The Instrument Control Electronics of the ESPRESSO Spectrograph @VLT

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INTRODUCTION

ESPRESSO [1] is the Echelle SPectrograph for Rocky Exoplanet and Stable Spectroscopic Observations that will be installed in the Combined Coudé Laboratory (CCL) of the ESO VLT. The main goals of ESPRESSO will be the measurement of high precision radial velocities of solar type stars for search for rocky planets, the measurement of the variation of the physical constants and the analysis of the chemical composition of stars in the nearby galaxies. ESPRESSO will be able to operate either as a single telescope instrument or as a multi-telescope facility, collecting the light of up to four telescopes. In fact the light of each UT is fed from the Nasmyth focus, through a tunnel made up of optical elements (Coudé Train), to a Front End Unit (FEU) in the CCL of ESO VLT.
The ESPRESSO Instrument Control Electronics aims to control all moving parts that allow the light to follow that specific path and the lamps that calibrates the final spectrum, assuring also the safety of the instruments and people through a large number of sensors and alarms [2].

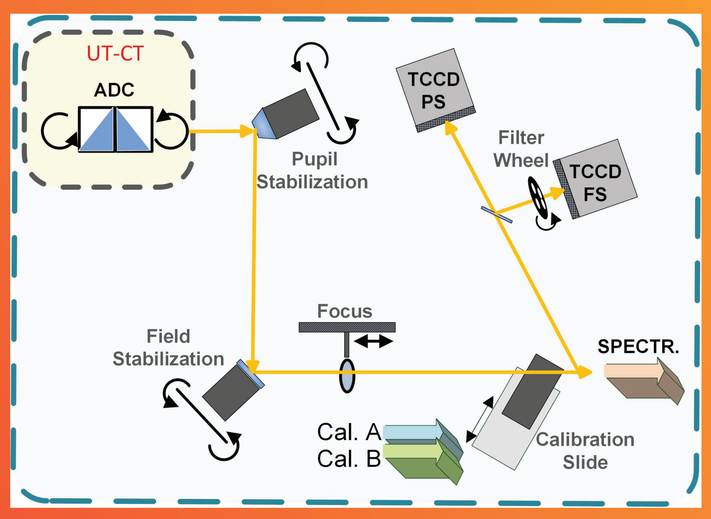

Figure 1 FEU functions in each of the four arm

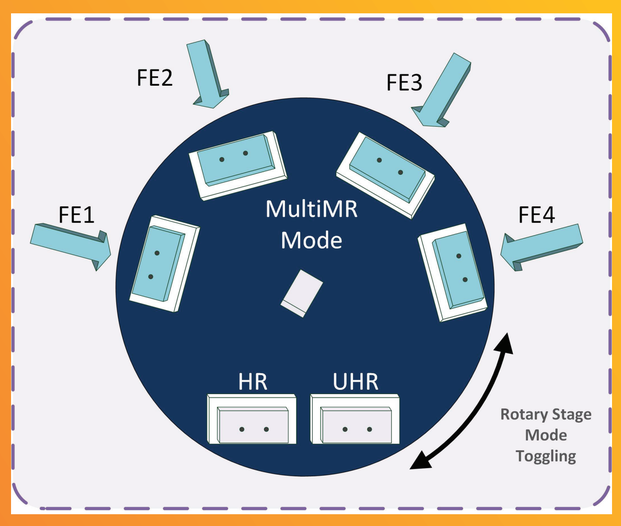

Figure 2 ESPRESSO Mode Selector

SYSTEM ARCHITECTURE

Composition of each FEU arms (Figure 1):
- Atmospheric Dispersion Corrector (ADC)
- field and pupil stabilization (a set of piezo tip-tilt stages for performing the corrections, a Technical CCD and a neutral filter)
- focus translational stage
- calibration slide (injection of the calibration light - white and spectral sources - into the spectrograph fiber)
- mode selector (Figure 2) mounted on a rotary stage

Two ESO Next Generation Controllers (NGCs) controls two scientific detectors: one for the red arm and one for the blue one.

CONTROL ELECTRONICS HW LAYOUT

ESPRESSO CPUs will be hosted in the main ICE cabinet that will be placed in the CCL. In the same place the Thermal Control Cabinet, Calibration Unit Cabinet, Vacuum Cryo Control Cabinet and Fabry Pérot calibration light source will be hosted. These cabinets are Schroff 2000 mm high 800 mm deep and wide type. Four 1200 mm high cabinets will control each FEU arm (Figure 4).
All the cabinets are mounted on a special custom made damper feet to reduce the effects of earthquakes. All the PLC CPUs and modules are mounted in 19” sub-racks, similar to those used for the VME crates, as shown in Figure 3.

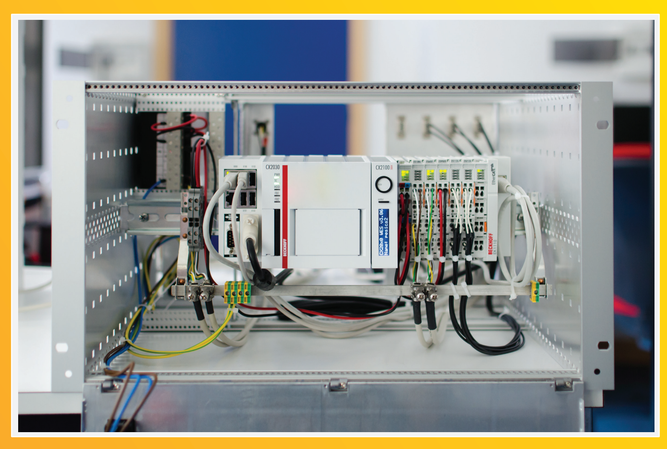

Figure 3 One of the main ESPRESSO PLC CPUs in a 19” sub-rack

SOFTWARE SUPPORT

ESPRESSO uses OPC-UA for the communication between the software components running on the PLC and the instrument control workstation [3] [4]. During the development and testing phase the use of the OPC-UA protocol proved to be useful since the process variables could be examined and set-up by using free commercial OPC-UA clients like Unified Automation UAExpert or Softing OPC client. In this way the PLC software components could be tested without the intervention of the instrument workstation, allowing for a better debugging.

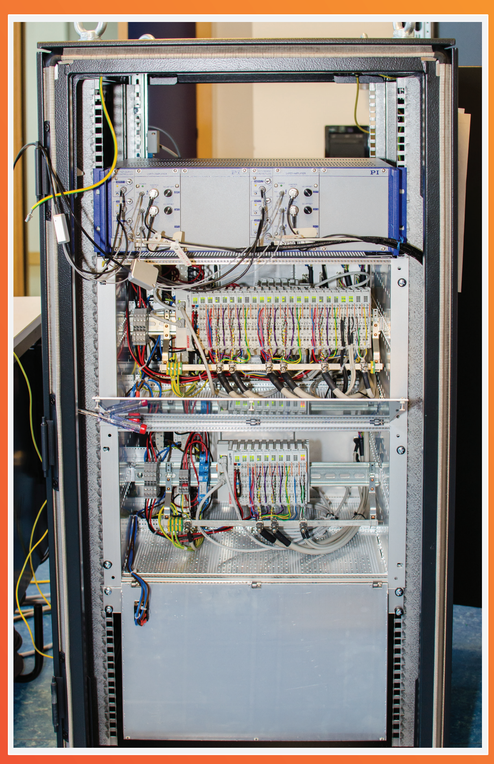

Figure 4 FEU #4 cabinet

ASSEMBLING AND TESTING PROCEDURES

The mounting of all the electronics cabinets and sub-racks of ESPRESSO is being done at various sites of the institutes participating to the instrument. Once all the hardware is ready it is fully tested with the Instrument Control Software. The first testing and acceptance procedure occurs at the site where the cabinets are mounted. The FEU electronics is sent to the observatory of Merate (Milano) to be tested also with the fully mounted and aligned optomechanical parts of the FEU. All the electronic cabinets will be then sent to Genève for the European integration and acceptance. After a successful test of the electrical cabinets and all the devices, all the equipment will be delivered to the Paranal Observatory in Chile for the final integration.

REFERENCES

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[4] R. Cirami, et al., Adoption of new software and hardware solutions at the VLT: the ESPRESSO control architecture case, Amsterdam (ND), SPIE2012