# Control Systems: An Application to a High Energy Physics Experiment (COMPASS)

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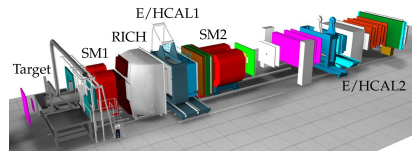
LIP-Lisbon

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# The COMPASS experiment at CERN





- 250000 detector channels, spread over 60 m
- >1000 TB/year of physics data
- Data taking since 2002
- Unique muon beam and polarized target (@ 50 mK)

- **CO**mmon **M**uon **P**roton **A**pparatus for **S**tructure and **S**pectroscopy
- ∼240 physicists
- 11 countries
- 28 institutions

# The COMPASS Detector Control System (DCS)

- The Detector Control System (DCS) is the set of hardware and software that monitors and controls equipment of all the COMPASS experiment and its environment.

- It is an exclusive responsibility of the LIP-Lisbon group participating in the experiment since 2003.

### Requirements and challenges

- Global view of the state of the experiment, in as short enough time to allow the shift crew to aknowledge problems and react to them, not wasting beam time

- Permanente monitoring and control of high and low voltage power supply channels and VME crates

- Recording and providing access to historical data

- Management of groups of settings of the equipment and of groups of conditions for alarms, with access control

- A big variety of equipments, with different generations of communication and control interfaces have to be monitorored and controlled

- Scalability, reliability, security

# The architecture of the COMPASS DCS
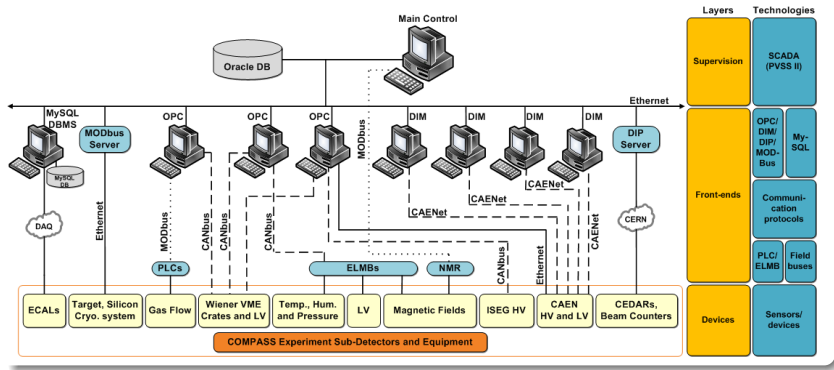
## Facts and numbers of the COMPASS DCS

- Uses PVSS as SCADA, which provides a graphical development environment, a programming language (Control), objects and libraries, and is *device oriented*
- Uses JCOP Framework, a layer of code on top of PVSS developed at CERN for High Energy Physics applications
- On top of PVSS and the JCOP Framework, a COMPASS layer allows to address the specificities of the experiment
- $\sim$ 20 000 datapoints (the basic structures of PVSS)
- Reading cycles from 1.5 s to 2 min
- $\sim$ 17 000 parameters with alert handling
- $\sim$ 19 000 parameter values archived, with regular cycles from 40 s to 30 min, or if changes $> \delta$ (pre-defined)
- 10 PCs for supervision and front-ends, in a PVSS distributed and scattered system
- Data stored in a centralized Oracle database and streamed to a replica database
- The most relevant data for physics analysis is copied to the experiment's mySQL Conditions DB

# The COMPASS DCS user interface

## Example: automated actions

- Too high temperature in aquisition cards $\Rightarrow$ Low voltage power supply channels switched off
- Trip of a spectrometer magnet $\Rightarrow$ High voltage power supply channels switched off
- New configuration of data taking detected $\Rightarrow$ New *recipe* of conditions for alarms loaded

# Example: monitoring of gains and readout chain of calorimeters



ECAL2: 2972/3068 channels.

# Example: beam and trigger rates
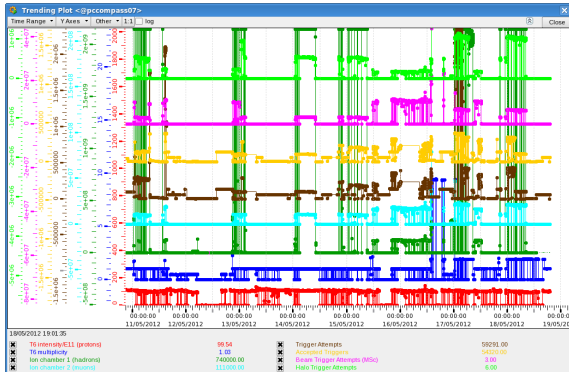


One week of commissioning in 2012.

## Conclusions and outlook

- A great variety of equipment, with different interfaces, have to be dealt with in the Detector Control System of COMPASS

- The experiment is quite flexible, which constitutes an additional challenge

- A group at CERN works specifically in the area of controls, and is responsible for the tests with external hardware, firmware and software, and for the development of generic solutions for the High Energy Physics context.

- As a smaller experiment that started before the experiments of the LHC, COMPASS was a benchmark for several of those solutions.

- The LIP-Lisbon group has been appointed to continue to be responsible for the DCS of the second phase of the experiment, COMPASS-II, already aproved by the Scientific Council of CERN.

Thank you for listening!