**Upgrade of the ATLAS Tile Calorimeter High Voltage System**

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### HV Upgrade main motivations and goals

- LHC upgrade aims to a luminosity increase in Phase II (High Luminosity LHC scheduled to start in 2026)
- Ageing of components requires new HV system
- Better radiation tolerance for increased luminosity
- Improve the reliability and reduce maintenance needs
- Need to provide 9852 voltages in ranges [-470, -830] or [-590, -950] V
- Achieve the same HV performance of previous LHC runs
- Voltage stability required: 0.5 V rms
- Achieve the same HV performance of previous LHC runs
- Temperatures required: 0-83°C
- Achieve the same HV performance of previous LHC runs
- Time variations of optocoupler phototransistor redone in 48 channel prototype
- On/off mechanism ok for most of the channels but failing for a few channels
- Individual regulation loop: optocoupler + 2 transistors
- Remote regulation off-detector
- No radiation
- Permanent access for maintenance
- Up to 48 HV inputs per module supplied using 100 m long multewire cables
- Passive HV bus cards
- Communication with detector control system using Ethernet
- Transistors removed from loop control

### Current High Voltage system

- Embedded, regulation in-detector in radiation hard board
- No access when running
- One single HV input per module
- Communication using Canbus

### HVremote prototype lab tests

- 12 channel prototype
  - Just a modified version of the original HV Opto boards used in the Tile Calorimeter
  - Used to demonstrate the feasibility of the remote solution
- 24 channel prototype
  - 6U boards with 24 channels
  - One ethernet connection per board
  - Implemented on/off switch for every channel (design redone in 48 channel prototype to avoid effect of dark current variations of optocoupler phototransistor)

### High Voltage for Phase II upgrade

- Remote regulation off-detector
- No radiation
- Permanent access for maintenance
- Up to 48 HV inputs per module supplied using 100 m long multwire cables
- Passive HV bus cards
- Communication with detector control system using Ethernet
- Transistors removed from loop control

### Other HV system components

#### Cable

- 100 m long cables will connect the HVremote boards to the detector.
- Worst constraint: maximum diameter of 17 mm for the cables with 32 pairs of wires that are used for the Extended Barrel modules.
- Prototypes available from 2 companies are being tested.
- DB25 connectors are also being tested.

#### HV Bus

- To be used inside the detector as extension of the cables. Fully passive (only 500 Ω resistors and connectors), 4 layers to have HV tracks protected in the inner layers. Prototypes being tested.

#### HV supplies

- Board with DC-DC converters that produce the primary high voltage (-830 or -950 V), and with on/off switches for the HVremote boards.
- First prototype in production.

#### Crates

- 6U crates to house the HVremote boards, HV supply boards, control board and low voltage power supplies (+24 V, +12 V, -12V).
- Currently in design phase.

### References

- F. Vazelli, Performance of a remote High Voltage power supply for the Phase II upgrade of the ATLAS Tile Calorimeter, JINST 11 (2016) C02050