

# FORS-UP: AN UPGRADE OF THE FORS2 INSTRUMENT AT ESO VLT

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## ABSTRACT

The FORS Upgrade project (FORS-Up), financed by the European Southern Observatory (ESO), aims at upgrading the FORS2 instrument currently installed on the UT1 telescope of the ESO Very Large Telescope in Chile. FORS2 is an optical instrument that can be operated in different modes (imaging, polarimetry, long-slit and multi-object spectroscopy). Due to its versatility, the ESO Scientific Technical Committee has identified FORS2 as a highly demanded workhorse among the VLT instruments that shall remain operative for the next 15 years. The main goals of the FORS-Up project are the replacement of the FORS2 scientific detector and the upgrade of the instrument control software and electronics. The project is conceived as “fast track” so that FORS2 is upgraded to the VLT for 2022. This poster focuses on the outcomes of the FORS-Up Phase A, ended in February 2019, and carried out as a collaboration between ESO and INAF – Astronomical Observatory of Trieste, this latter in charge of the feasibility study of the upgrade of the control software and electronics with the latest VLT standard technologies (among them the use of the PLCs and of the latest features of the VLT Control Software).

## INSTRUMENT DESCRIPTION

**FORS2 (FOcal Reducer/low dispersion Spectrograph)** is a multimode (imaging, polarimetry, long slit and multi-object spectroscopy) optical instrument mounted on the Antu Unit Telescope Cassegrain focus of ESO Very Large Telescope. FORS2 covers a wide wavelength range spanning from 330 nm to 1100 nm and is equipped with a mosaic of two blue-optimized 2k x 4k detectors.

It physically consists of the following parts (Figure 1):

- **Top section.** The motorized functions are an entrance shutter, a Multi-Object Spectroscopy (MOS) unit with 19 movable slits, a longslit mask unit with 9 slits and a mask exchange unit for MOS spectroscopy (MXU) holding up to 10 masks.
- **Internal calibration units.** They are equipped with arc lamps.
- **Collimator section.** It contains the two collimators (Standard Resolution and High Resolution) and the electronic cabinets.
- **Filter/camera section.** It contains the retarder plate mosaics swing arm with the linear and circular retarder plate mosaics (used for polarimetry and spectro-polarimetry), the camera focusing stage, the exposure shutter, five filter wheels containing the Wollaston prism, the grisms and the broadband and interference filters and the scientific detector.
- **External calibration unit.** It consists of three flat field lamps.

Beside the motorized functions reported above, several sensors are used to monitor the instrument status.

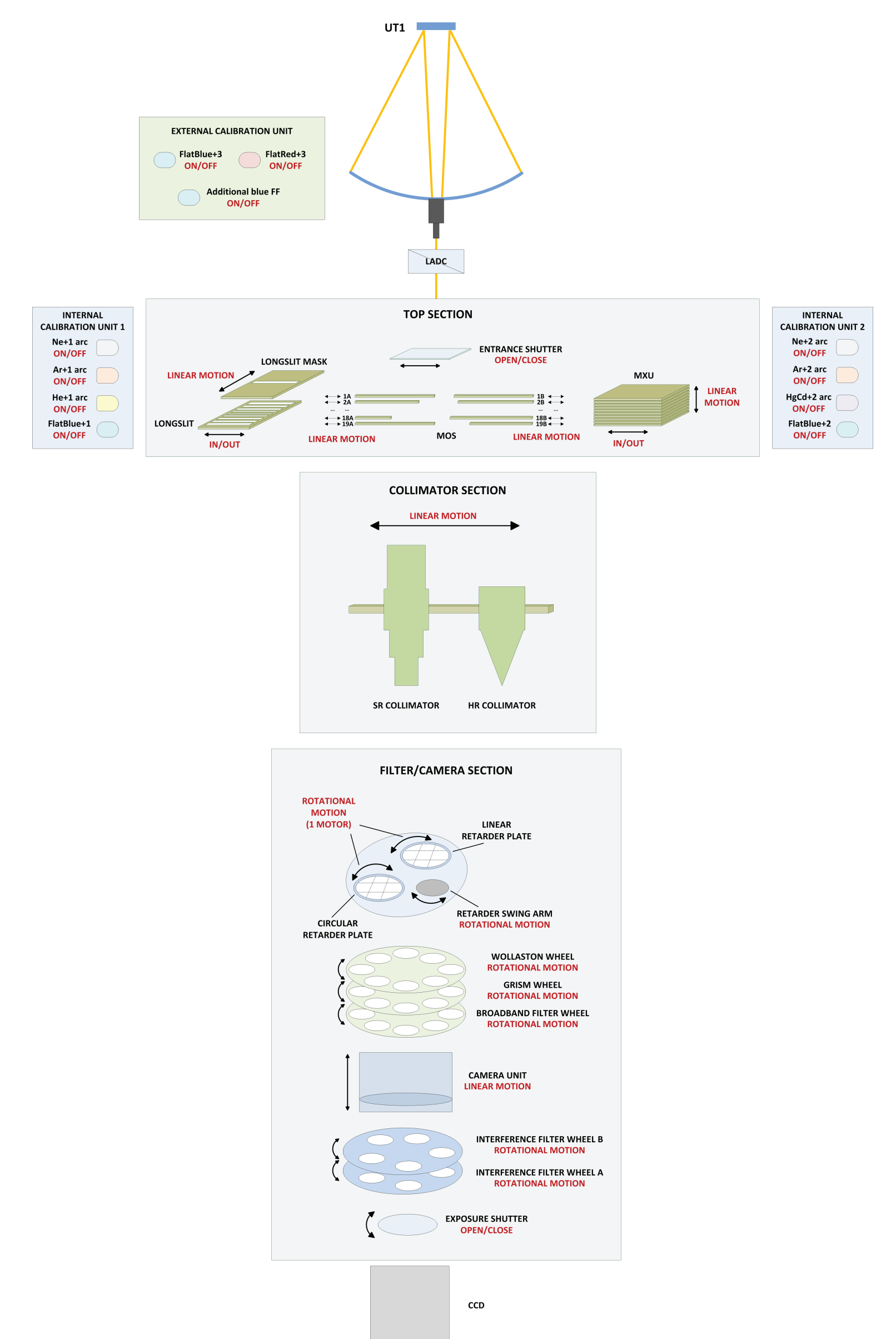


Figure 1: FORS2 instrument overview.

## INSTRUMENT UPGRADE MOTIVATION

Due to its versatility, the ESO Scientific Technical Committee has identified FORS2 as a highly demanded workhorse among the VLT instruments that shall remain operative for the next 15 years. To fulfill this requirement the VLT Instrument Operation Team identified as critical points the need to replace the **scientific detectors** and to upgrade the **instrument control software and electronics** (both developed at the end of the '90s, with several control parts not supported anymore by vendors).

These considerations led to the FORS-Up project, financed by ESO. The main goals of the project, beside the upgrade of the FORS2 scientific detector (and of some instrument optics), is the upgrade of the instrument control software and electronics [1].

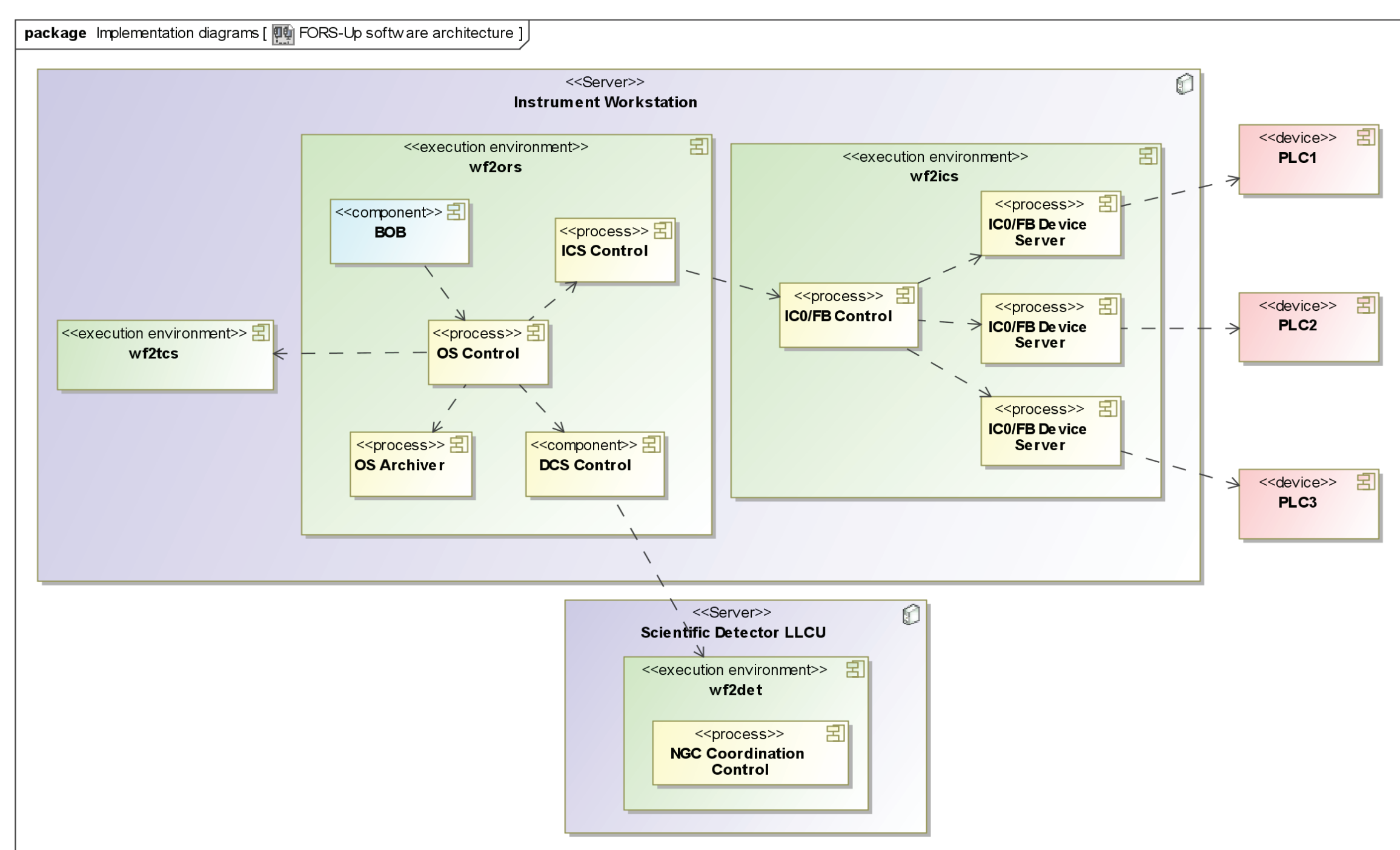


Figure 2: FORS-Up proposed control architecture.

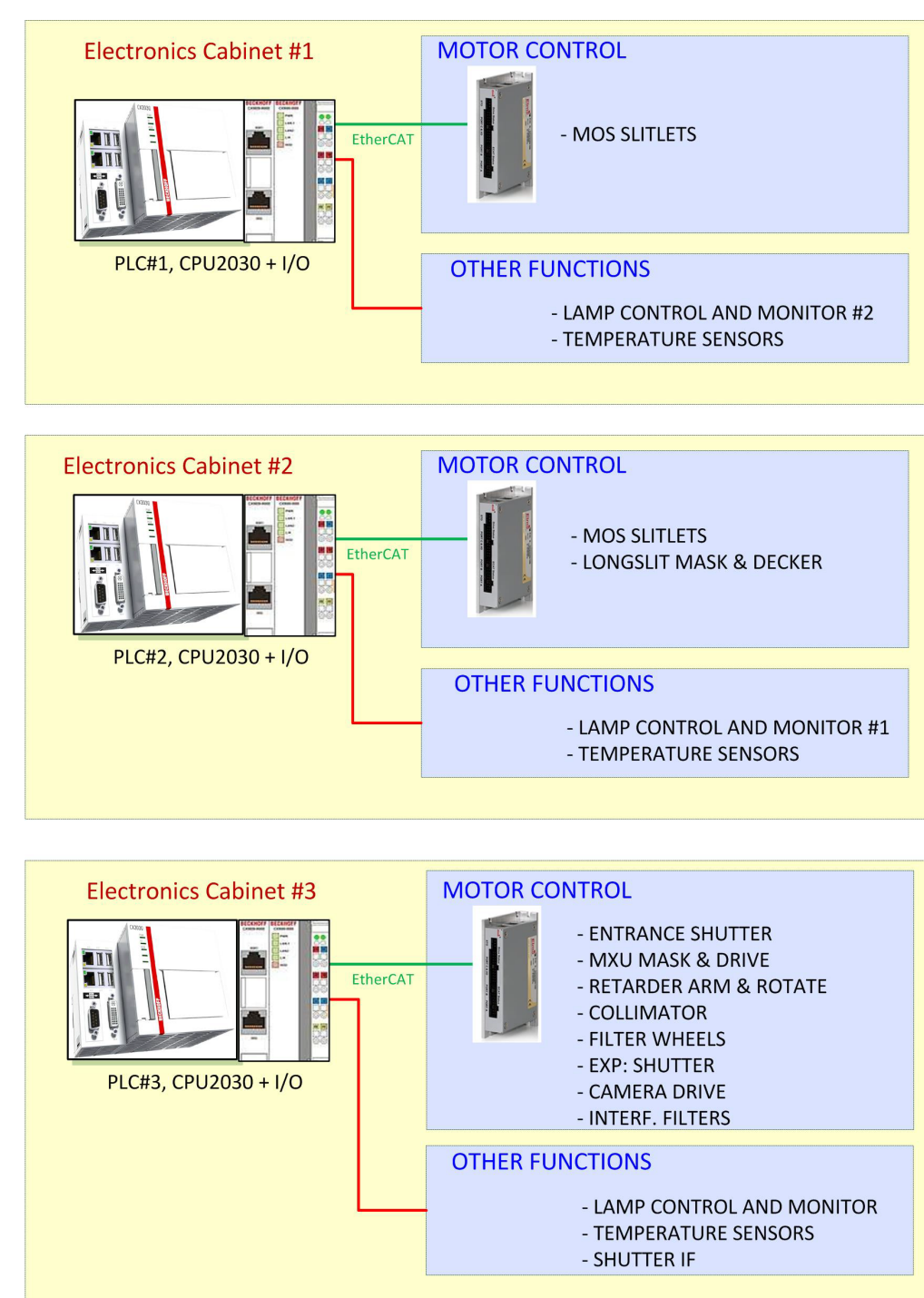


Figure 3: FORS-Up proposed hardware architecture.

## UPGRADE FEASIBILITY STUDY

The goal of the Phase A, ended in February 2019, was the identification of the crucial points for porting the current FORS2 control software and electronics to the latest VLTSW standard, together with the realization of the software and electronics design [3][4].

### Control software

The FORS-Up **control software** will be based on the latest VLTSW release (VLTSW 2018) (see Figure 2). From the hardware point of view, the most notable modification is the adoption of Beckhoff PLCs and OPC-UA communication protocol, which replaces the current system based on VMEs. As a consequence, at ICS level, the ESO standard *IC0/FB framework* will be used to control the instrument devices.

In the new upgrade, the **Observation Software** (the software that manages the scientific exposure) will be based on the standard VLT *boss* package, replacing the “custom” FORS2 OS.

The old FORS2 scientific **Detector Control Software** controller, FIERA, not anymore supported, will be replaced by the *New General detector Controller (NGC)* package.

### Control hardware

The proposed baseline design does not foresee changes in the electro-mechanical architecture, keeping the motor assemblies as they are and refurbishing the parts where necessary.

The proposed control electronics hardware is based on a **Beckhoff PLC platform**. The I/O modules are either connected on the CPU itself or decoupled using EherCAT bus and couplers (see Figure 3).

## NEXT PROJECT PHASES

In the last years, ESO is working in developing new software and electronics control standards for the forthcoming ELT telescope that will supersede VLT standards named CII (Core Integration Infrastructure). To this purpose and amendment of the Phase A, Phase A+, has been signed by INAF - OATs with the purpose to evaluate functional compliance, feasibility, potential hazards and approximate cost in adopting also for FORS2 the **ELT Instrument framework** and **ELT electronics standards**.

## REFERENCES

- [1] Derie F., et al., “FORS-Up Phase A Report”, ESO Doc. n. ESO-326862, Ver. 1, 21/02/2019.
- [2] Cirami R., et al., “FORS-Up Instrument Software Design Description”, ESO Doc. n. ESO-312666, Ver. 2, 04/09/2019.
- [3] Coretti I., “FORS-Up Instrument Control Electronics Feasi-bility Study Report”, ESO Doc. n. ESO-312667, Ver. 1, 24/01/2019.