Beamline for Schools
DAQ and shift responsibilities

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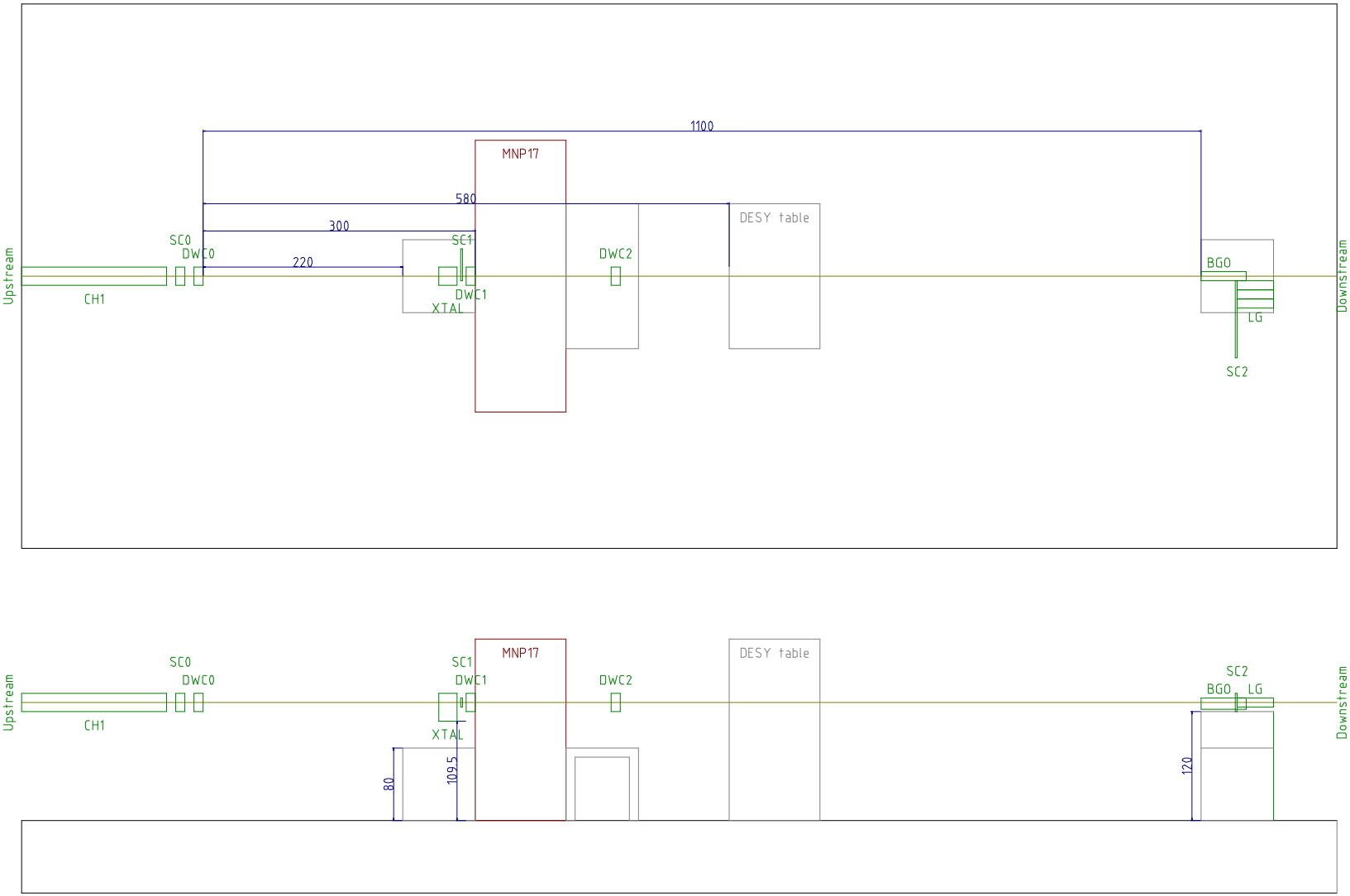
T9 facilities

T9 control room

T9 experiment zone access door

Experiment set-up



We (ab)use acronyms to refer to detector elements:

Detector type	Names
Cherenkov	CH0, CH1
Scintillator	SC0, SC1, SC2
Delay Wire Chamber	DWC0, DWC1, DWC2
Lead Glass Calorimeter	LG0, LG1, LG2, LG3
Bismuth Germanate Calorimeter	BGO

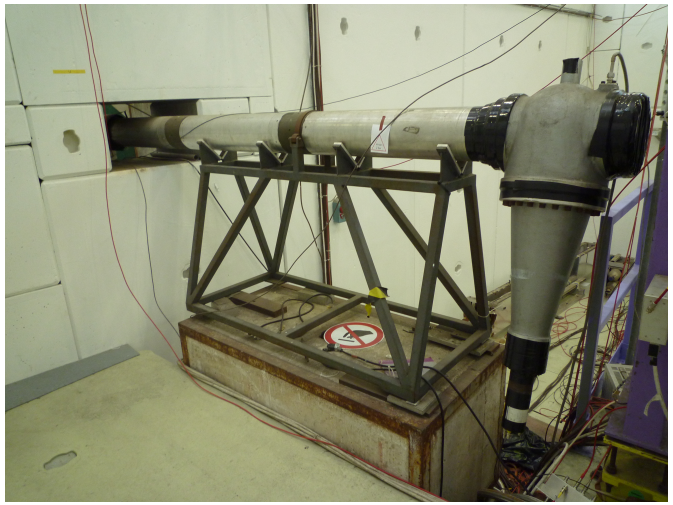
PMT threshold detectors

Scintillating plastic

Light guide

Photo-Multiplier Tube

Scintillator assembly- charged particle timing



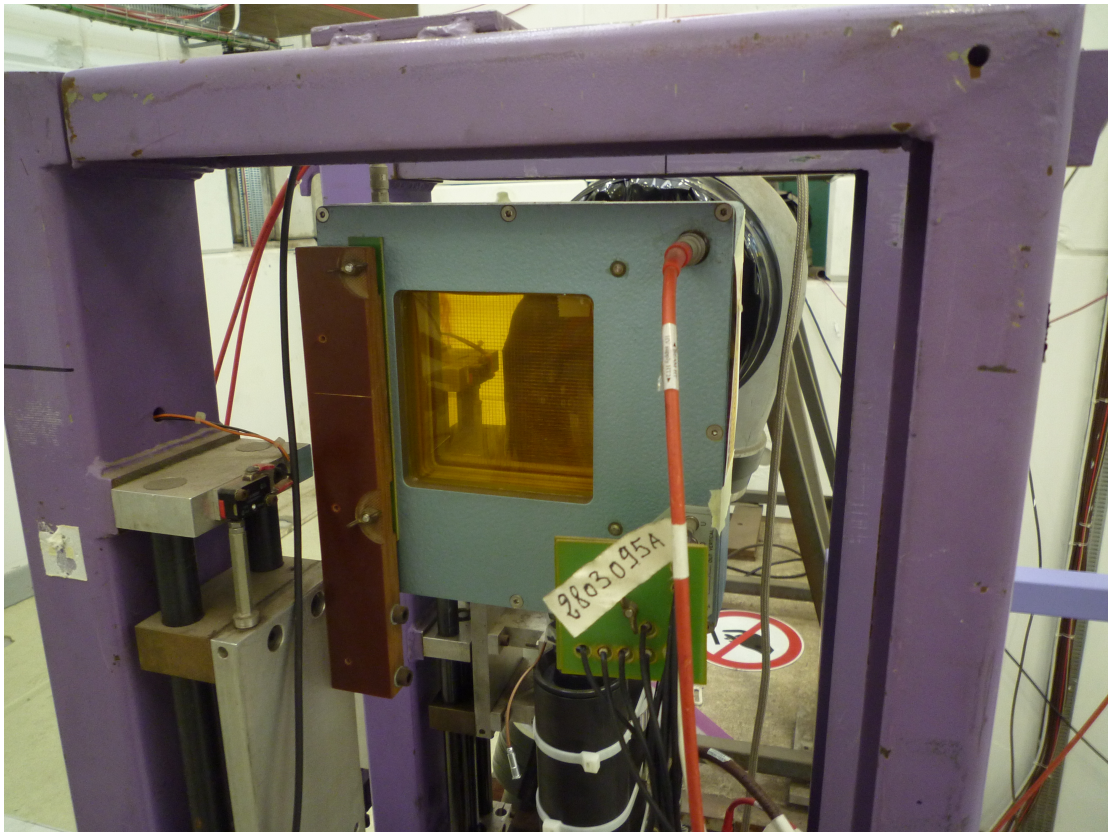
Cherenkov detector- charged particle identification

PMT integral detectors

- Absorb electromagnetic particles fully
- Energy converted to light
- PMT converts light into electrical pulse
- Integrate pulse to recover the particle energy

Calorimeter blocks

Delay wire chamber



Delay Wire Chamber (DWC0)

- Multi-Wire Proportional Chamber (MWPC)
- Charged particles ionise gas
- On board 'Front-end' electronics
- Two outputs per axis
- Compare the timing of signals on an axis
- Gives an X-Y location of hit

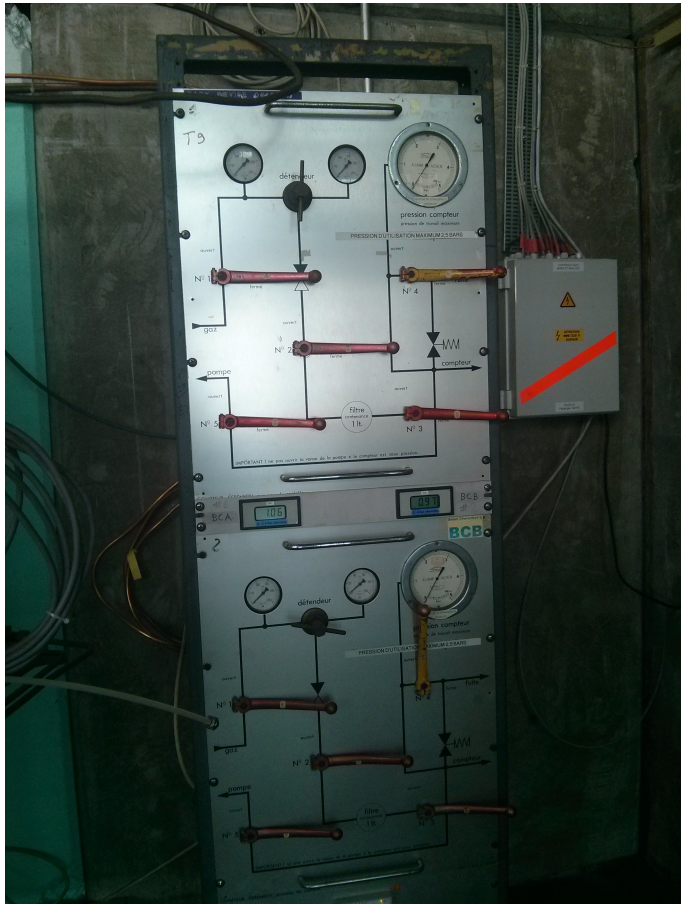
Gas supply

The Delay Wire Chambers require gas to ionise

A supply of Argon and Carbon Dioxide (Ar + CO_2) is provided from a distribution panel behind the beam control room

The Cherenkov detectors may be filled with Nitrogen or CO_2

They can also be evacuated by vacuum pumps



Cherenkov gas panel

Power supply

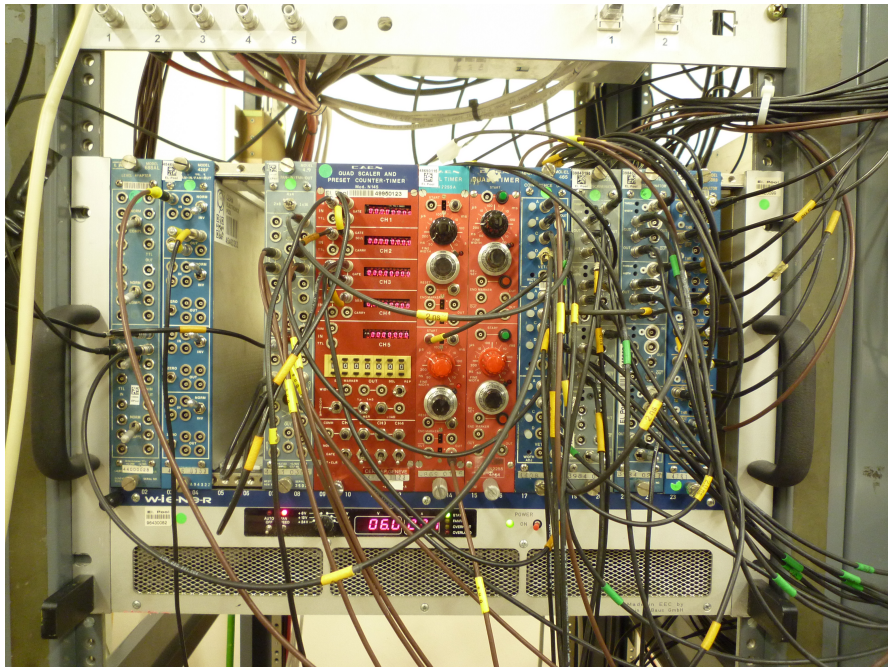
HV crate and modules

- Modular power supply unit
- Rack mount 'crate' holds modules, provides power and controls output
- Modules:
  - A1833P 12 channels, $4\,\mathrm{kV}$ positive, $2\,\mathrm{mA}$
  - A1833N negative voltage version of above
- Modules monitor voltage and current usage, tripping off in case of problems

The Delay Wire Chamber also needs low voltage power from a bench top power supply

Analog electronics: NIM

- Nuclear Instrumentation Module (NIM)
- Modular standard for analog electronic components
- Rack mount 'bin' holds modules and provides power
- Modules:
  - Amplifier
  - Fan-in (logical OR), Fan-out
  - Discriminator
  - Coincidence (logical AND)
  - Timer
  - Counter



NIM bin and modules

Analog electronics: NIM

Discriminator

A discriminator has two settings; a 'Threshold' and a 'Width'

Noise with a voltage below the Threshold is ignored

If the input signal crosses the Threshold, a pulse is generated with the desired Width

Coincidence module

Many pulses are not interesting but if two detectors see a signal at the same time, there may be something interesting

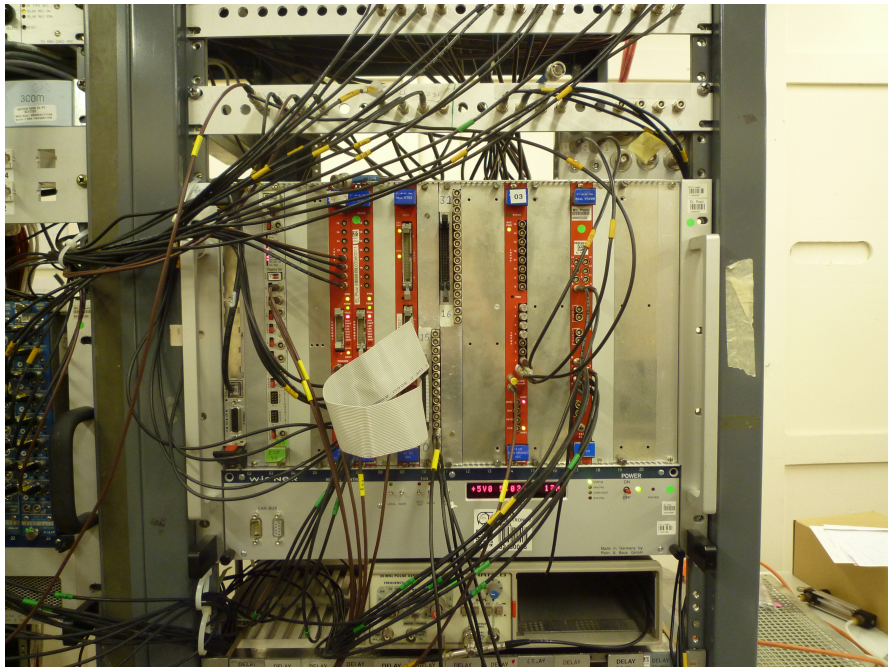
A coincidence is the logical AND of some signals

If we use inverted signals, we can 'Veto' a certain detector

Trigger

- We will generate too much data to store everything
- Particles will cross the detector in a few nano-seconds
- A trigger is needed to only record interesting 'Events'
- By combining signals from the detectors we can detect a particles 'Signature' and begin recording
- Big experiments have higher level triggers that look in more and more detail at the data before keeping or rejecting events

Digitisation: VME



VME crate and modules

- Versa Module Europa
- Originally designed for Motorola 68k computers
- Rack mount 'crate' holds modules, provides power and hosts a data bus
- Modules:
  - Scaler/Counter
  - Analog to Digital converter (ADC)
  - Charge to Digital converter (QDC)
  - Time to Digital converter (TDC)

Digitisation: VME

V560 Scaler

- Counts pulses from the NIM apparatus
- Gives the Rate for threshold detectors
- Records coincidences, triggers
- Labels events coming from the same spill

V785 ADC

- Measures the Peak voltage of its input
- Considers pulses in a window of time - 'gated'

Digitisation: VME

V792 QDC

- Integrates charges in gate window
- Internal 'Pedestal' current must be calibrated

V1290 TDC

- Records leading edge of signal
- Also saves additional leading edges if a second signal is close by
- 25 ps time resolution (25×10^{-12}!)
- Can save up to a microsecond before and after the trigger

Digitisation: VME

CORBO trigger module

- Receives trigger to start recording
- Sends a busy signal to prevent subsequent triggers
- Signals computer to start readout

Single board computer

- Bus master - controls the other modules
- Complete computer in a module
- 2GHz Intel Core i7 processor
- 4GB of RAM
- Laptop size hard drive

Deadtime

- Electronics take time to digitize signals
- We can't generate any signals while the digitizers are busy
- Veto triggers using the busy output
- The period while the DAQ is busy is the 'Deadtime'
- Typically we take 100 μs to readout
- Our trigger has to be careful to pick the best events

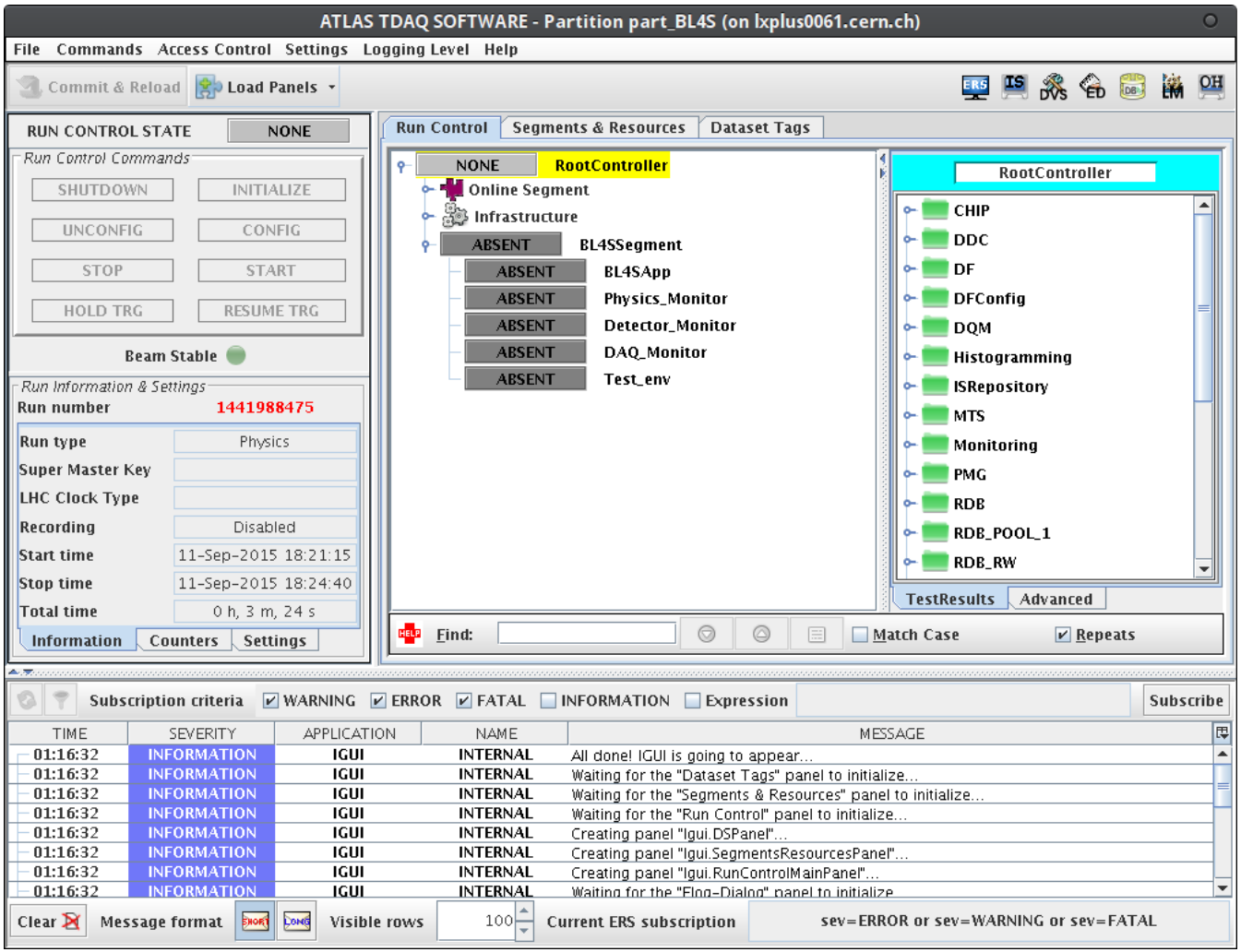
High voltage control

The HV panel can be opened from a desktop icon on the control room PCs

BL4S-HV-01

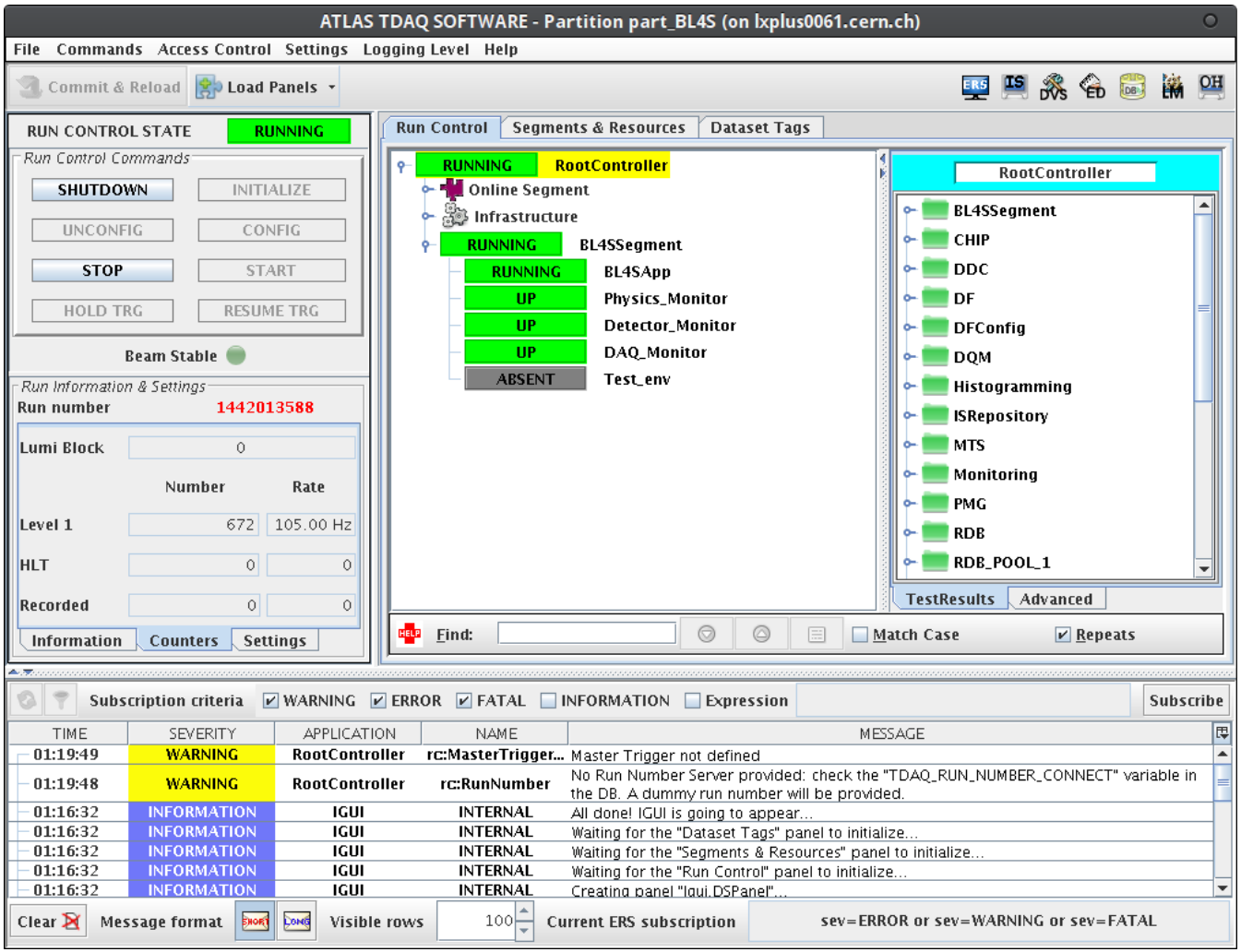
```
-  Main  Utility  Setup  Groups  View                                  Admin
Group 00
Channel Name  VOSet     IOSet     VMon      IMon      Pw  Status          Ch#

DWC1         2850.00 V 100.00 uA    0.00 V   0.00 uA Off  Ext-Dis     00.0000
DWC2         2850.00 V 100.00 uA    0.00 V   0.00 uA Off  Ext-Dis     00.0001
BGO           480.00 V 150.00 uA    0.00 V   0.00 uA Off  Ext-Dis     00.0002
-03             0.00 V  20.00 uA    0.00 V   0.00 uA Off  Ext-Dis     00.0003
-04             0.00 V  20.00 uA    0.00 V   0.00 uA Off  Ext-Dis     00.0004
-05             0.00 V  20.00 uA    0.00 V   0.00 uA Off  Ext-Dis     00.0005
-06             0.00 V  20.00 uA    0.00 V   0.00 uA Off  Ext-Dis     00.0006
-07             0.00 V  20.00 uA    0.00 V   0.00 uA Off  Ext-Dis     00.0007
-08             0.00 V  20.00 uA    0.00 V   0.00 uA Off  Ext-Dis     00.0008
-09             0.00 V  20.00 uA    0.00 V   0.00 uA Off  Ext-Dis     00.0009
-10             0.00 V  20.00 uA    0.00 V   0.00 uA Off  Ext-Dis     00.0010
-11             0.00 V  20.00 uA    0.00 V   0.00 uA Off  Ext-Dis     00.0011
LG00         1062.00 V  500.0 uA    0.00 V    0.0 uA Off  Ext-Dis     01.0000
LG08         1208.00 V  500.0 uA    0.00 V    0.0 uA Off  Ext-Dis     01.0001
LG03         1151.00 V  500.0 uA    0.00 V    0.0 uA Off  Ext-Dis     01.0002
LG04         1090.00 V  500.0 uA    0.00 V    0.0 uA Off  Ext-Dis     01.0003
CH0          2000.00 V 1500.0 uA    0.00 V    0.0 uA Off  Ext-Dis     01.0004
CH1          2000.00 V 1500.0 uA    0.25 V    0.0 uA Off  Ext-Dis     01.0005
SC1          1800.00 V 1500.0 uA    0.25 V    0.0 uA Off  Ext-Dis     01.0006
Channels Display/Edit Screen                  LocEn V0 IO     N   CAEN SY2527
```

Data Acquisition software



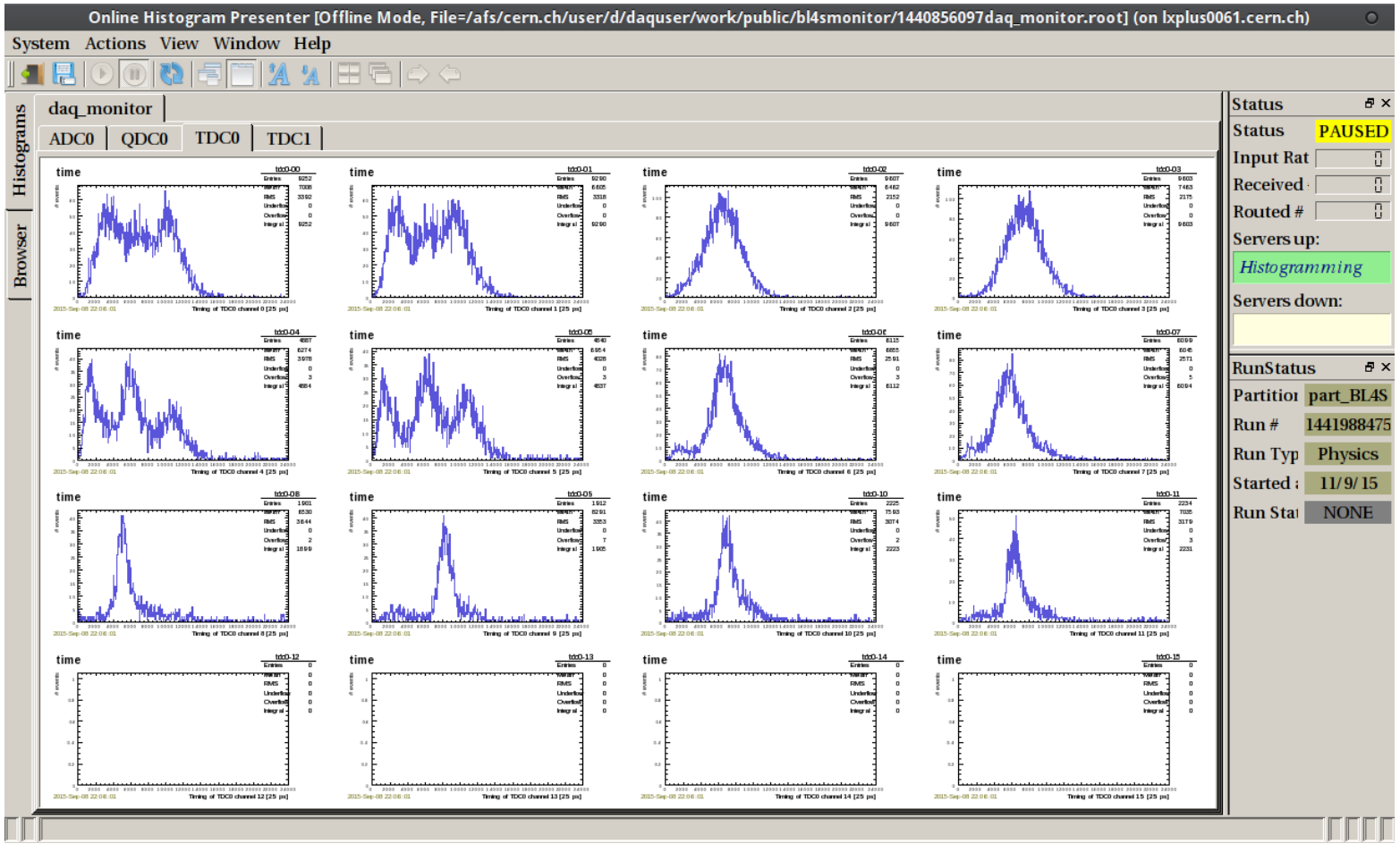
ATLAS DAQ software

Data Acquisition software



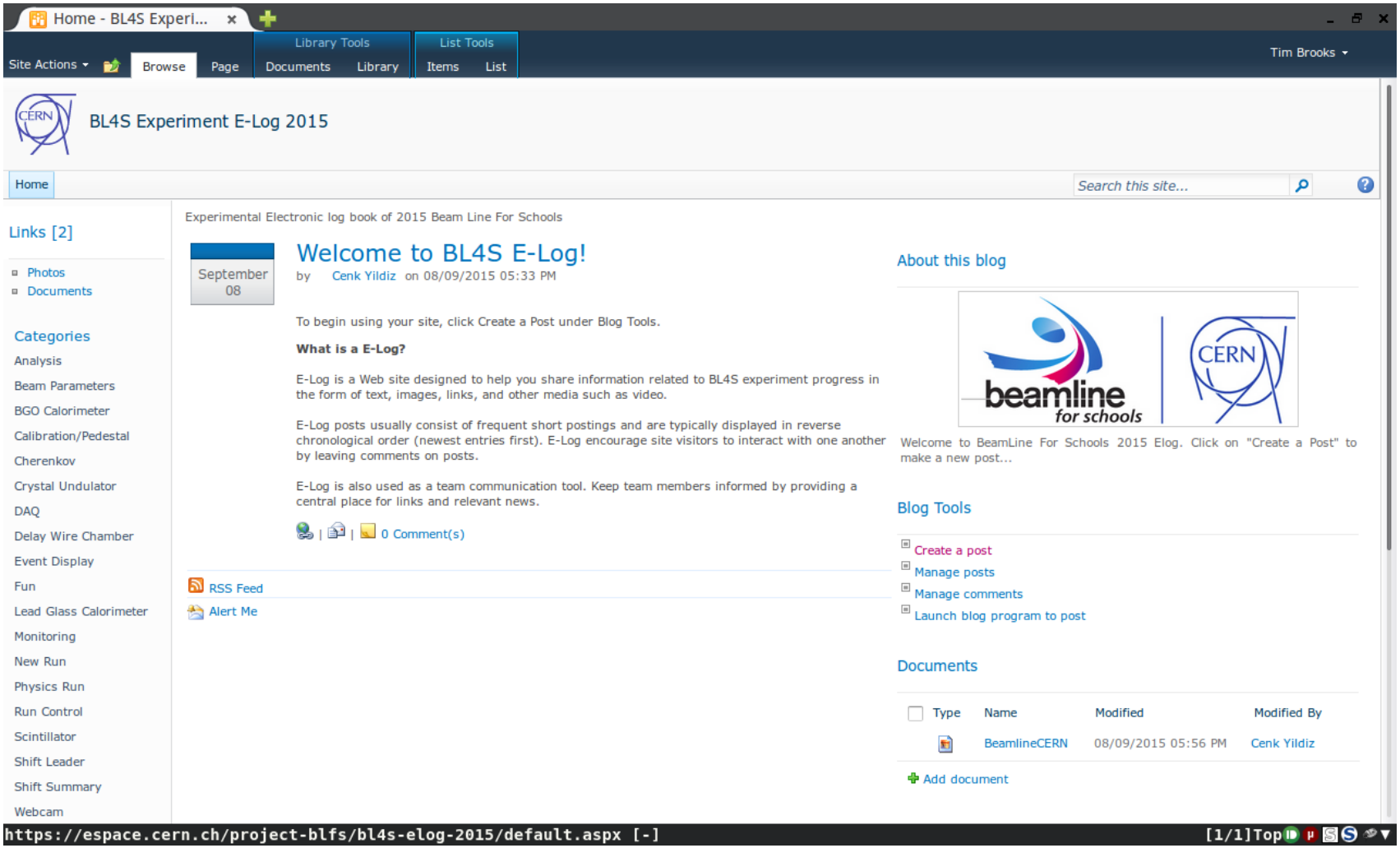
ATLAS DAQ software

Monitoring software



Online Histogram Presenter (OHP)

Log book



BL4S online log book - it's only science if you write it down!

Shift tasks

1. Check run plan - online whiteboard
2. Check detector set-up - access:
   - HV must be disabled
   - Magnet switched off
   - Shift leader will check the zone first
   - All shifters can then key into the zone
3. Ensure HV (and LV) is on
4. Collect calibration data - pedestal programs
5. Check run settings before starting to record
6. Check monitoring histograms
7. Write a log entry when:
   - Changing settings
   - Starting/stopping a run
   - Ending your shift

Help

1. Pay attention and ask questions in the morning meeting
2. Check the log book - some problems may be known already
   `http://espace.cern.ch/project-blfs/bl4s-elog-2015/`
3. Documentation is available on our twiki:
   `http://twiki.cern.ch/twiki/bin/view/BL4S`
4. If you're unsure - ask your shift leader
5. Contacts:
   - Markus Joos (160663)
   - Tim Brooks (167969)
   - Candan Dozen (167970)