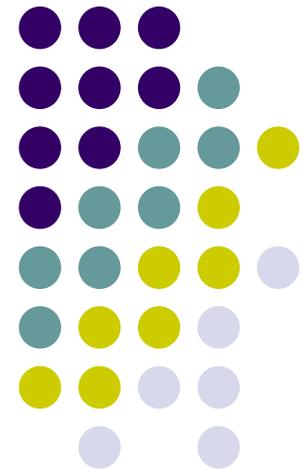


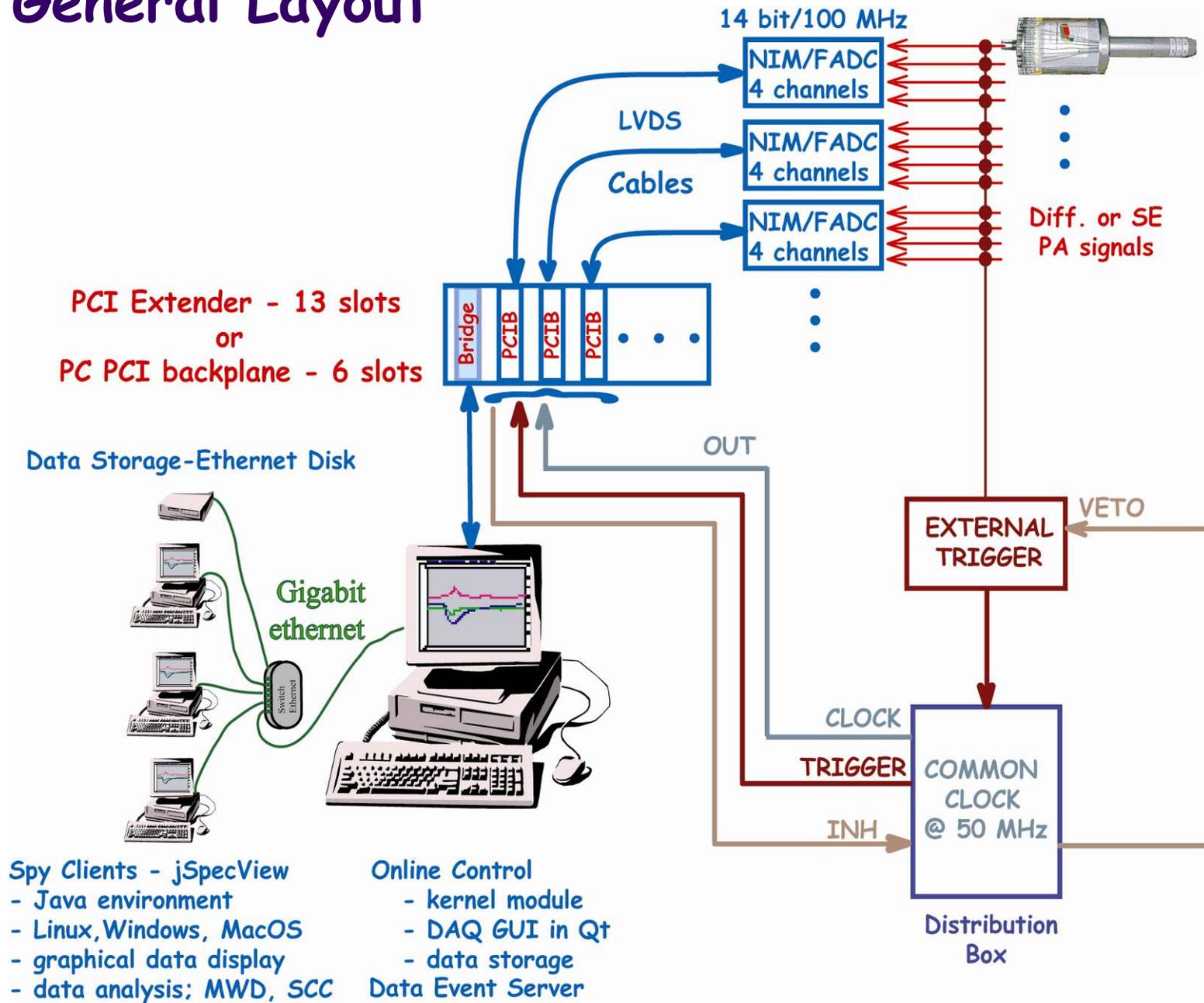


The PCI-NIM Based DAQ System

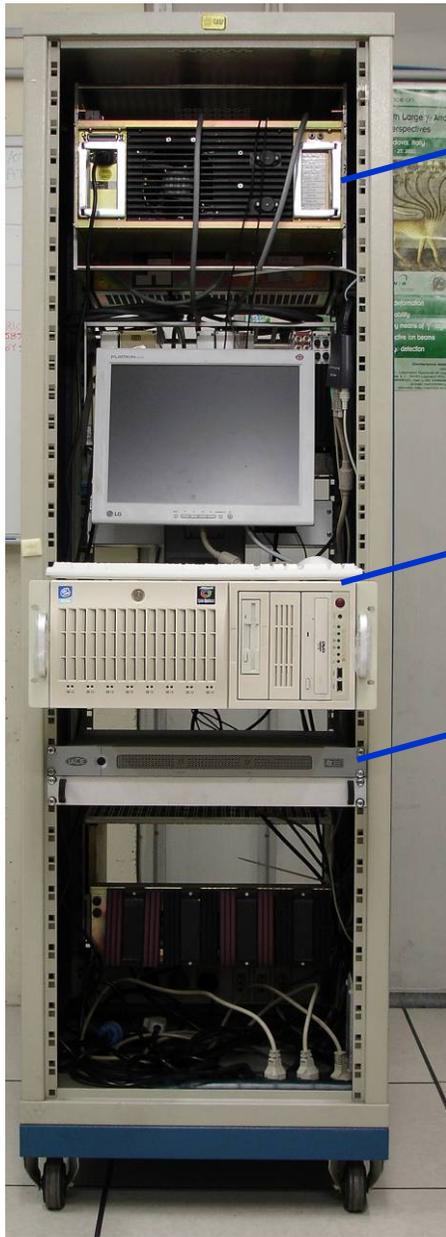
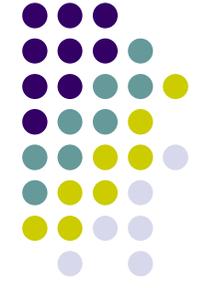
Călin A. Ur
INFN - Padova



General Layout



General Layout



*BIN NIM
600 W*

DAQ PC

*500 GB
Ethernet
Disk*



FADC

*Trigger
electronics*

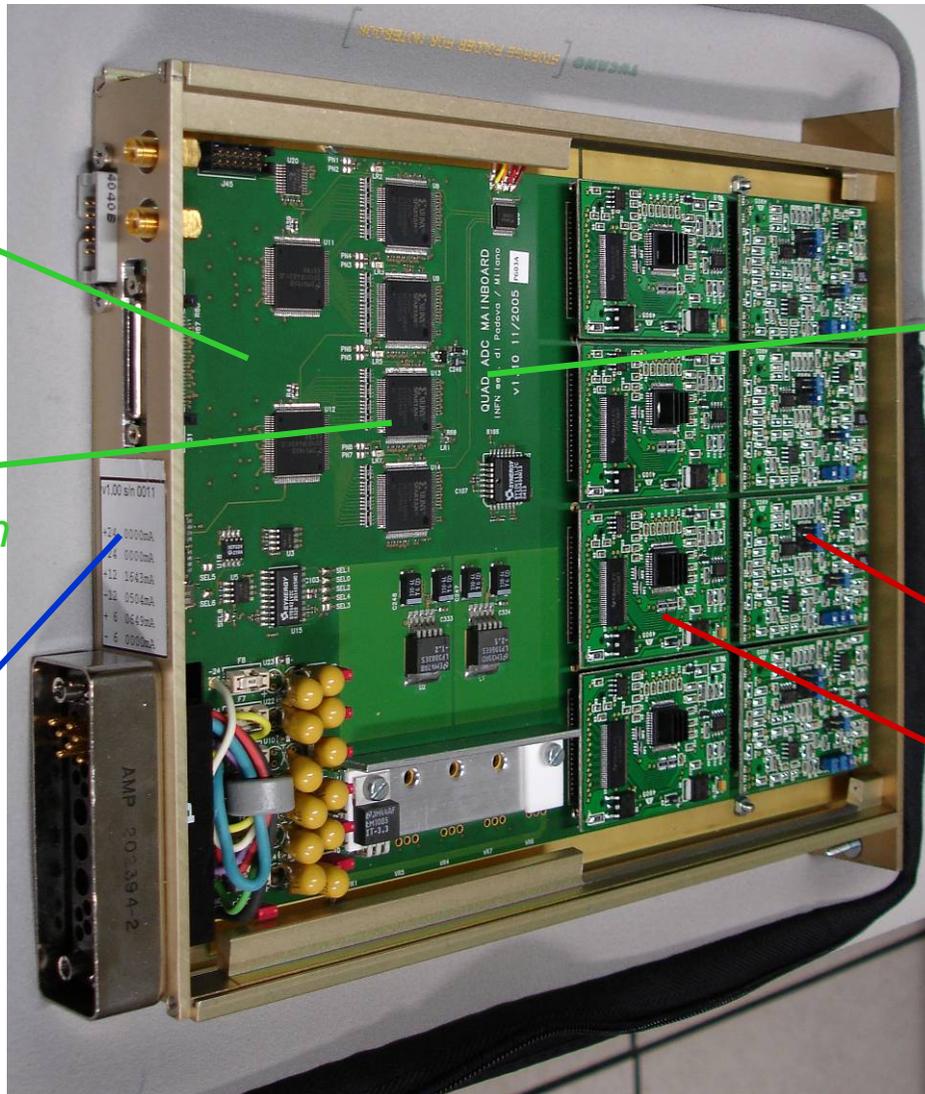
*Distribution
box*

PCI boards

The Digital Sampling Modules



Collaboration Padova – Milano (2005 – 2006)



LVDS Transmitters

FPGA Data Transmission

+ 12 V 1.35 A
- 12 V 1.35 A
+ 6 V 1.40 A
- 6 V 1.40 A

- modularity for future upgrades
- stability against manipulation
- good electrical contact

Motherboard

Daughterboards

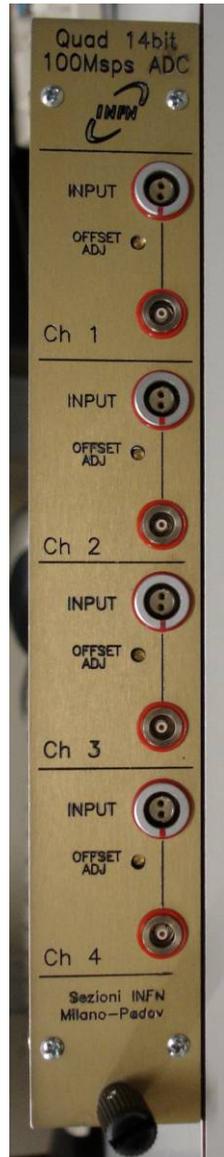
Signal Conditioning Boards

FADC boards

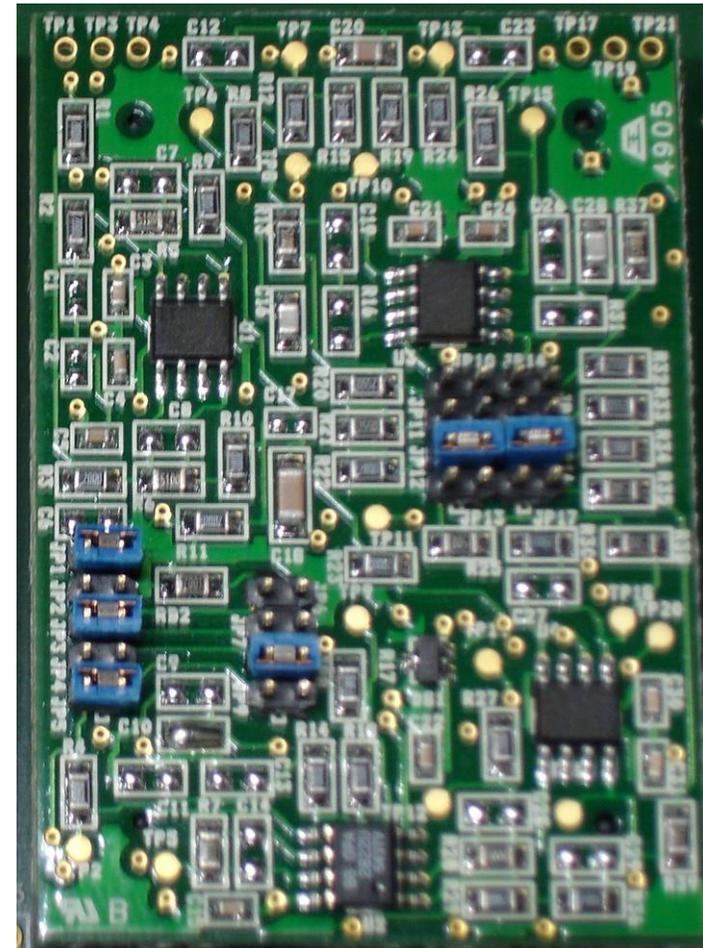
ANALOG DEVICES AD6645

14 bit
100 MHz

The Signal Conditioning Board

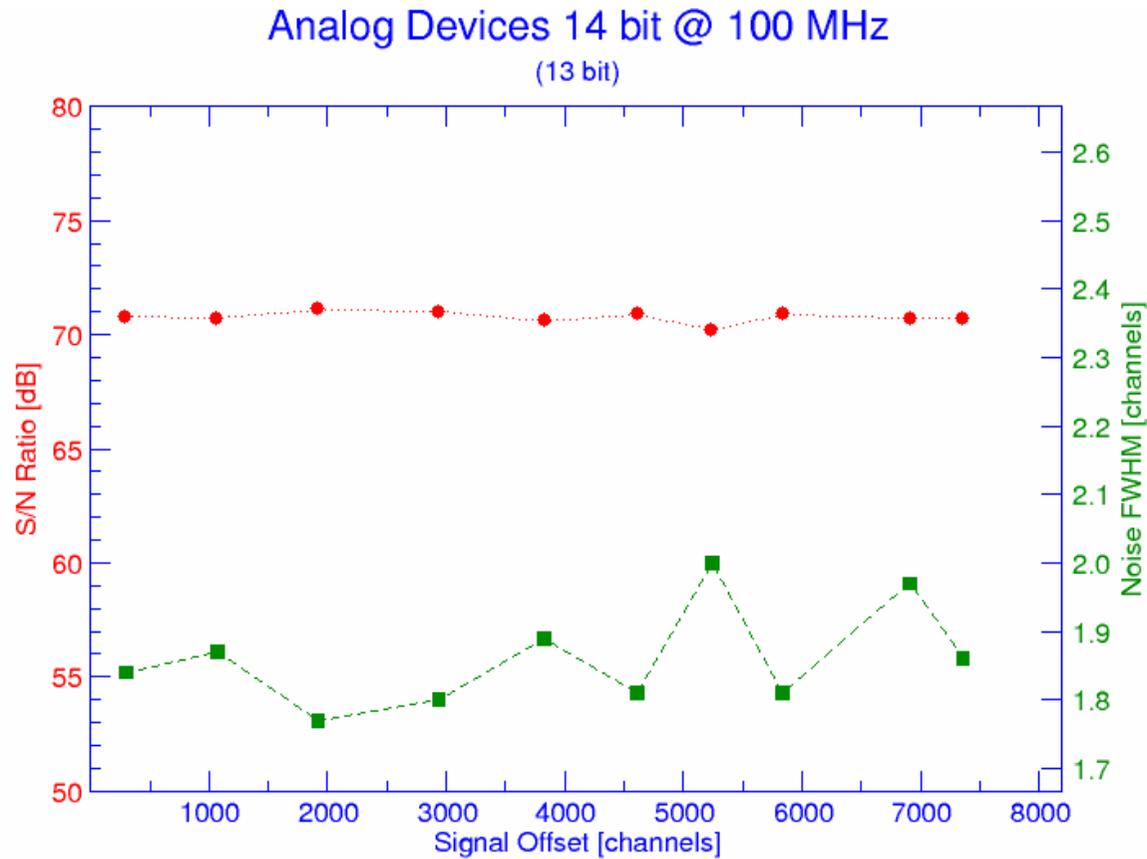


- input signals
 - differential -1 V to +1 V
 - single ended 0 V to +1 V
 - positive or negative
- offset
 - screw adjusted continuously
- gain
 - set by jumpers
- analog frequency
 - up to 40 MHz



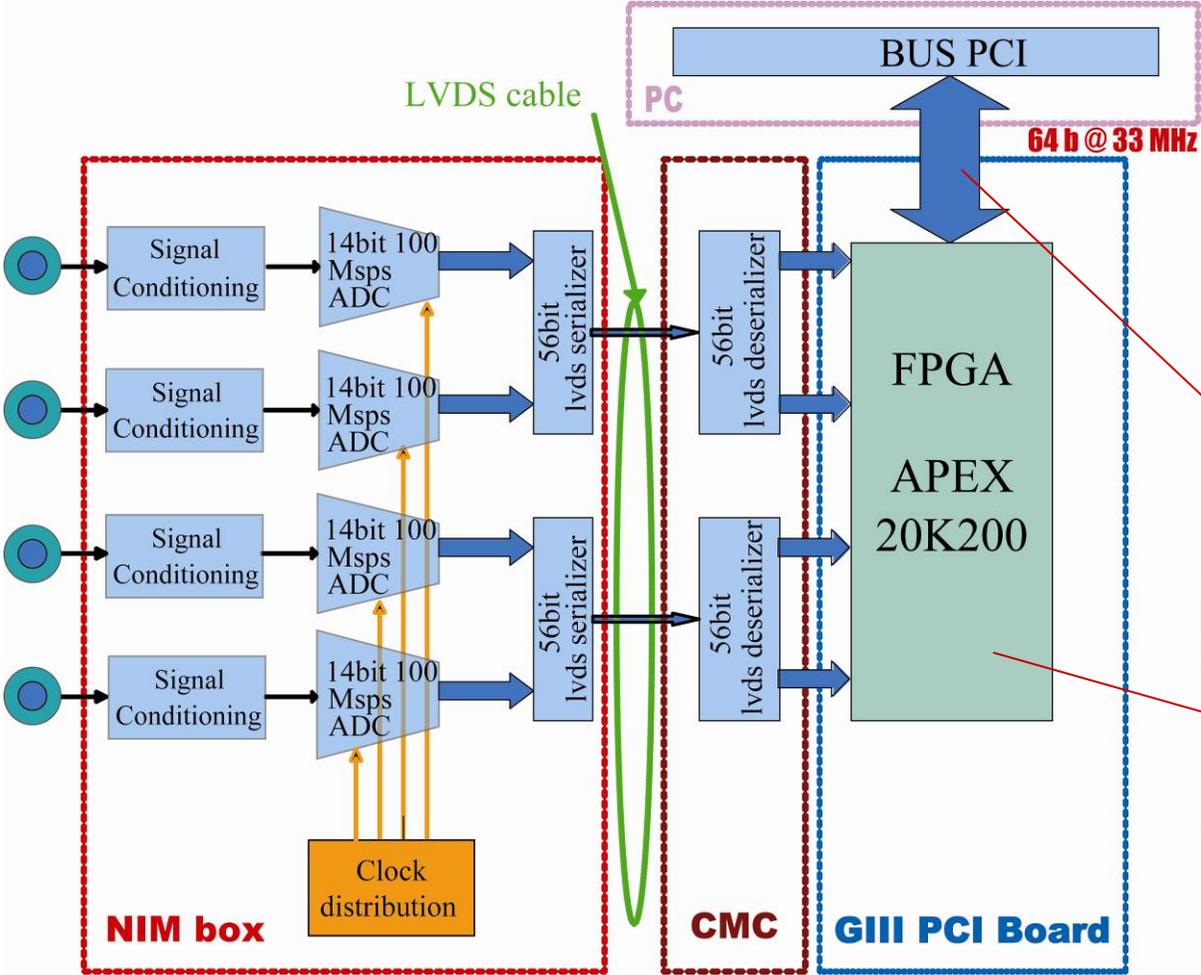
Effective Number of Bits

Noise measurement without input signal

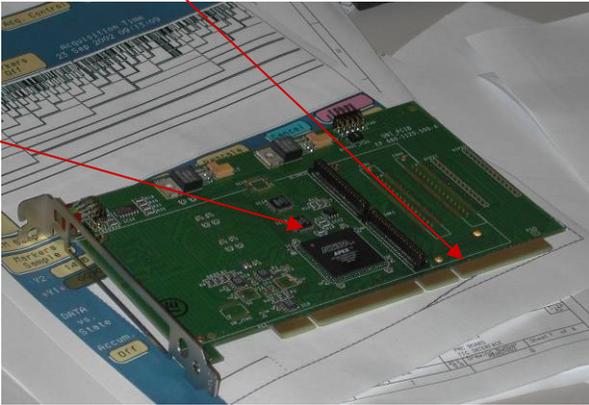


ENOB = 11.5

Data Readout



ALTERA APEX 20K200EFC484
200.000 Gates,
up to ~13 Kb of memory



CERN Design

Main Features of the DAQ System



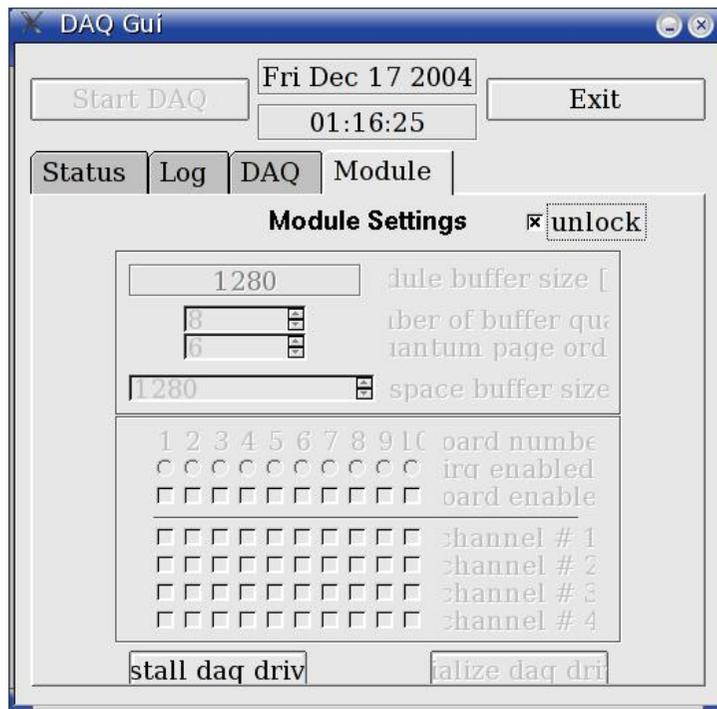
	MD2S Padova
Channels	4
FADC bits	14 (13)
FADC rate (MHz)	100
FPGA k-gates/ch	100
Internal trigger	no
Trace length (samples)	max 2048
Control & i/f	NIM/PCI
Data xfr	PCI
Max output rate (MB/s)	6

DAQ Control



The acquisition software is implemented for Linux O.S.

- Setup the DAQ configuration
- Manage the communication between PC and PCI cards
- Interrupt-based data transfer (6 MB/s)
- Enable/disable the trigger between the data saving



kernel module linux 2.4

- handles the interrupts from PCI cards
- transfers the data from PCI cards
- minimal data manipulation
- pipes the data into a character device

user program

- takes the data from the character device
- writes the data on HD

graphical user interface

- developed in Qt 3
- controls module loading and data manipulation
- start/stop of the acquisition

Data Format



Header

?MSDAQ01 Data Label
?CHN0003 Number of Channels
?P002048 Number of Sampling Points
?SPR0016 Sample Precision in Bits
?LBT0013 Number of ADC Conversion Bits
?LTR0016 Trailer Length in Bytes
?CH10002 Channel #1 Enable Pattern 0000000010
?CH20000 Channel #2 Enable Pattern 0000000000
?CH30001 Channel #3 Enable Pattern 0000000001
?CH40002 Channel #4 Enable Pattern 0000000010
?MHZ0100 Sampling frequency
?RUN0007 Run No.
?ORIGDAT Original data
?U000029 User Comment Length (in bytes)
"Data Comment with User Comment Text"
"new lines"
"....." up to 512 characters
?ENDHEAD End of Header

Data Format



Data Block

1st Event:

```
Number_of_Channels_Enabled * ..... 3
Number_of_Sampling_Points * sizeof(u16) + .... 2048 * 2
Event_Trailer_Lentgh = ..... 16
Event_Length = ..... 12304 bytes
```

Event Trailer Format - 4 x u32 integers = 16 bytes

#0 = Irq Counter (32 bits)

#1 = packed date and time

#2 = time stamp (32 bits) → synchronization

#3 = End of Event = 0xFFFFFFFF

2nd Event:

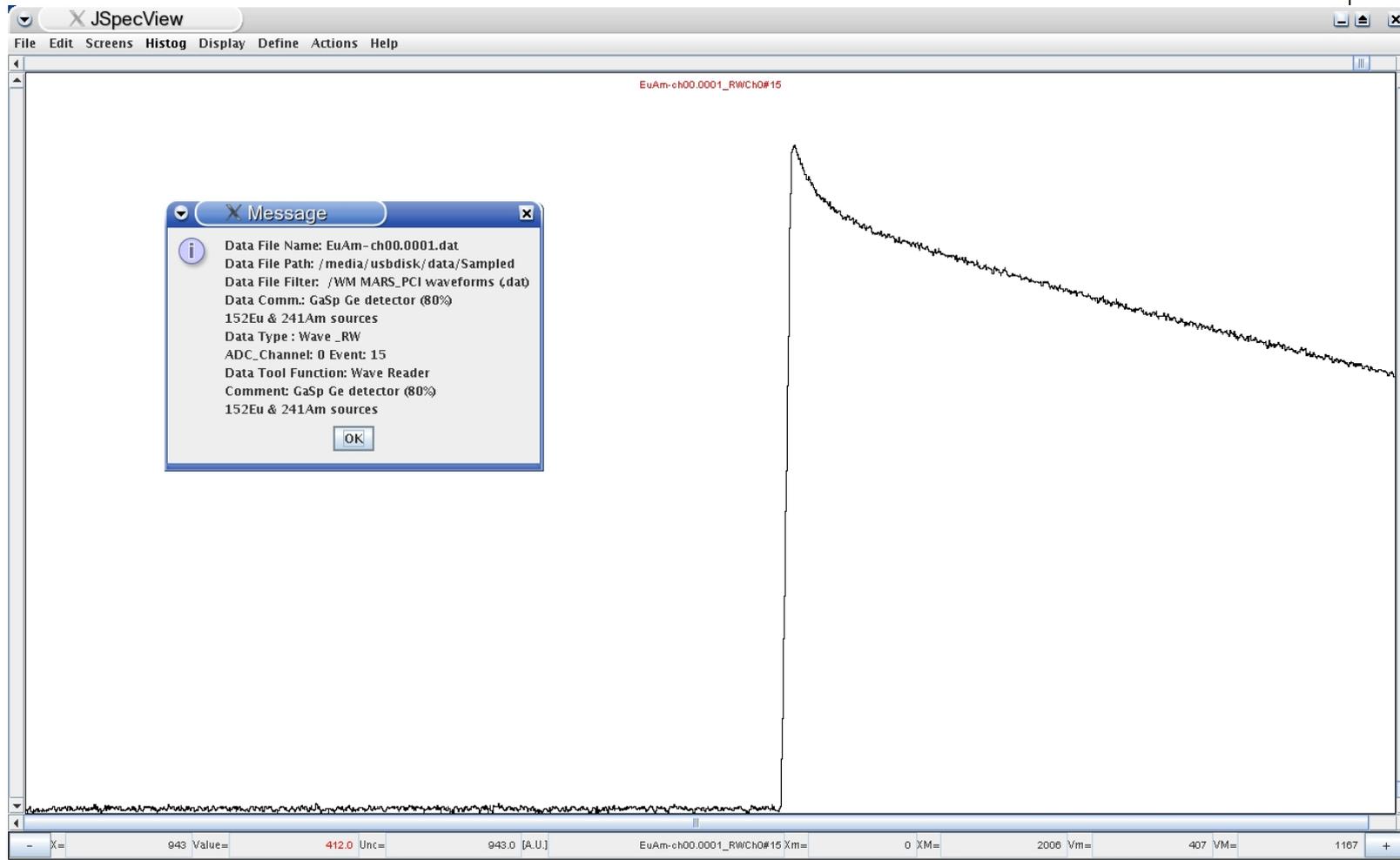
Analysis Program - jSpecView



Graphical viewer and analysis program

- platform independent (Java)
- manipulation of digital waves - digital filters
- building and saving of histograms
- setting gates and building histograms with conditions
- standard spectra operations (calibration, fit, integral, ...)
- oscilloscope function
- generating and viewing of 2-D matrices

Analysis Program - jSpecView



Analysis Program - jSpecView



Control Parameters Setup

HistFastMWD, select one Parameter

SubOffset = false
OffsetFrom = 50
OffsetTo = 650
Gain = 1
Shift = 0
UseTrap = true
FlatTopTol = 5

Set Default

Parameter Type: boolean

false

Set New Val...

Parameter description: Subtract offset average after MWD

Cancel [i] Exit

Tool Selection

Select Vector type, OPTool Function and last select Condition and Operation V...

Histogram the Moving Window Deconvolution (Fast)

Set Function Parameter... Set Global...

Selected Function: HistFastMWD

Deselect Select Tool Condition Panels

Operation Panels: Wave Spectra

data001_RW

Choose ...

Cancel OK

Available Tools:

- gaussFirst
- gaussSecond
- filterDFFT
- HistFastMWD
- HistOffset
- HistTau
- HistYProj
- HistSSE
- HistMSE
- HistLECoinc
- HistGFCoinc
- HistCFDCoinc
- HistVeto
- HistGate
- MatTest
- MatExEy

Histogram the Moving Window Deconvolution (Fast)

Help

Fast Moving Window Deconvolution Histogram.
Use: Globals: m_nMWDwidthE, m_fLETlevelE, m_nLETwidthE, m_nMWDwidthT, m_nWwidthE, m_fOffsetMin, m_fOffsetMax

The function has several parameters:

- 1) Wave from the Input selected Panel
- 2) SubOffset. Subtract offset after MWD (Boolean)
- 3) OffsetFrom. Start of offset region
- 4) OffsetTo. Stop of offset region
- 5) Gain of the spectrum
- 6) Shift of the spectrum
- 7) UseTrap. Perform trapezoidal Deconvolution (Boolean)
- 8) FlatTopTol. Percent of the flat-top flatness accepted

The Moving window Deconvolution is calculated over the m_nMWDwidthE width the resulting wave is stored in newWave.

Then a trigger filtering using m_fLETlevelE is performed obtaining the pulse width (Pwidth) and the trigger position

- if no trigger or Pwidth < m_nLETwidthE
channel 0 is incremented and exit
- if more than 1 trigger
channel 1 is incremented and exit

A flat top width (FTwidth) is calculated subtracting (2 * m_nMWDwidthT + m_nWwidthE) from Pwidth where

- m_nMWDwidthT is the trapezoidal rise and fall width
- m_nWwidthE is a protection time for the pulse overshoot

if FTwidth < 0 m_nMWDwidthE/2

- channel 3 is incremented and exit

The offset value of newWave is calculated in the region from OffsetFrom to OffsetTo

- if checkOffset is true
if offset is not within m_fOffsetMin, m_fOffsetMax
channel 2 is incremented and exit

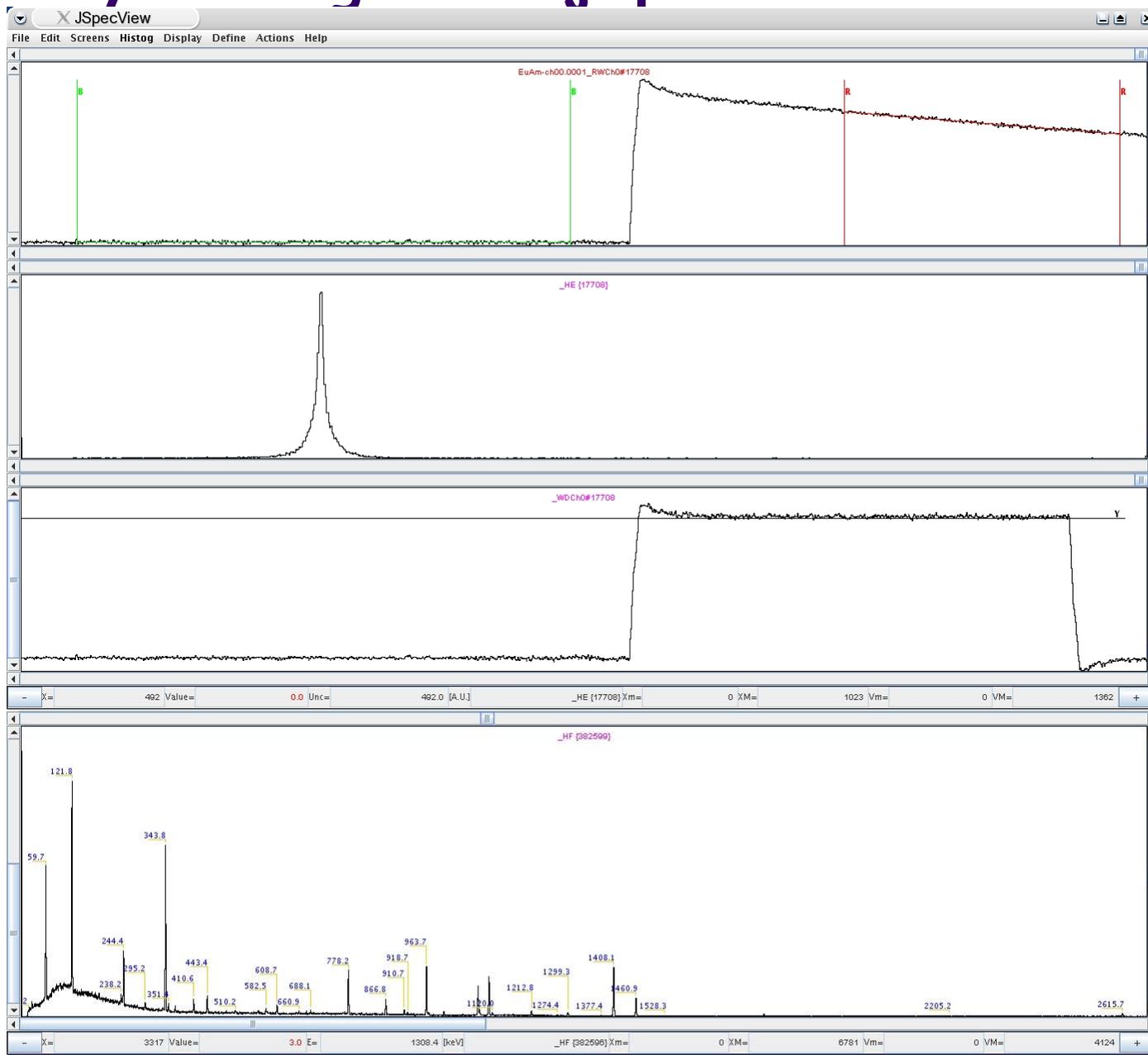
A rectangular (UseTrap = false) or trapezoidal (UseTrap = true) average is performed. The amplitude mean in the first half (amp1), second half (amp2) and total (ampIT) flat top region is performed.

- if SubOffset is true
the offset value is subtracted from all the amplitudes
if (amp2 - amp1) / ampIT > FlatTopTol * 100
channel 4 is incremented and exit
- else
channel ampIT * Gain + Shift is incremented and exit

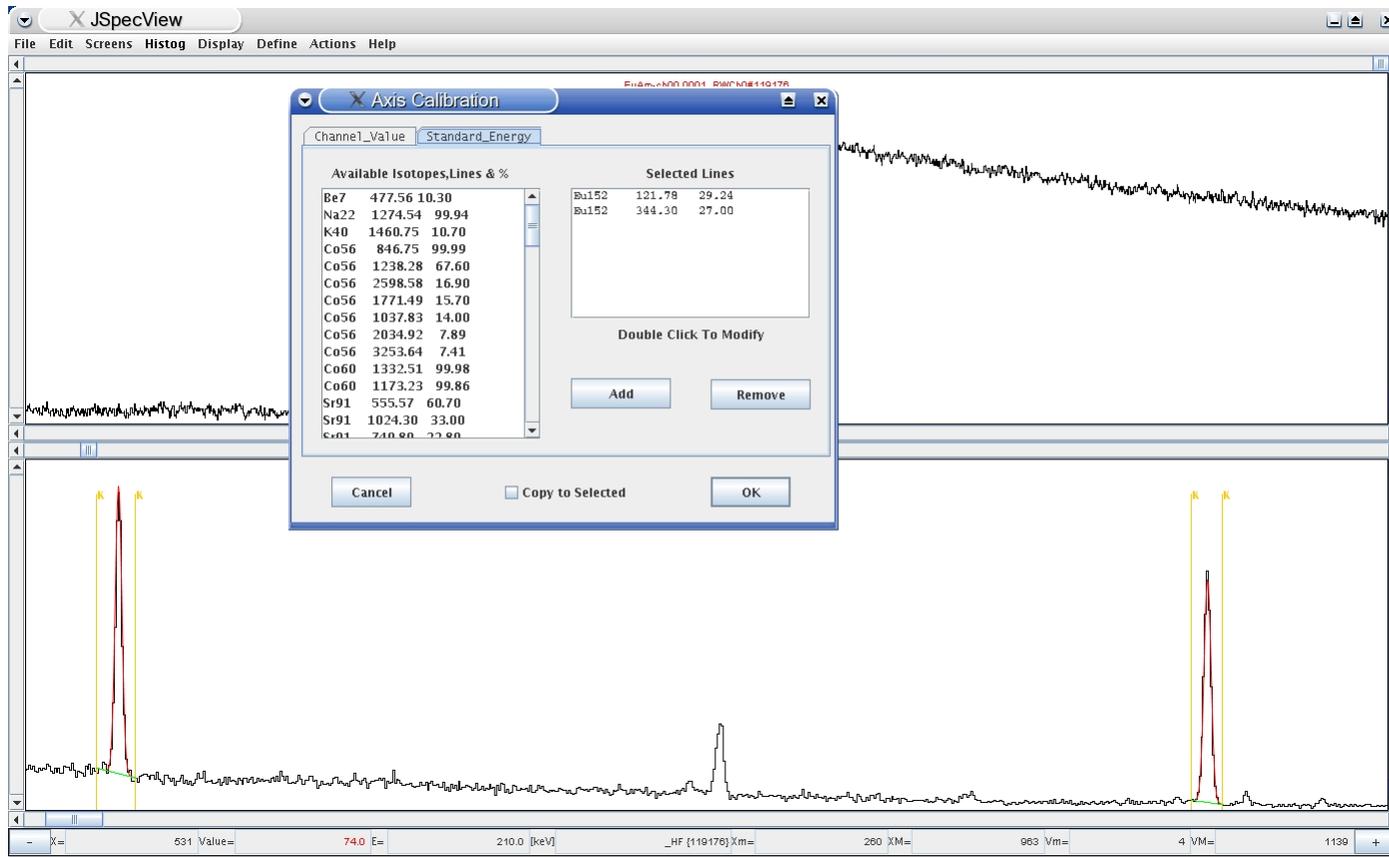
OK

Status bar: X= 904 Value= 6559.0 T= 9040.0 [nsec] data001_RWCh2#1 Xm= 0 XM= 2047 Vm= 6556 VM= 6561 +

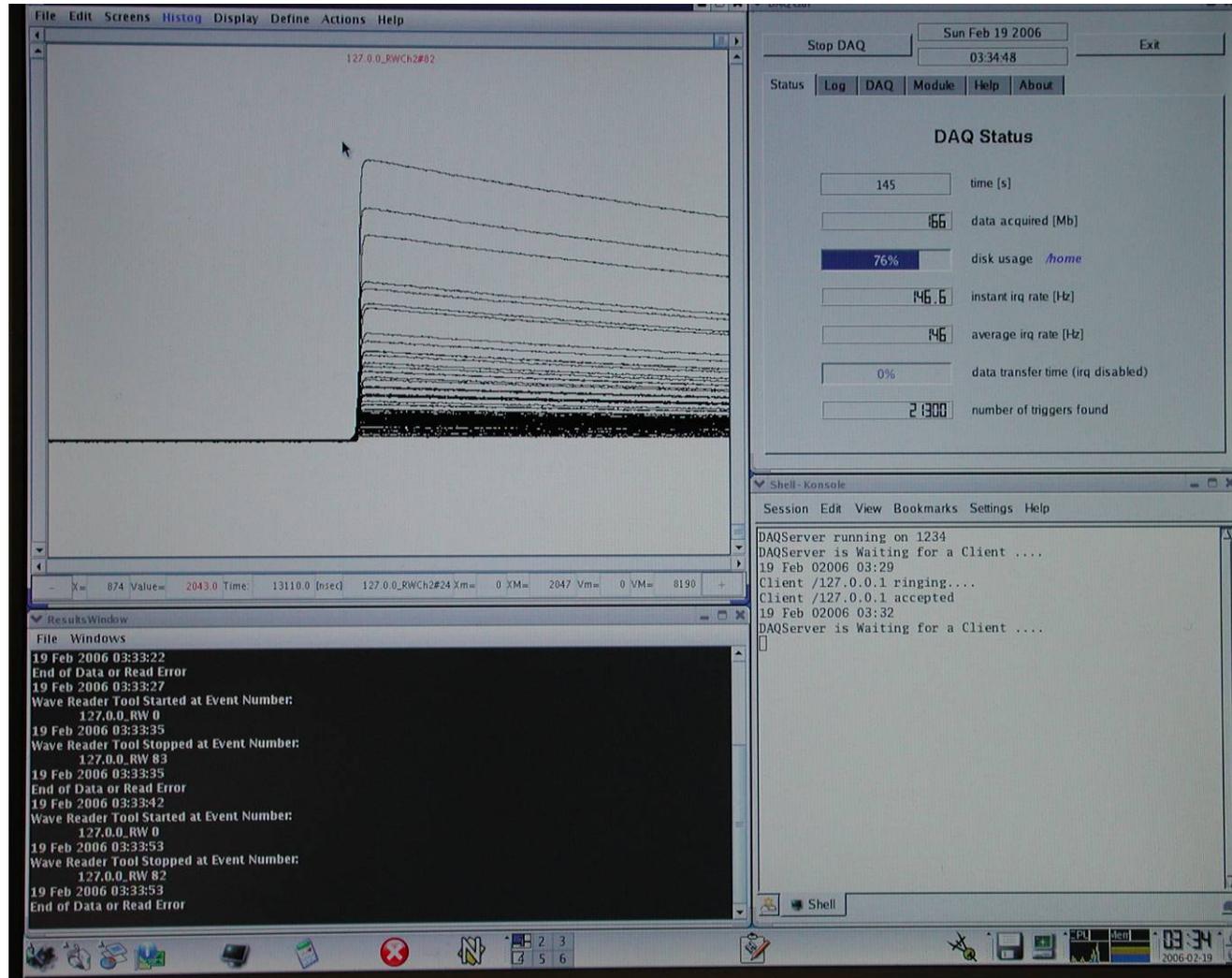
Analysis Program - jSpecView



Analysis Program - jSpecView



Online Monitoring - jSpecView Server



Server - Client
over IP

Status & Perspectives



- the PCI - NIM DAQ system is operational
- data analysis and online monitoring program - working

- transfer to LNGS
 - 2 modules - end of July
 - + 2 modules - end of September
 - + 2 modules - end of the year