LAPP IPMC Usage in LAr System

IPMC Workshop

9 October 2018

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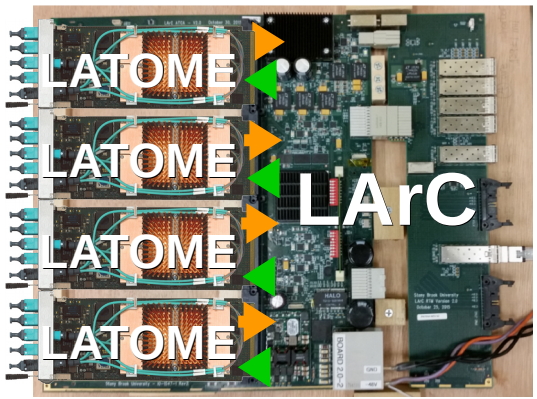
Additional LAr Electronics for Run-3

LAr Front End Trigger Board

L1 CALO Trigger

LAr Back End Boards

- ATCA carrier (LArC) hosting 4 Advanced Mezzanine Cards (LATOME)
- 1 carrier hosts 1 LAPP-IPMC
- 1 AMC hosts 1 MMC



TTC

Atlas Monitoring

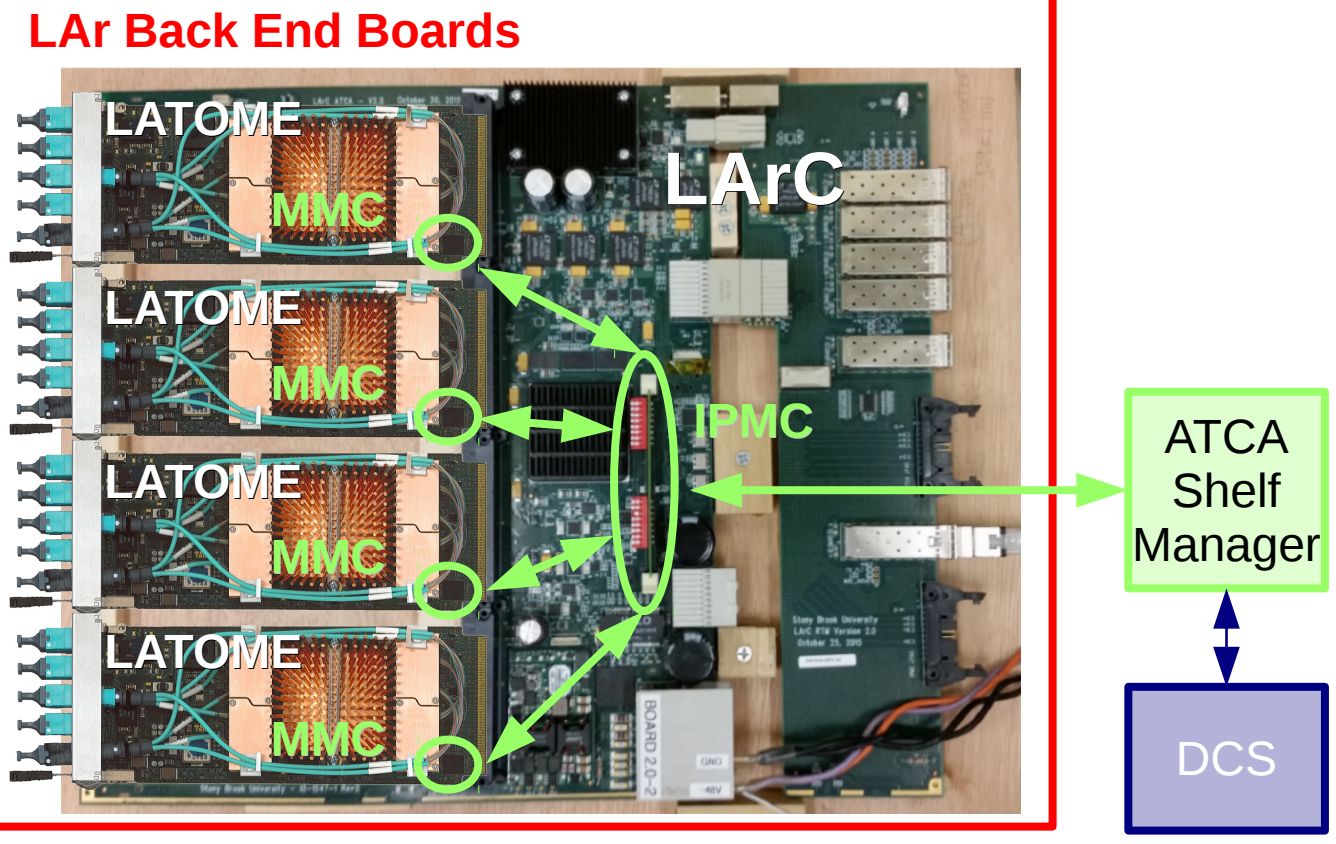
TTC

FELIX

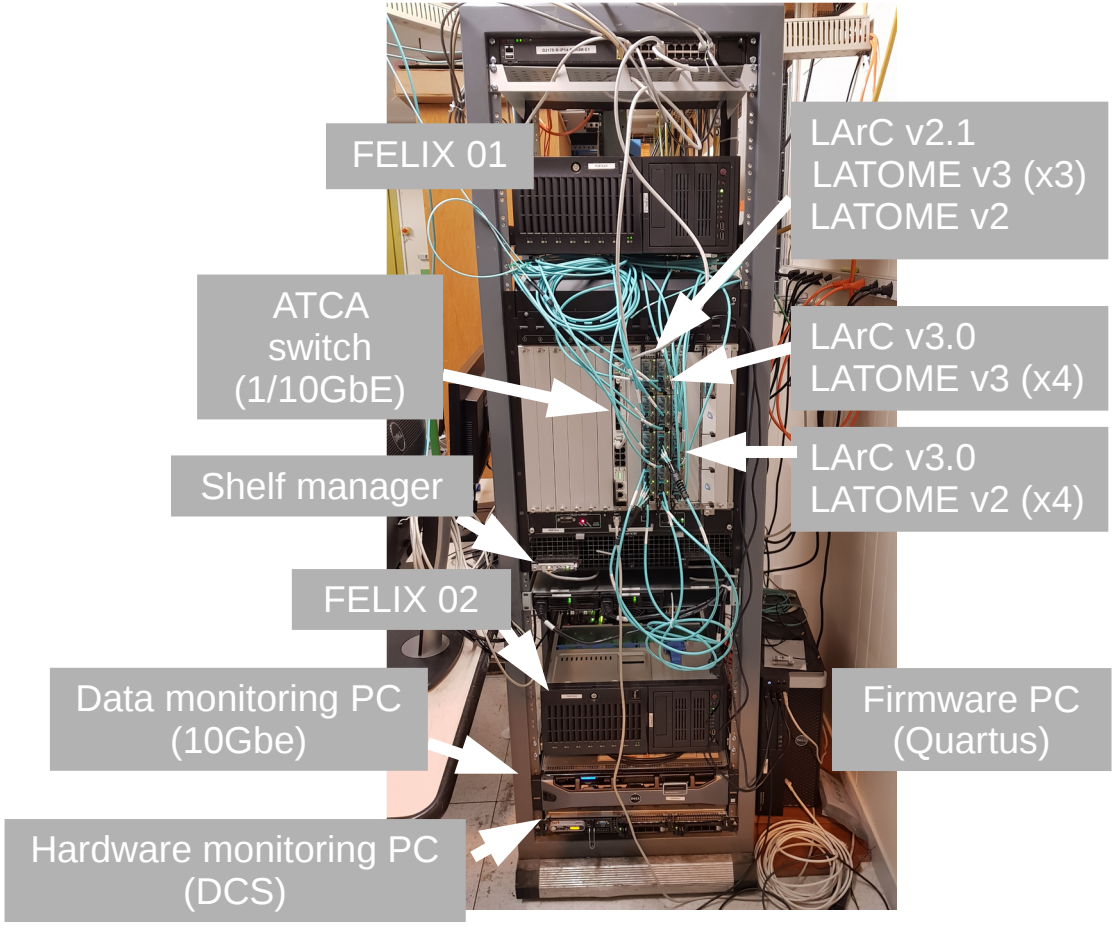
LAr Monitoring

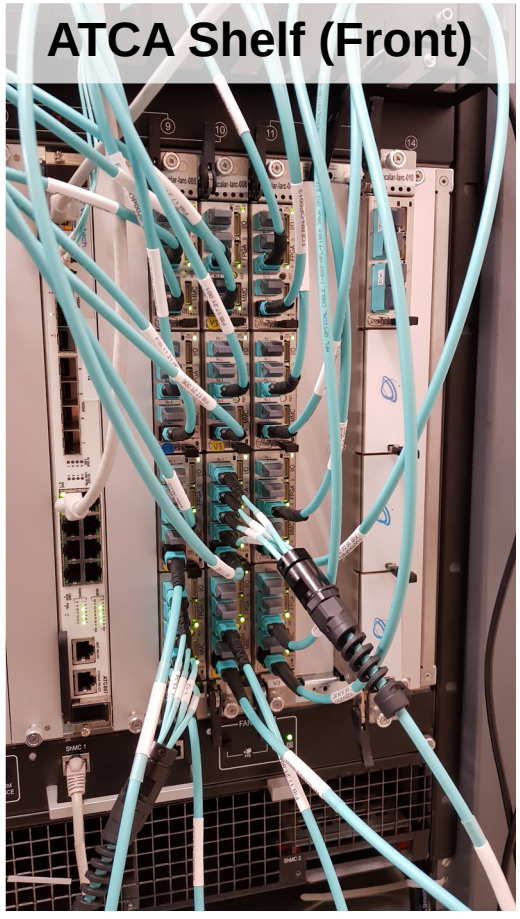
Additional LAr Electronics for Run-3

- **MMC :**
  - Supports IPMI commands
  - AMC power & sensors reading (I,V,T)
  - Discuss to IPMC via IPMB-L bus (I2C)
- **IPMC :**
  - Carrier power & sensors reading (I,V,T)
  - Discuss to shelf manager and AMC MMC



Setup @ LAr electronics Lab (EMF)



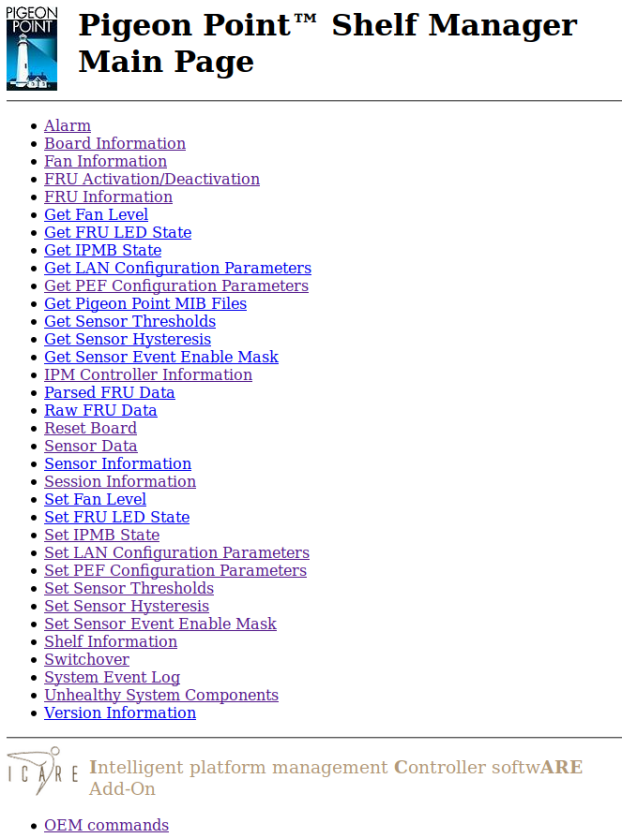


Setup @ LAr electronics Lab (EMF)

LAPP-IPMC Usage in LAr

- **LAPP-IPMC is used to**
  - Manage the power on the Carrier and the 4 AMC boards
  - Read the Current, Voltage and Temperature sensors : provide this info to Shelf Manager & DCS system
  - Program the Carrier and LATOME FPGA via ethernet (Not yet tested)
- **Shelf Manager : regulates fan speed depending on the boards temparature**
  - Alert thresholds are set by the user (we want our FPGA temperature < 80°C)
- **DCS : keep history of the sensor values (in future should handle alerts)**

Shelf Manager Web Page at LAr EMF



Pigeon Point™ Shelf Manager Main Page

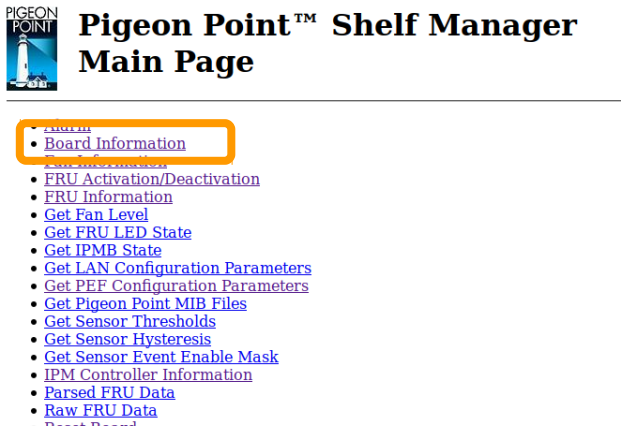
- Alarm
- Board Information
- Fan Information
- FRU Activation/Deactivation
- FRU Information
- Get Fan Level
- Get FRU LED State
- Get IPMB State
- Get LAN Configuration Parameters
- Get PEF Configuration Parameters
- Get Pigeon Point MIB Files
- Get Sensor Thresholds
- Get Sensor Hysteresis
- Get Sensor Event Enable Mask
- IPM Controller Information
- Parsed FRU Data
- Raw FRU Data
- Reset Board
- Sensor Data
- Sensor Information
- Session Information
- Set Fan Level
- Set FRU LED State
- Set IPMB State
- Set LAN Configuration Parameters
- Set PEF Configuration Parameters
- Set Sensor Thresholds
- Set Sensor Hysteresis
- Set Sensor Event Enable Mask
- Shelf Information
- Switchover
- System Event Log
- Unhealthy System Components
- Version Information

ICARE Intelligent platform management Controller softwARE Add-On

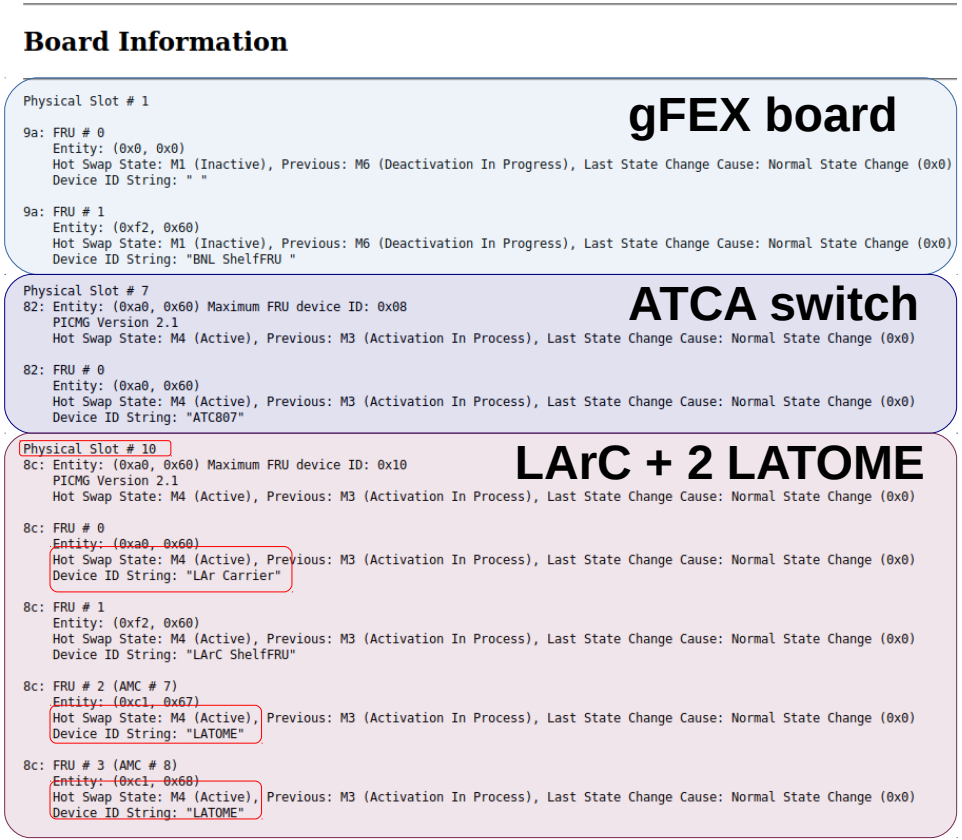
- OEM commands

- **Web page heavily used during our tests**
  - Much more user-friendly than CLI
  - Check of boards correct detection and activation
  - Check sensor values
  - System Event Log
  - Set manually Fan Level

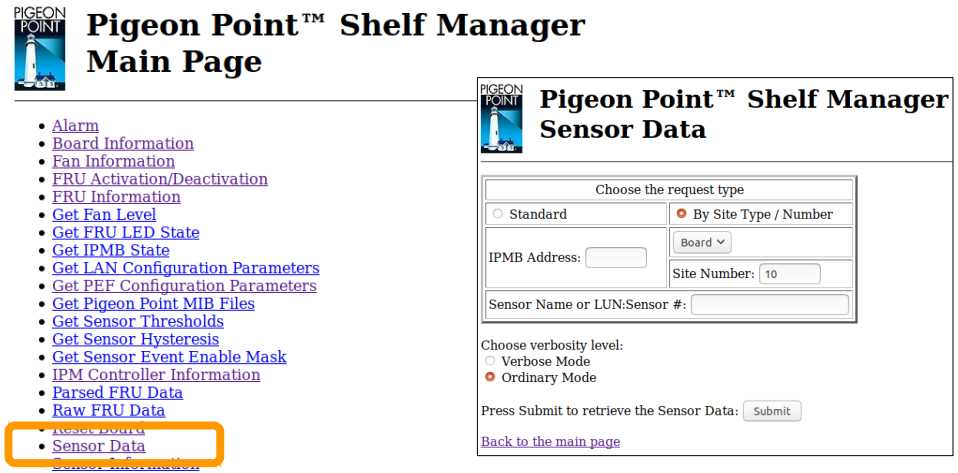
Board Information



- **Board Information list the boards in the crate (FRU)**
  - List by Physical Slots
  - Gives boards actual and previous states : Is my board « Active » (M4) ?



Sensor Data



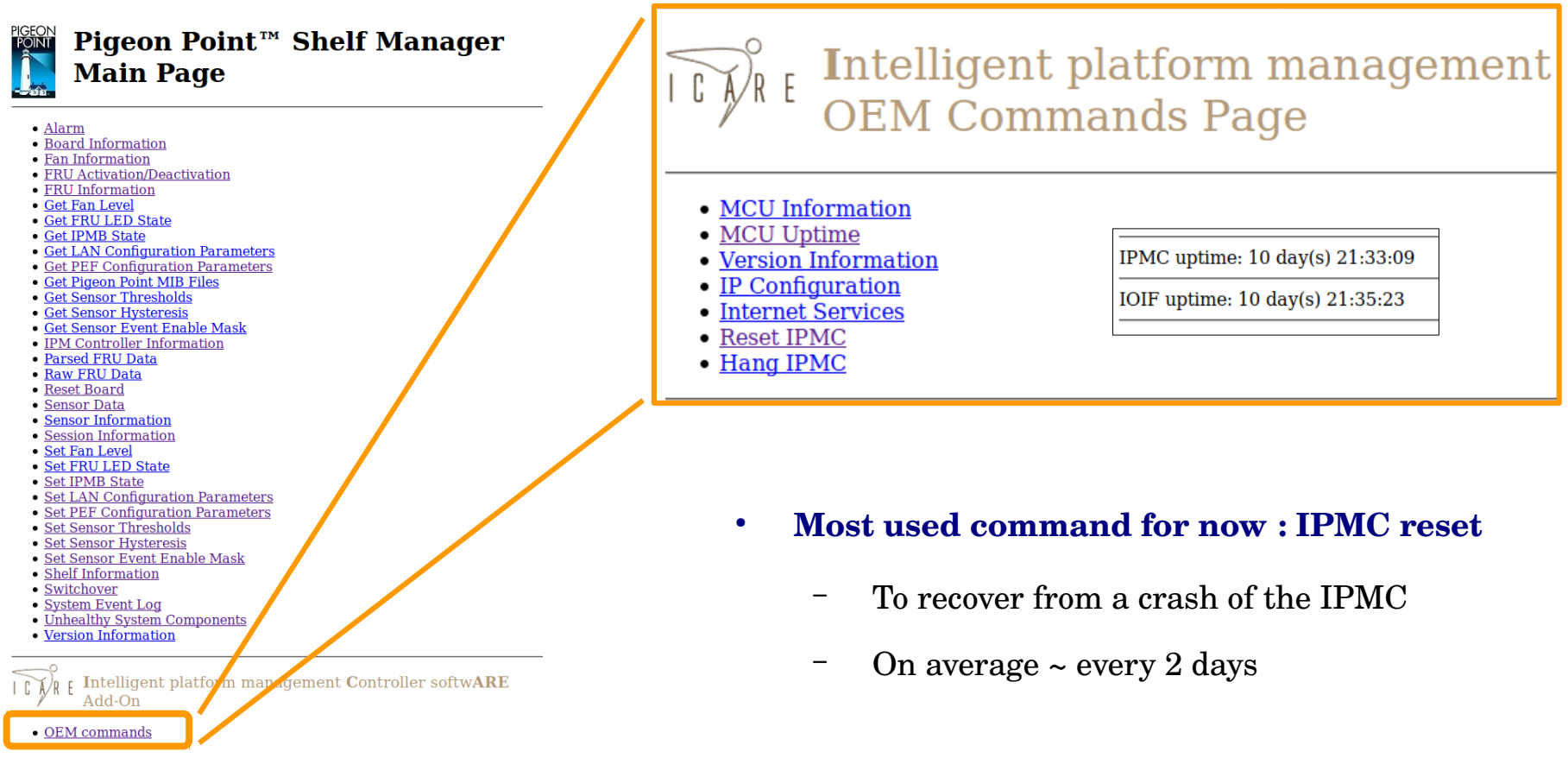
Sensor Data Information

```
8c: LUN: 0, Sensor # 47 ("AMC3 Voltage")
    Type: Threshold (0x01), "Voltage" (0x02)
    Belongs to entity (0xa0, 0x60): FRU # 0
    Status: 0xc0
        All event messages enabled from this sensor
        Sensor scanning enabled
        Initial update completed
    Raw data: 159 (0x9f)
    Processed data: 11.925000 Volts
    Current State Mask: 0x00

8c: LUN: 0, Sensor # 48 ("AMC4 Voltage")
    Type: Threshold (0x01), "Voltage" (0x02)
    Belongs to entity (0xa0, 0x60): FRU # 0
    Status: 0xc0
        All event messages enabled from this sensor
        Sensor scanning enabled
        Initial update completed
    Raw data: 160 (0xa0)
    Processed data: 12.000000 Volts
    Current State Mask: 0x00
```

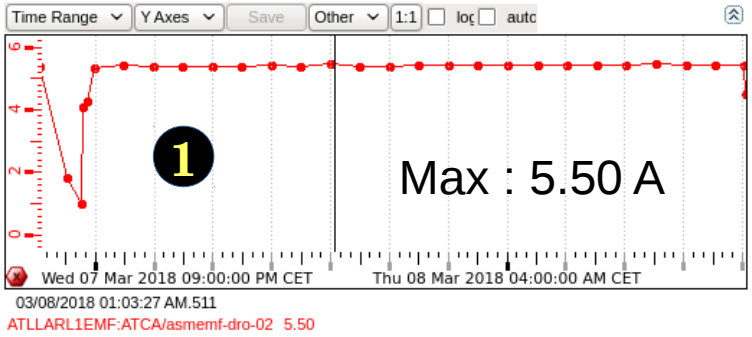
- **Sensor Data gives quick reading to sensor values**
  - DCS have access to this data (use Sensor number to identity it)
  - Caveat : for the moment sensor numbers are dynamically allocated (according to who is turn on first)

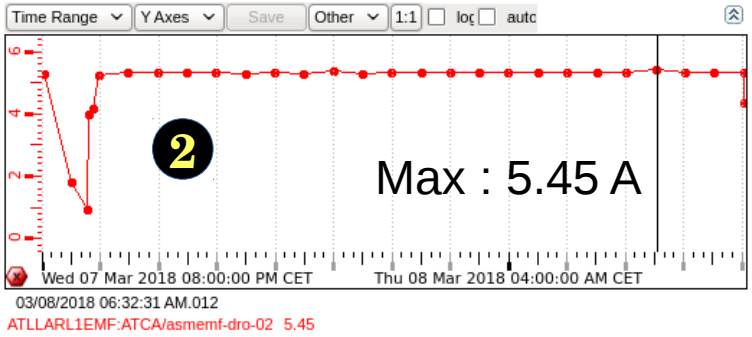
OEM commands

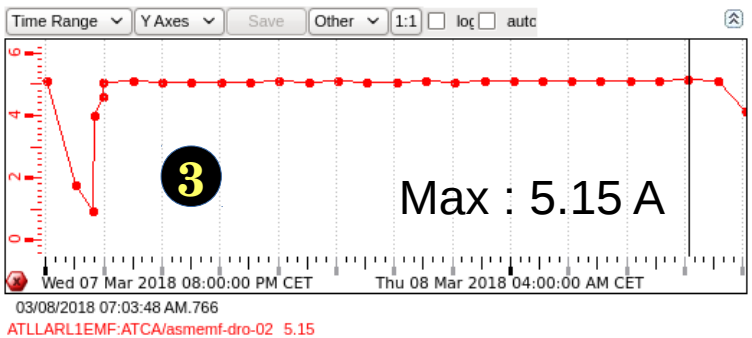


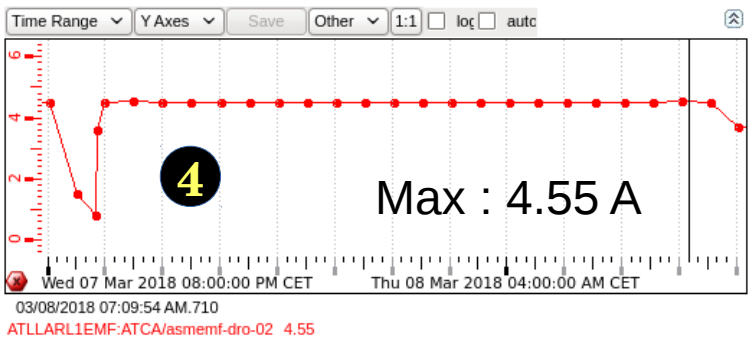
- **Most used command for now : IPMC reset**
  - To recover from a crash of the IPMC
  - On average ~ every 2 days

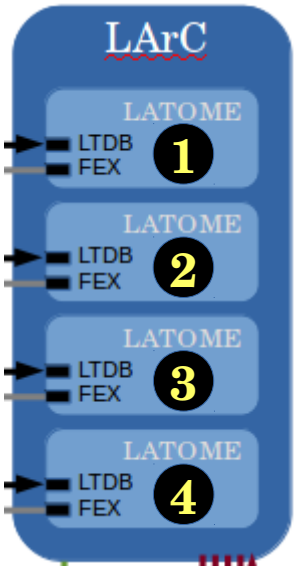
DCS screenshots : LATOME current





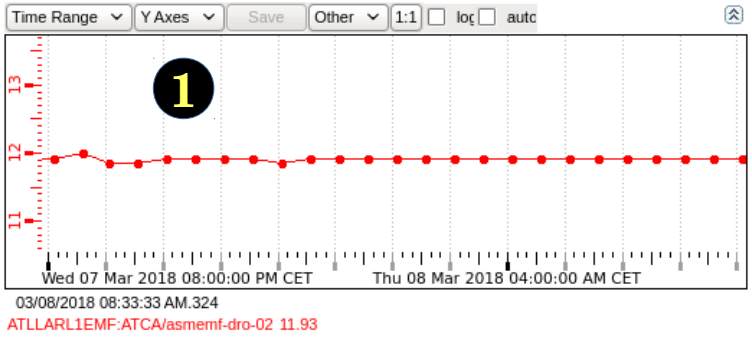






Running : 3 LArC with 12 LATOME

DCS screenshots : LATOME Voltage



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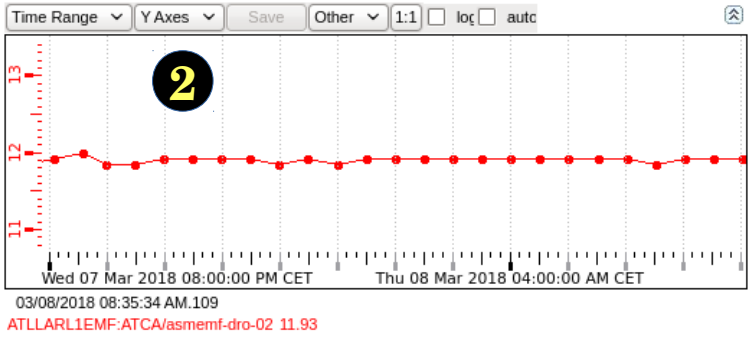
ATLLARL1EMF:ATCA/asmemf-dro-02 11.93



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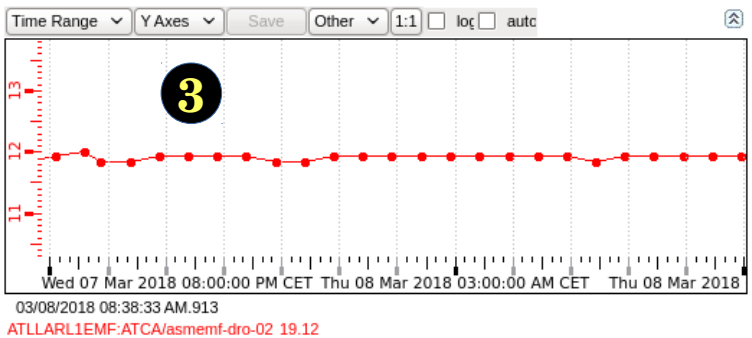

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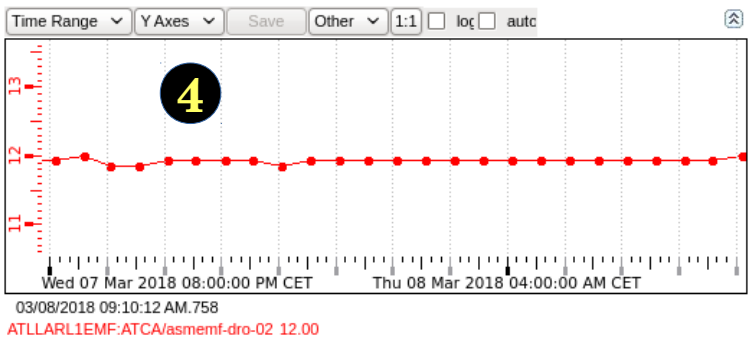

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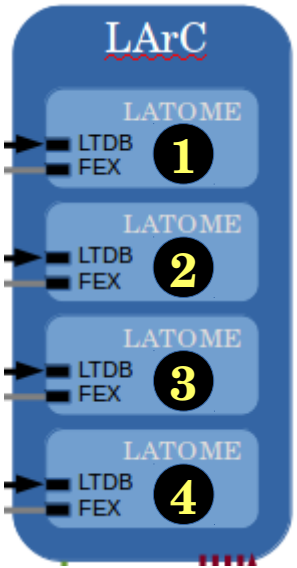
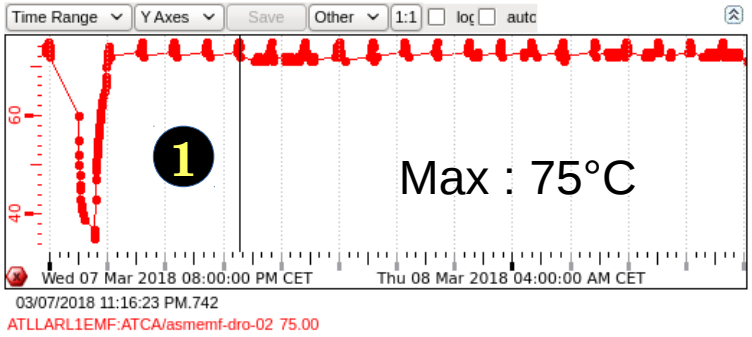
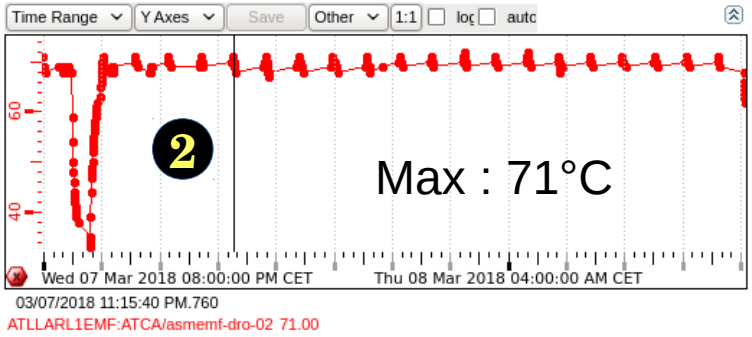
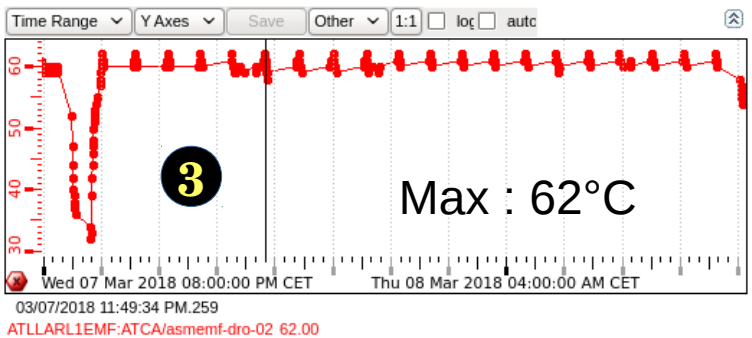


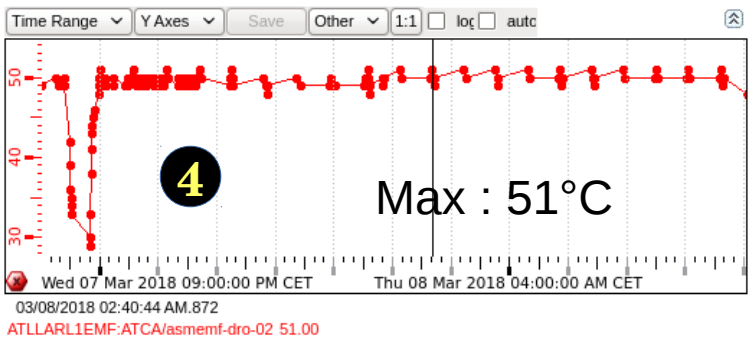
Stable voltages : 12V

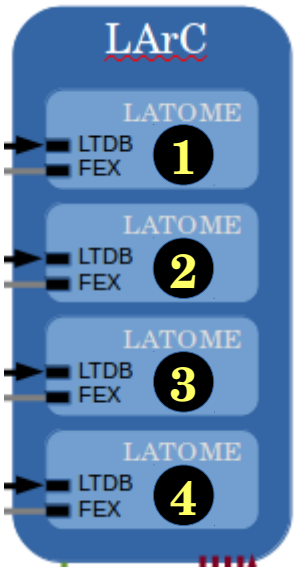
DCS screenshots : LATOME Temperature











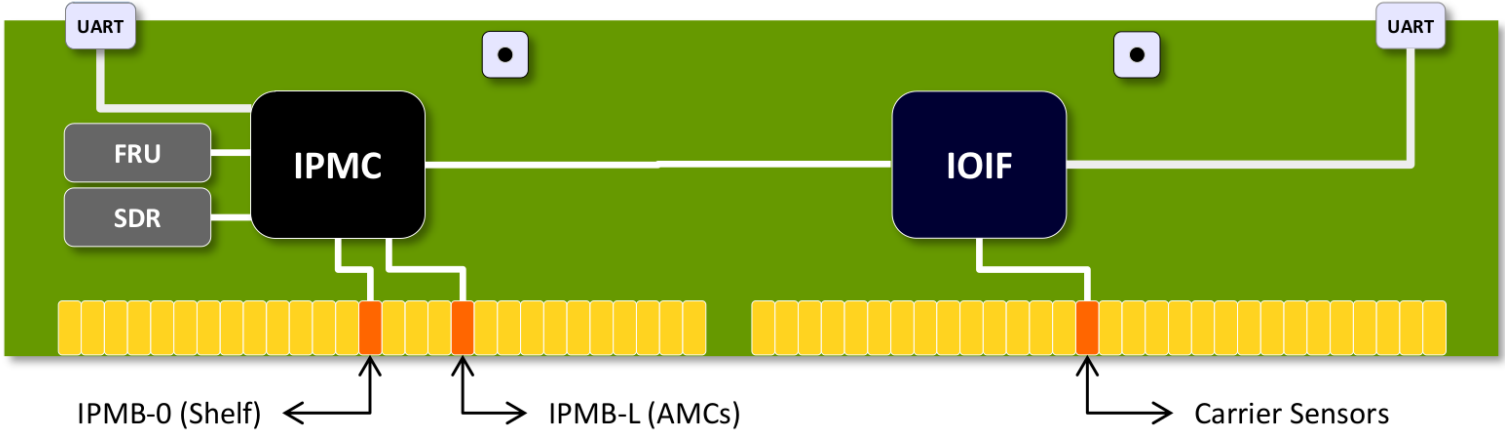
Fan speed oscillates between 10 and 12 (over 15)

Main issues encountered

- **Integration tests of LArC and LATOME unveiled several bugs in IPMC software**
- **Main observations from the user side :**
  - Inopportune reboot of IPMC → reboot of LArC and LATOME
  - Sometimes after reboot some AMC were not powered up anymore
  - Instability increased with numbers of AMC hosted in a carrier
    - At beginning : no AMC → no reboot, 1 AMC → reboot after 1 day, 4 AMC→ after 30min
- **These crashs had different origins**
  - I2C bus issues
  - Power sequence not robust enough
  - Communications between IPMC and IOF µControllers not robust enough

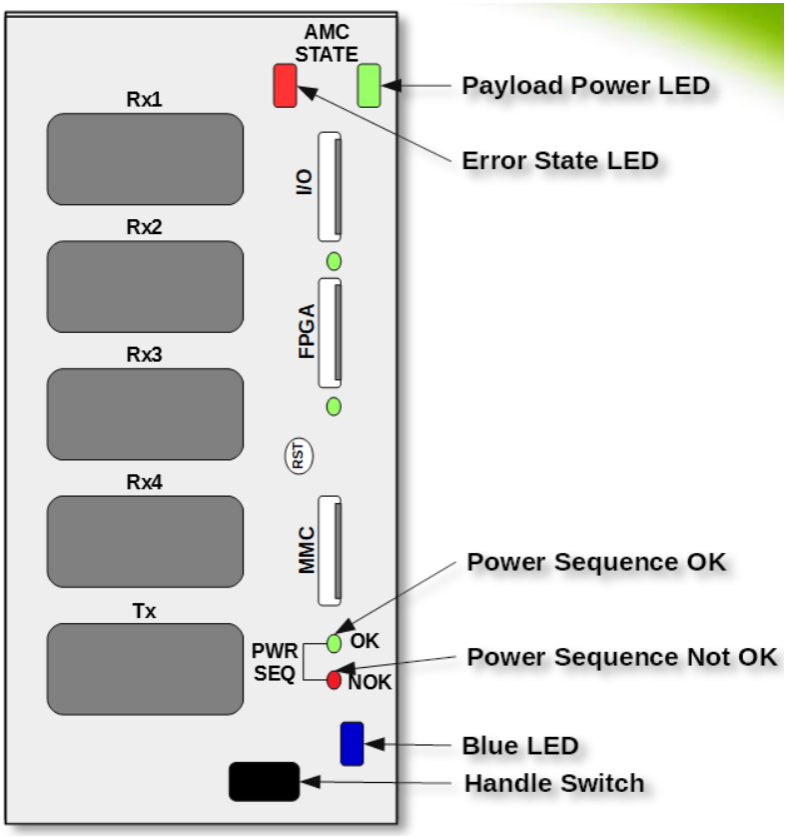
I2C bus issue

- **Sometimes IPMC-Shelf Manager & IPMC-AMCs communications lost**
  - Fix bus error handling (reset i2c interface)
  - Fix AMC bus busy (both IPMC software and MMC software)
  - Fix memory leak when deleting a too old IPMB request message
  - Memory allocation was not I2C-interrupt safe



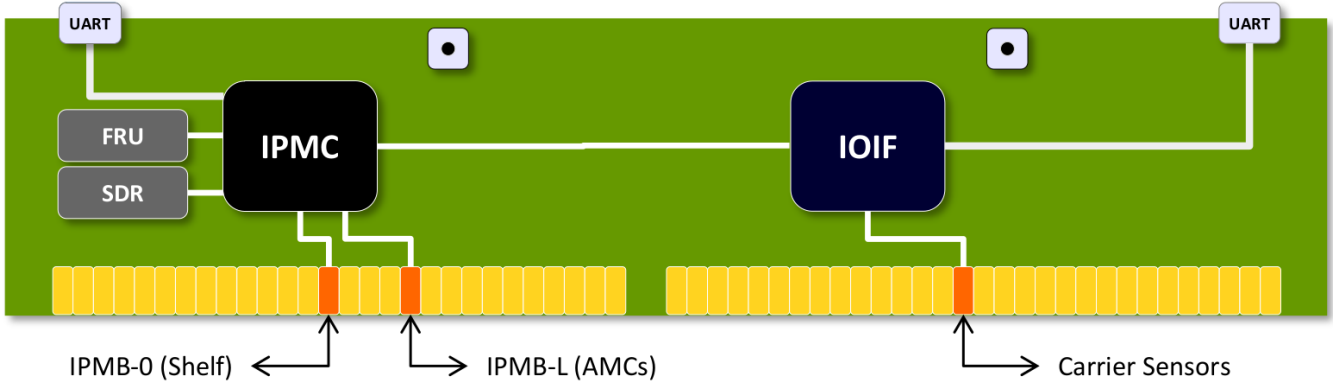
AMC power sequence

- **When rebooting IPMC, AMC were not always powered up correctly :**
  - Stuck in deactivation state (blue LED blinking)
    - Fix carrier management power sequence
  - Stuck in inactive state (blue LED on)
    - Fix IPMB retry process, when timeout
  - Failure of MMC power sequence
    - Oocurs when power not yet stabilized
    - Mechanism to delay and automatically restart power sequence in case of failure



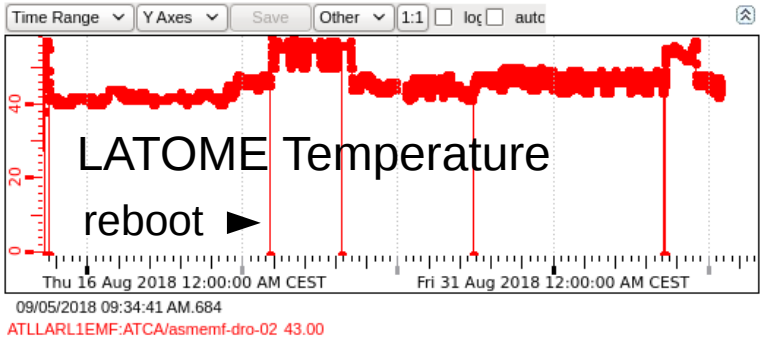
Communication between IPMC & IOIF

- **IPMC : communications to Shelf Mangaer & AMCs**
- **IOIF : sensors reading, firmware upgrade, JTAG programming**
- **Sometimes communication between IPMC and IOIF was lost**
  - Fix error propagation, retry process when timeout, assignment in message sequence
  - Fix memory leak when deleting a message that was too old



Ongoing Issue

- **Still an issue remaining on the IPMB-L bus, that triggers a reboot of the IPMC (when using AMC)**
  - IPMC-AMC communication lost, after 5 retries → reboot
  - At worst occurs every two days with 3 LATOME
  - Experts are working on it ;-)



- **Not an easy task to debug this kind of memory corruption :**
  - Software behaviour change when you had « printouts »
  - Not easy to find patterns, when you have to wait several days for an occurrence
  - Not same behaviour on different setups

Foreseen Developments

- **Fix remaining IPMB-L bug**
- **Test SVF player to program FPGA via ethernet**
- **Static allocation of sensor numbers, to not mix AMC sensors in DCS**
- **On DCS side, ignore unvalid sensor values ?**

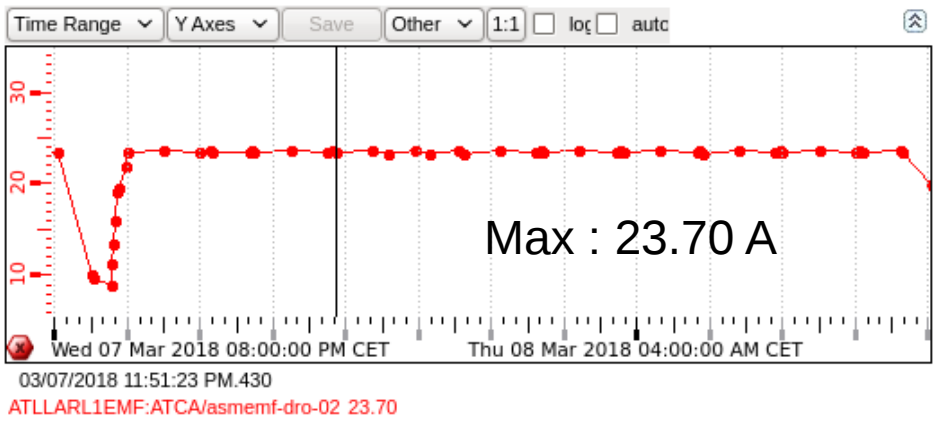
Conclusion

- **LAPP-IPMC is daily used in ATLAS LAr Phase-1 Back End Electronics boards**
  - Boards are correctly powered
  - Automatic cooling of the ATCA crate is effective
  - Current, Voltage and Temperature sensors are monitored, up to a DCS interface
  - Several bugs were solved
  - Stable system over several days even with several AMC

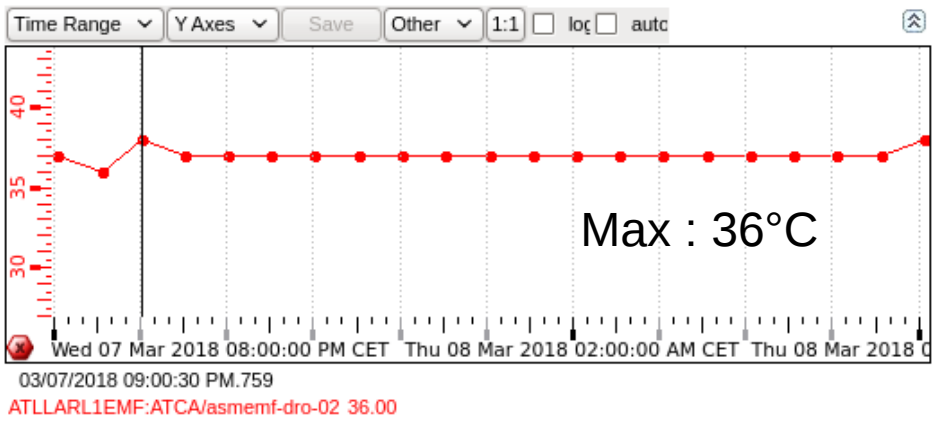
BACKUP

DCS screenshots : LArC Current & Temperature

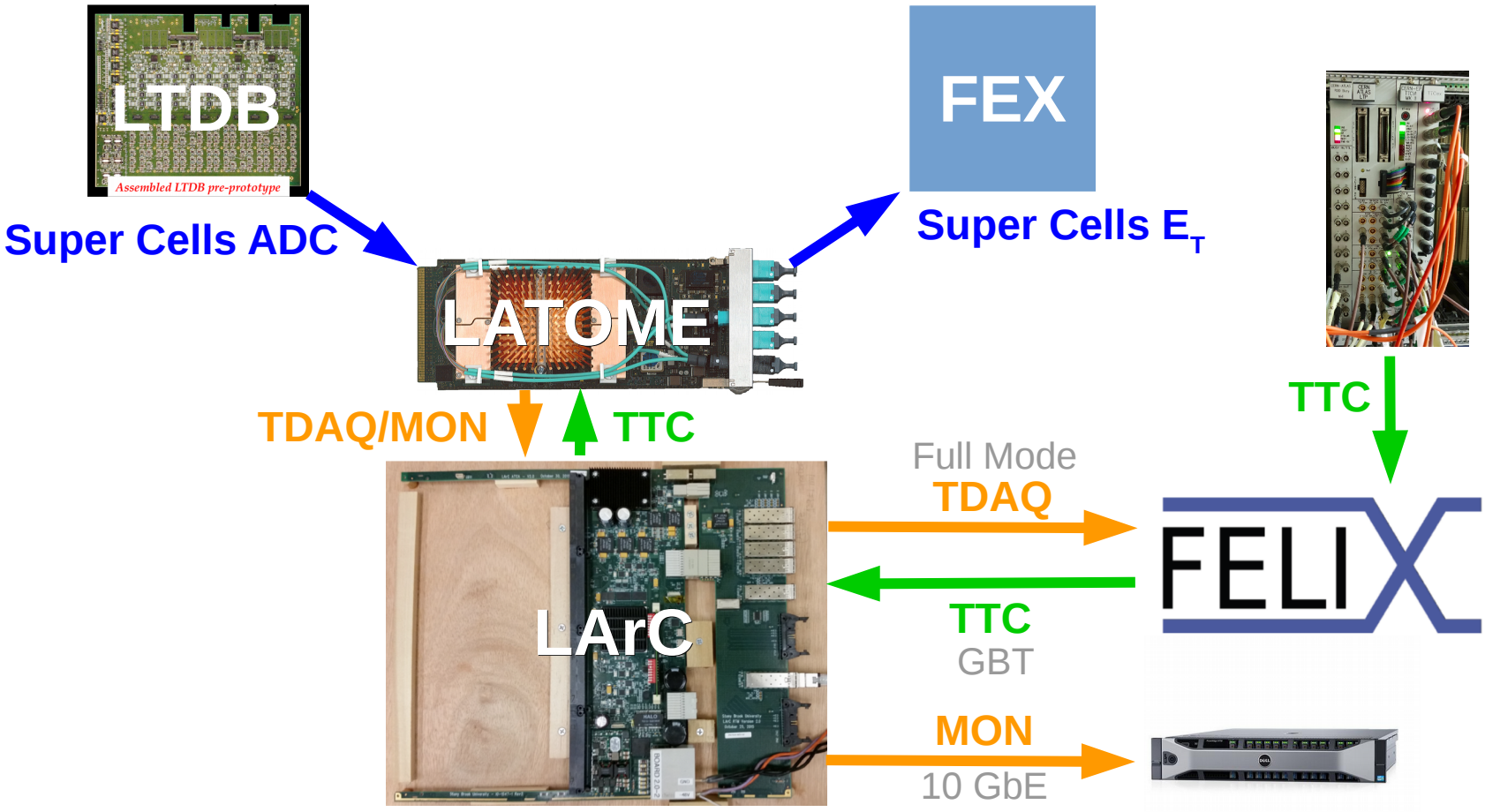
Total Current



LArC FPGA Temperature

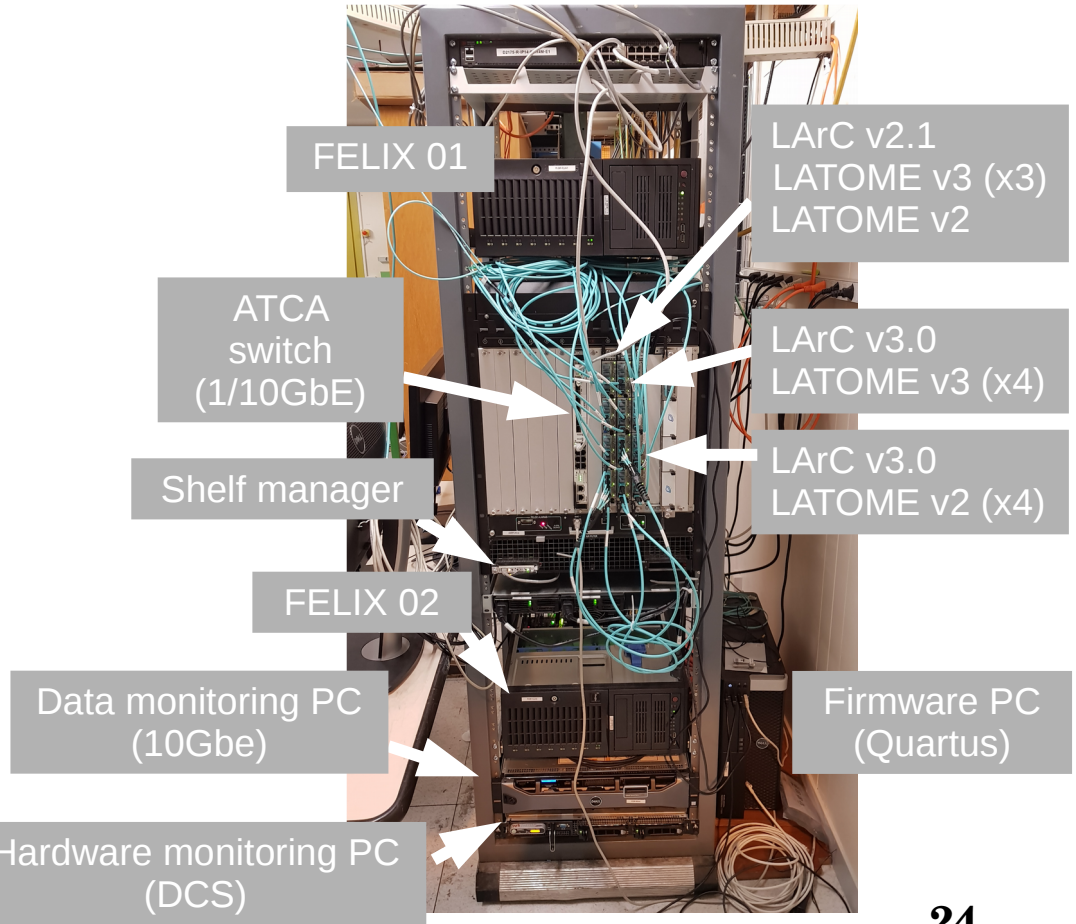


LAr Phase-1 Electronics

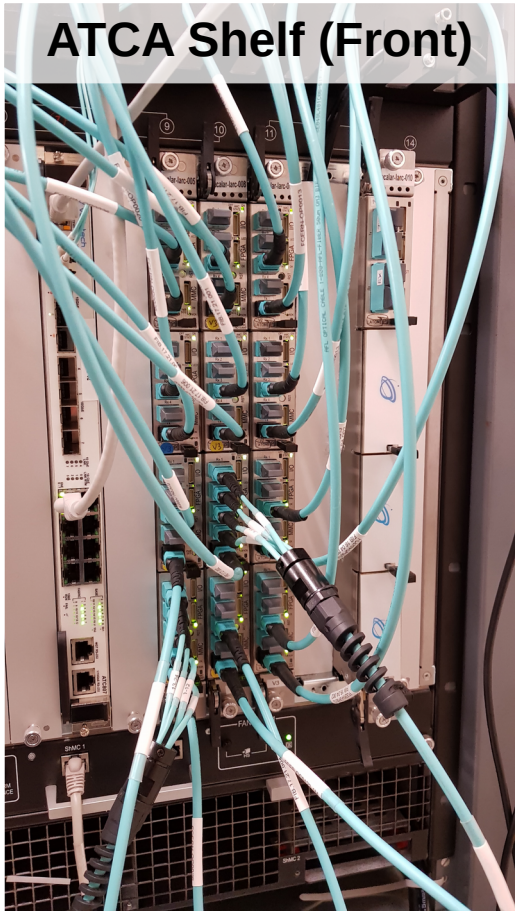


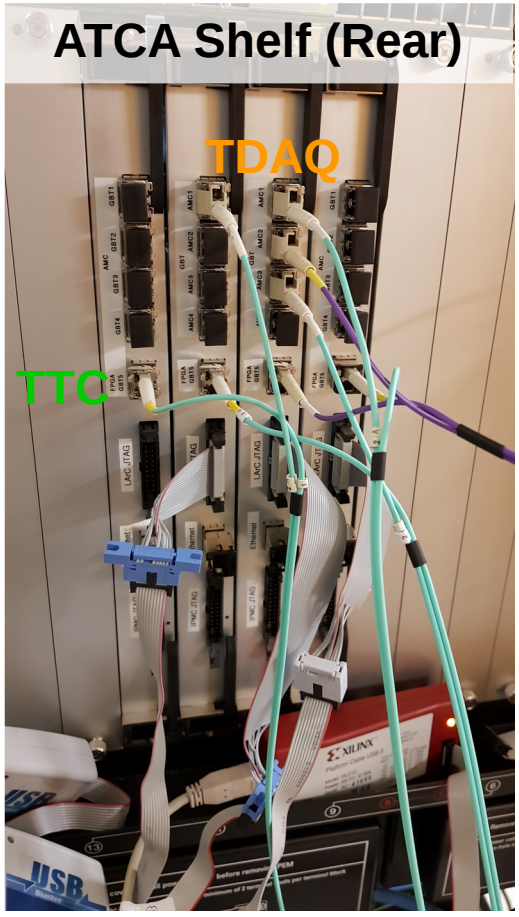
Setup @ EMF

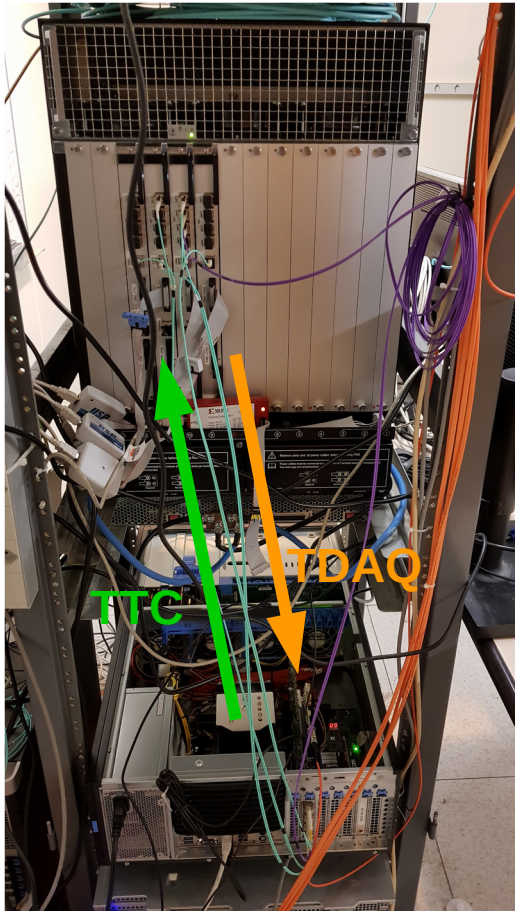
- **3 LPDB :**
  - LArC : 1 v2.1, 2 v3
  - LATOME : 5 v2, 7 v3
- **Two FELIX PC (VC709)**
  - One for LTDB, one for LDPB
- **One local monitoring PC (10GbE)**
- **One hardware monitoring PC (DCS)**



Setup @ EMF







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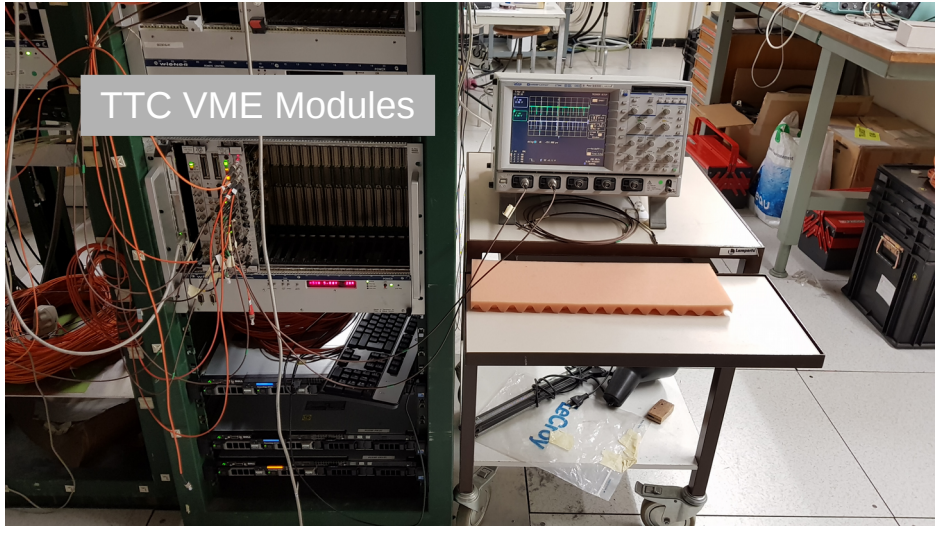
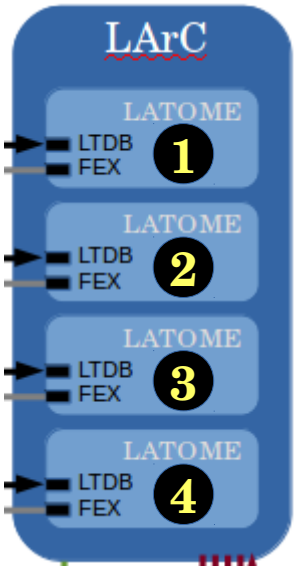


Summary on Power & Tempareture (as of PRR)

- **With final setup with 12 LATOME, running LATOME code with basic E_T computation :**
  - **Total Current: 23.70 A → 284W** (max allowed 400W)
  - Temperature LArC: 36°C (max allowed 70°C)
  - **AMC1 : 5.50 A, 75°C** (max allowed 6.7 A, 85°C)
  - AMC2 : 5.45 A, 71°C
  - AMC3 : 5.15 A, 62°C
  - AMC4 : 4.55 A, 51°C



- **The temperature and power requirements are fulfilled**
  - The cooling with the production version of the LArC will even be improved
    - The test version of LArC have connectors to host 8 compact-sized AMC, that slow the air flow