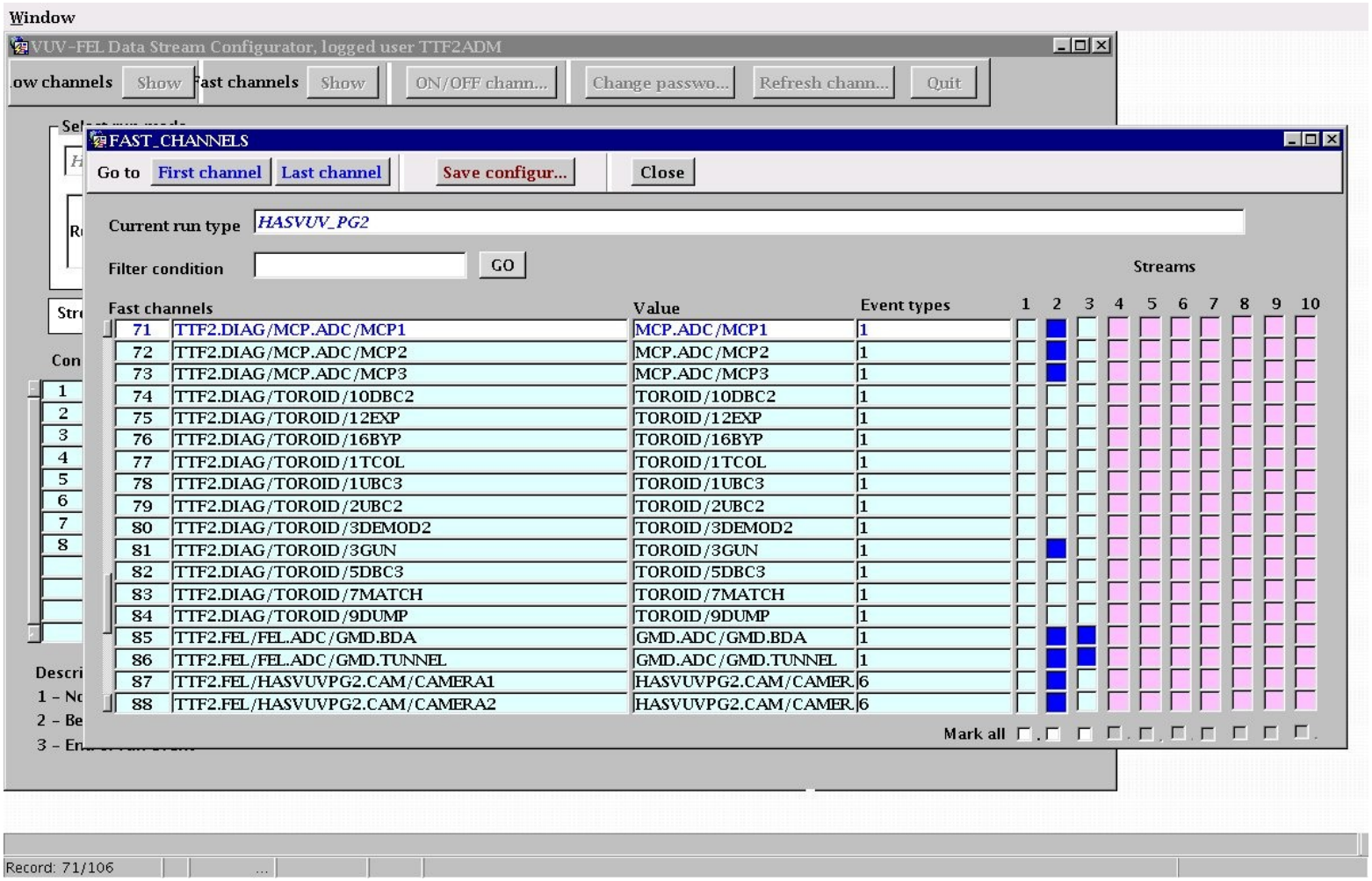
FLASH DAQ Data Flow



- data volume control
- data separation (streams)
- data files
- bookkeeping

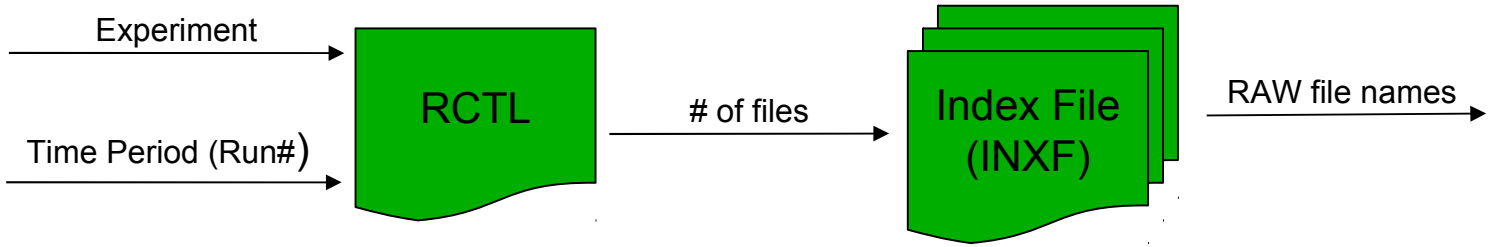
FLASH DAQ Stream Configuration

Configuration via WEB



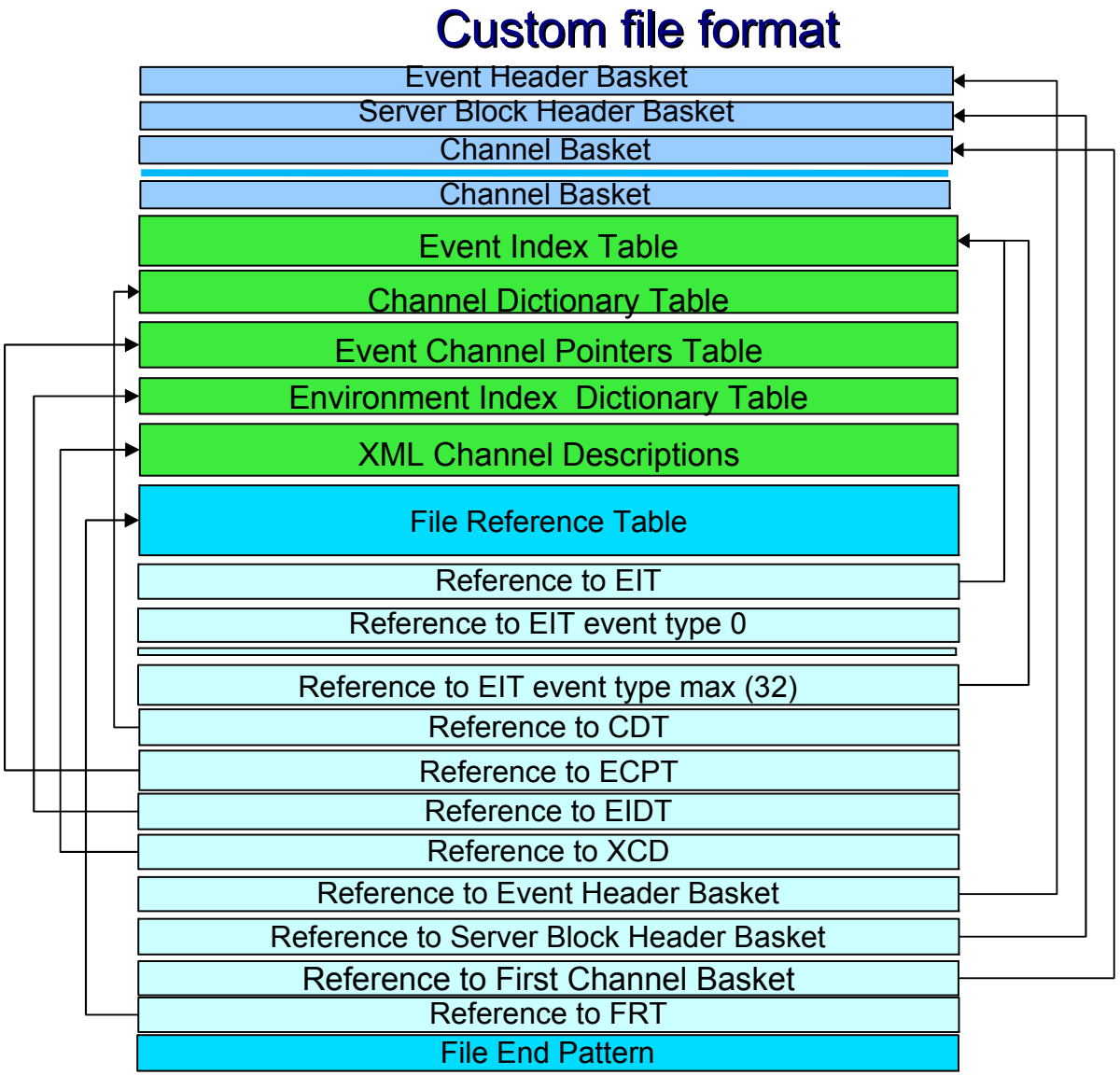
FLASH DAQ Run Catalog, Index Files

DAQ data file names finding



linac_main_run4902_file6885_20100926T122748.1.raw
EOS_THz_stream_4_run4902_file161_20100926T114704.1.raw

FLASH DAQ Data Files

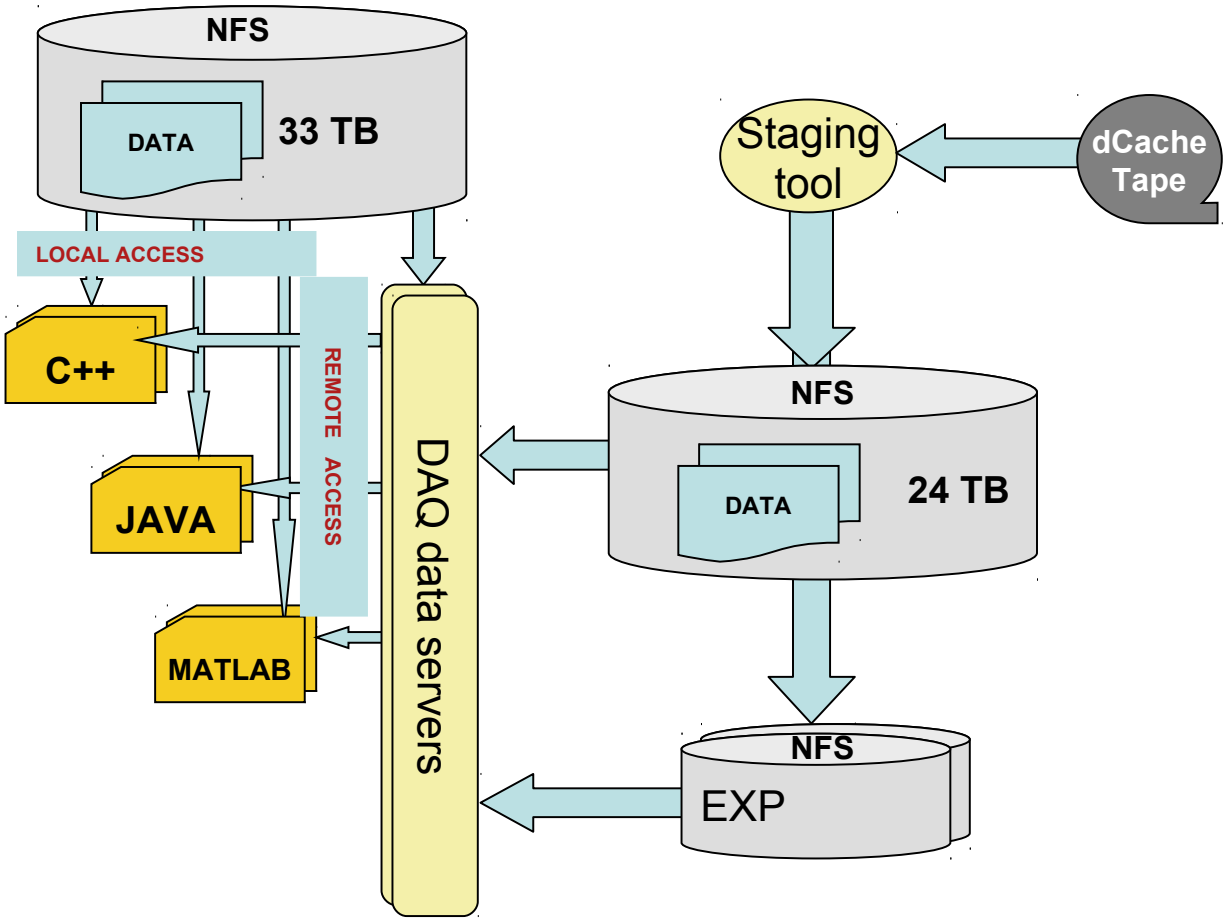


3 steps to access data

- read File Reference Table
- read the channel basket
- decompress data if required (ZLIB, LZO)

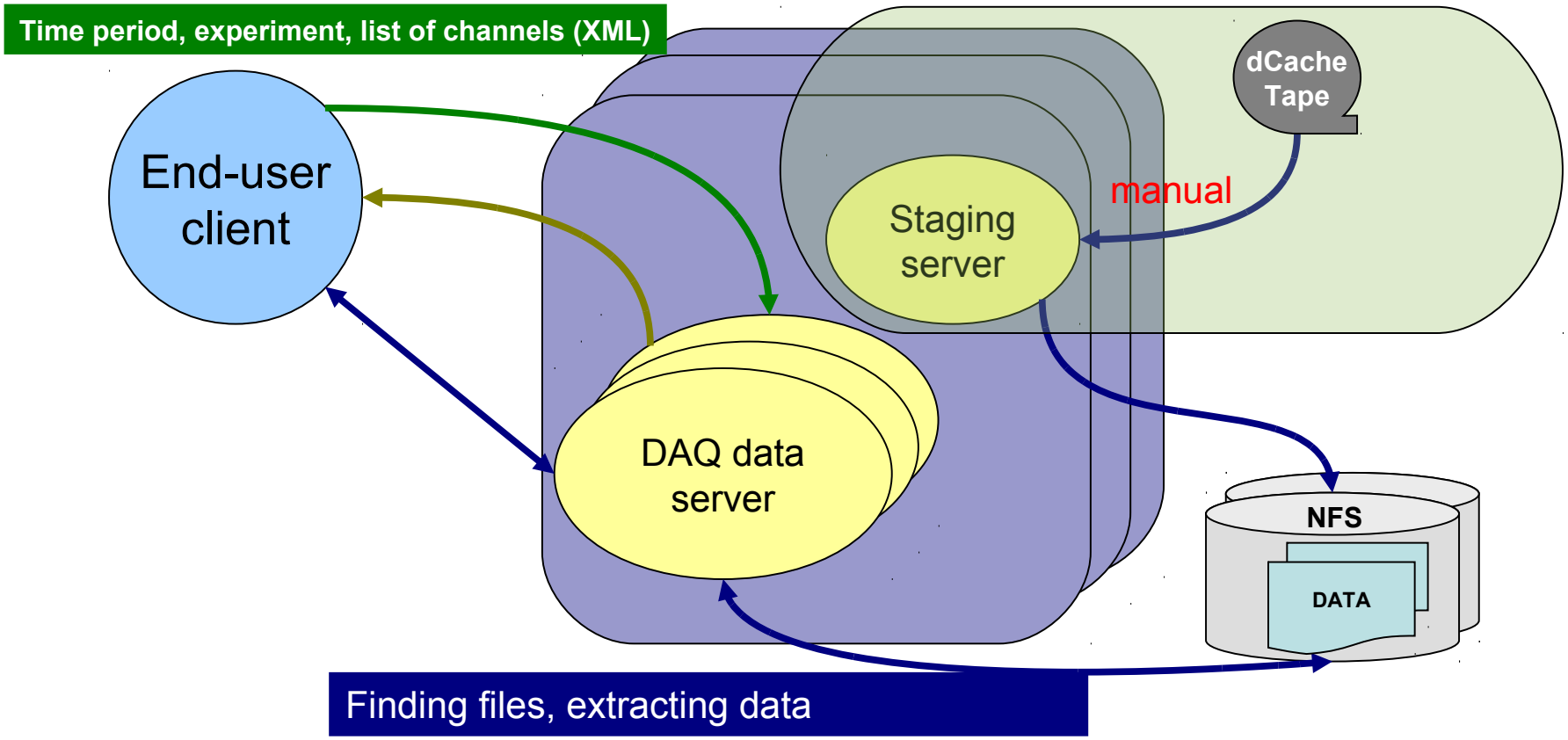
FLASH DAQ Data Access Tools

Two access methods



FLASH DAQ Data Servers

Remote access



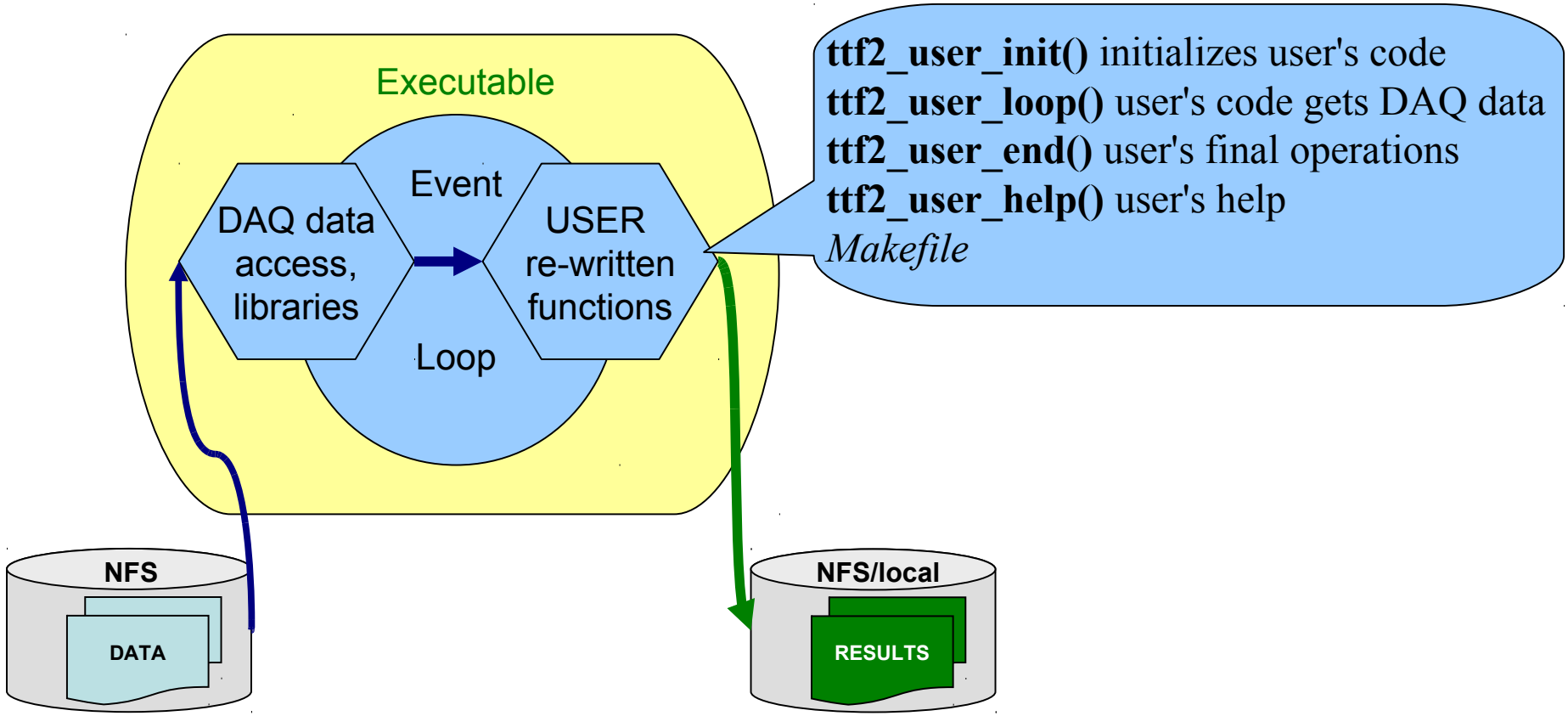
FLASH DAQ Data Access Tools

Programming language	Available	Access
C++	Library, framework	Local, remote
MATLAB	MEX functions	Local, remote
Java	Library, GUIs	Local, remote

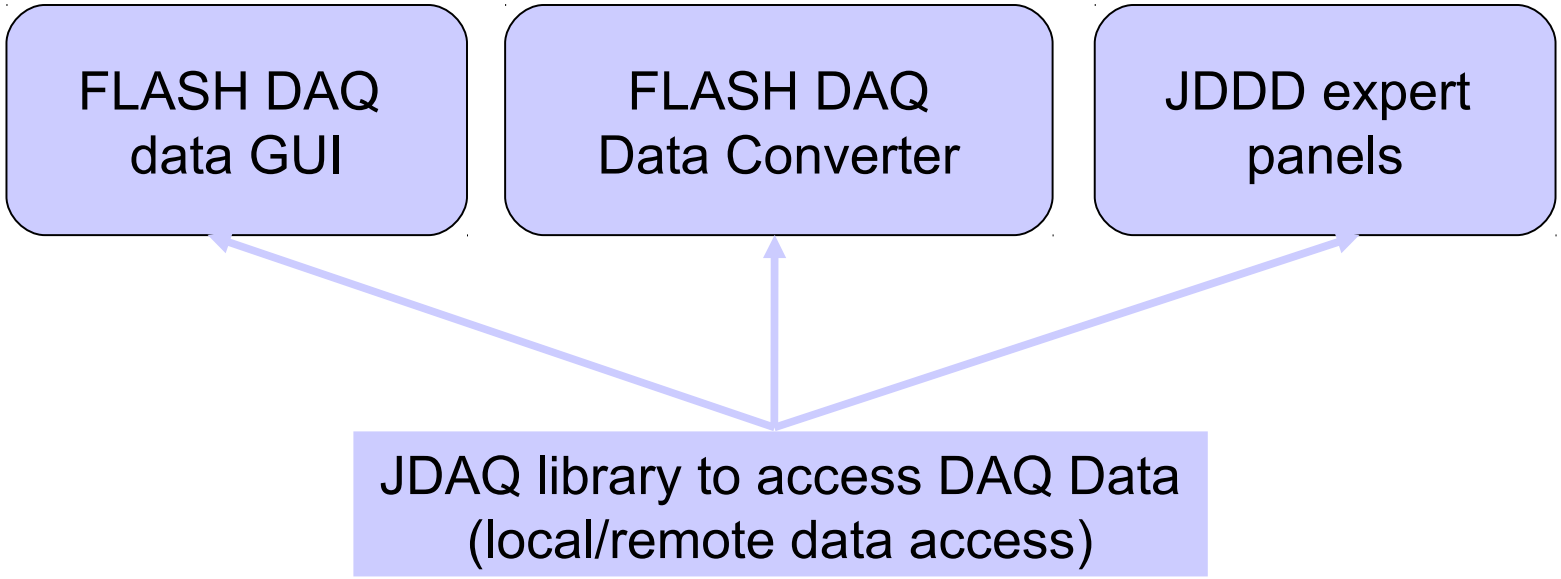
- Linux: Ubuntu 8.04, Ubuntu 10.04
- Solaris: Solaris 8, Solaris 10
- Mac OS X: 10.6
- Windows (Java)

C++ Based Tools

DAQ Data C++ framework



Java Based Tools

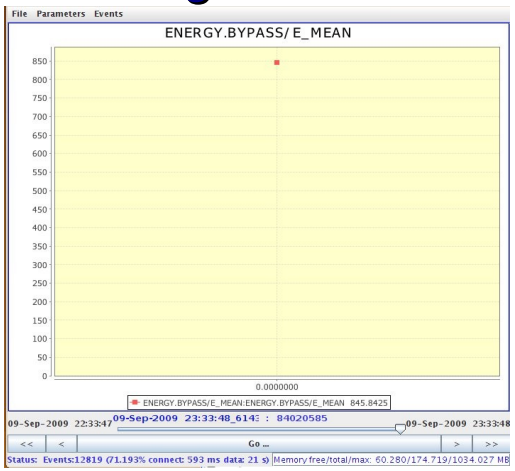


FLASH DAQ data GUI

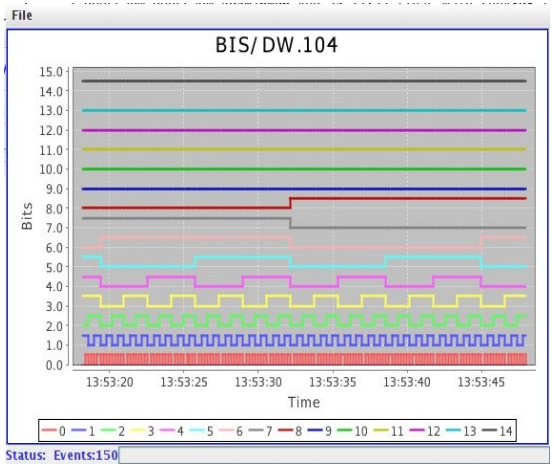
JFreeChart http://www.jfree.org/jfreechart/
Can be started from Web

FLASH DAQ data GUI (Visualization)

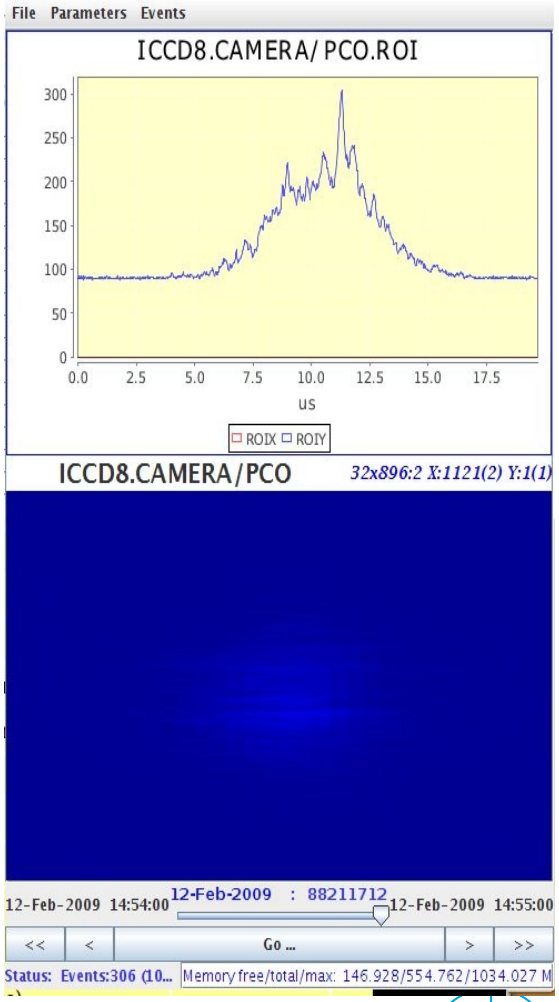
Single value



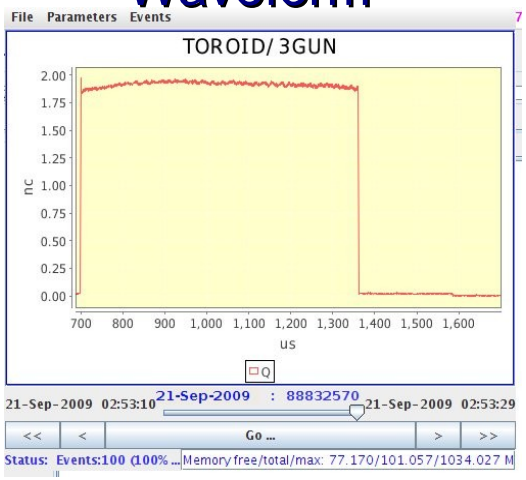
Bit mask



Combination



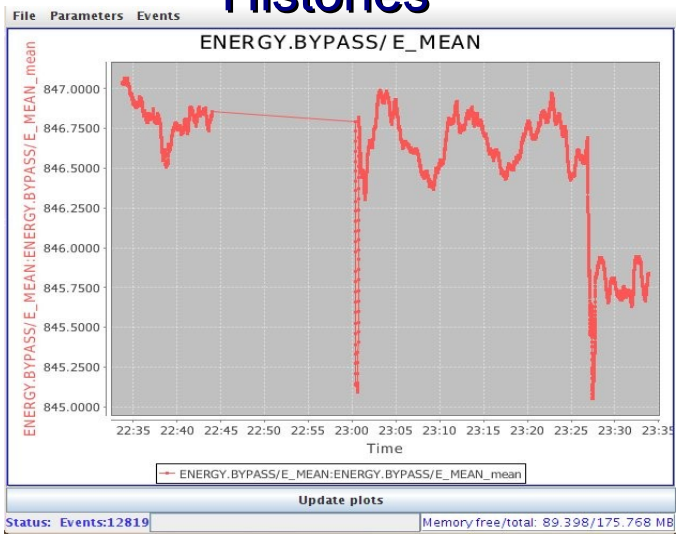
Waveform



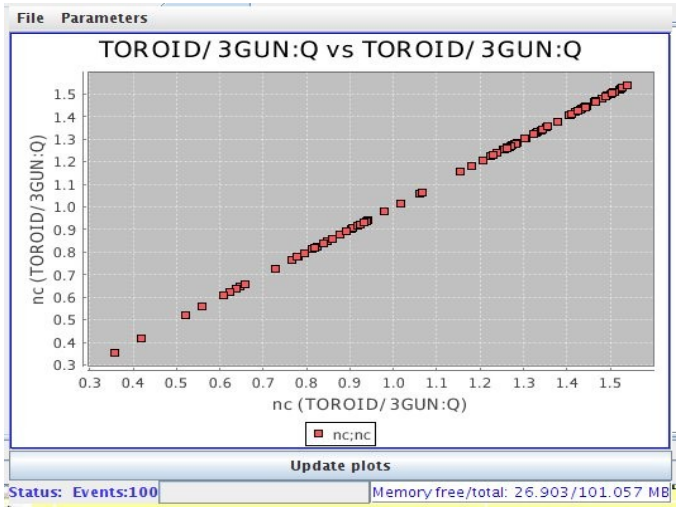
Image

FLASH DAQ data GUI (Simple processing)

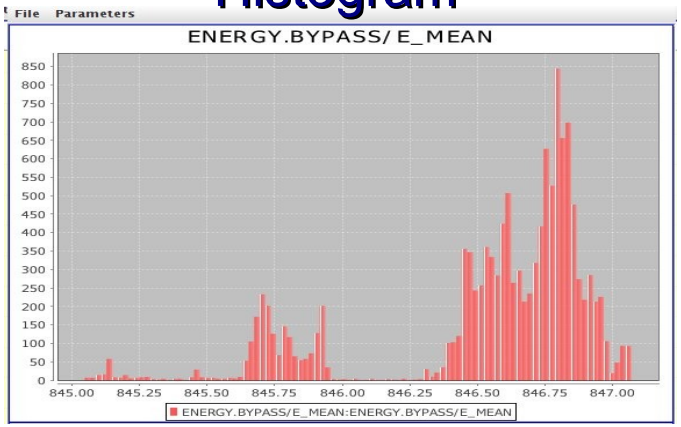
Histories



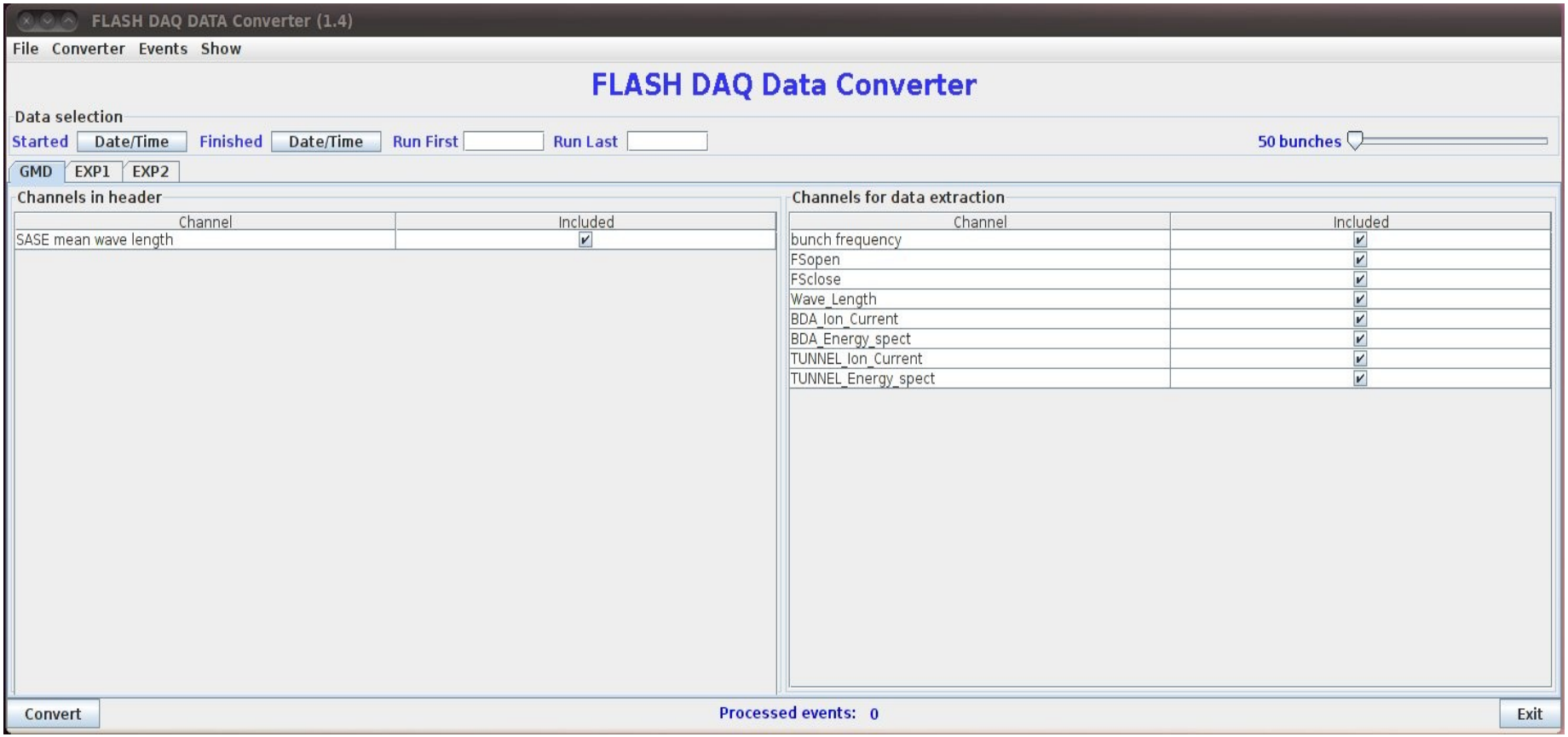
Correlations



Histogram

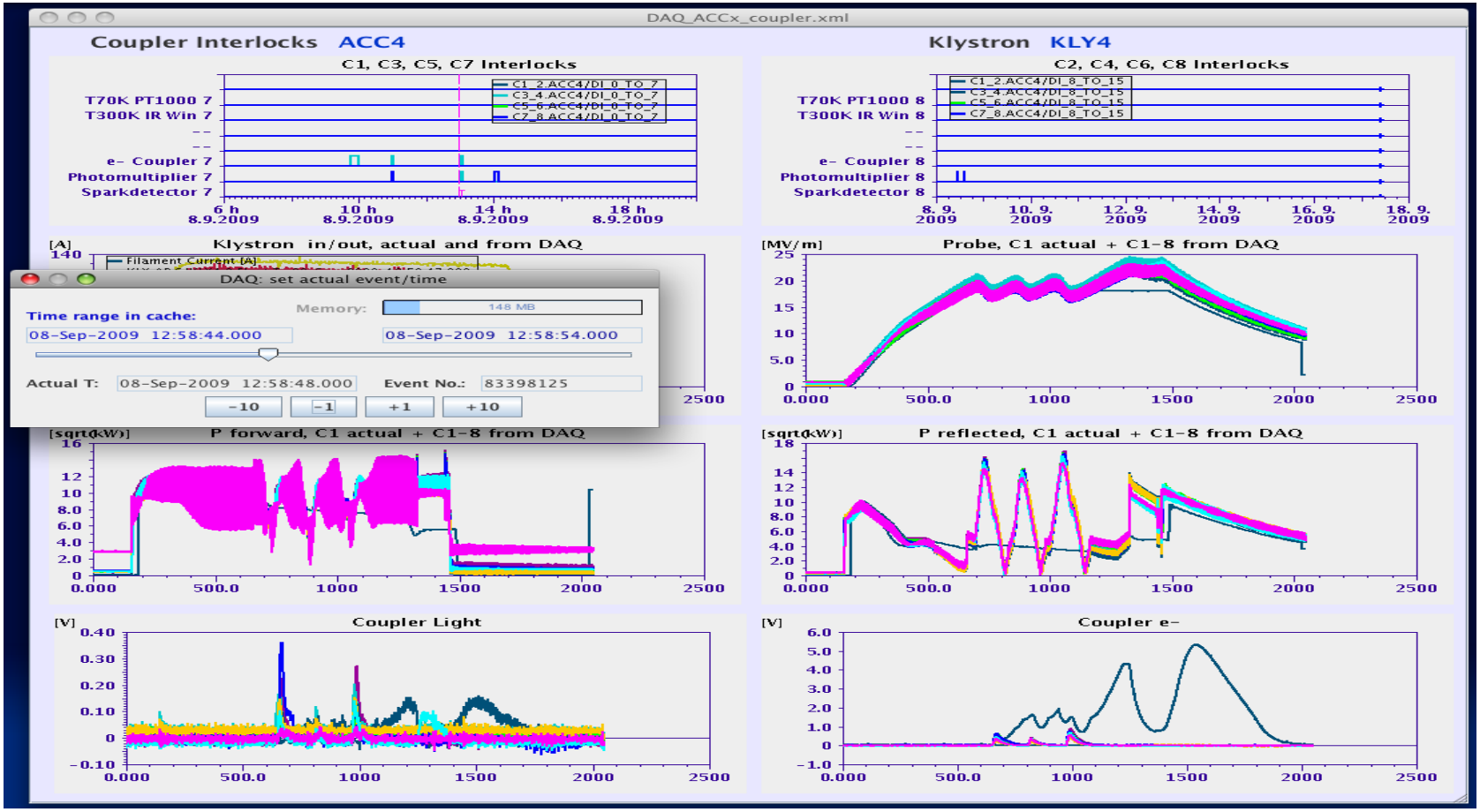


FLASH DAQ Data Converter



Mostly used by the user experiments that have their own DAQ systems.
They need beam parameters
GUI converts FLASH DAQ Data to ASCII
Other format converters can be easily plugged in.

JDDD Expert Panels



Finding an event of interest by DOOCS histories
Extracting DAQ data before and after the selected event
Plotting DAQ data along with the on-line data
Finding sources of problems

MATLAB Based Tools

3 external MATLAB functions

daq_list_serv() provide channel list for selected experiment and dates.

daq_read_serv() converts DAQ data to MATLAB structures (remote)

daq_read() convert DAQ data to MATLAB structures (local)

```
[a,err]=daq_read_svr(name);
if err
     err
     return
end
names=fieldnames(a);
[n,nn]=size(names);
for i=1:n
     b=getfield(a,char(names(i)));
%b.time(2)
%b.time(3)
     nm=fieldnames(b);
     d0=getfield(b,char(nm(1)));
     d1=getfield(b,char(nm(2)));
     subplot(1,2,1)
     plot(d0.data(1:100,:));
     drawnow
     subplot(1,2,2)
     plot(d1.data(1:100,:));
     drawnow
end
```

XML DAQ data request

```
<DAQREQ>
<ReqId  id='1285571727'/>
<TStart time='2010-09-26T22:41:00'/>
<TStop time='2010-09-26T23:10:46'/>
<Exp  name='EOS_THz'/>
<Chan name='ICCD9.CAMERA/ANDOR.IDUS' />
<Chan name='BPM/16DUMP'/>
</DAQREQ>
```


DESY

Performance & Plans

Performance

- ➔ DAQ is capable to store beam relevant information with the rate 8000 bunch/sec (800 bunches at 10 Hz)
- ➔ LINAC data (~26 TB) is available for 2 weeks
- ➔ Request processing < 1sec
- ➔ Data retrieval speed depends on disks performance and network bandwidth
- ➔ Typical extraction time for a channel (2000 floats) 0,1 – 0,2 ms/event

Plans

- ➔ Improving the tools
- ➔ Adding new features (e.g. data preprocessing by DAQ data servers)

Thank you

Thank you for your attention!

DAQ Data Volume

- DAQ produces on average 2 Tbyte/day
  - Most accelerator data not taped but kept for 2 weeks on disk (migration).
  - Photon diagnostics, experiment and R&D data kept on disk and taped (dCache).
  - Rate OK right now – might require filtering and dedicated run configuration in future.