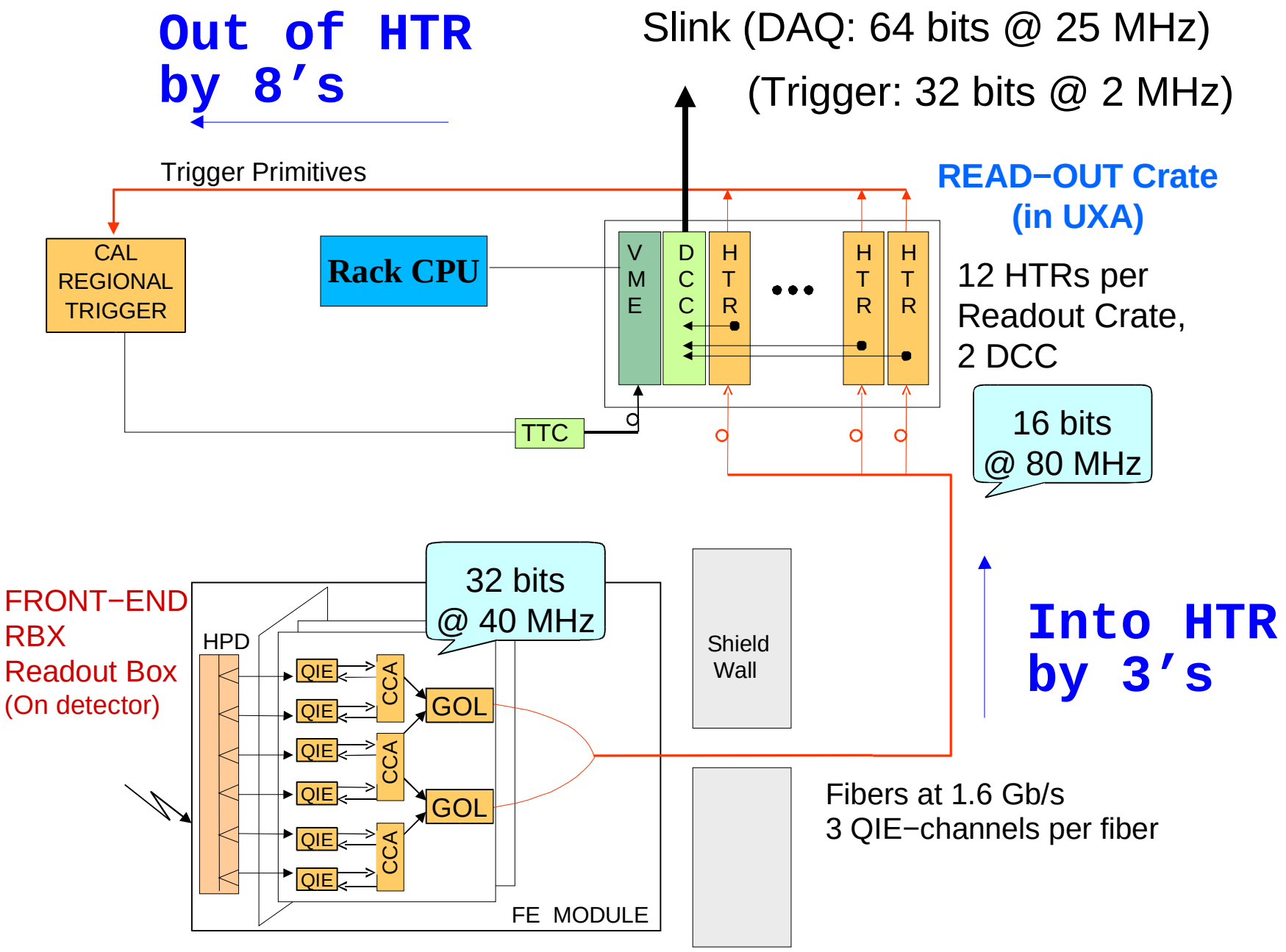
DCS Workshop
March 1, 2002

Status of HCAL Controls

J. Rohlf
Boston University

HCAL FE/DAQ Overview



HCAL Electronics

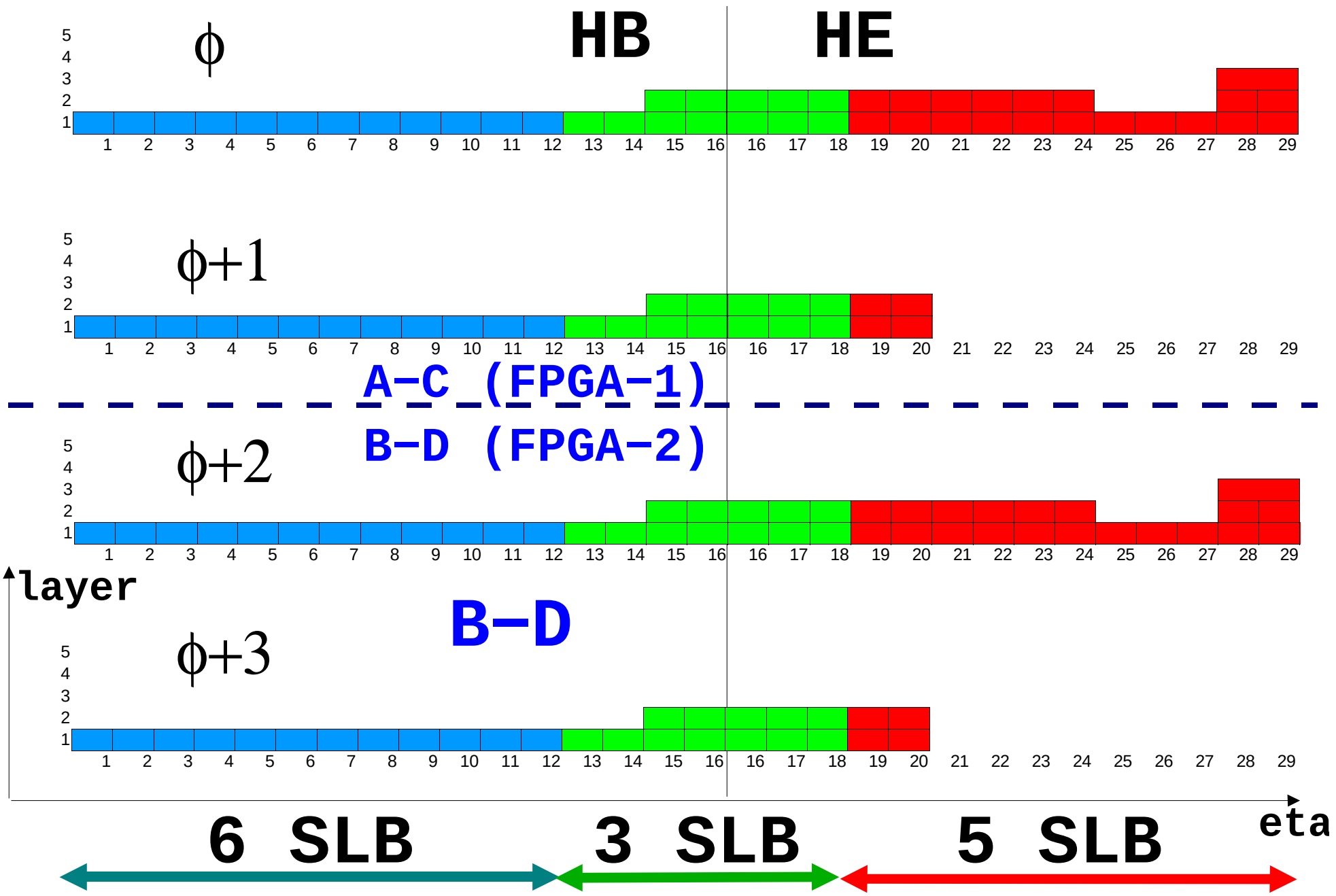
front end

HB	**36 RBX (HPD+QIE)**
HE	**36 RBX**
HO	**36 RBX**
HF	**24 3u crates (QIE) + 72 PMT boxes**

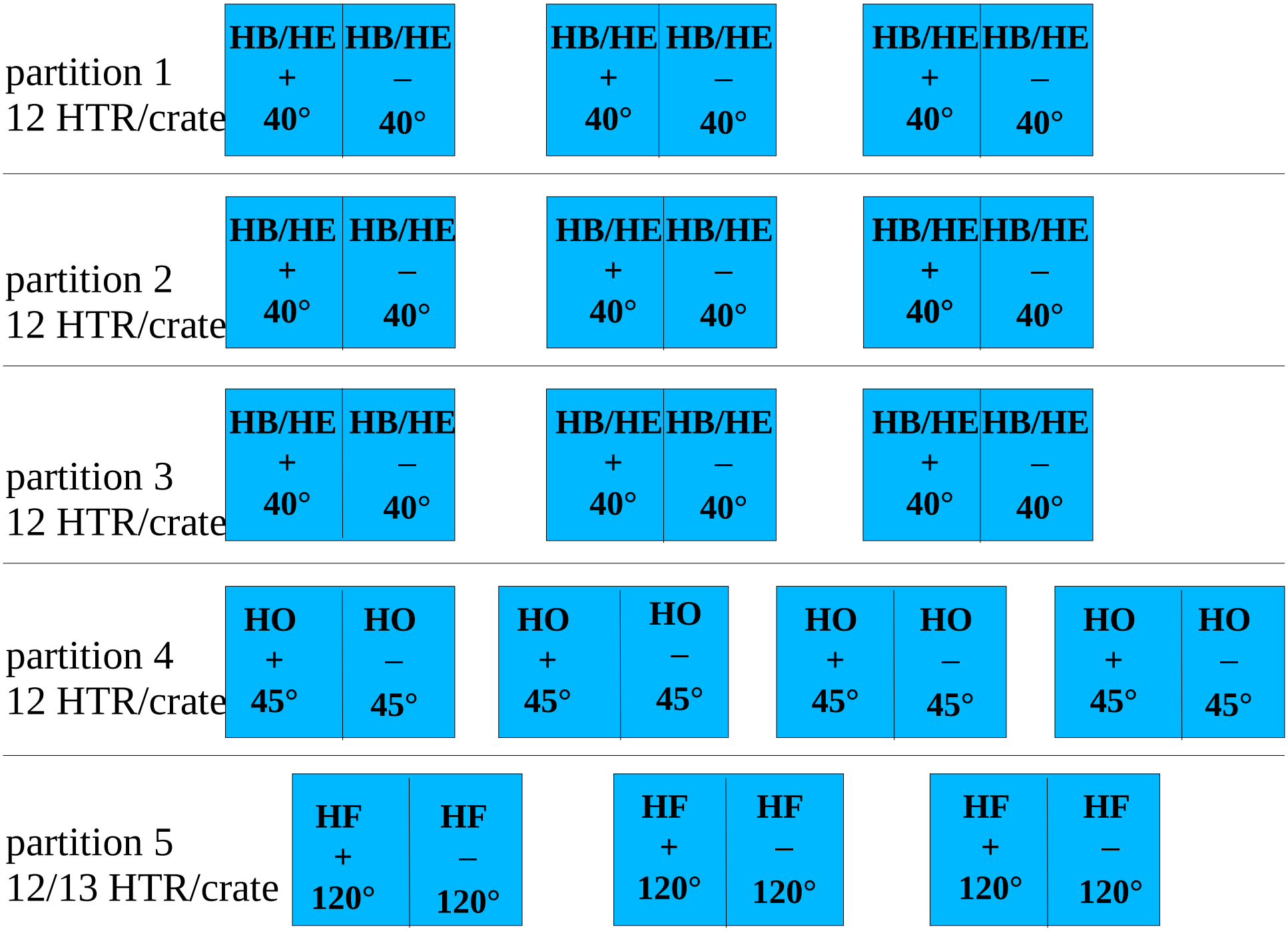
digital

	channels	fibers	trig towers	SLB	HTR	crates	HTR/crate
HB (pure)	1728	576	1728	216	36	3	12
HB/HE overlap	1728	576	864	108	36	3	12
HE (pure)	1728	576	1440	180	36	3	12
HO	2160	720			48	4	12
HF	1800	600	144	18	38	3	12.67
TOTAL	9144	3048	4176	522	194	16	

20° slice: 144 ch. (3 HTR)



HCAL DAQ Partitions

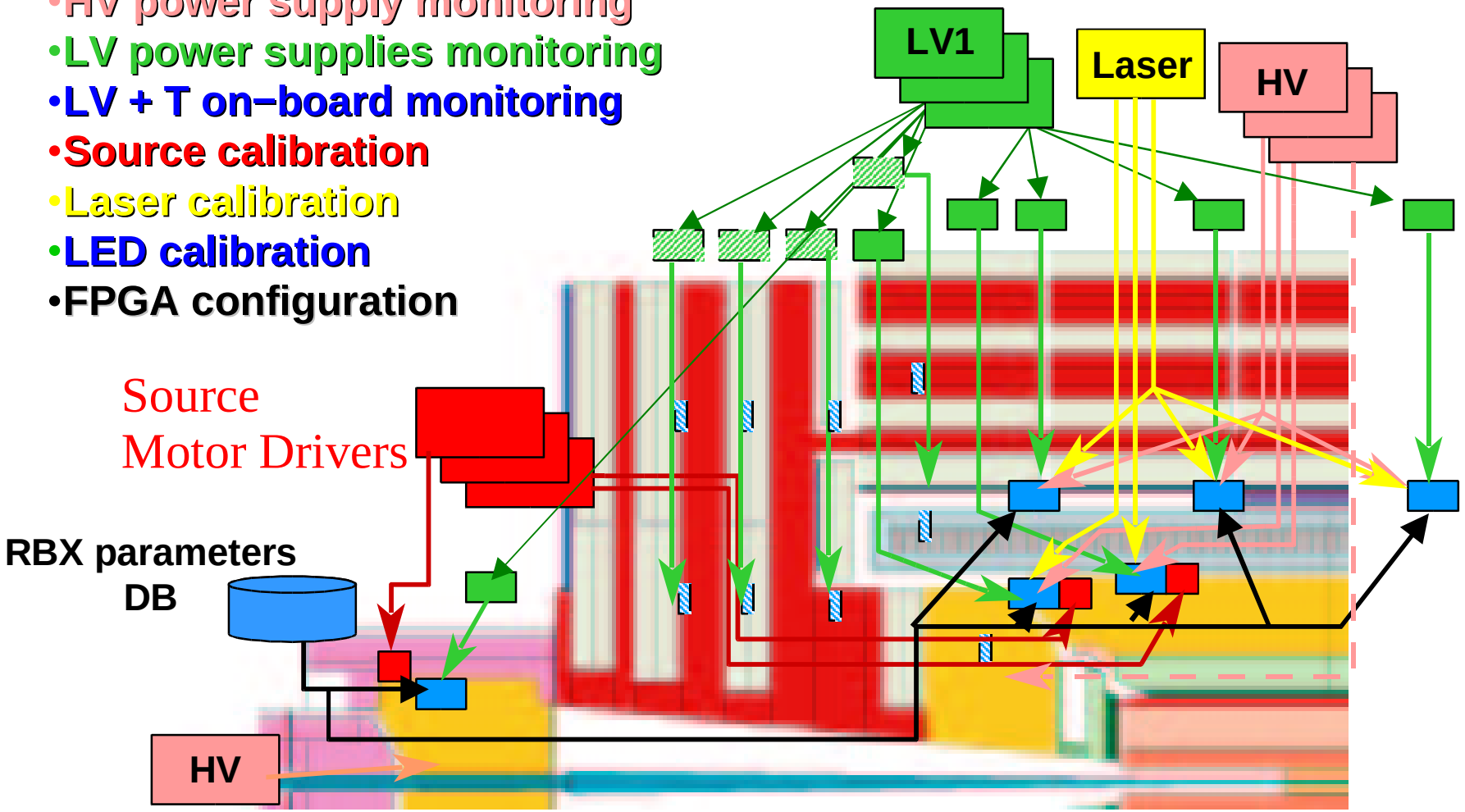


HCAL DCS Components:

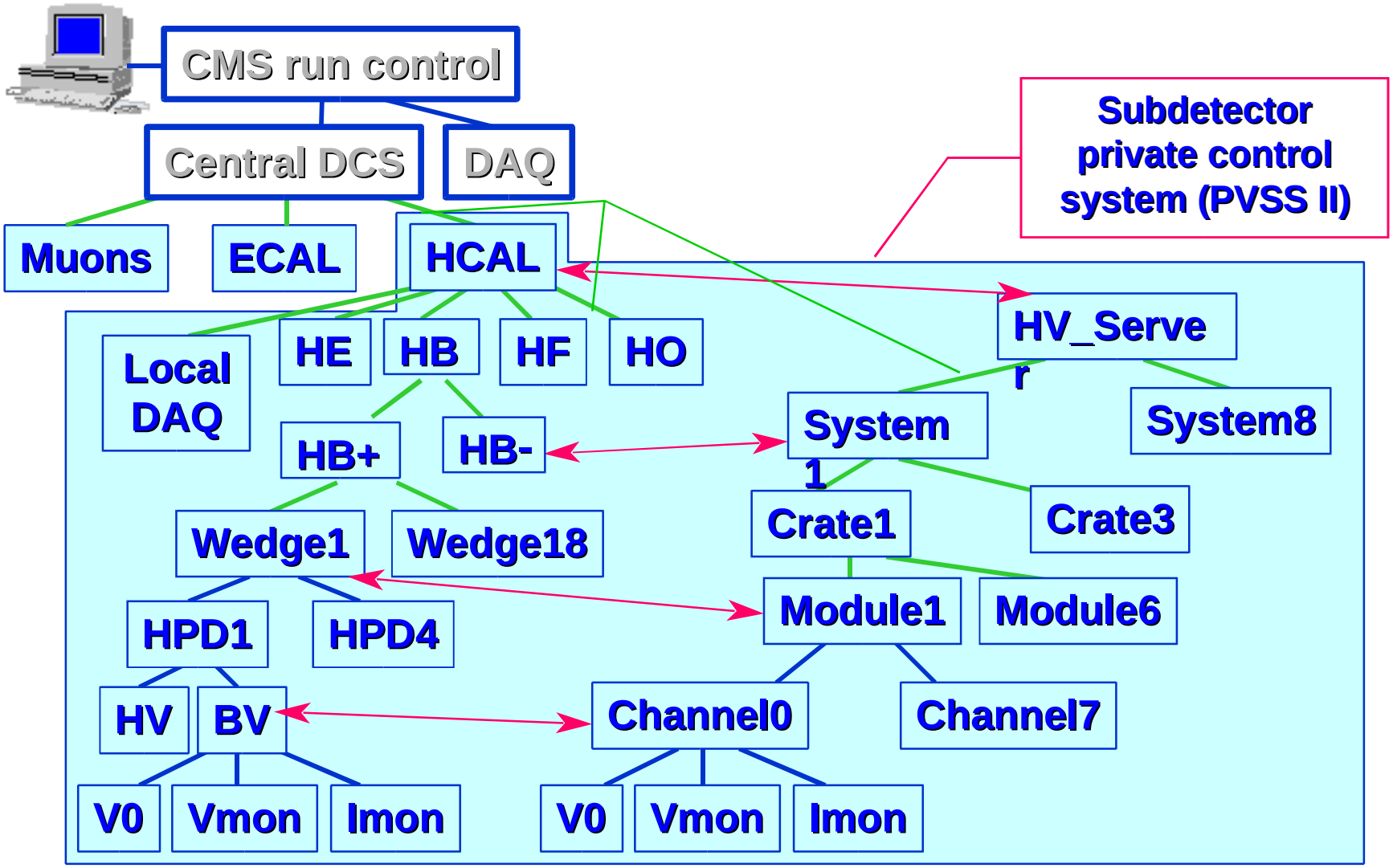
High Voltage (HPD, PMT)
Low Voltage (FE)
FPGA Configuration (FE, HTR, DCC)
Laser (pulse once per month)
LED (diagnostic only)
Source Calibration (once per year)
Event Spy (continuous)

HCAL DCS Overview

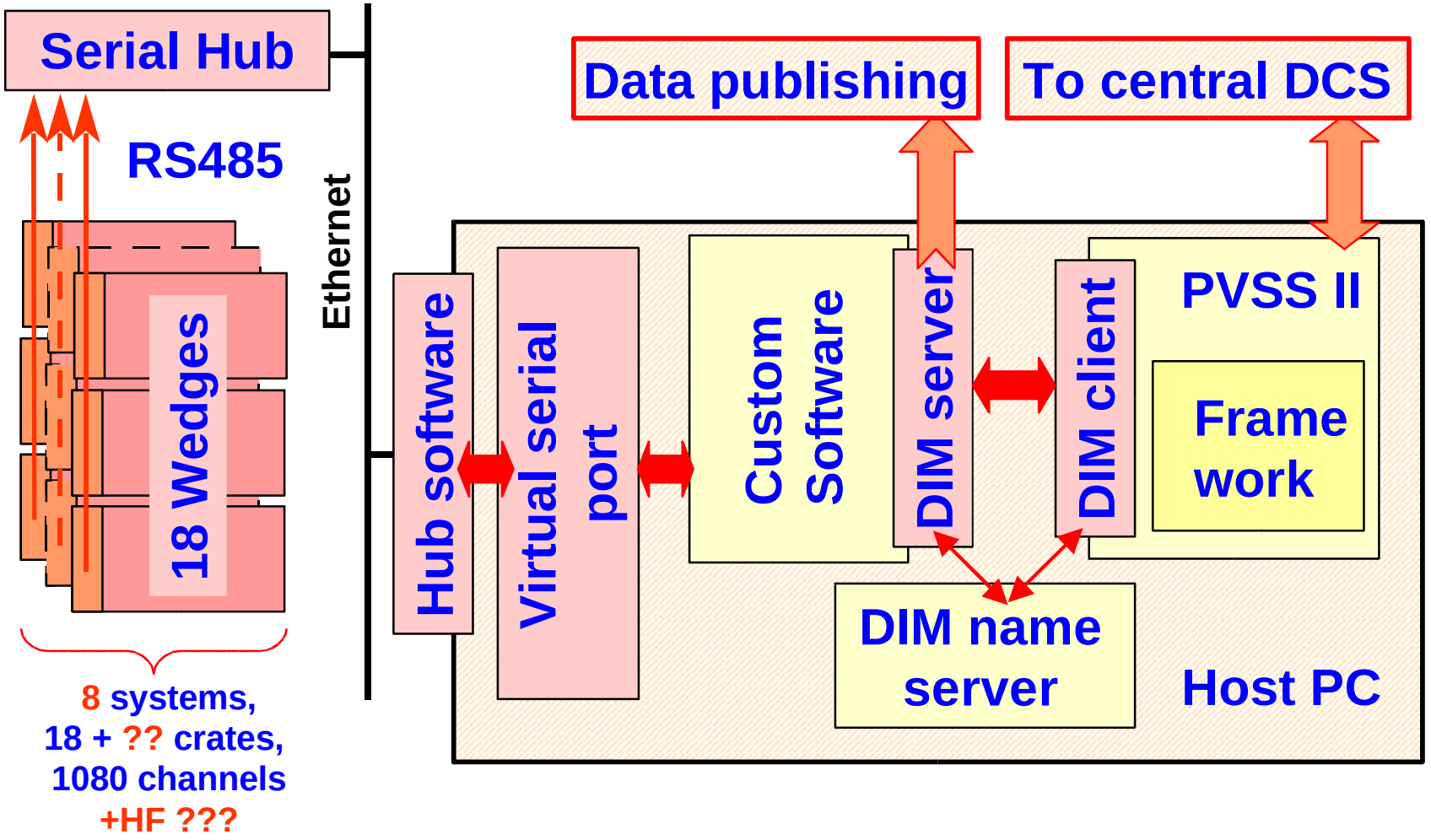
- HV power supply monitoring
- LV power supplies monitoring
- LV + T on-board monitoring
- Source calibration
- Laser calibration
- LED calibration
- FPGA configuration



Logical and Physical Trees

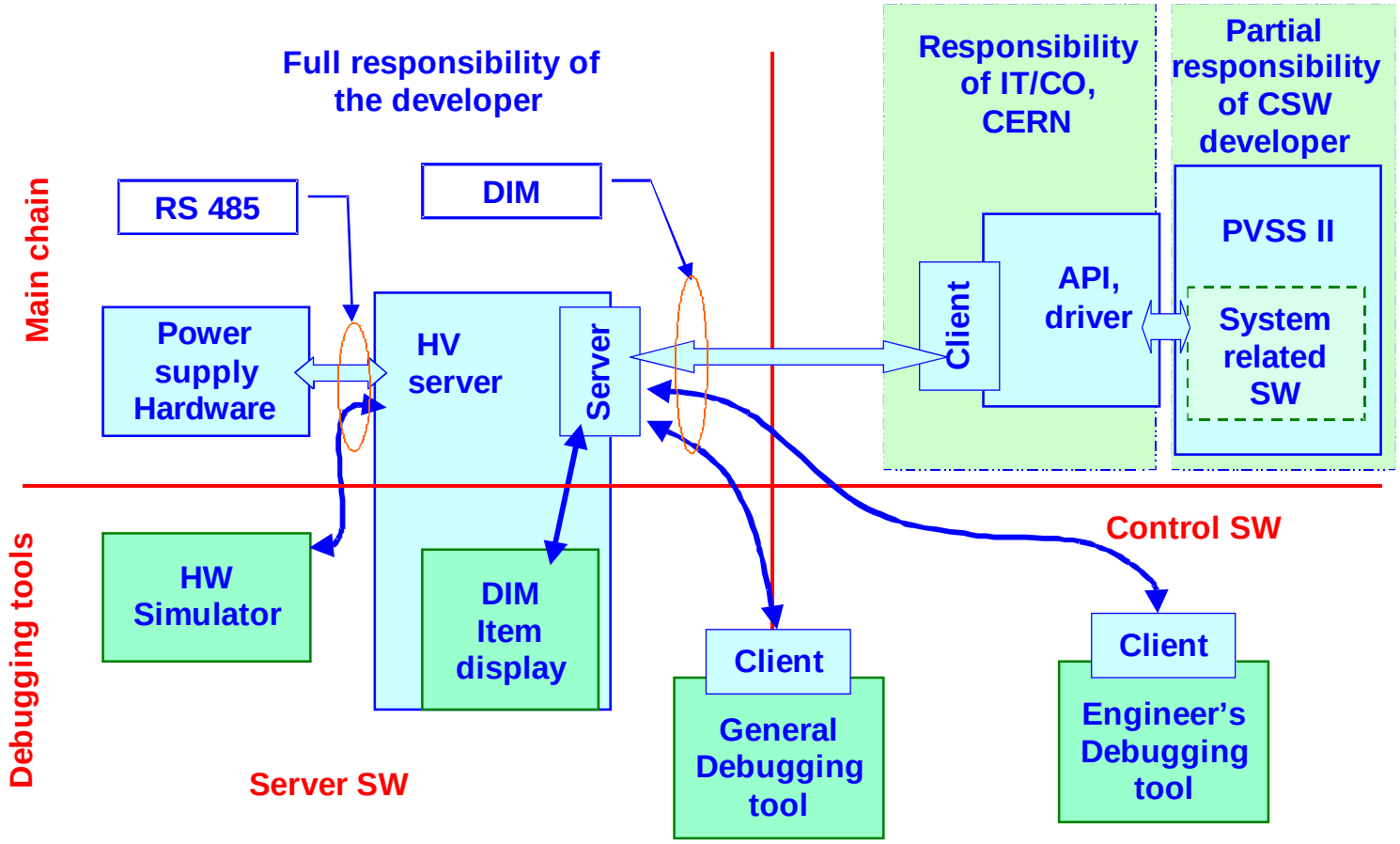


HV system structure (I)

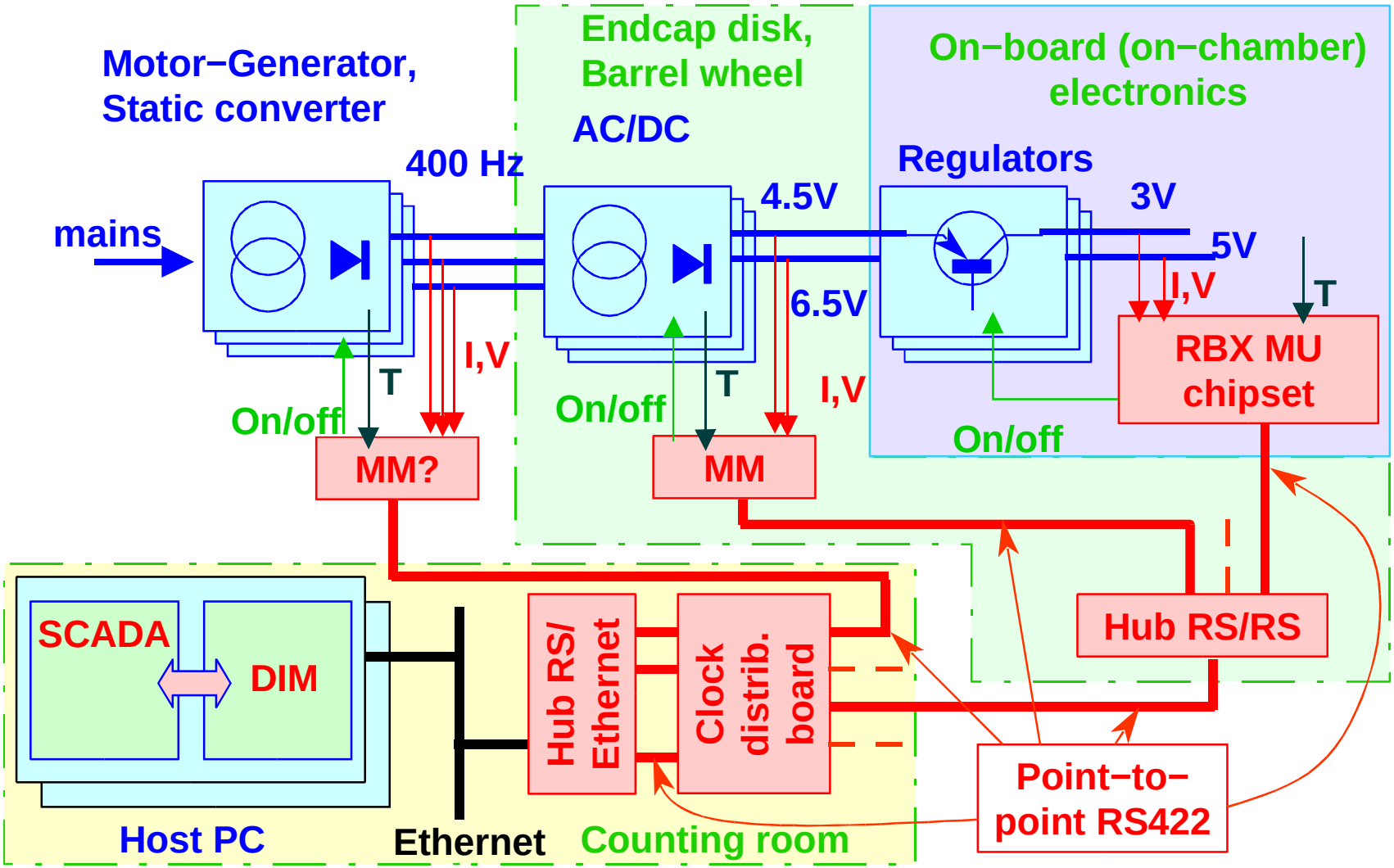


HV system structure (II)

HV control system software architecture



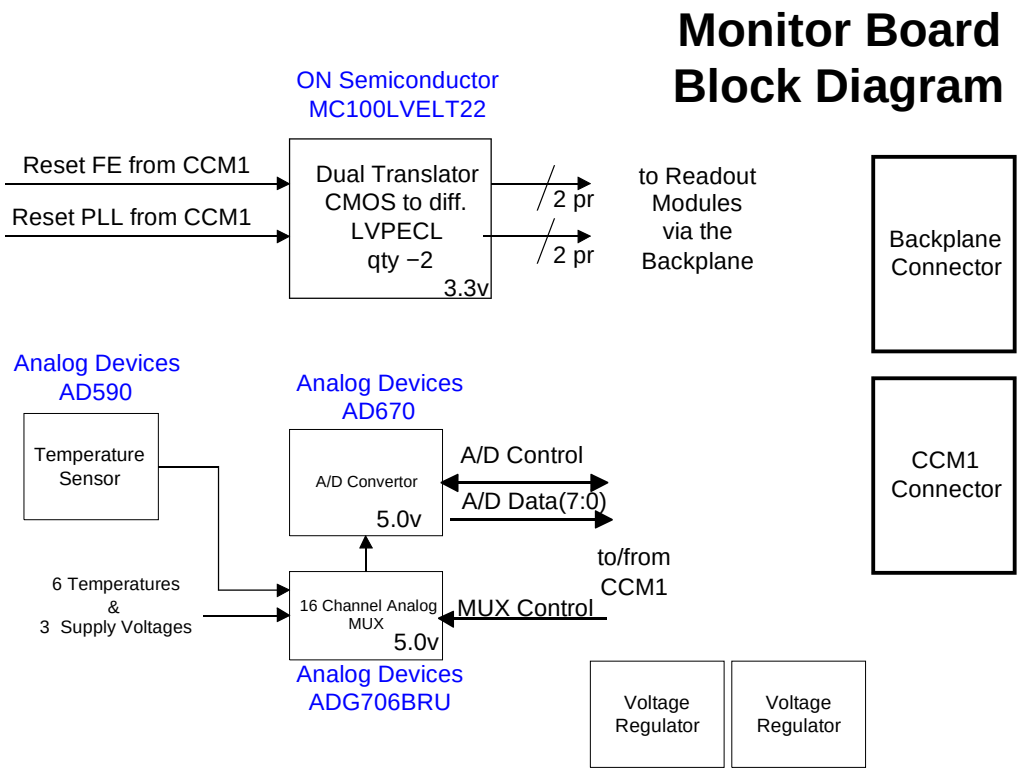
Low Voltage Control System



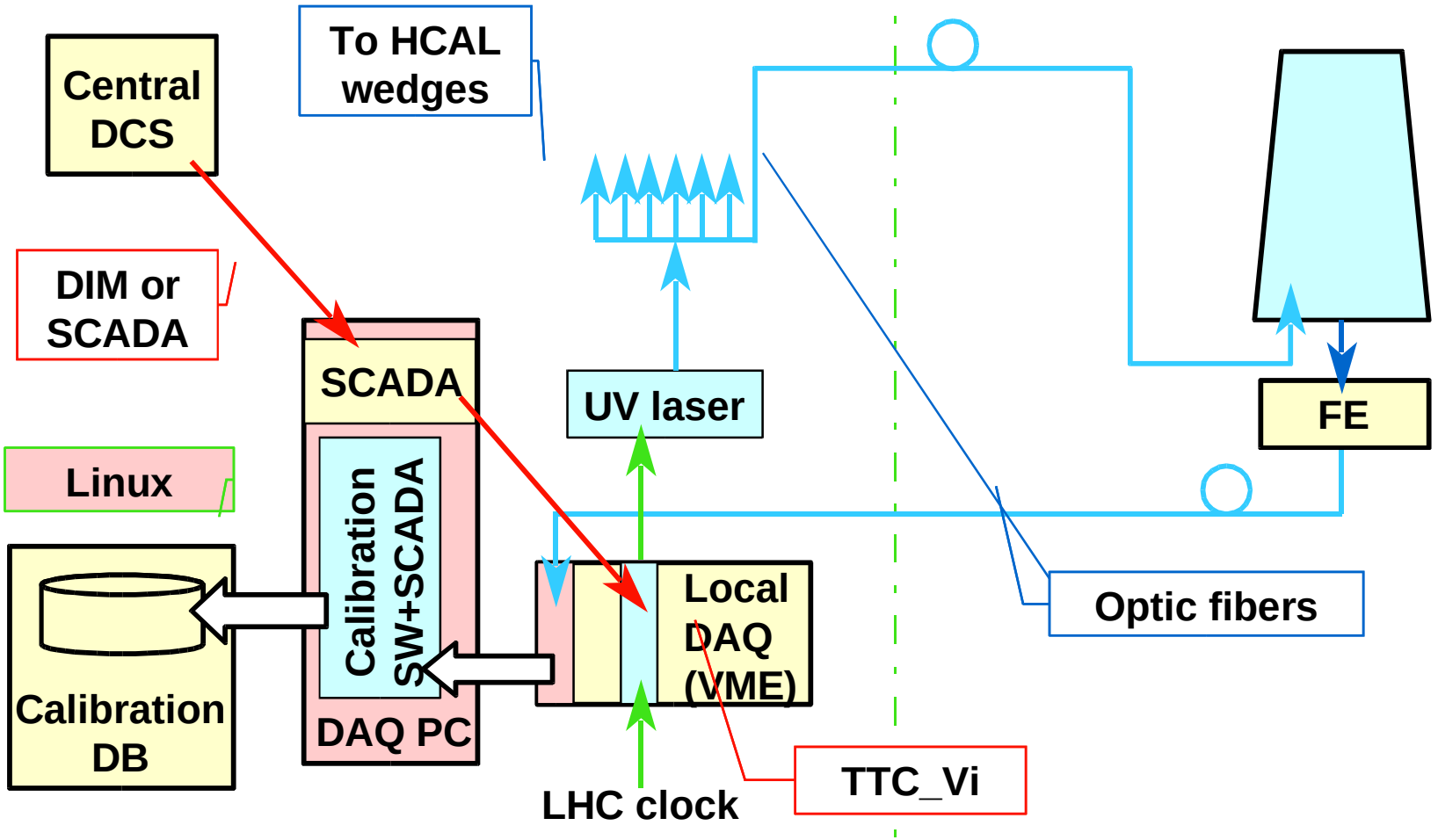
CMS HCAL TIMING & CONTROL MODULE(CCM)

- MONITOR BOARD FUNCTION
  - Monitor supply voltages
    - 3 voltages regulated
  - Monitor temperature of RBX boards
    - 6 Front End boards
    - 1 CCM module
  - Monitor Board − Parts
    - Analog Devices Parts
    - AD670 8−Bit Analog to Digital Convertor
    - ADG670 16−Channel Multiplexer
    - AD590 Temperature Sensor

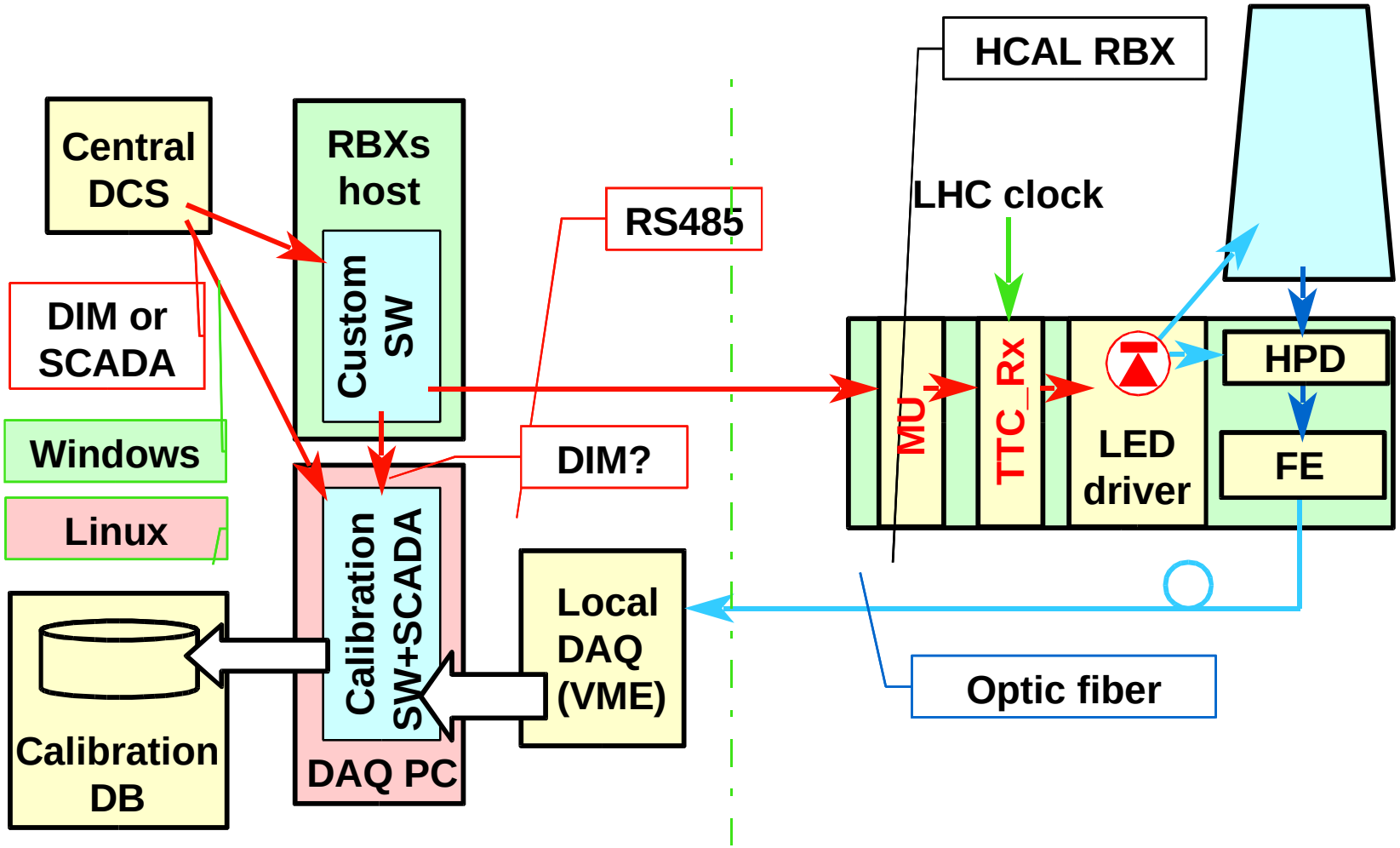
CMS HCAL CLOCK & CONTROL MODULE(CCM)



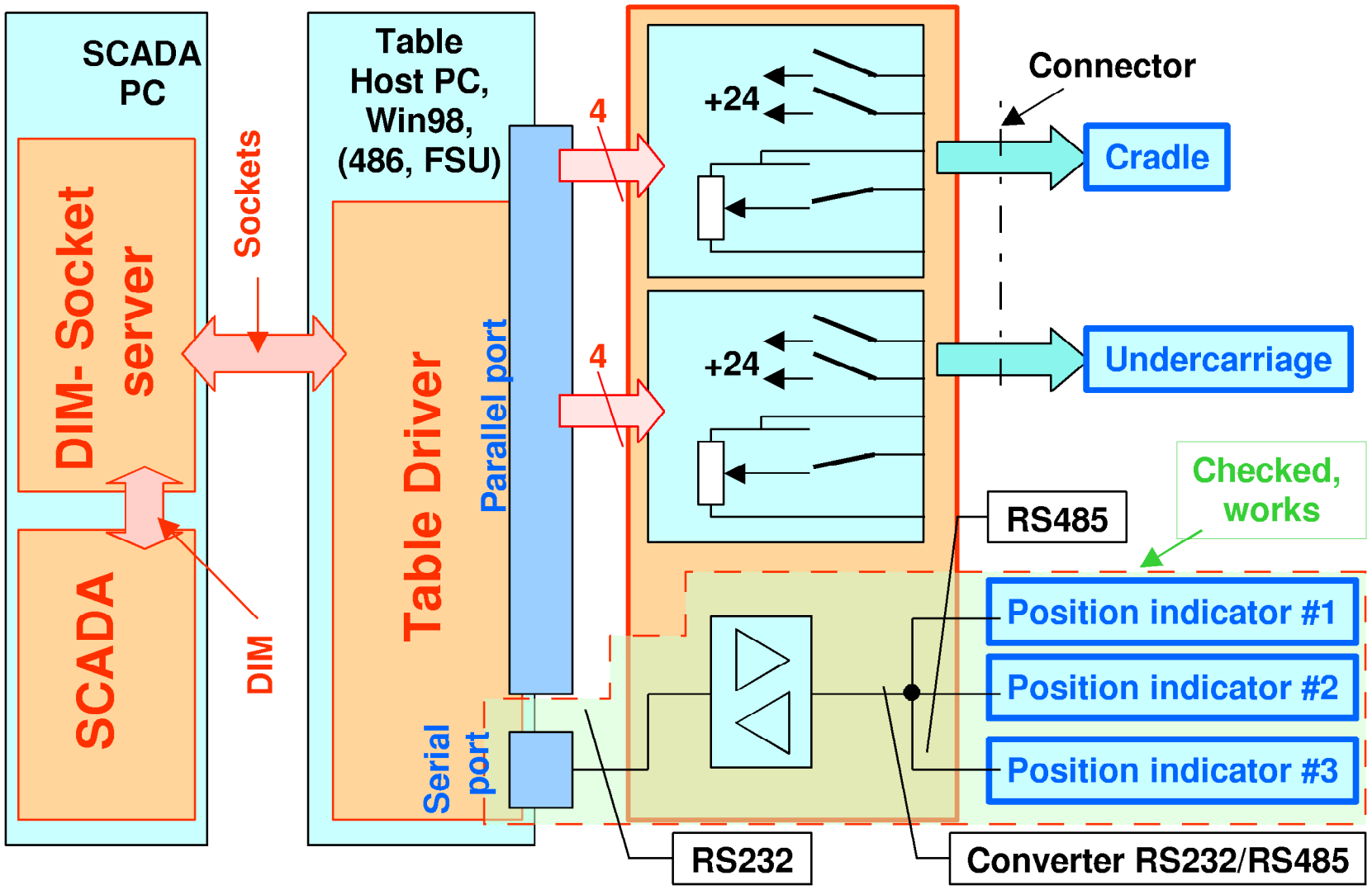
Laser Calibration



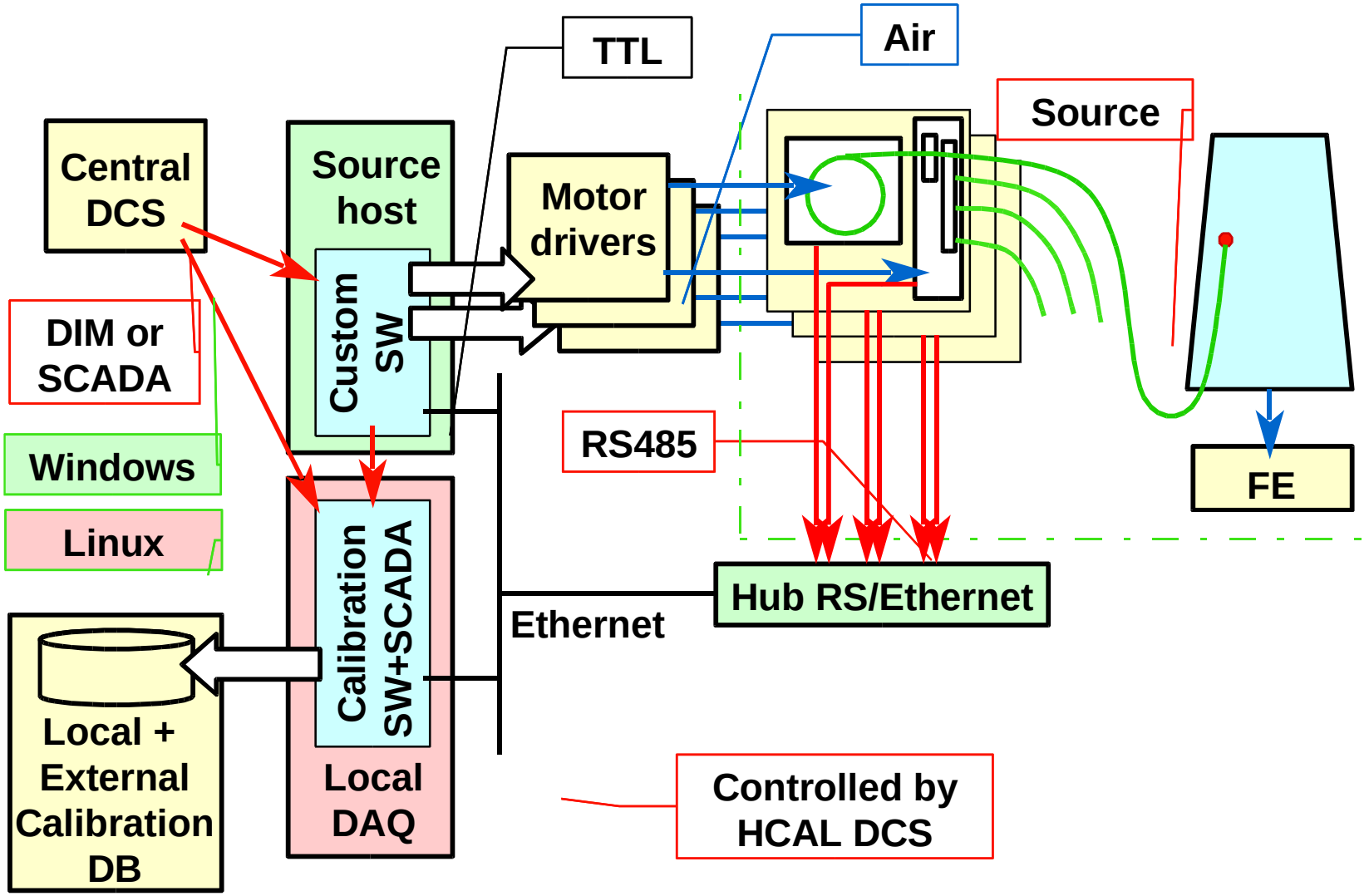
LED Calibration



Moving Table (Test Beam Only)



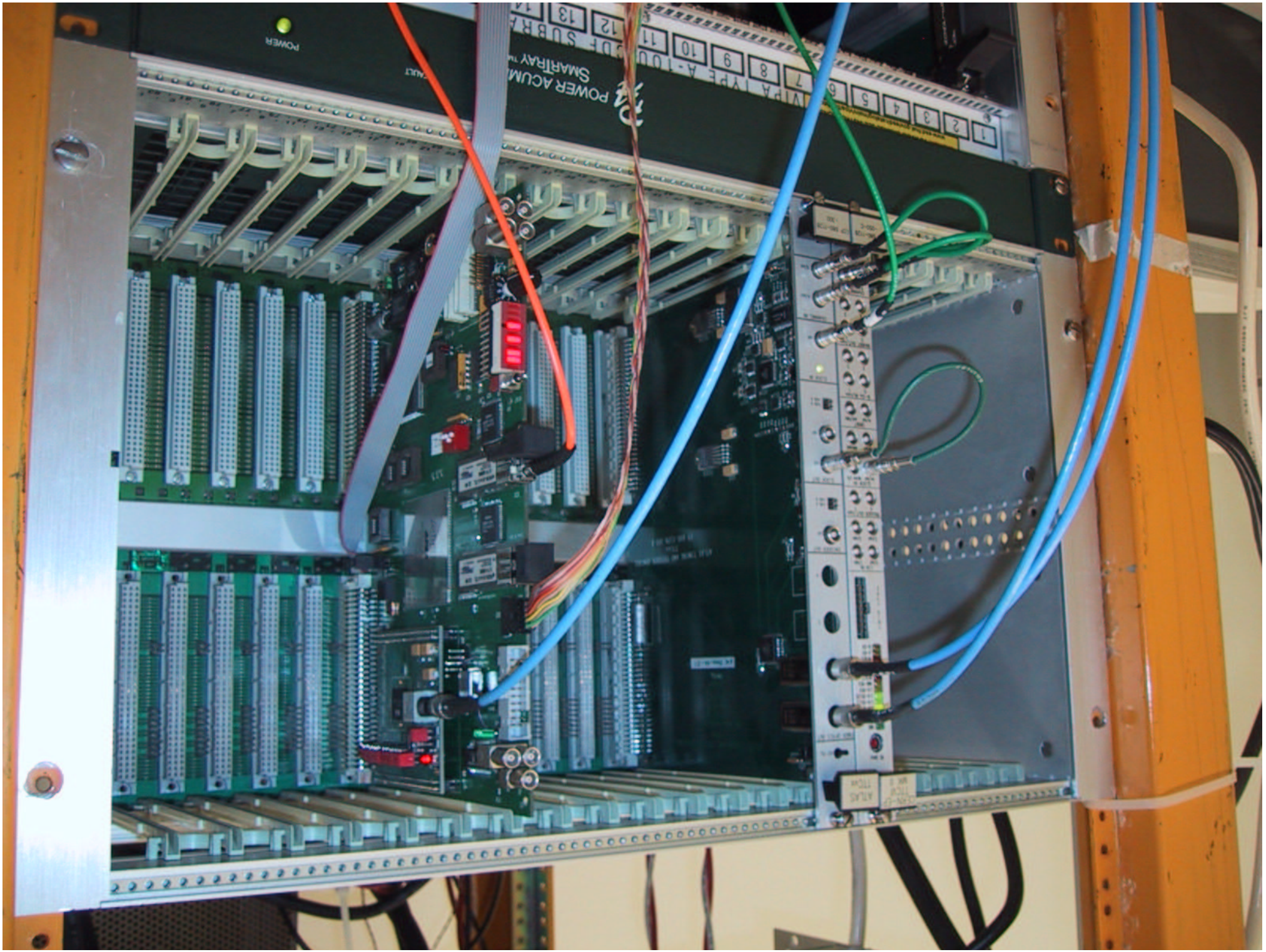
Source Calibration Control

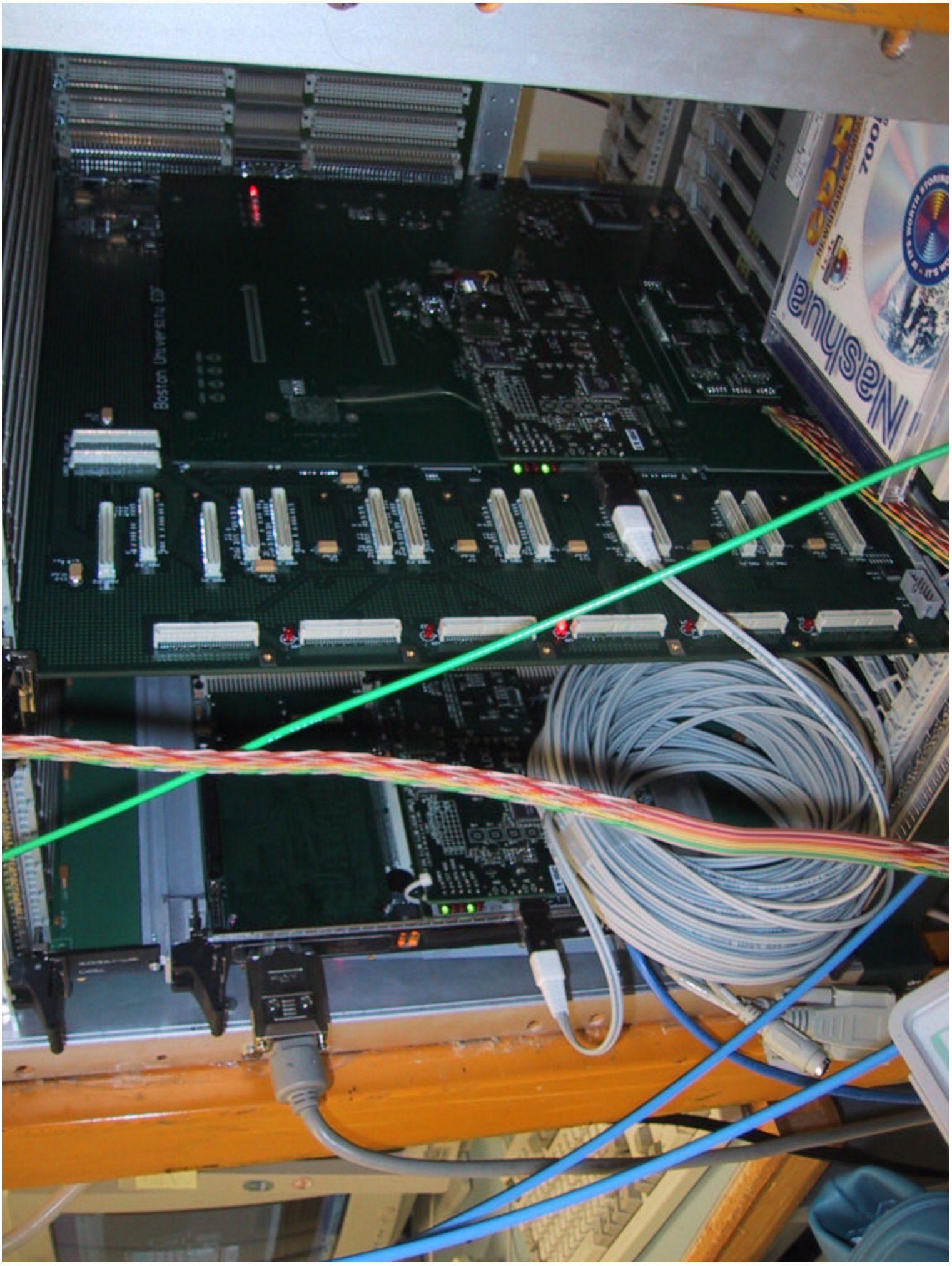


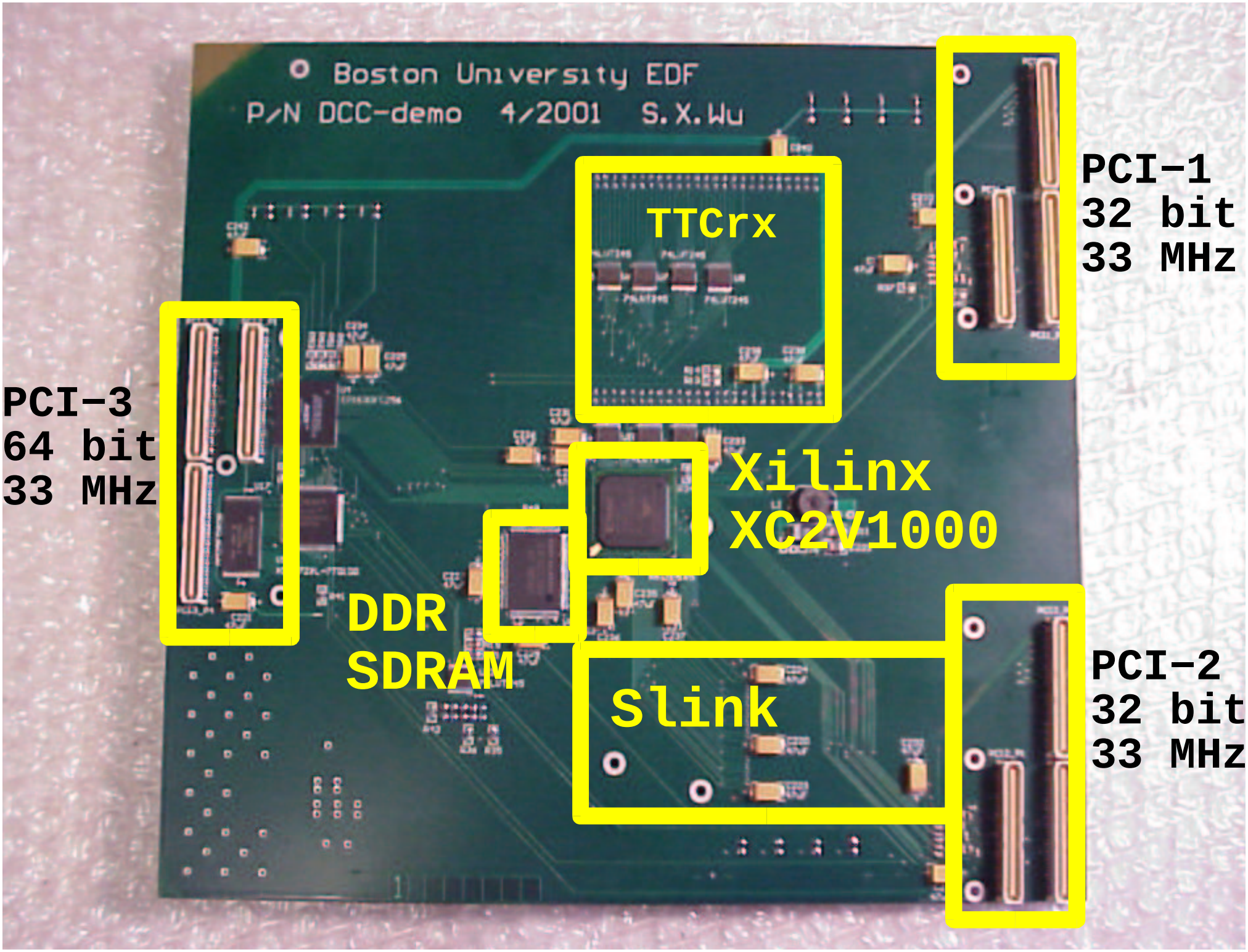
Basic Source Calibration Parameters

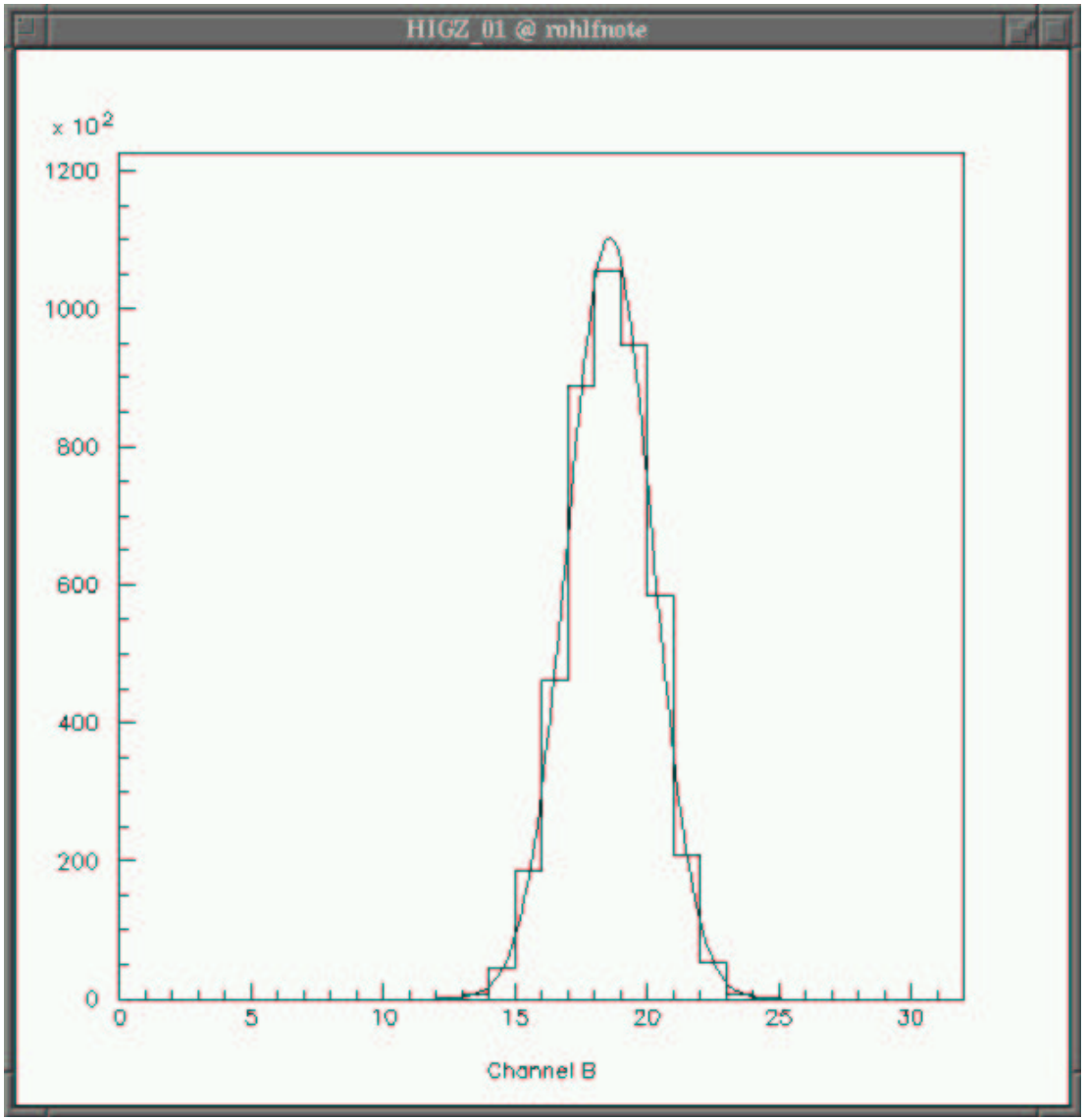
HCAL Stand−alone DAQ

5 mC source
Moving at 10 cm/s
Data every 2 mm (20 ms)
Need ~1M events for 2% calibration


POWER
POWER ACUM
SMARTRAY


Boston University ECE


Boston University EDF
P/N DCC-demo 4/2001 S.X.Wu
TTCrx
PCI-1
32 bit
33 MHz
PCI-3
64 bit
33 MHz
Xilinx
XC2V1000
DDR
SDRAM
Slink
PCI-2
32 bit
33 MHz



Run 10261, pedestal Ch. B all Caps

0.4 M events

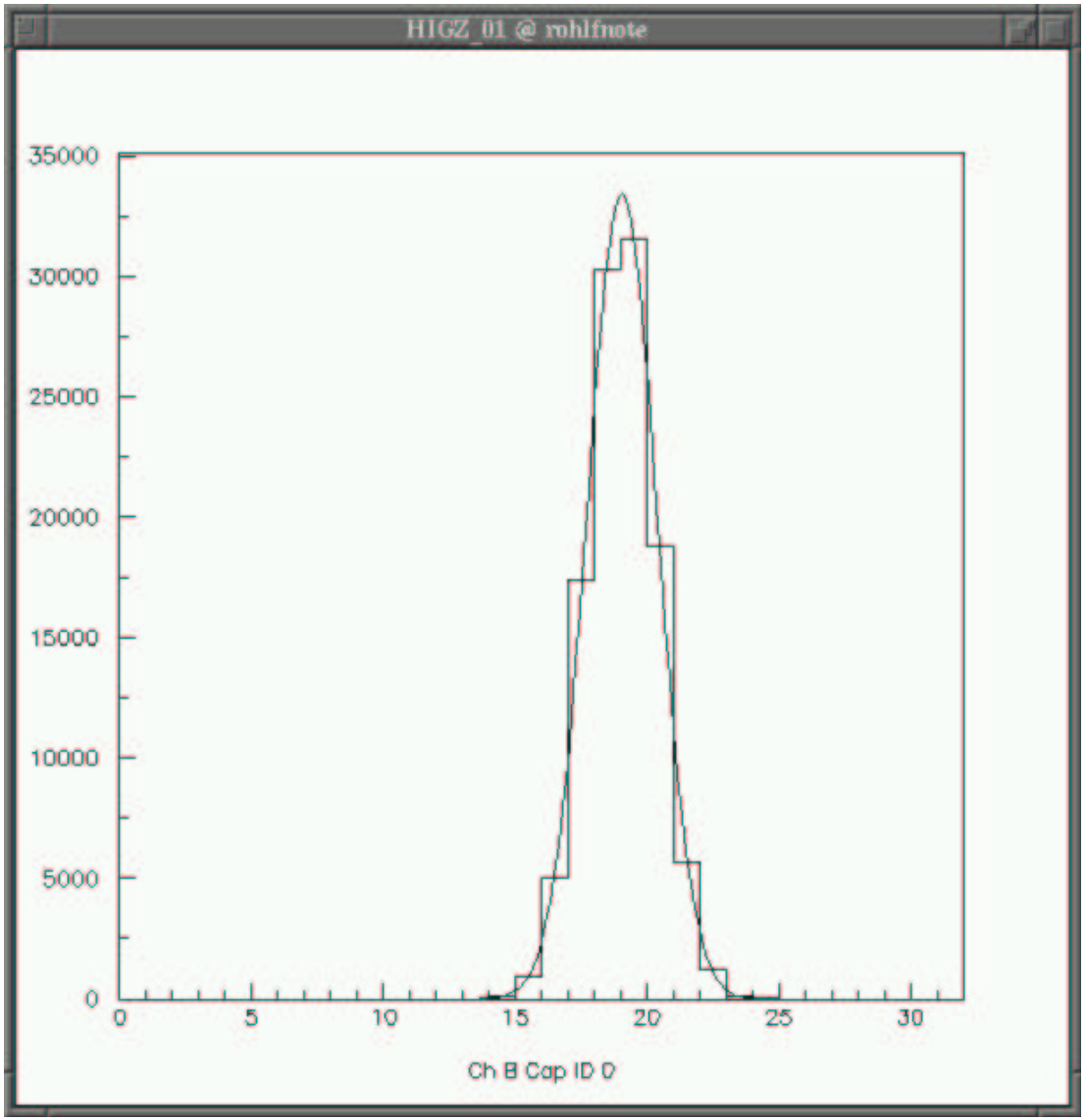
18.089 ± 0.002

σ = 1.603 ± 0.002

(3300 electrons)

EXT PARAMETER NO.	NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	Constant	0.11041E+06	200.12	279.31	−0.41532E−07
2	Mean	18.589	0.24187E−02	0.47027E−01	−16.952
3	Sigma	1.6027	0.16153E−02	0.40546E−02	−13.280

CHISQUARE = 0.5797E+02 NPFIT = 18



Run 10261, pedestal
Ch. B Cap ID = 0

0.1 M events

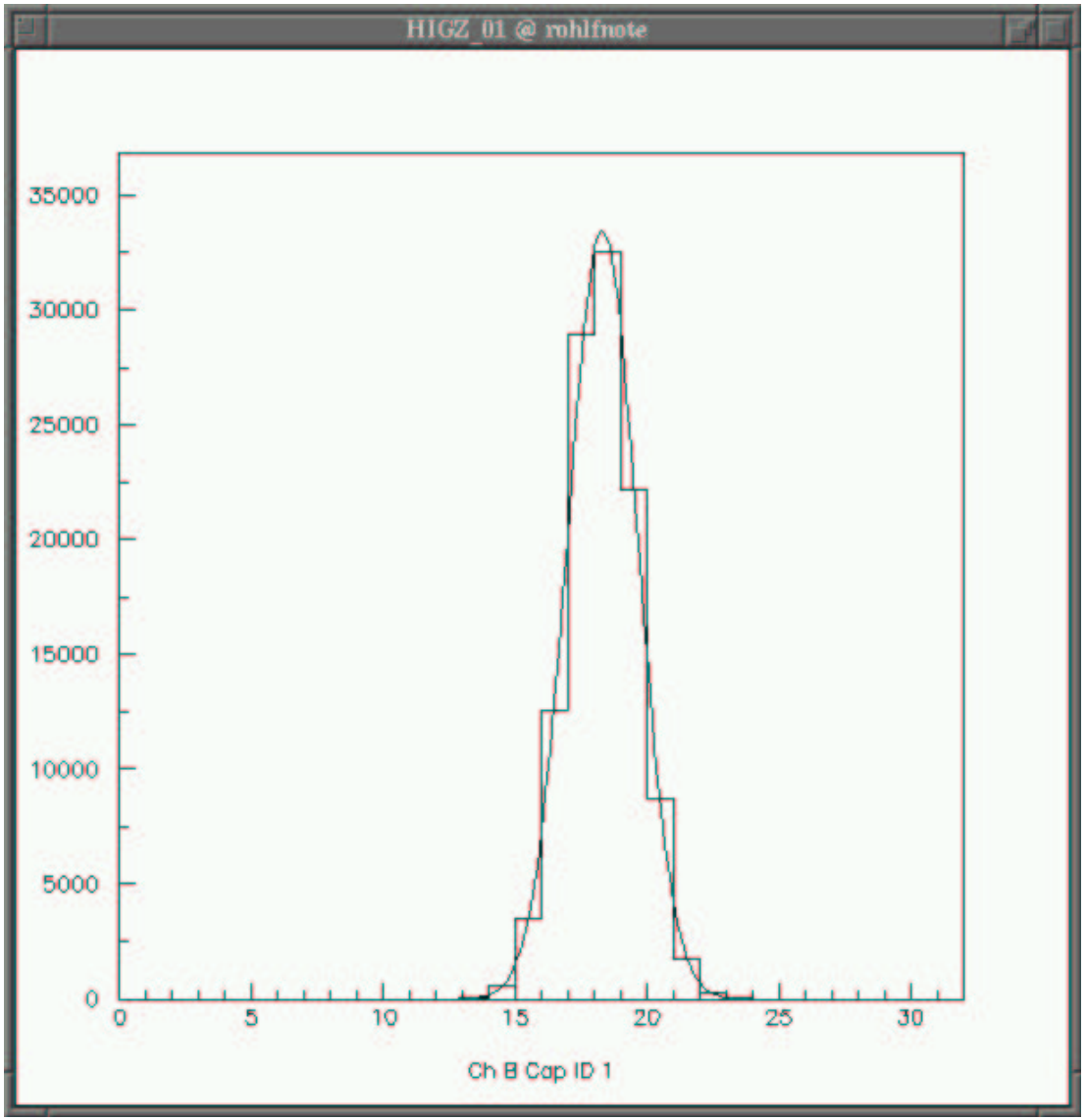
18.550 ± 0.004

$\sigma = 1.324 \pm 0.003$

(2750 electrons)

EXT NO.	PARAMETER NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	Constant	33454.	124.09	84.632	−0.91608E−05
2	Mean	19.050	0.39749E−02	0.48194E−01	0.17653
3	Sigma	1.3239	0.28546E−02	0.33492E−02	−2.5962

CHISQUARE = 0.7285E+01 NPFIT = 15



Run 10261, pedestal
Ch. B Cap ID = 1

0.1 M events

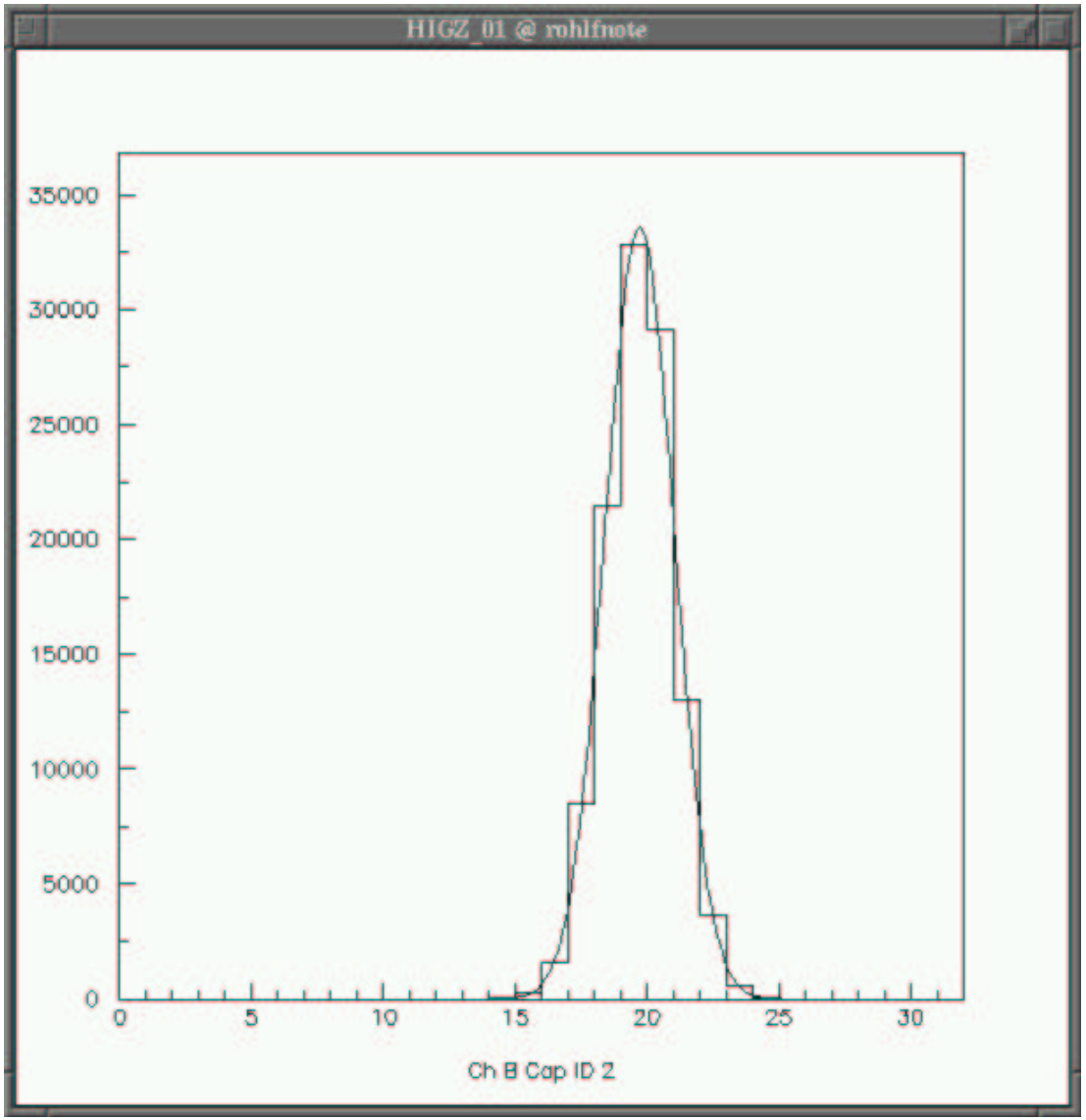
17.812 ± 0.004

$\sigma = 1.323 \pm 0.003$

(2750 electrons)

EXT PARAMETER NO.	NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	Constant	33456.	124.61	84.639	−0.63124E−05
2	Mean	18.312	0.39740E−02	0.46326E−01	1.7546
3	Sigma	1.3234	0.28851E−02	0.33480E−02	−2.7766

CHISQUARE = 0.9096E+01 NPFIT = 16



Run 10261, pedestal
Ch. B Cap ID = 2

0.1 M events

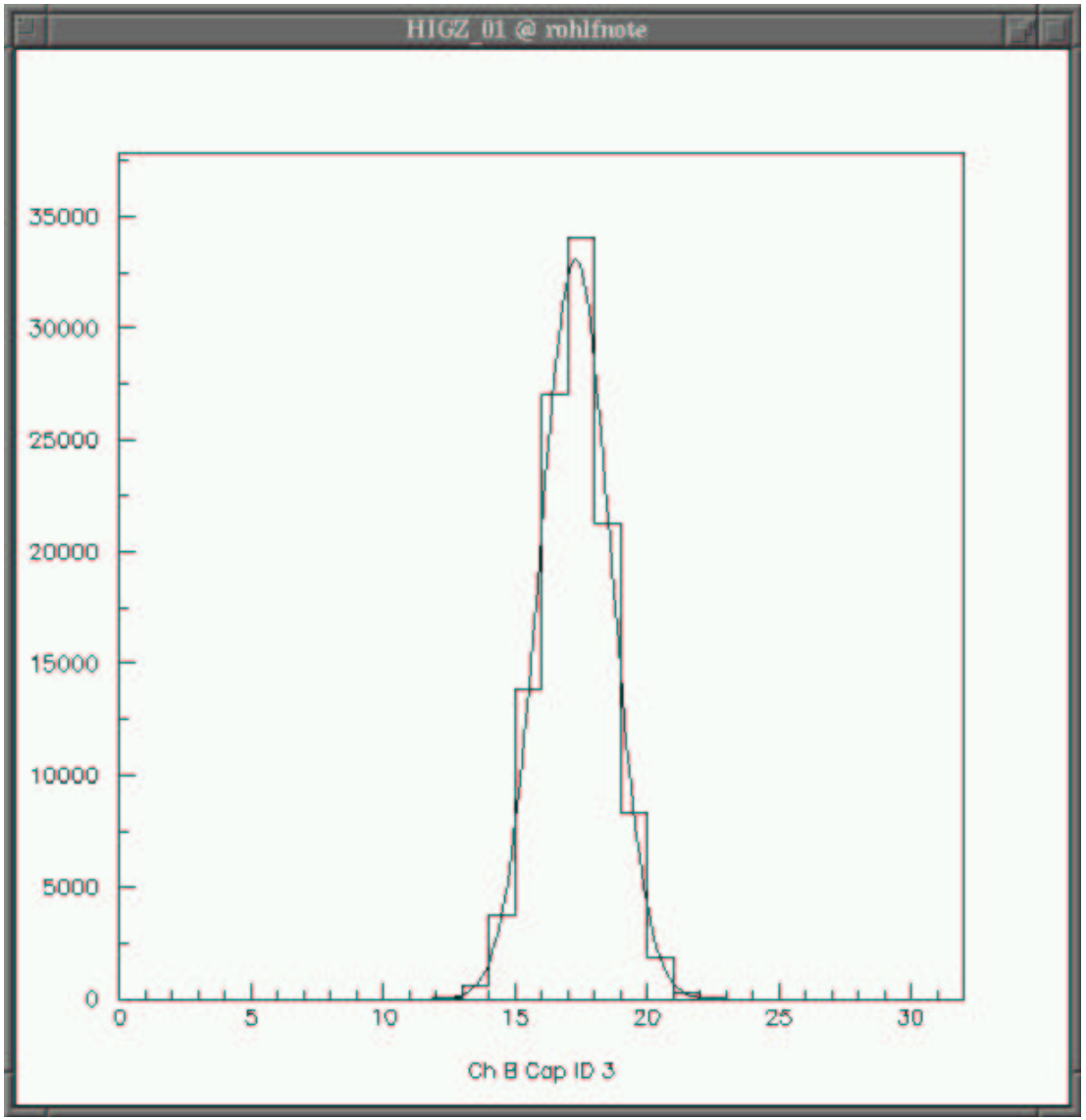
19.220 ± 0.004

$\sigma = 1.319 \pm 003$

(2740 electrons)

EXT PARAMETER NO.	NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	Constant	33573.	124.74	84.934	−0.60208E−05
2	Mean	19.720	0.39635E−02	0.49887E−01	−0.59073
3	Sigma	1.3190	0.28620E−02	0.33369E−02	−2.9135

CHISQUARE = 0.8460E+01 NPFIT = 15



Run 10261, pedestal
Ch. B Cap ID = 3

0.1 M events

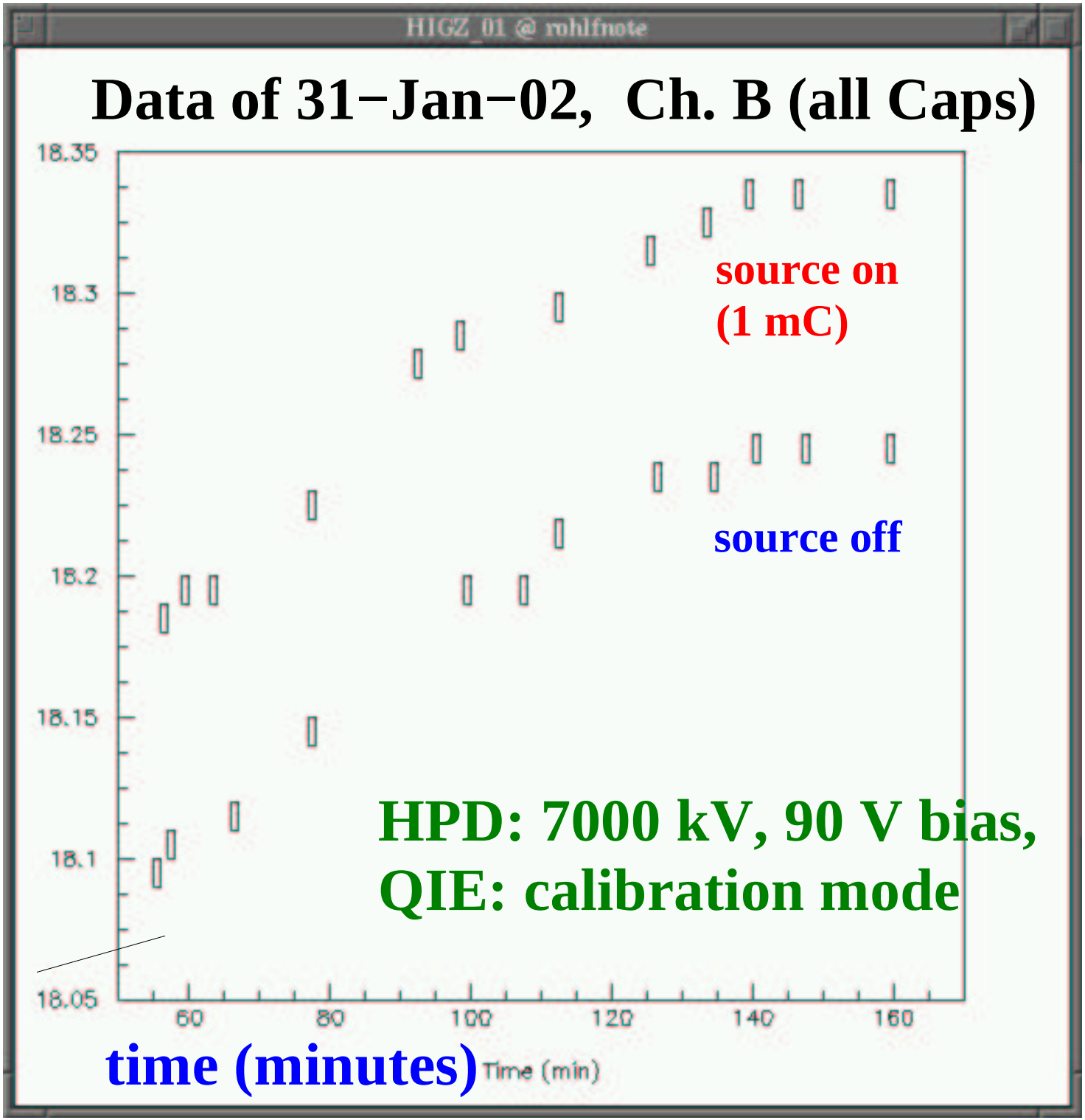
16.782 ± 004

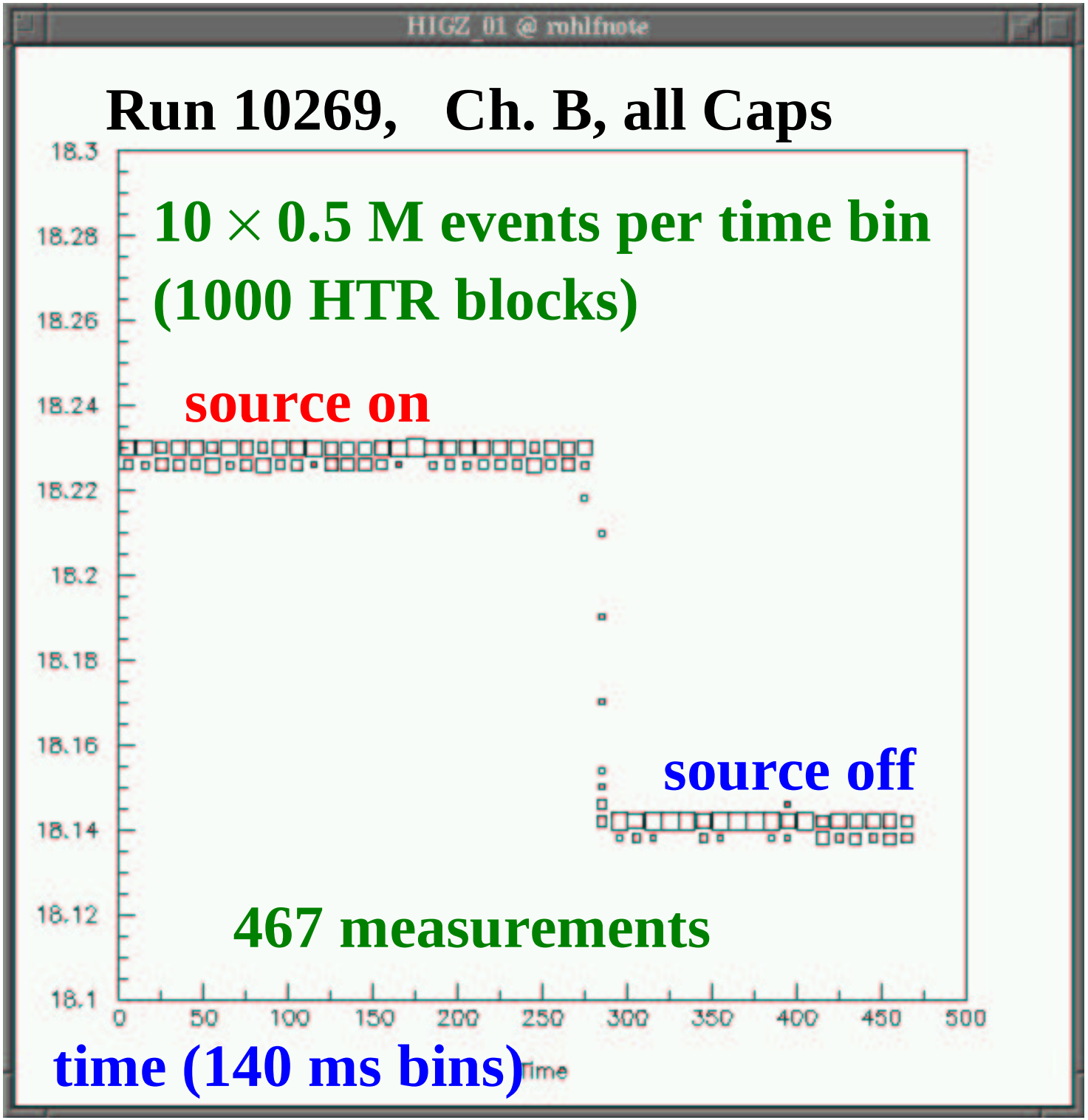
σ = 1.337 ± 0.003

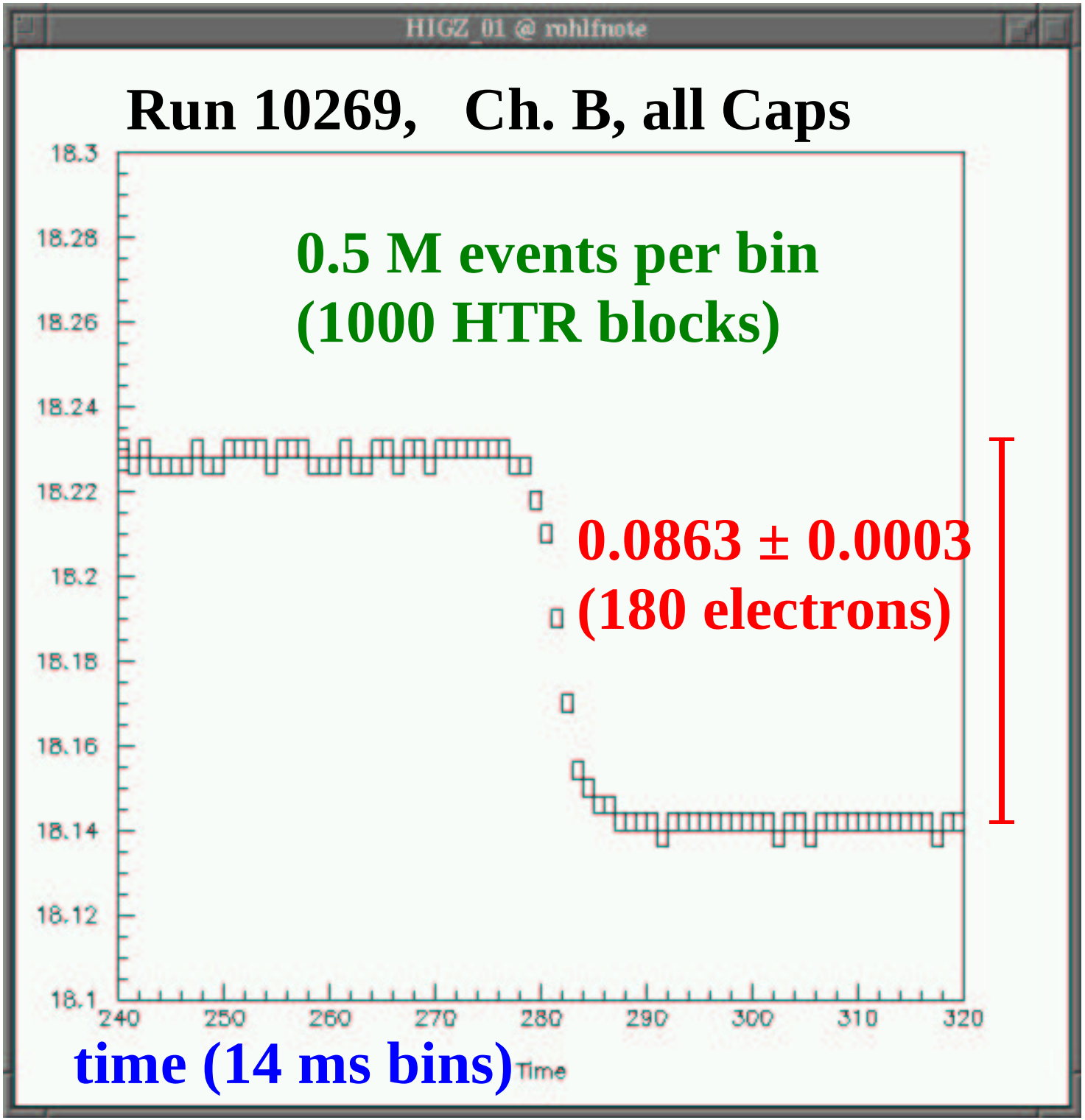
(2780 electrons)

EXT PARAMETER NO.	NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	Constant	33111.	123.52	83.766	−0.12907E−04
2	Mean	17.282	0.40153E−02	0.43721E−01	−0.96354
3	Sigma	1.3372	0.29311E−02	0.33828E−02	−2.4250

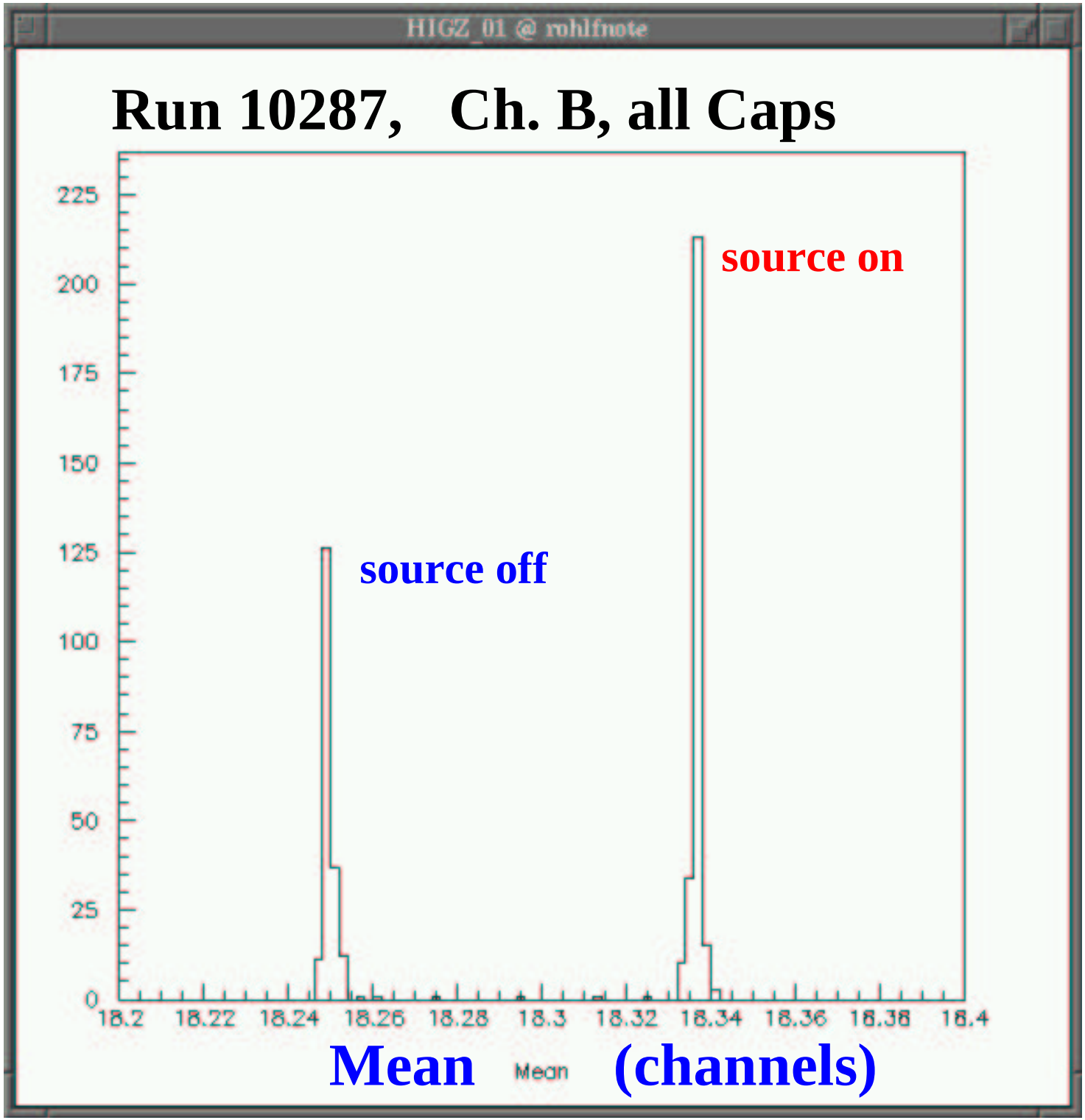
CHISQUARE = 0.9296E+01 NPFIT = 16


HIGZ_01 @ rohlfnote
Data of 31−Jan−02, Ch. B (all Caps)
18.35
18.3
18.25
18.2
18.15
18.1
18.05
60
80
100
120
140
160
Time (min)
source on
(1 mC)
source off
HPD: 7000 kV, 90 V bias,
QIE: calibration mode
Mean
(channels)
supp.
zero
time (minutes)

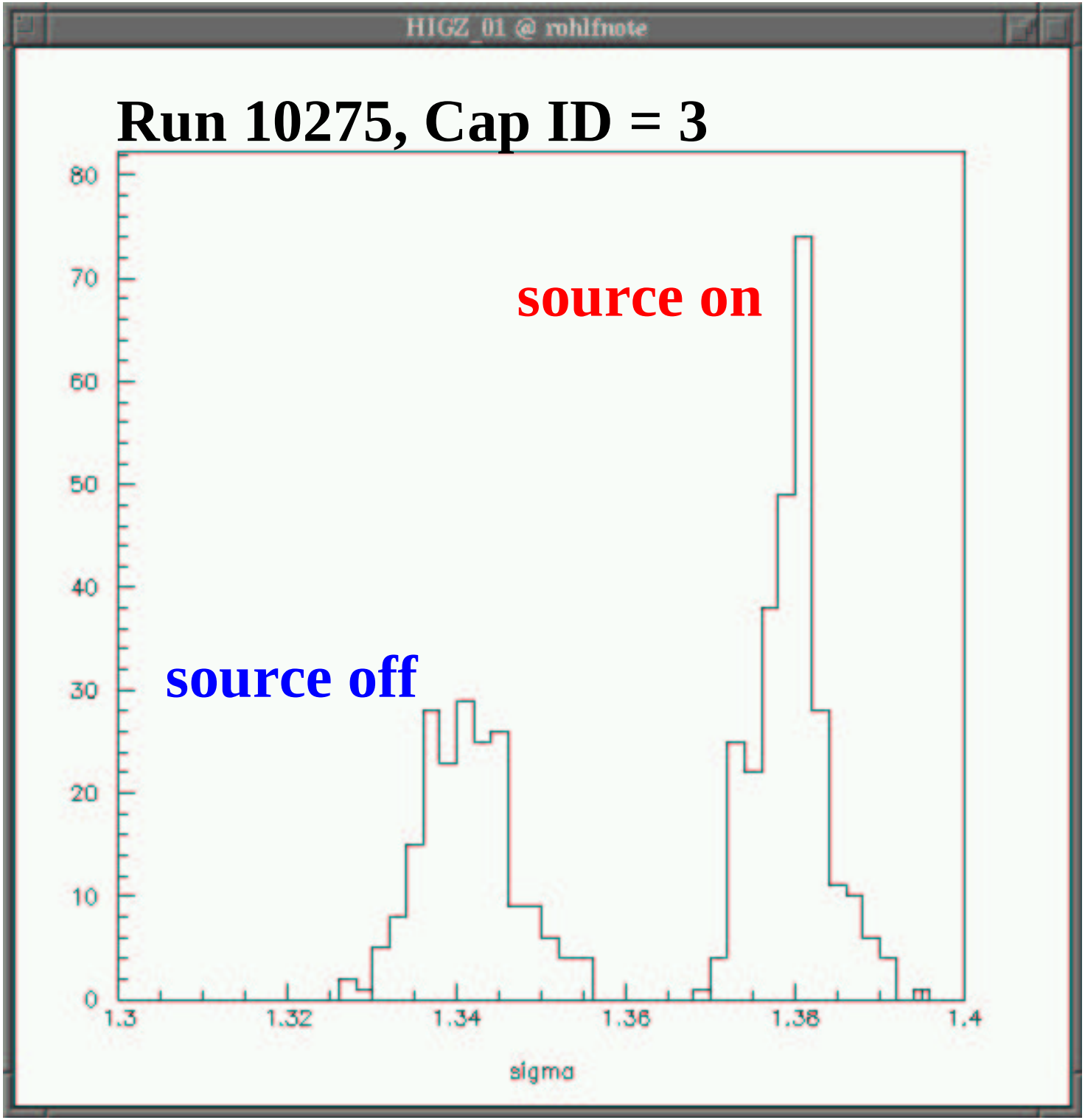

HIGZ_01 @ rohlfnote
Run 10269, Ch. B, all Caps
10 × 0.5 M events per time bin
(1000 HTR blocks)
source on
source off
467 measurements
Mean
(channels)
time (140 ms bins)
Time
18.3
18.28
18.26
18.24
18.22
18.2
18.18
18.16
18.14
18.12
18.1
0
50
100
150
200
250
300
350
400
450
500

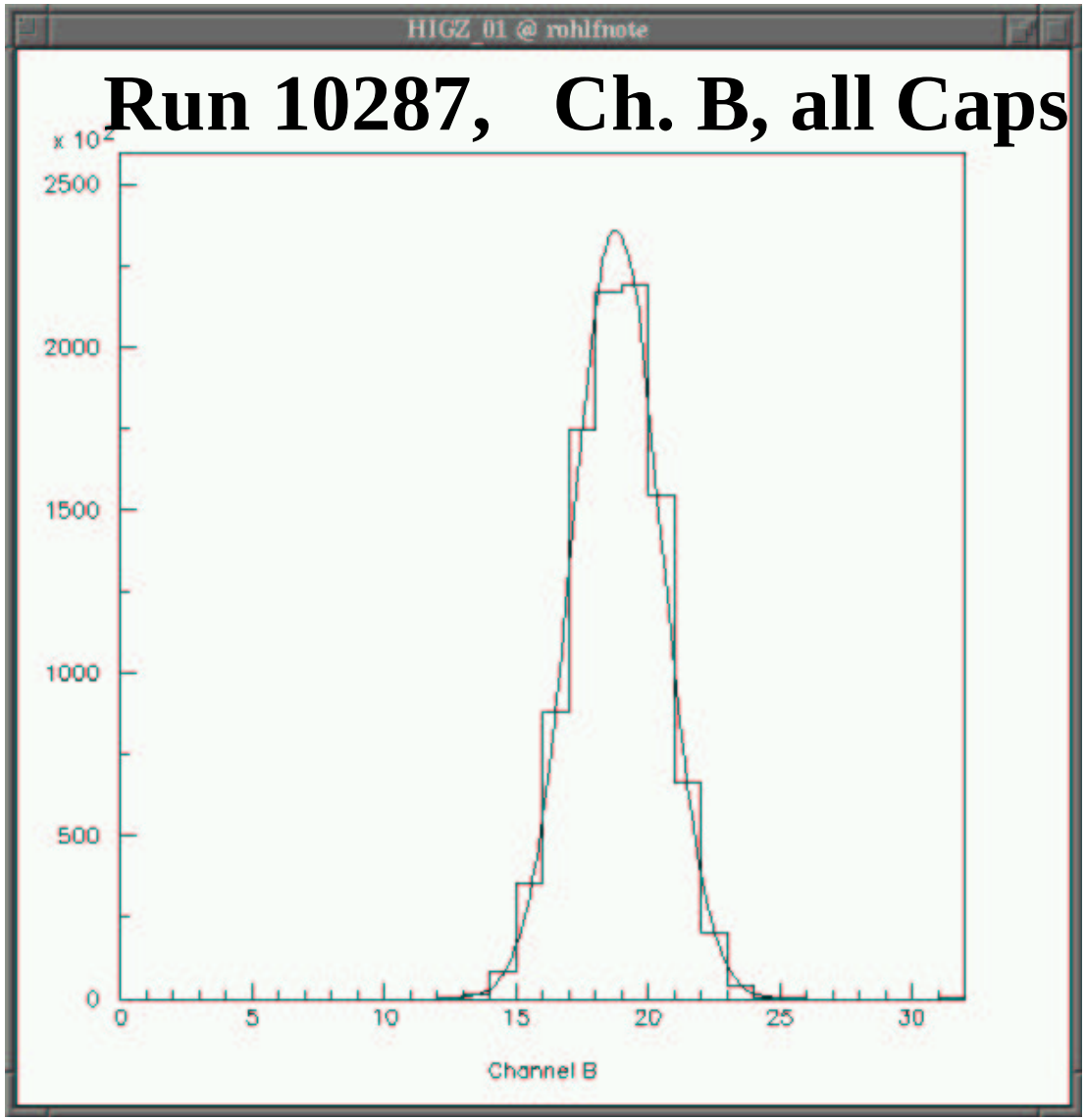

HIGZ_01 @ rohlfnote
Run 10269, Ch. B, all Caps
0.5 M events per bin
(1000 HTR blocks)
0.0863 ± 0.0003
(180 electrons)
time (14 ms bins)
Time
18.3
18.28
18.26
18.24
18.22
18.2
18.18
18.16
18.14
18.12
18.1
240
250
260
270
280
290
300
310
320

Number of measurements (0.5 M events) per 0.002 ch.



Dist. of widths (meas. per 0.002 ch.)





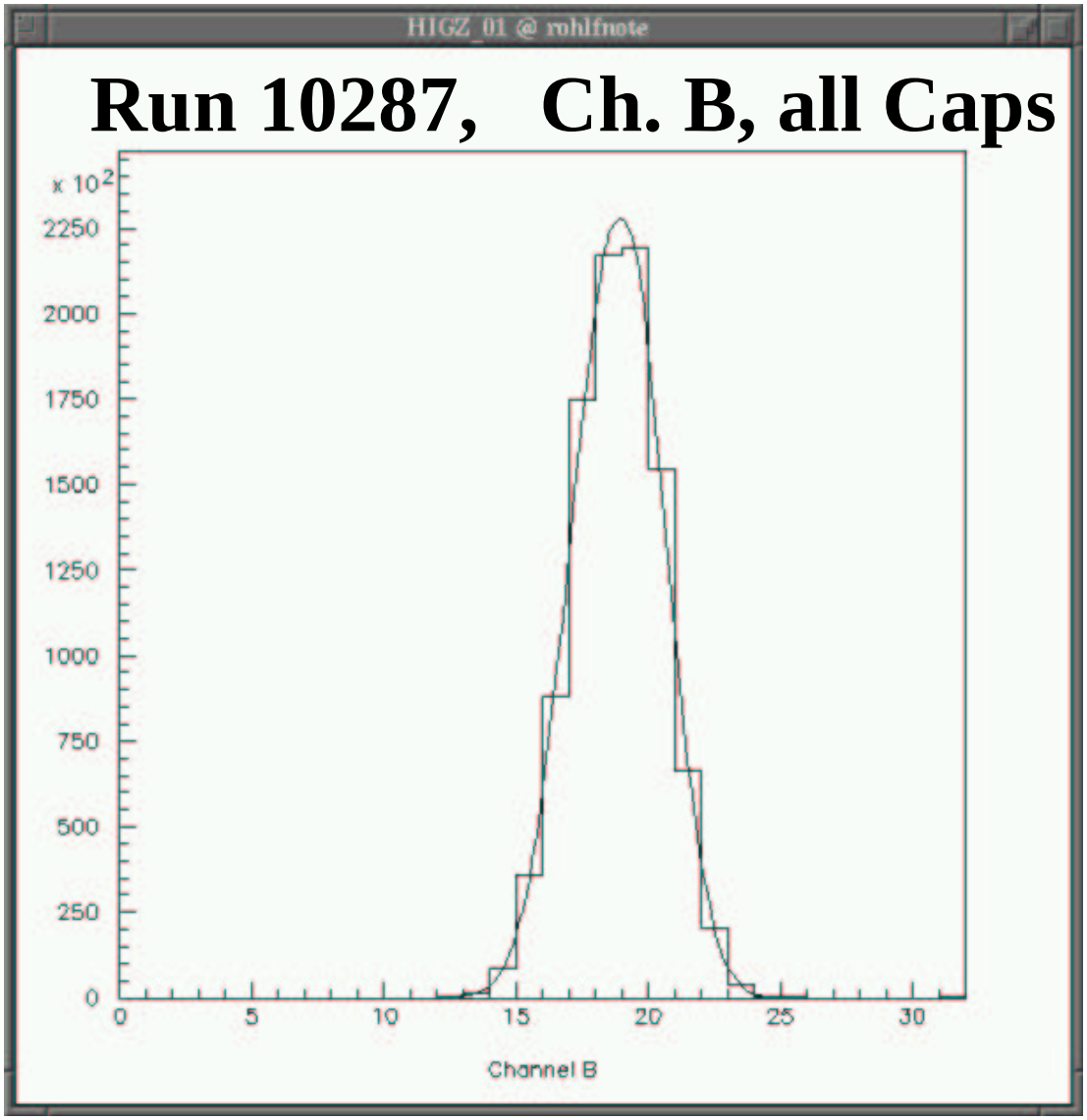
1 M events

From mean:
0.0870 ± 0.0017

From fit (g+p):
0.0876 ± 0.0015
(182 ± 3 elec.)

EXT PARAMETER NO.	NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	P1	0.24146E+06	242.91	610.84	−0.88025E−04
2	P2	0.87629E−01	0.14759E−02	0.31000E−02	24.093

CHISQUARE = 0.1585E+03 NPFIT = 24



From fit (4g+p):
0.0867 ± 0.0015

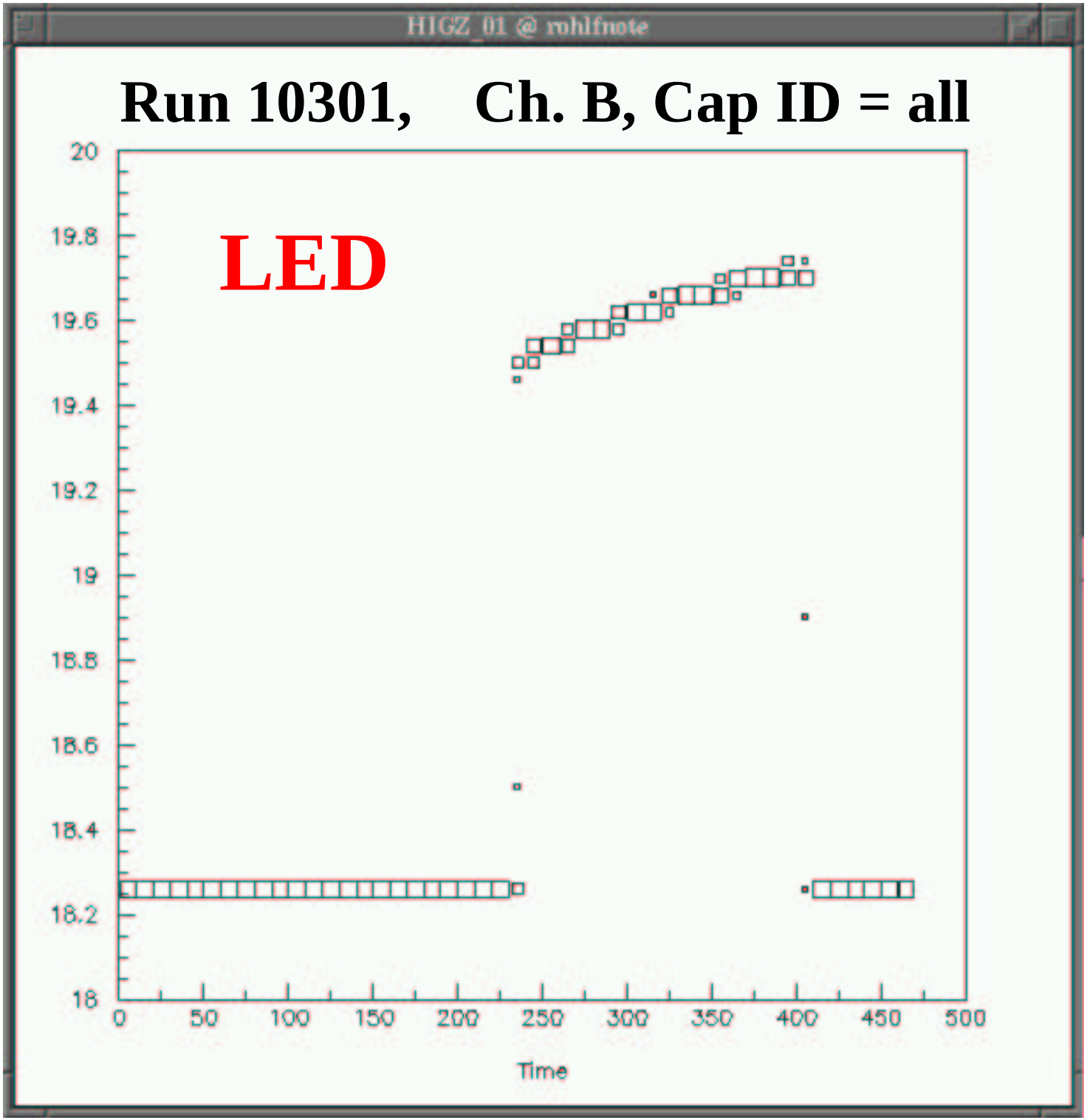
Comments:

1) This is a check of the observed pulse shape with source

2) Need to know mean from each cap to do this fit

EXT PARAMETER NO.	NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	P1	98728.	99.169	−7.3996	0.53694E−05
2	P2	0.86691E−01	0.14941E−02	−0.31544E−04	1.8051

CHISQUARE = 0.5055E+02 NPFIT = 24

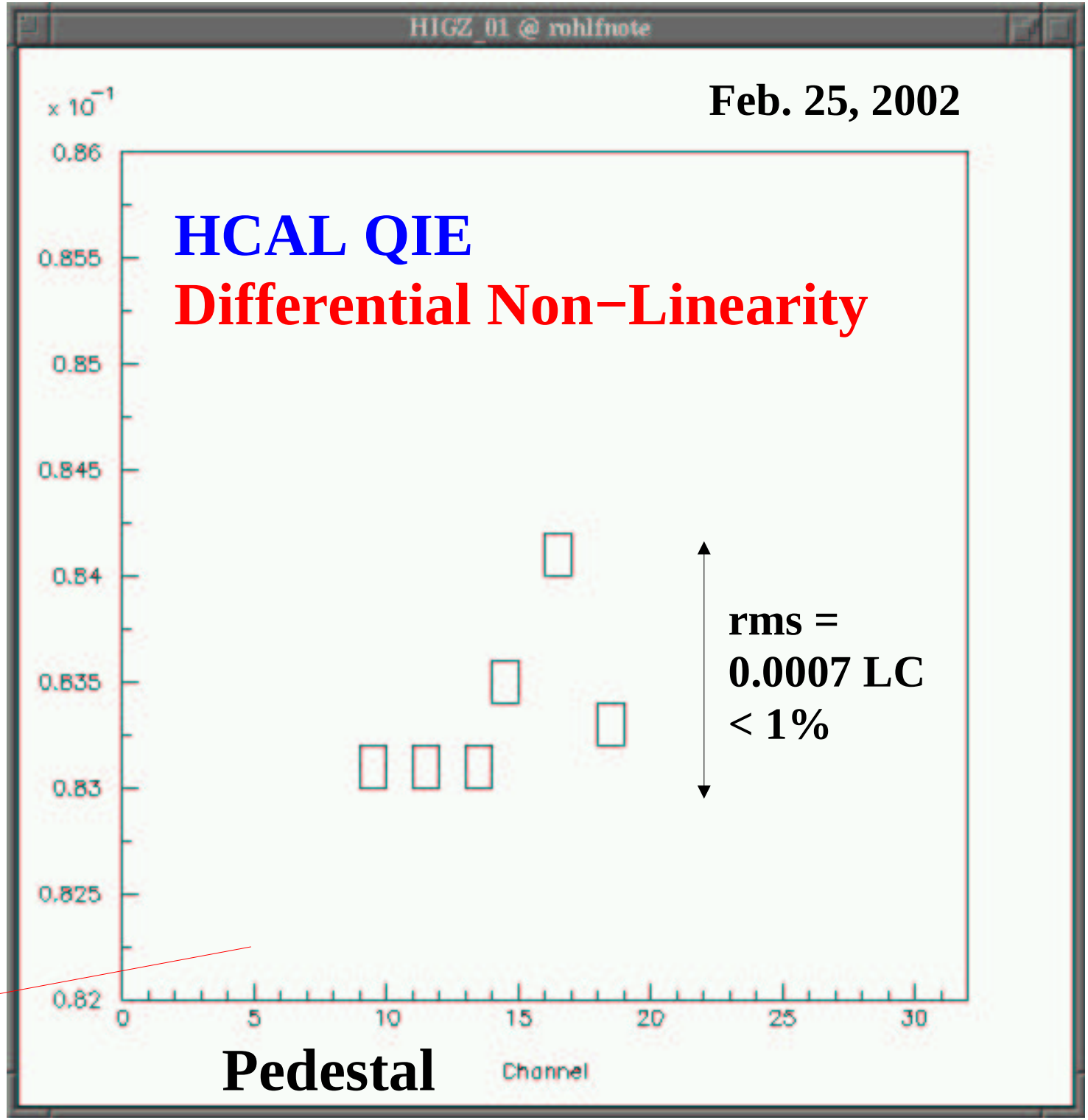

HIGZ_01 @ rohlfnote
Run 10301, Ch. B, Cap ID = all
LED
20
19.8
19.6
19.4
19.2
19
18.8
18.6
18.4
18.2
18
0
50
100
150
200
250
300
350
400
450
500
Time

Stability of source signal good to better than 1%

as observed over one month

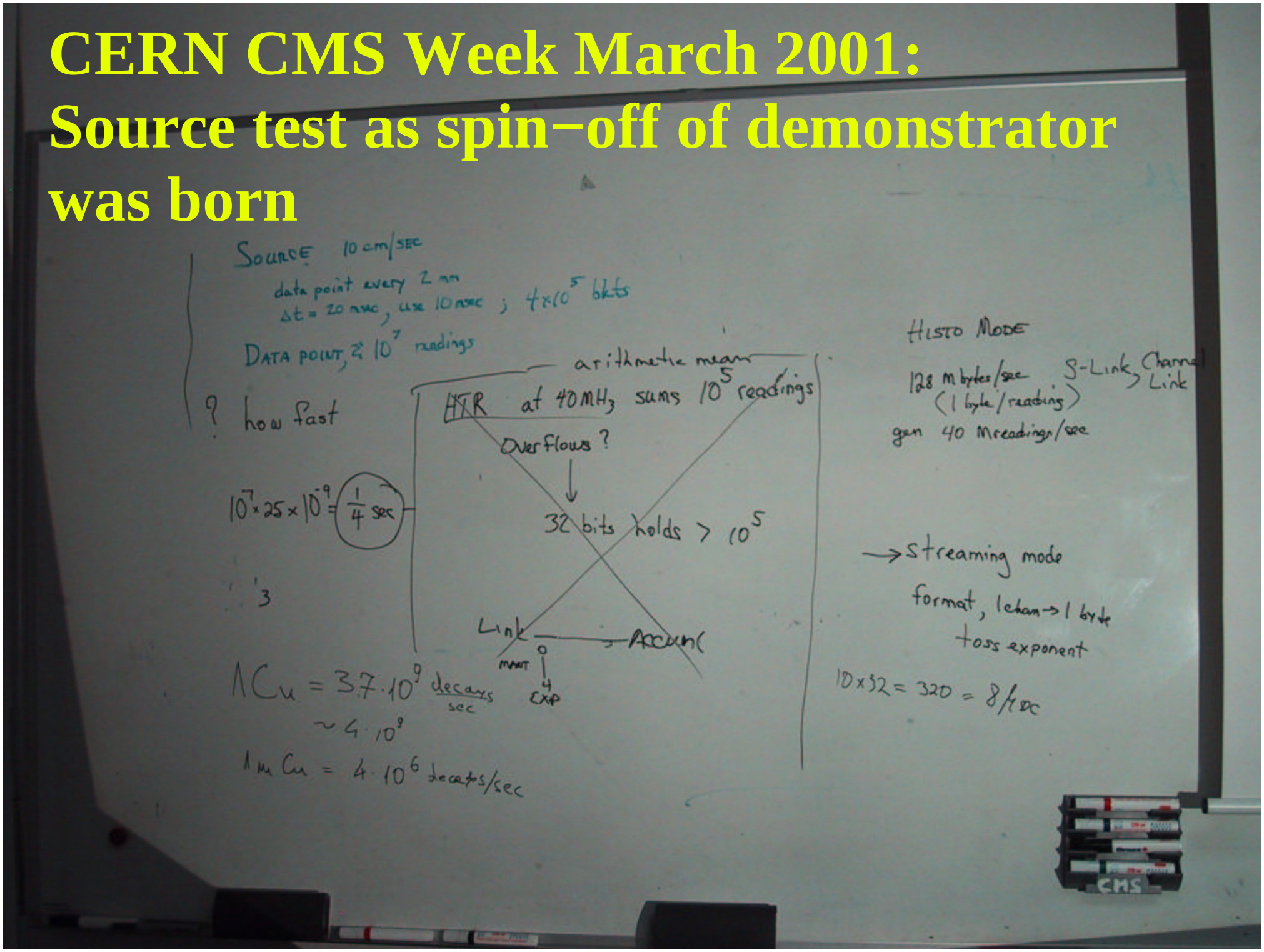
Source Signal

(LC above ped.)



suppressed zero

CERN CMS Week March 2001: Source test as spin−off of demonstrator was born



Conclusions (source calibration):

Calibration of HCAL by radioactive source to $\leq 2\%$ can be made to work, (the "source test" is completed)

Scintillator + fibers, HPD, QIE, TTCvx, TTCvi, Glink, HTR, LVDS link, DCC, Slink, VME CPU have been successfully integrated!

(2 channels, $\times$5000 to do)

Detector Controls Work List

1) Finish HV (2 crate test + documentation)
2) Test beam environment
3) LV (custom code and SCADA panels)
hardware and software
4) Source (wrapper on CDF with DIM)
this system will then evolve to meet our specific needs and DCS framework
5) Laser
6) Event spy and FPGA code loading

HCAL DCS Plans:

Test Beam 2002 (24 July−10 Sept.)

Computer control of
HV, CCM, Source, Moving Table

Bandwidth for Testbeam

Spill is 5.2 s on, 11.6 s off

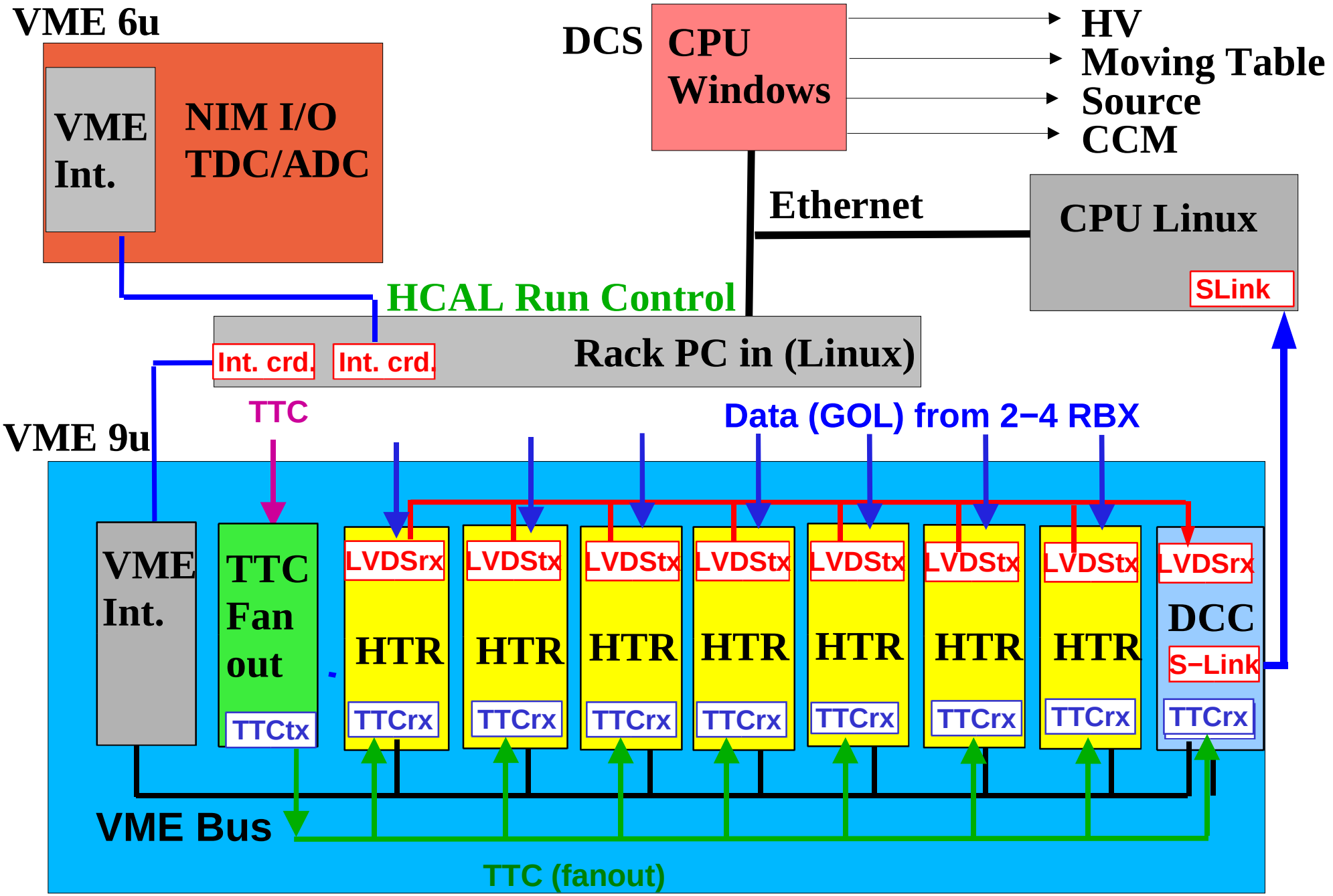
Trigger rate = 5 kHz

(144 ch.)(10 Bytes/ch.)(5000/s)(5 s)= 1.5 MB/s

8 MBytes per spill

30 MBytes/m or 2 GByte per hour

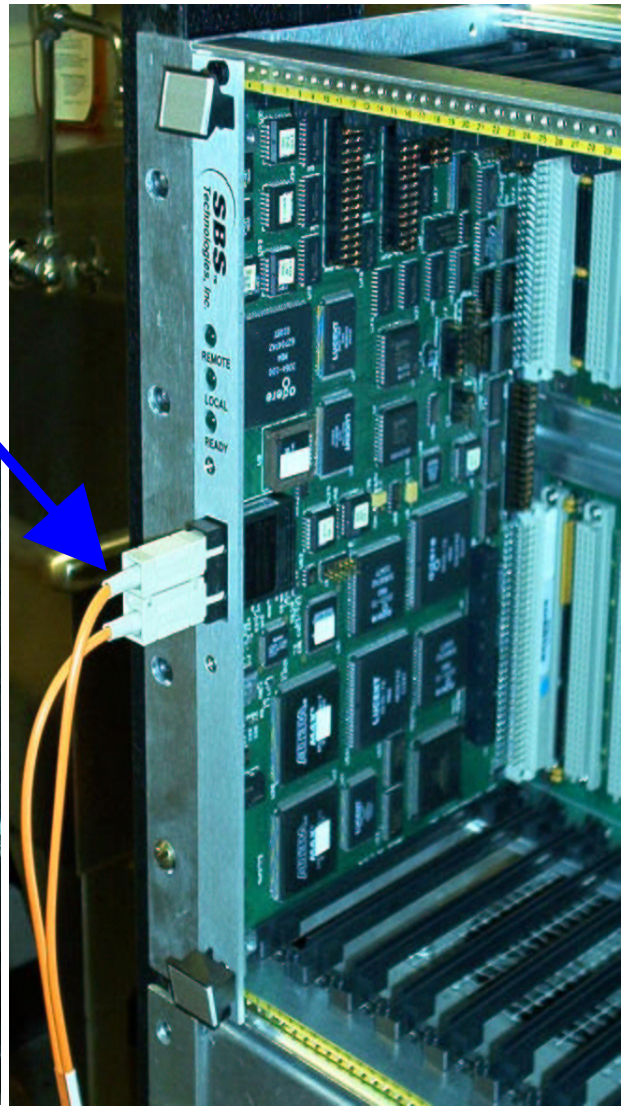
CERN 2002 Test Beam



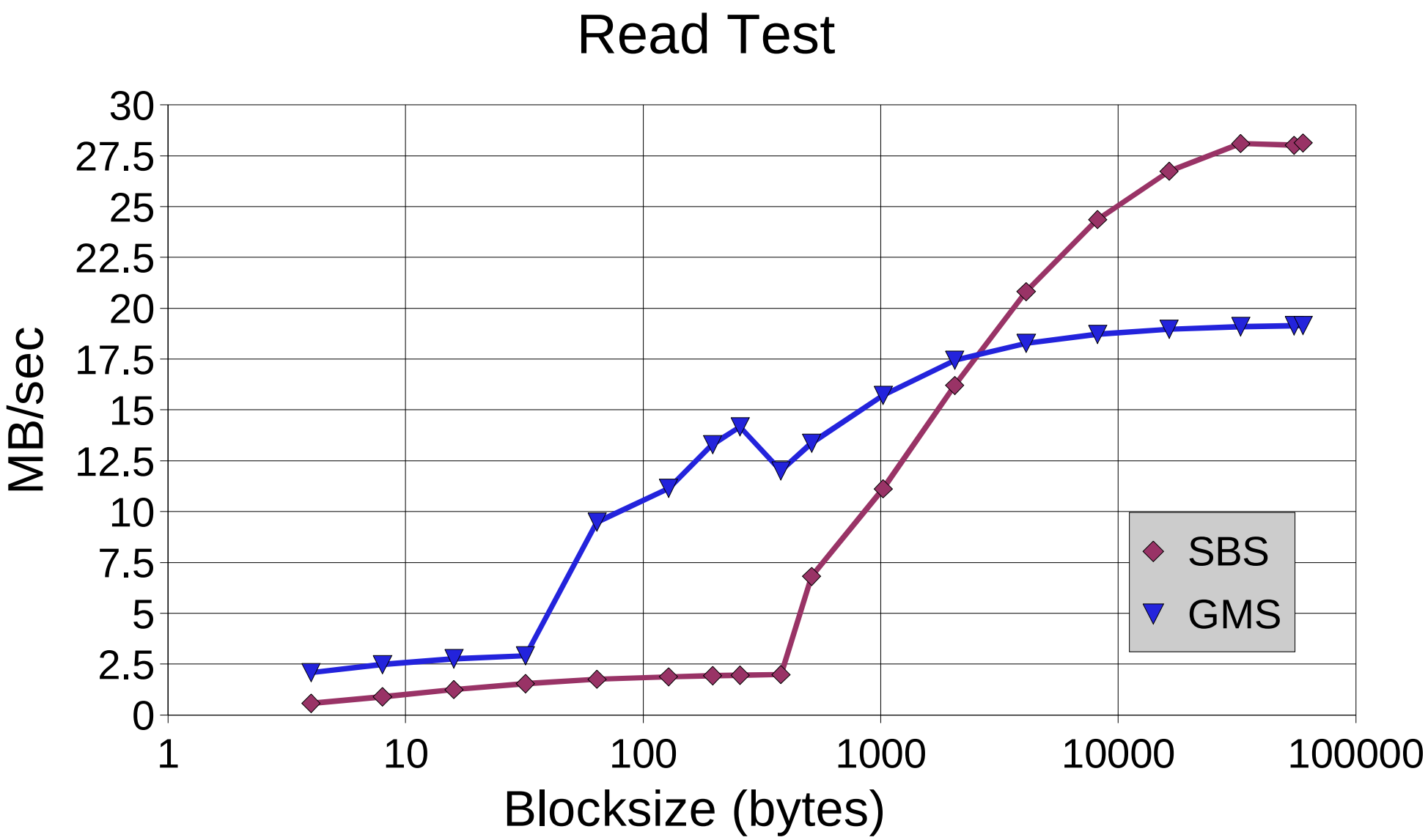
VME Interface:

High I/O rackmount PC driving an SBS/Bit3 VME master board via PCI interface

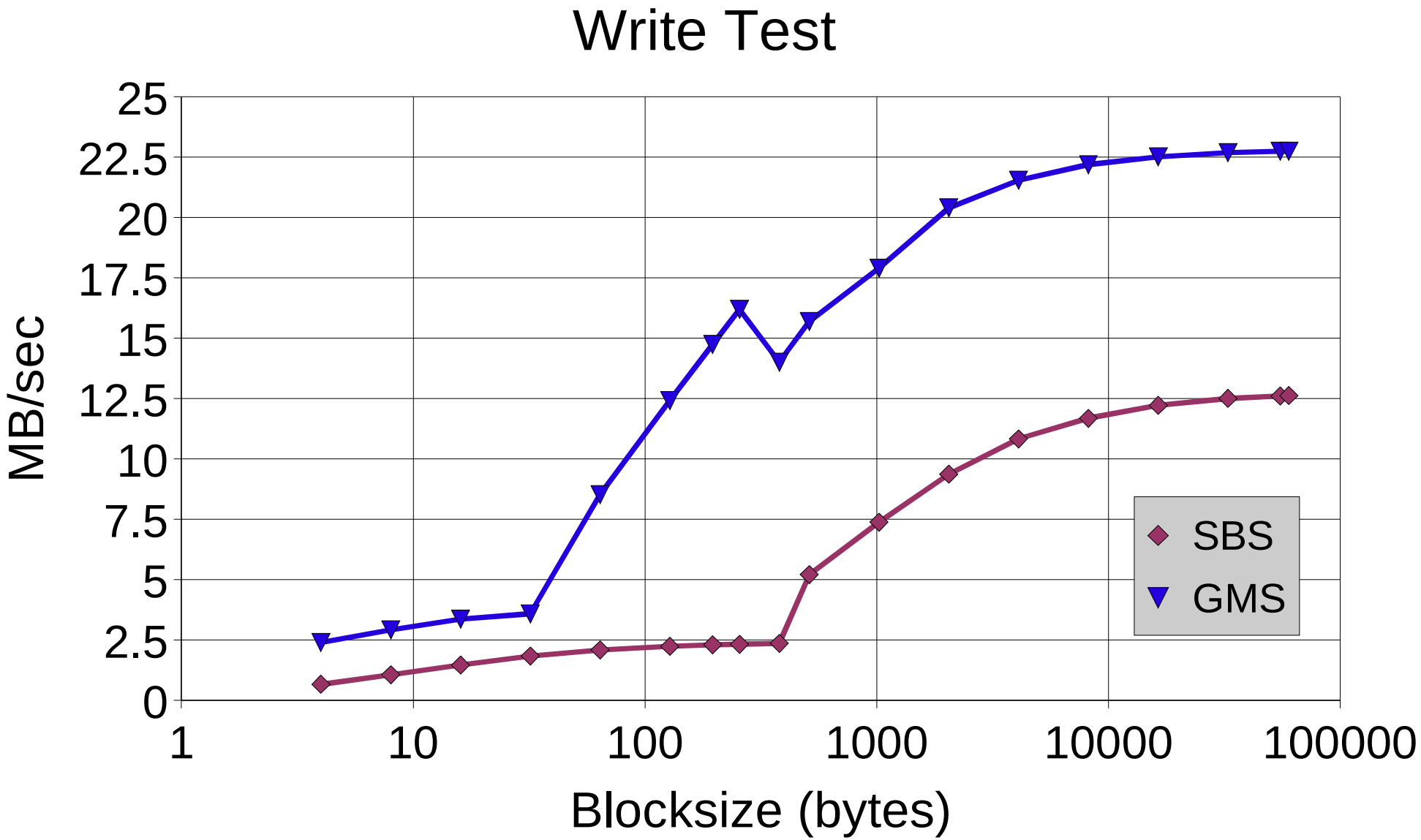
Optical Fiber Link



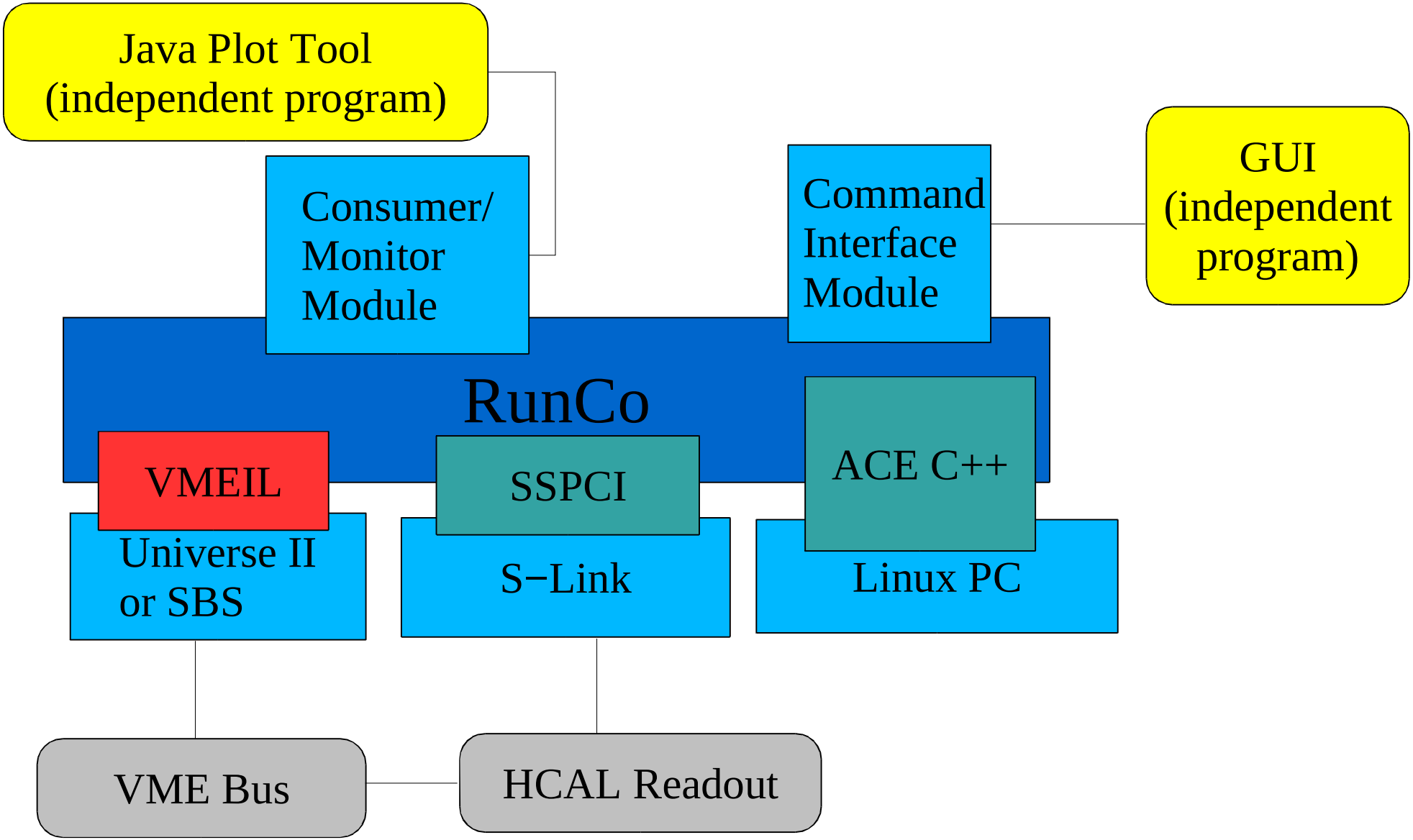
VME Read Results



VME Write Results



Software Architecture: HCAL Local DAQ



Requests

1. For JCOP
   - Extension of the HV framework to HCAL HV Power supplies
   - Stability of releases (do not change philosophy)
   - Description and toolkit for all interfaces including interface of PVSS DB to external (condition) DB.
   - humidity control
   - gas control (primitive)
   - cooling control
2. For CMS DCS group
   - Continuation of development and definition of
     - Interfaces
     - Naming scheme (naming convention)