Pixel Detector Control System

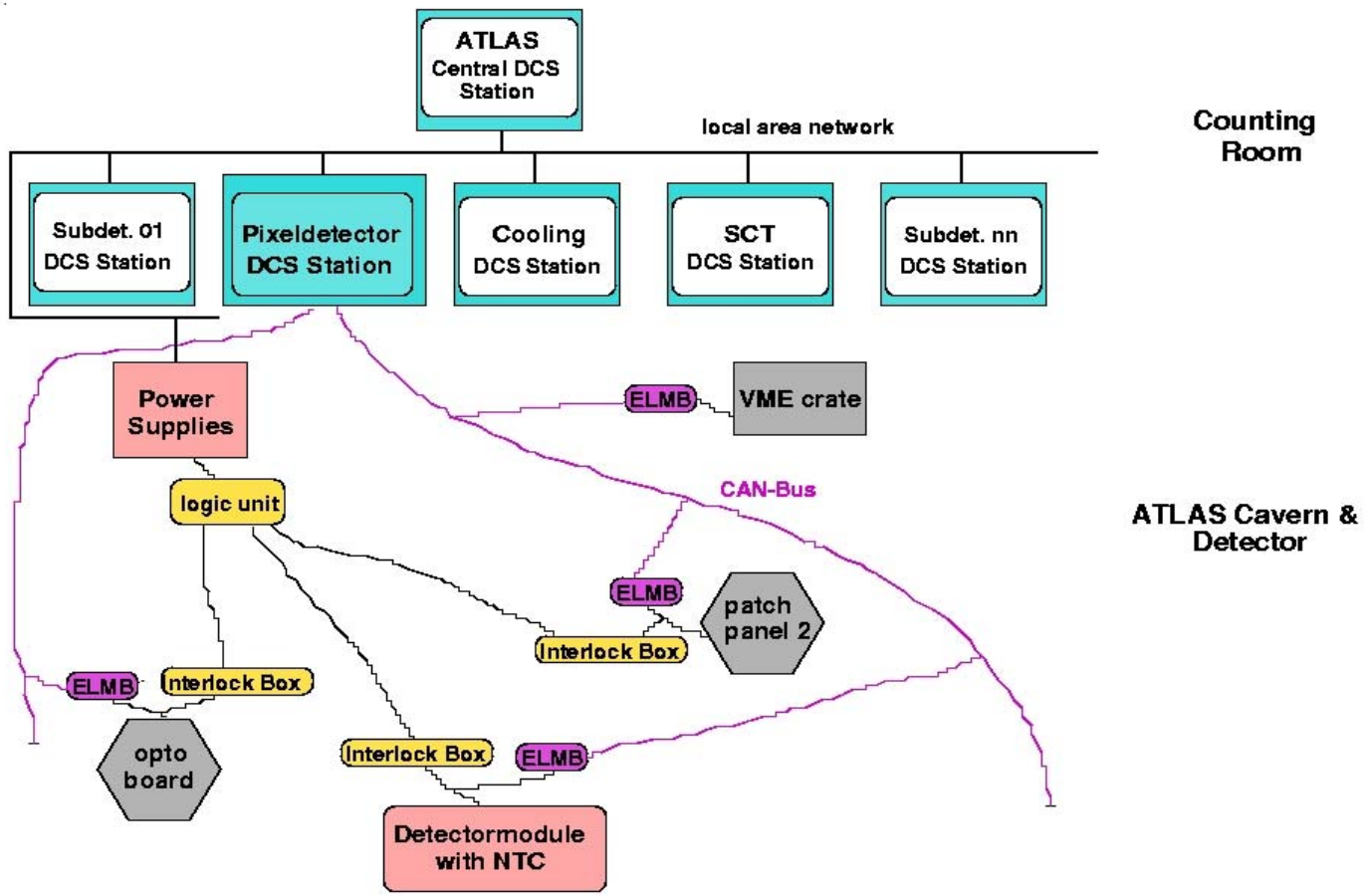
DCS Workshop

October 2001, Amsterdam

- Overview on the Pixel DCS
- Interlock Box
- Pixel DCS Hierachy
- First Experience with PVSS
- Outlook to work in 2002
- Wishes for PVSS
- Estimated Numbers of ELMBs for the final system

S. Kersten, University of Wuppertal

Pixel DCS Overview



DCS building blocks

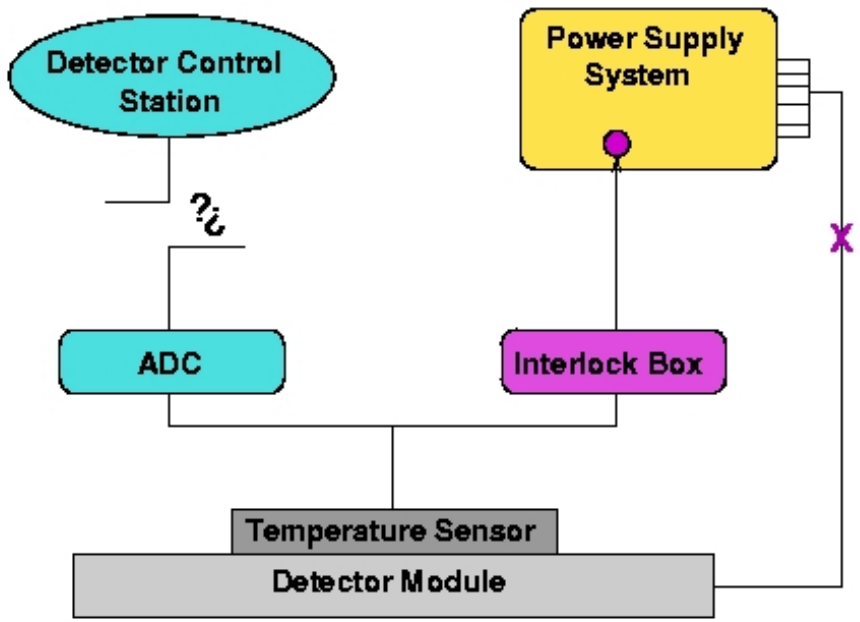
- **Cooling system:** seperate PVSS system,
- Inside Pixel SCADA system status info only needed
- **Power supplies:** „high local intelligence“,
- performing monitoring by its own,
- able to execute control function
- reduces netware traffic and increases safety,
- communication via OPC-server
- **Hardware Interlocks** acting on the power supplies
- **Logic unit:** supplementation to the Interlock System, taking into account different modularities
- **ELMB:** temperature monitoring (NTCs),
- monitoring currents and voltages of the regulators, VME crates, digital outputs for test signal, (DAC channels in the cooling partition)

Interlock Box: Idea

- Idea: If DCS software fails, emergency exit
- Pure hardware based solution
- A 2-bit logic:

okay	*1*	*1*
Temp high or short circuit	*1*	*0*
Temp low	*0*	*1*
error	*0*	*0*

- Compatible with ELMB but also able to operate in stand alone

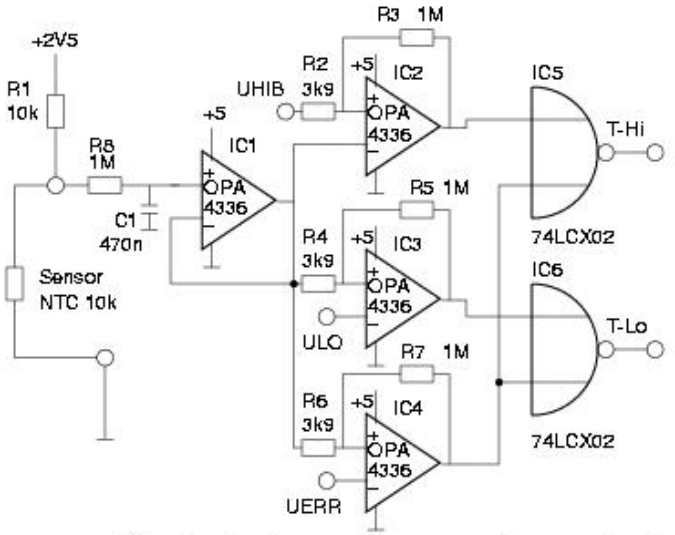


Interlock Box: Circuit

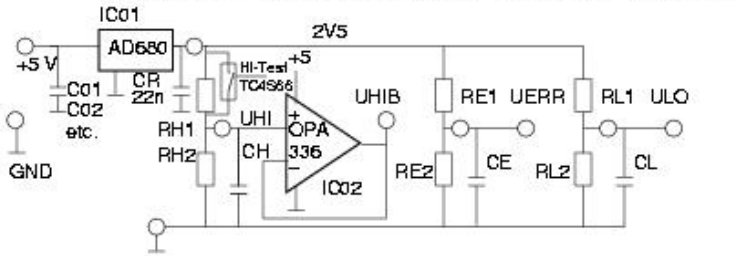
- **Temperature sensor: 10 kΩ NTC resistor,**
- **modification for the use of other NTC resistors is possible**

- **Clean reference voltage**
- **Signal from NTC is compared to different thresholds, op-amps acting as discriminators**
- **Nor gates combine information**

- **Neg. TTL compatible logic (active low)**
- **Shooting point adaptable by resistor network**



Discriminator section, one for each channel



Reference section, common for all channels

Interlock Box: electrical results

NTC:

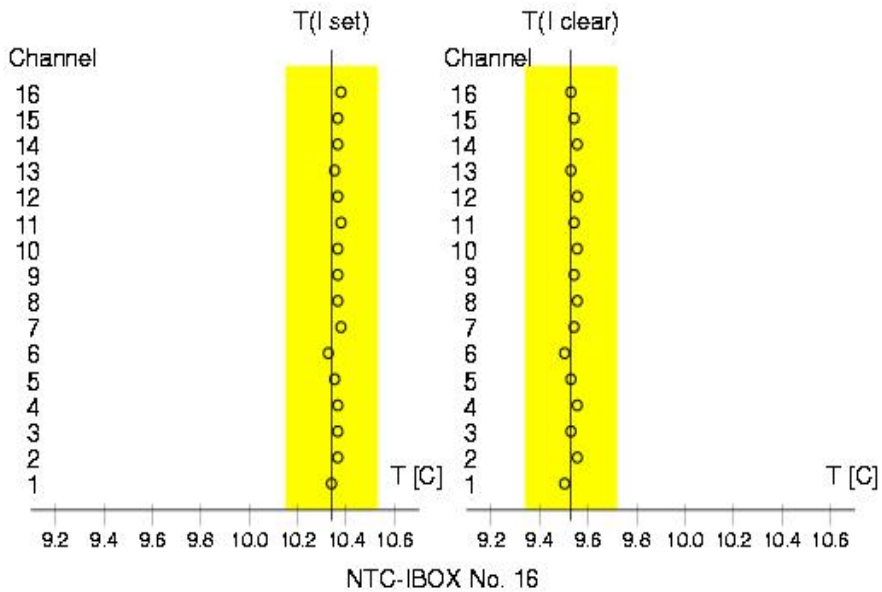
from Ishituka, SMD 0603, 10 kΩ @ 25°C ± 1%
and B-value: 3435 K ± 1%

R(T) non linear function, spread f(T)

- Theoretical spread confirmed (ca. 0.3 K) √
- Accelerated ageing @ 100 °C for 1 week √
- Irradiation with 24 GeV/c protons
  up to 2.05 10^{15} p/cm^2 √

Accuracy of the Interlock Box:

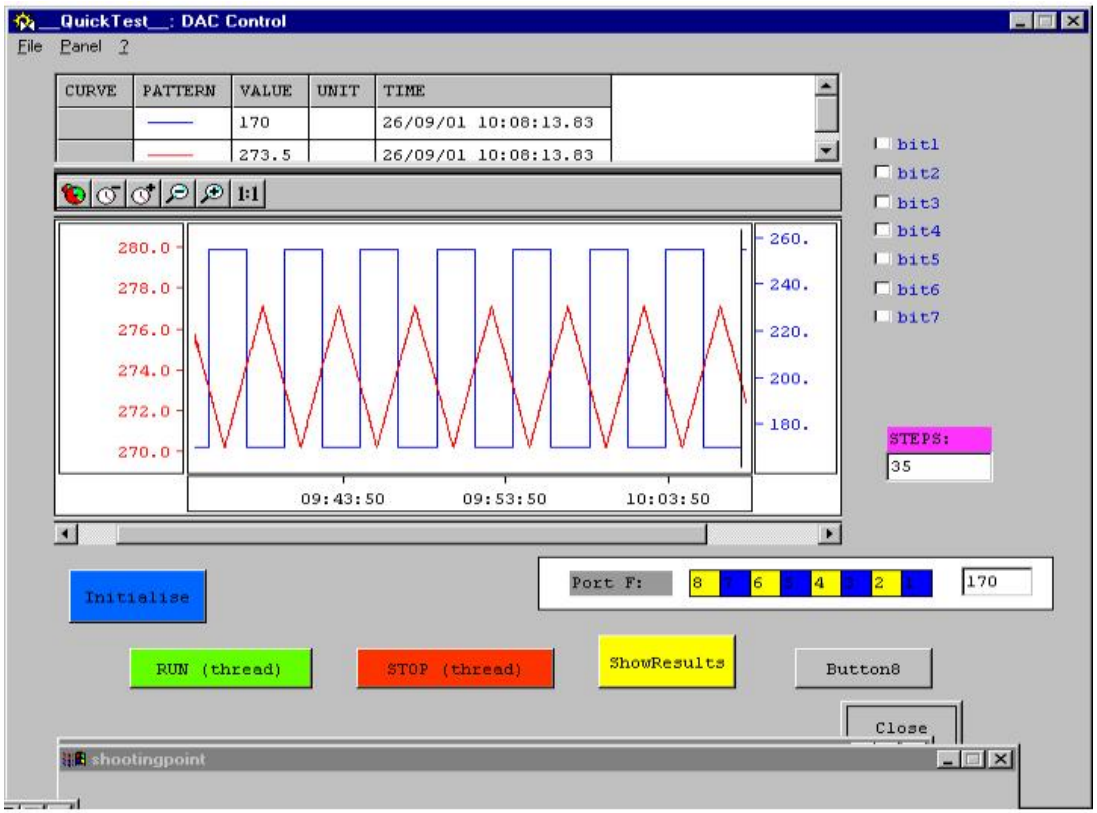
- theoretical value < 0.2 K
- Max value due to tolerances of components:
- < 0.2 K (offset voltage of op-amp, high precision resistors 0.1 %)
- measured and confirmed for 3 Boxes
- Hysteresis: ca. 1K



Interlock Box: Hysteresis

Measurements at CERN in the DCS group

Amongst other things, test in magnetic field (1.5 T) √



Interlock Box: Irradiation

Values according to M. Dentan:

ATLAS Policy on Radiation tolerant Electronics, ATC-TE-QA-001

Radiation tolerance criteria (MDT Barrel3) incl. several safety factors for 10 years operation of ATLAS

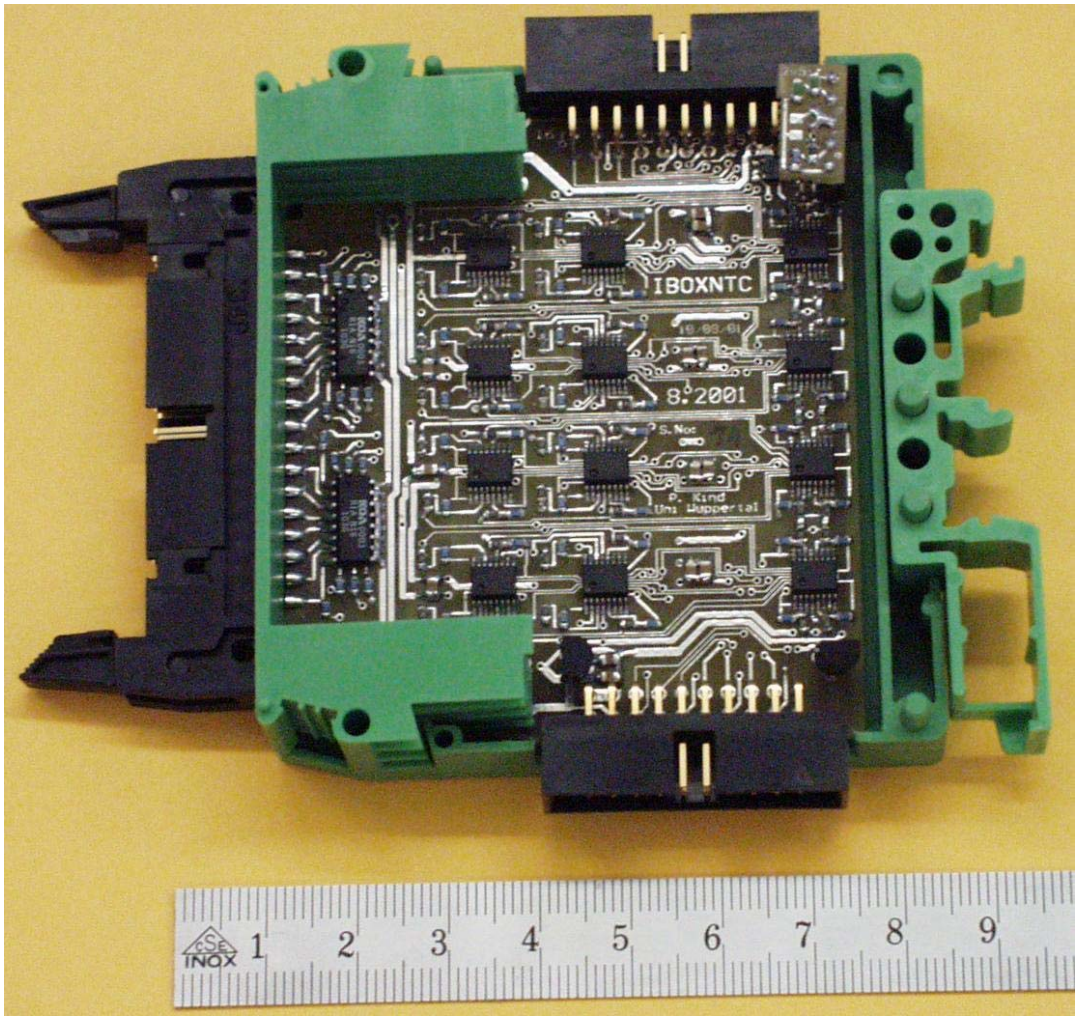
RTC_{TID}	93 Gy	Co-60 source @ CIS, Saclay
RTC_{NIEL}	4.8 10E11 n/cm² (1MeV)	Reactor @ CEA, Valduc
RTC_{SEE}	9.210E10 h/cm² (> 20 MeV)	60 MeV protons @ UCL, Belgium

individual test boards,

additionally special program for Interlock Box during SEE tests

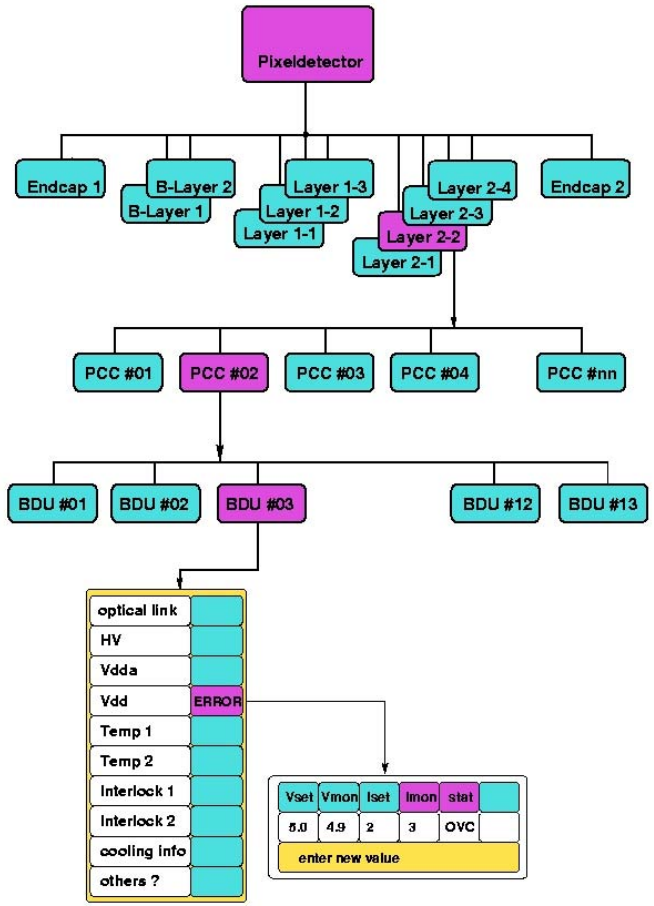
set of components to build the Interlock Box pre-selected

Interlock Box



Pixel DCS Hierarchy

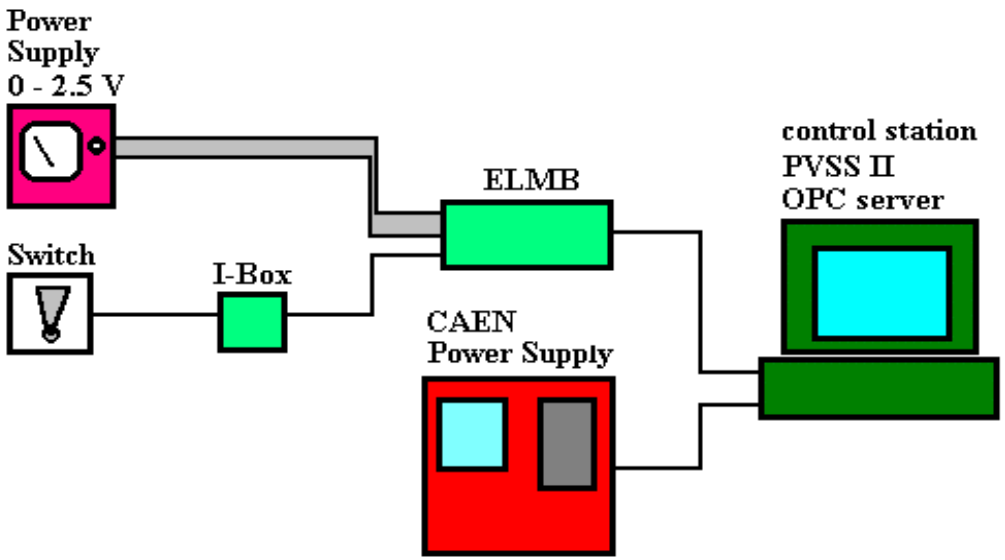
- Apparatus or Geographically oriented?
- Geographical approach simplifies error tracing for shifter
- Top: pixel detector
  - Makes connection to outer world
  - Receives commands from ATLAS DCS
  - passes commands to the lower levels
- Level 1 + 2: barrel layer 1 & 2, B-layer, disks
- (segmentation according to mechanical structures)
- Base level: base detector unit (13/bi-stave)
- 2 real detector modules with voltages, temperatures, etc.



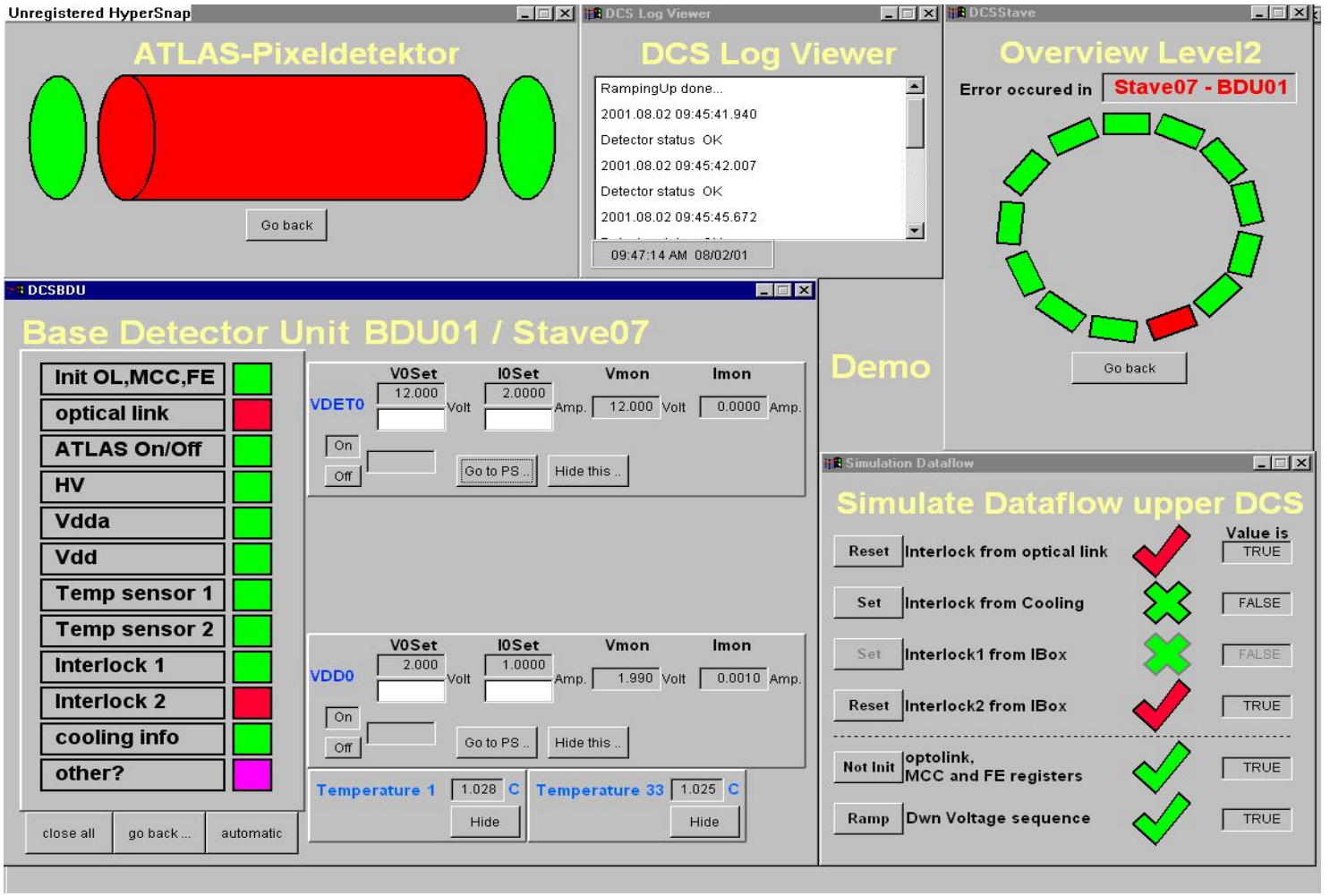
First Experience with PVSS

- Performed by Martin Imhäuser in collaboration with ATLAS DCS group

- Test Setup →
- Windows NT platform with NI-CAN card and NI-CAN software (v1.4.2)
- PVSSII v2.11.1
- CANopen OPC server v1.0
- CAEN OPC server v1.0
- Adjustable power supply to simulate voltages coming from the NTCs
- Switch used to force an interlock signal



Control Panel



DCS Tests: results

- First experience in handling the program
- As a starting point the base detector unit is defined
- For developing, configuration etc. an additional apparatus oriented approach is useful
- Compatibility of ELMB and Interlock Box okay
- Running in the limit for some data structures (home made problem?)

- CANopen OPC server running stable and reliable
- CAEN OPC server running for limited periods
- CAEN and CAN OPC server together, CAEN servers crashes in 1 minute

Outlook Work in 2002

Interlock Box:

- **test with real detector module, crosstalk?**
- **qualification tests concerning irradiation**
- **set up a test system for production and its qualification (using PVSS)**
- **hopefully start production**
- **$\rightarrow$ need numbers of required boxes from other interested groups by Feb. 2002**

PVSS:

- **solve „data structure“ problem**
- **participation in testbeam activities**
- **make base detector unit more realistic**
- **build up a greater detector part with it**

Constructive Criticism, Wishes

- **CAEN OPC server needs improvements**

- **Automatic tool for calibration**
- **Speed for exchange of information between 2 PVSS systems?**
- **Driver for GPIB**

Number of ELMBs for final system

Channel type	Number of channels – number of ELMBs	
DAC channels	258	5
ADC channels	14000	218
Digital output lines	160	
Sum of ELMs		ca. 250
ELMBs required in 2002		ca. 5