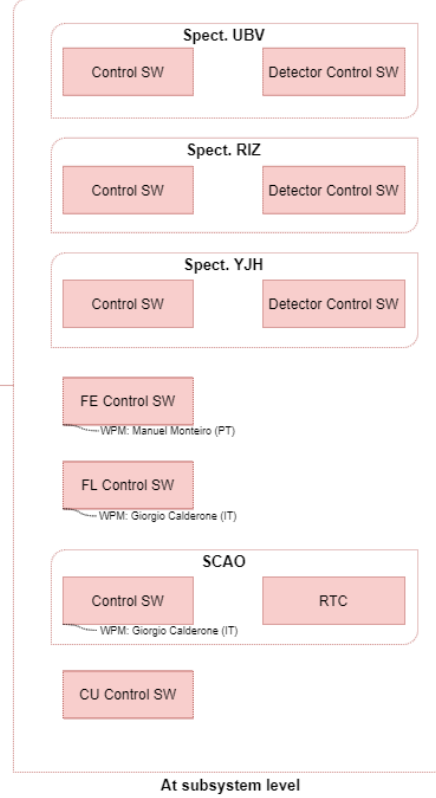
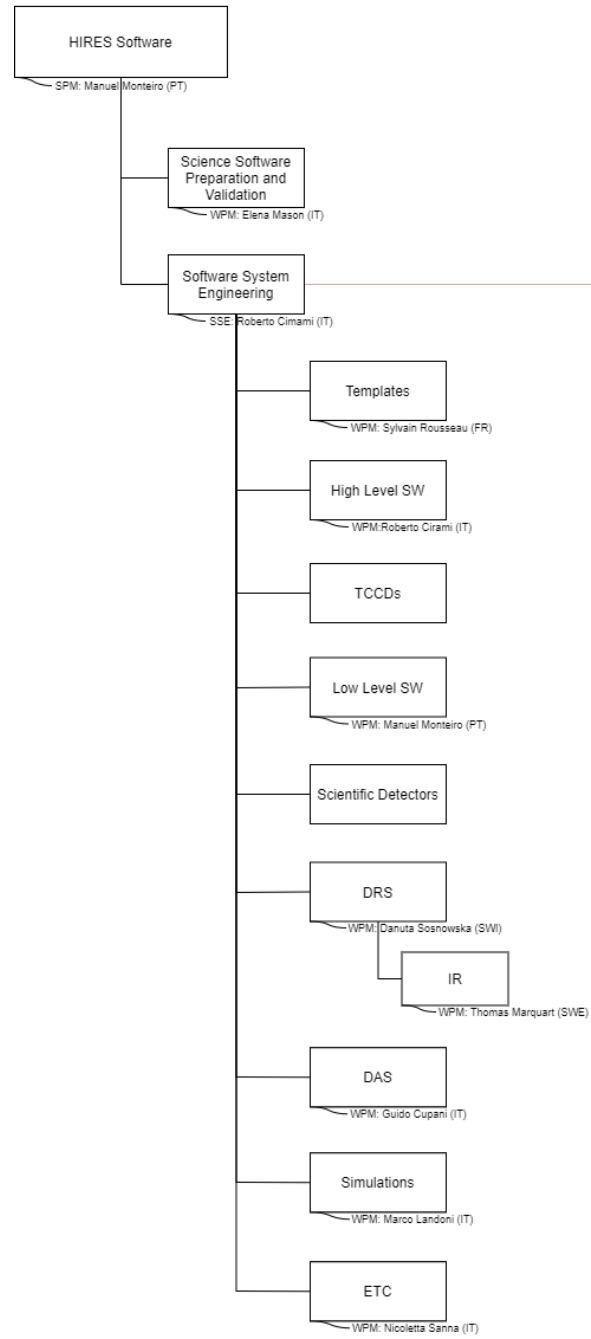


ELT High Resolution Spectrograph

SOFTWARE

Manuel Monteiro (IA / U.Porto)
Software Project Manager
on behalf of the software team

WBS Phase B

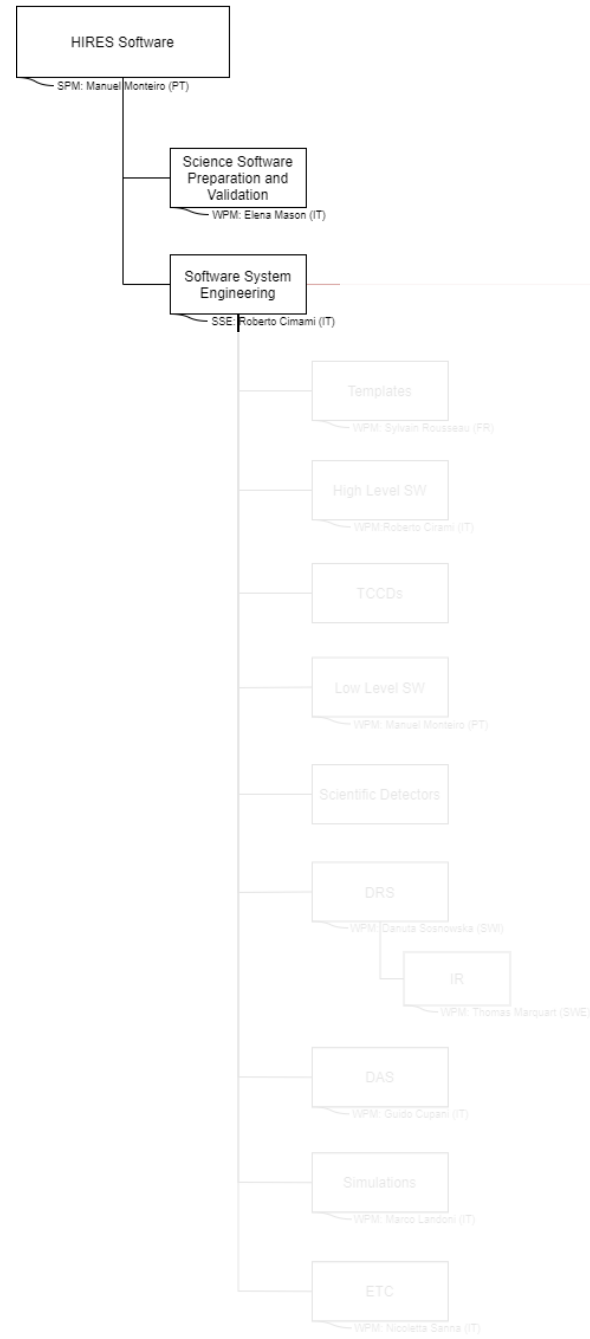


- we have a highly distributed system

- each subsystem will handle its own (local) software

- managed at high level by Roberto Cirami, as a Software Architect, to ensure coherence at project level and fulfillment of ESO standards

WBS Phase B

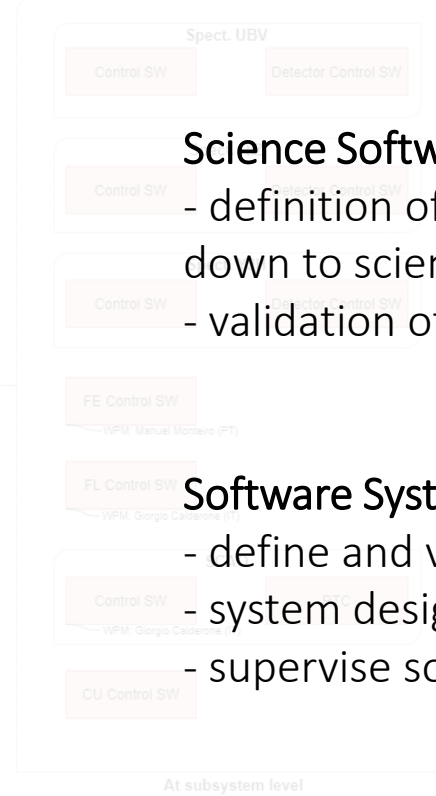


Science Software Preparation and Validation

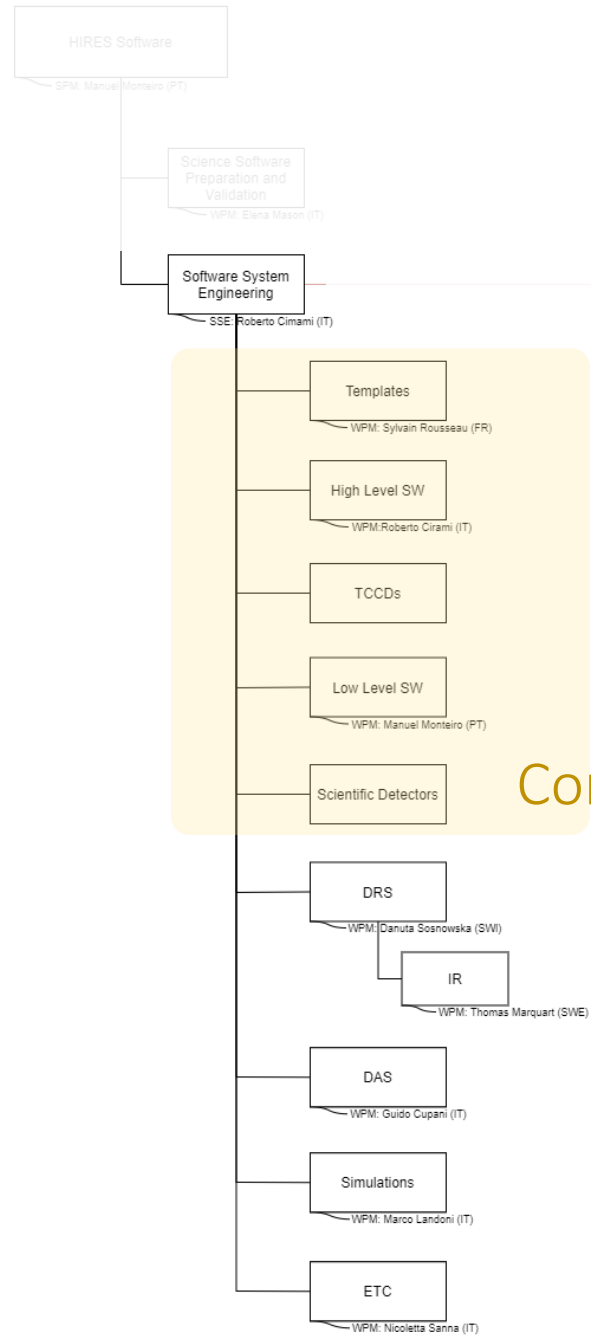
- definition of science software requirements and flow down to science software work packages
- validation of science software products

Software System Engineering

- define and verify software interfaces
- system design description
- supervise software packages



WBS Phase B



Templates

- instrument Templates (acquisition, observation, calibration and maintenance templates)

High Level Control Software

- coordination of scientific exposures (data acquisition, managing the data products creation and archiving)

TCCDs

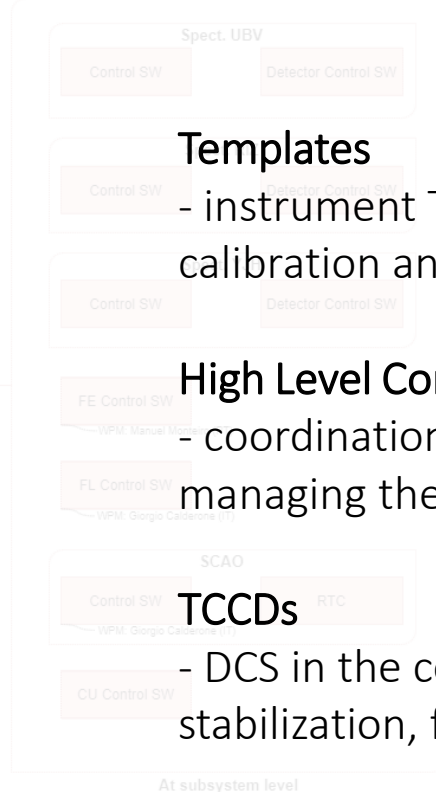
- DCS in the context of instrument control (field stabilization, field curvature compensation, etc.)

Low Level Control Software

- common needs, e.g., global engineering GUI, etc.

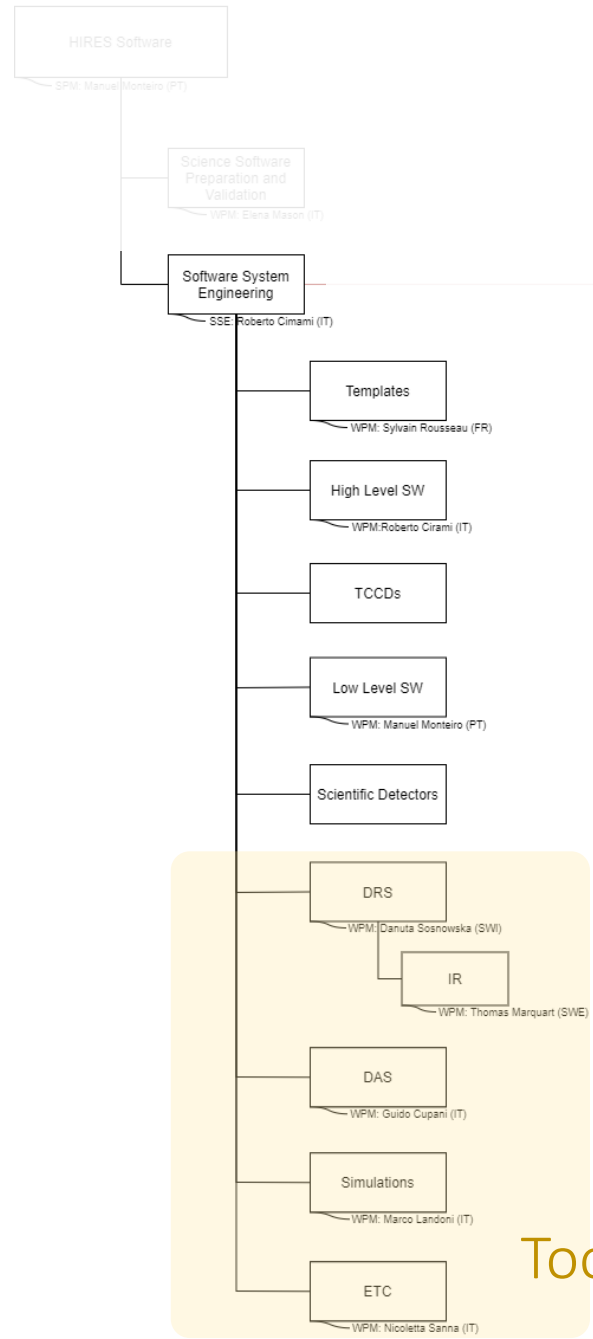
Scientific Detectors

- may not be necessary since it will be handled at subsystem level

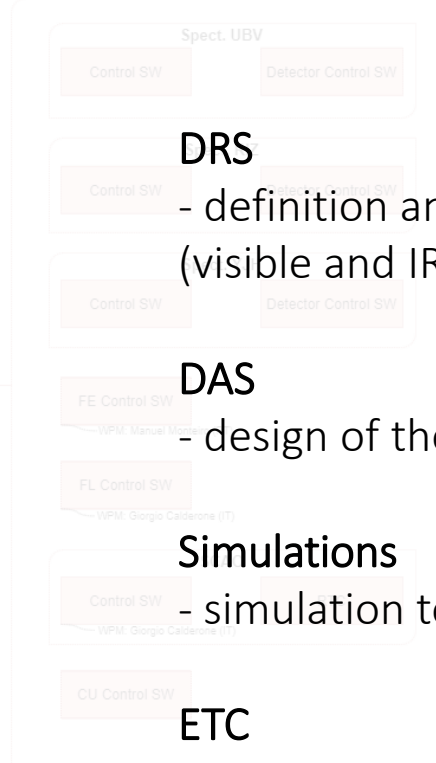


Control

WBS Phase B



Tools



DRS

- definition and design of the Data Reduction Software (visible and IR)

DAS

- design of the Data Analysis Software

Simulations

- simulation tools, namely the End-to-End simulator

ETC

- design and development of the Exposure Time Calculator

HIRES

Science Software Preparation and Validation

Elena Mason (INAF – OATs)

EXPERIENCE/BACKGROUND:

_ science on (galactic) transients
using HR spectrographs
(FEROS,UVES,STIS,FIES)

_ former support astronomer and
instrument responsible at the VLT
(ISAAC and XShooter)

TASKS:

_ define requirements for the science
software (Template, ETC, DRS, DAS,
Simulator, ...) *

_ identify need of dedicated tools (e.g.
observing) *

_ verify and validate science products **

* expect participation to Science Team and
Software System Engineer Team meetings

** needs help for the tests (e.g. internship
students and alike)

HIRES

Control Software & Software Phase B deliverables

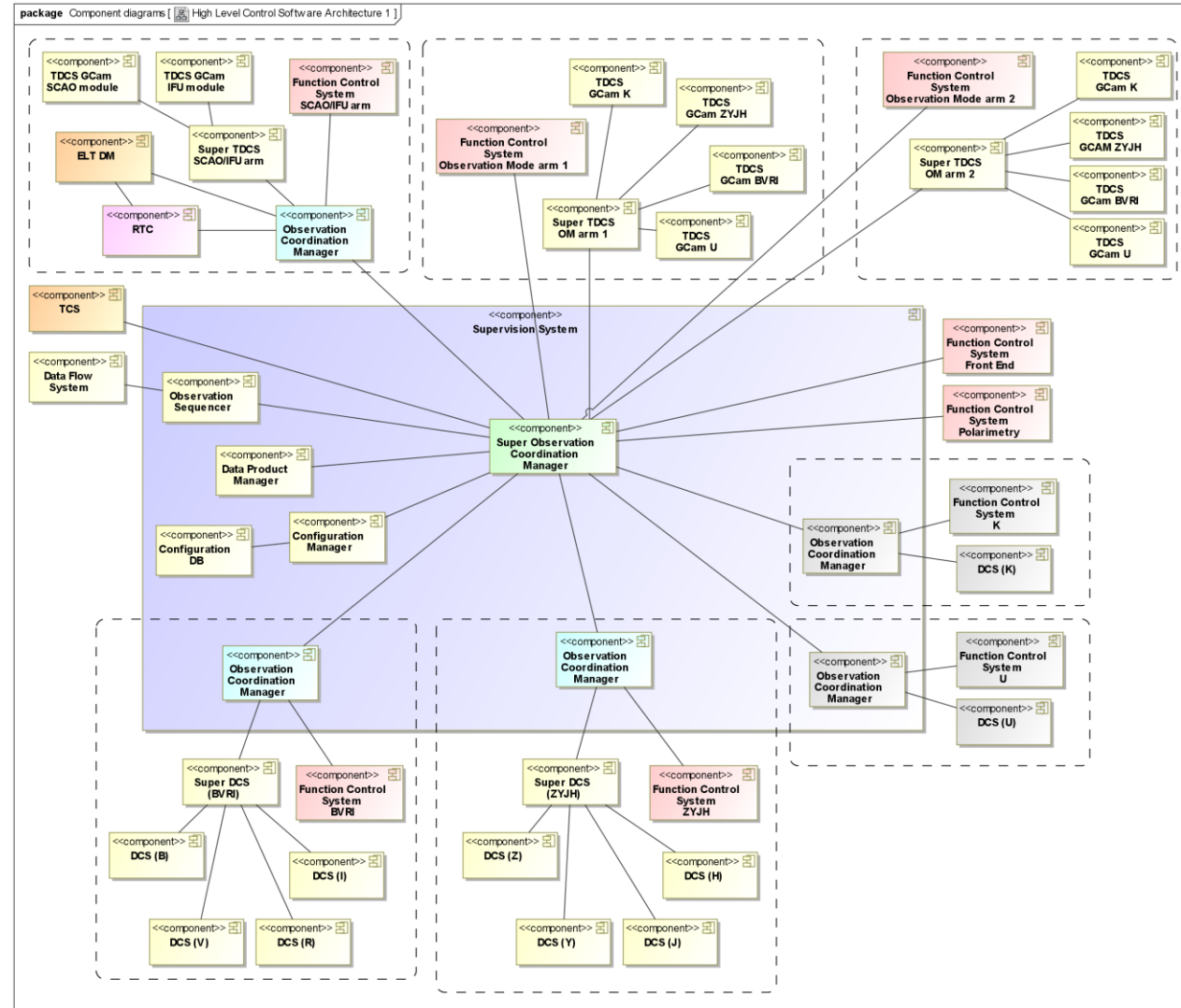
Roberto Cirami – INAF - Astronomical Observatory of Trieste

Software System Engineer / Software Architect

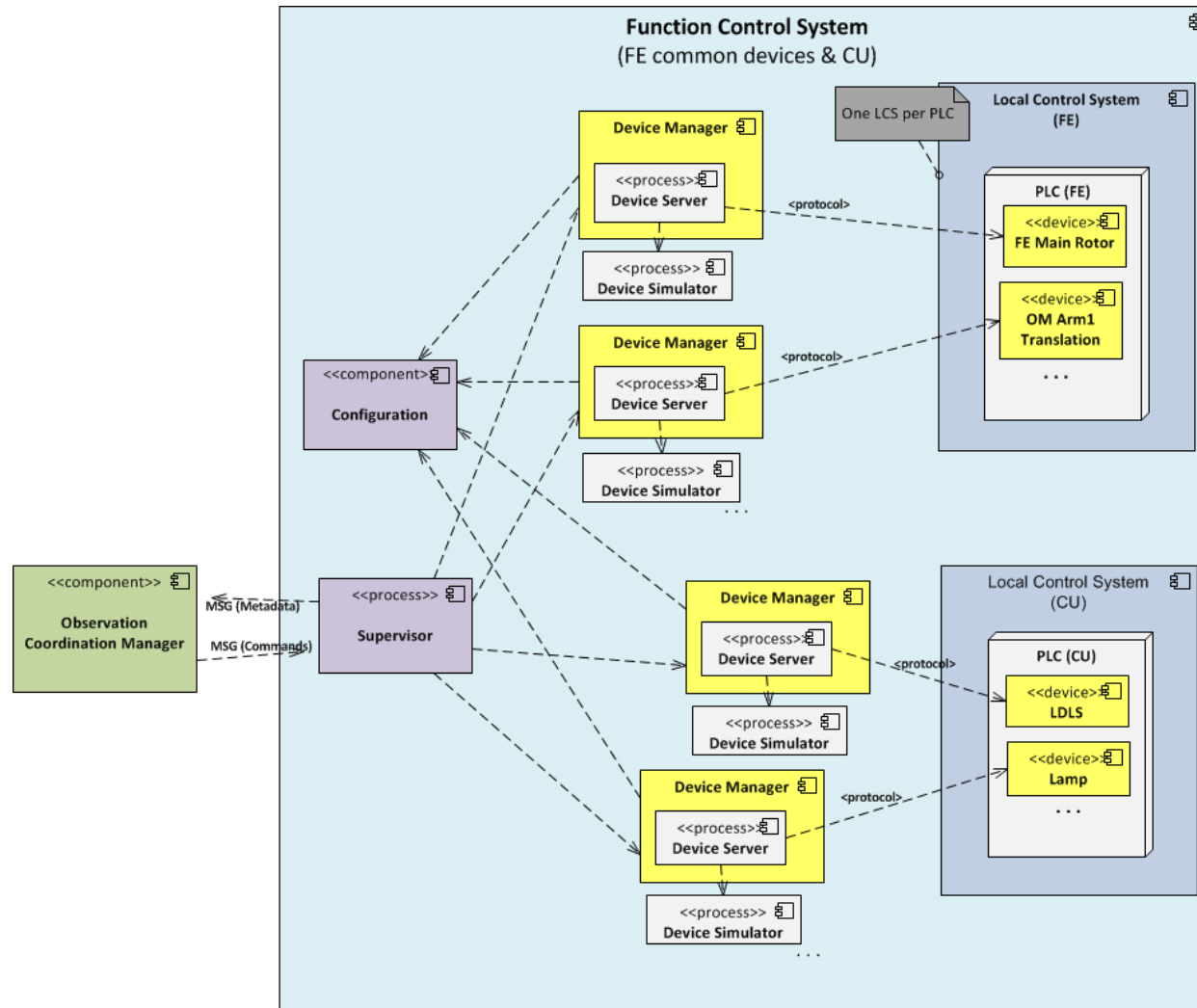
Instrument Control Software

- Based on **ELT Instrument Control Software Framework**
- Standard Instrumentation Software subsystems:
 - **Function Control System** (FCS): controls and monitors instrument hardware functions
 - **Observation Control System** (OCS): coordinates the execution of an exposure
 - **Detector Control System** (DCS): carries out all the tasks to control the detectors subsystems
 - **Maintenance Software** (MS): used for instrument configuration and maintenance procedures

Phase A – control software architecture



Phase A – Function Control System architecture



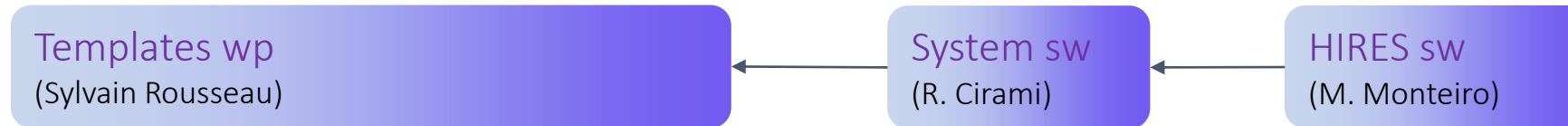
Phase B – software deliverables

- List of software deliverables specified in the following ESO documents:
 - [E-ELT Instrument Control System Development Process Requirements \(ESO-267497, v. 1\)](#)
 - Instrument Software User Requirement Specifications
 - Instrument Software Functional Specifications
 - Instrument Software Management Plan
 - [Dataflow for ESO Observatories Deliverables Specifications \(ESO-037611, v. 4\)](#)
 - Data Reduction Library Specifications
 - Exposure Time Calculator Specifications
 - Observation Preparation Tool Specifications (if needed)

HIRES

Templates

Sylvain Rousseau (Lagrange Lab / EDISOFT)



- Acquisition templates
 - Set up the telescope, point the target, close image stabilization loops, ensure spectro light feeding
- Observation templates
 - Handle scientific exposures and monitor the image stability loops
- Calibration templates
 - Related to the calibration unit, it aims at calibrate the calibration sources and the scientific detectors
- Technical templates
 - Perform maintenance and testing operations in an automatic way

HIRES

DRS

Danuta Sosnowska (Obs. Genève)
on behalf of the DRS team

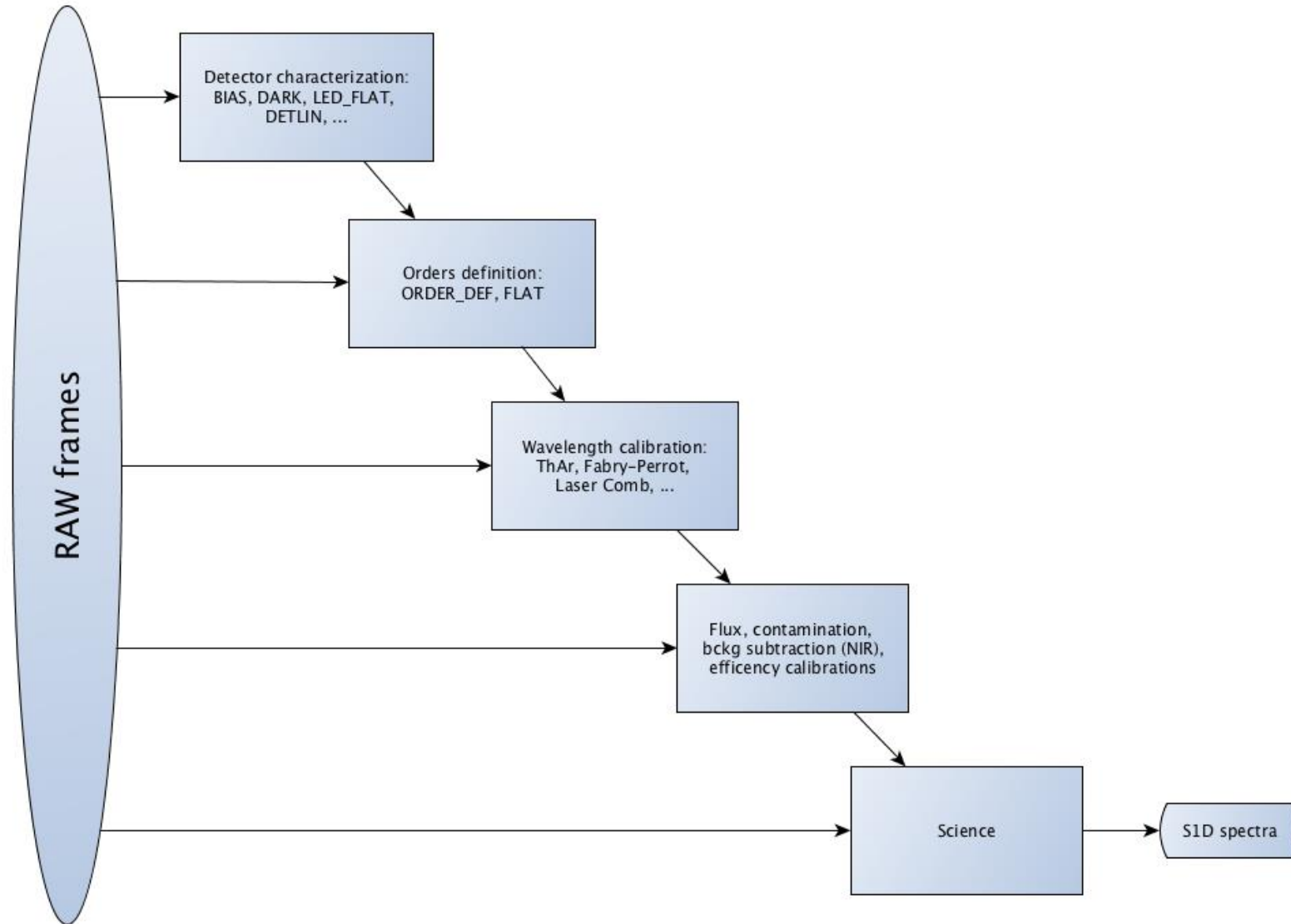
DRS work package

- Data Reduction Software:
For phase B – prepare the specifications and the required documentation, identify the critical algorithms
- DRS WP structure:
 - Managed by Danuta Sosnowska
 - IR DRS part managed by Thomas Marquart
 - A lot of overlapping between VIS & IR parts

Phase A summary

- Identification of the recipes steps:
 - Detector characterization
 - Orders definition
 - Wavelength calibration
 - High level calibrations
 - Science reduction

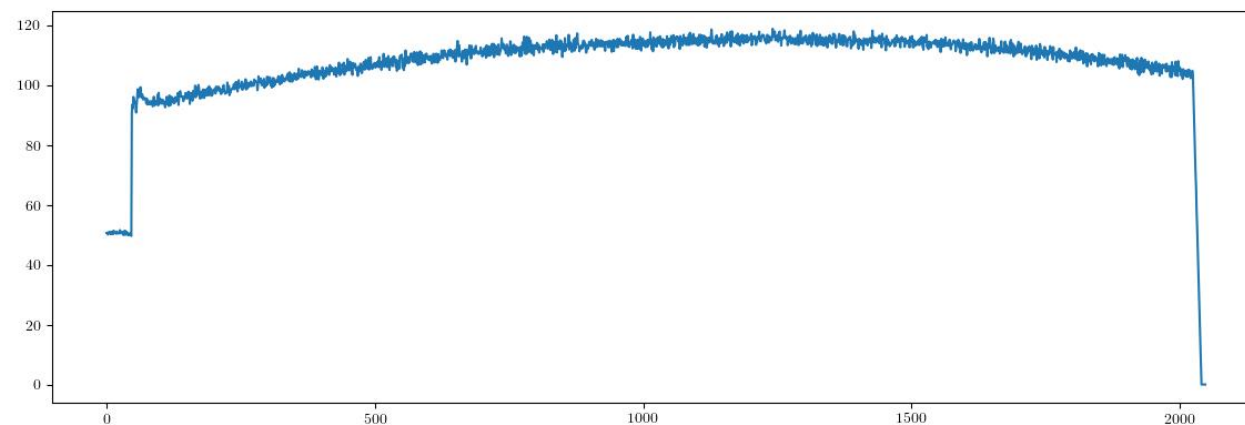
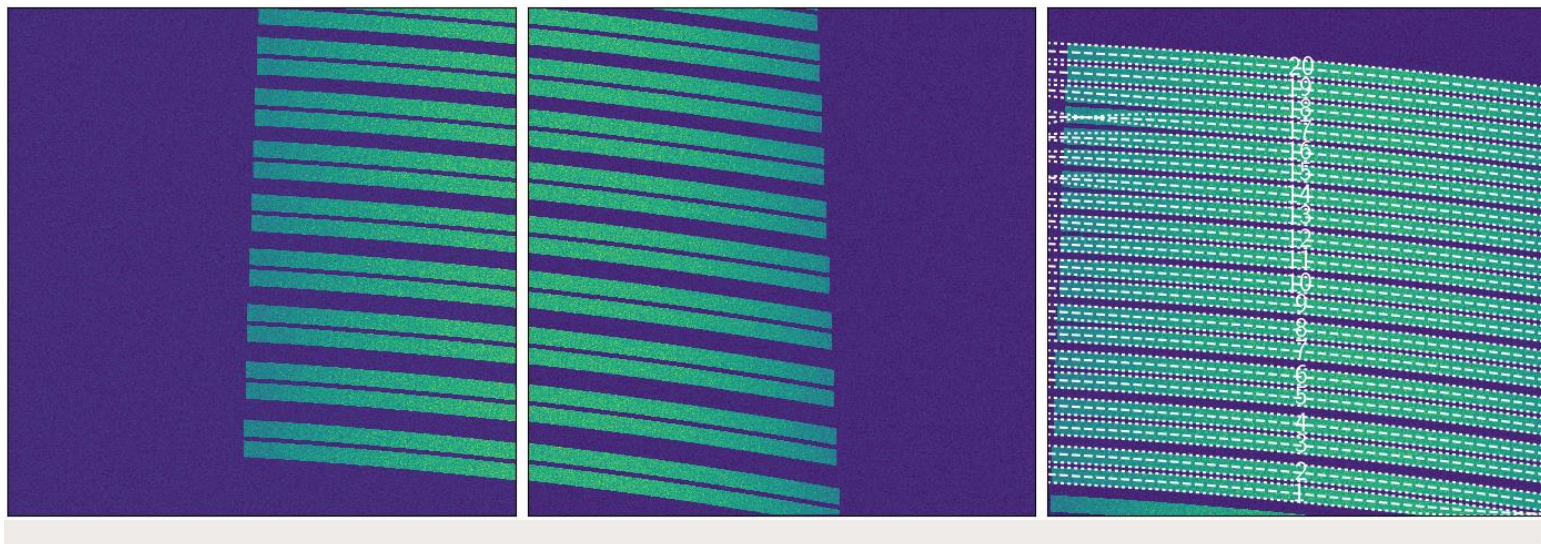
HIRES DRS workflow



Phase A summary

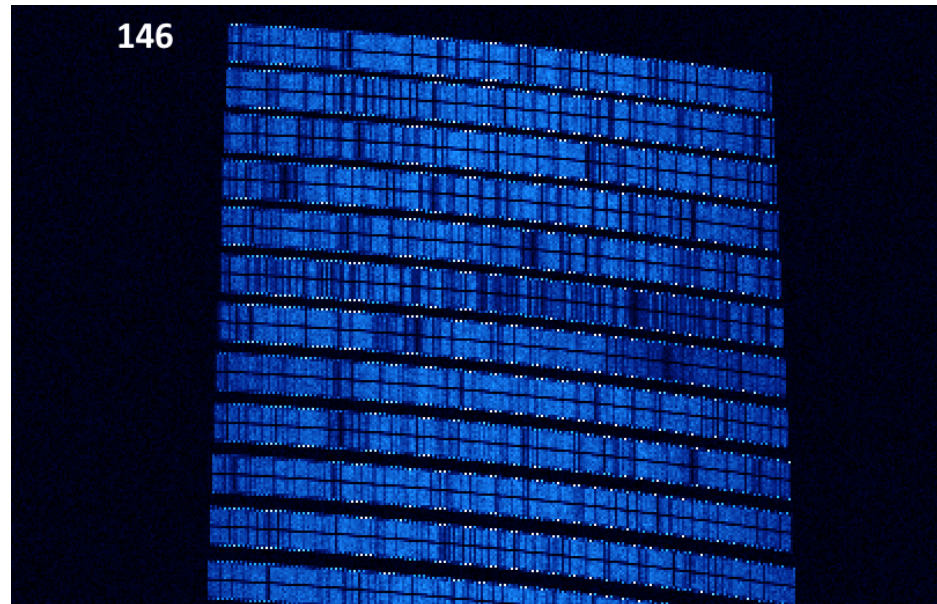
- Identification of the recipes steps:
 - Detector characterization
 - Orders definition
 - Wavelength calibration
 - High level calibrations
 - Science reduction
- Extraction of the simulated science spectra provided by the E2E team, using the CRIRES+ pipeline by Thomas Marquart

Simulated data – flat spectrum



Orders detection & extraction, using CRRES+ PPL (Thomas Marquart)

Simulated data – science

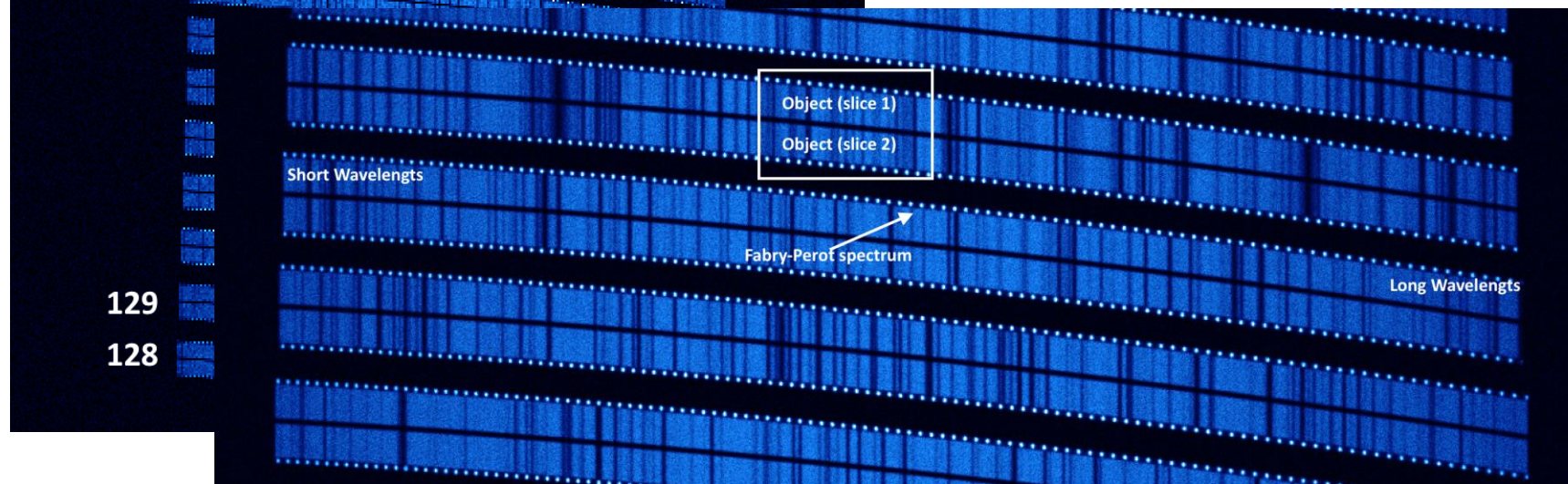


G2V star

1. full spectrum image

2. detail

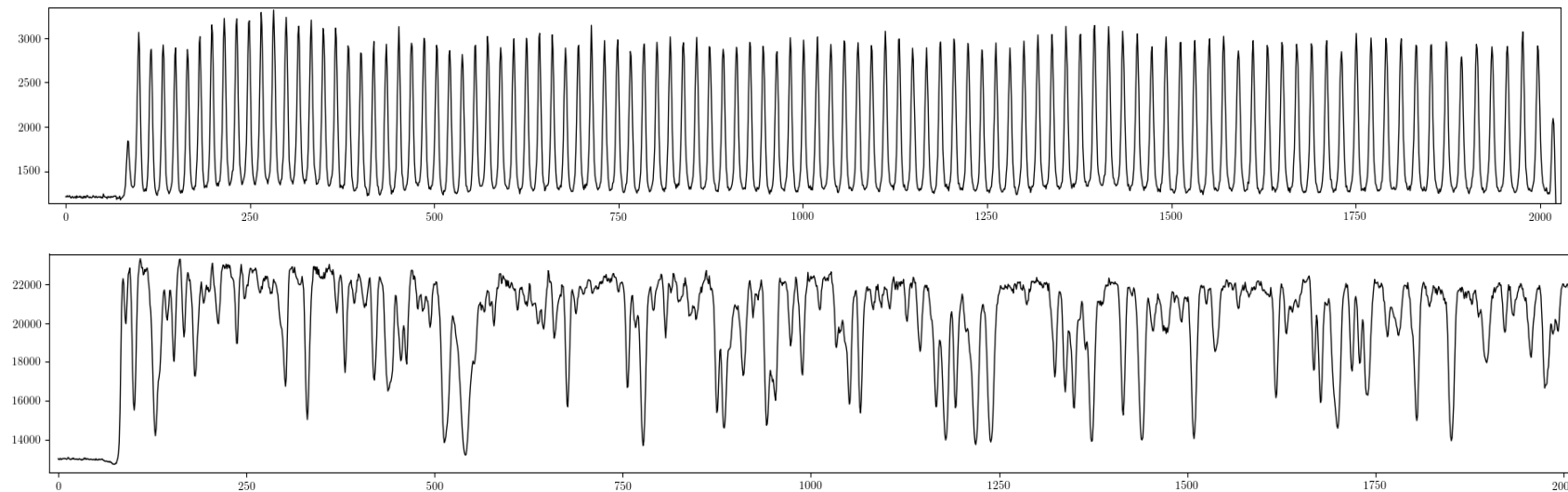
(E2E, Marco Landoni & Matteo Genoni)



Science extraction

by Thomas Marquart, CRRES+ PPL

- One order extraction, no bias, no flat-fielding, along detected order (polynomial), vertical slit
- Slit decomposition extraction (Piskunov & Valenti 2002) independent of the slit illumination function



Extraction: FP (upper), science (lower)

DRS key tasks

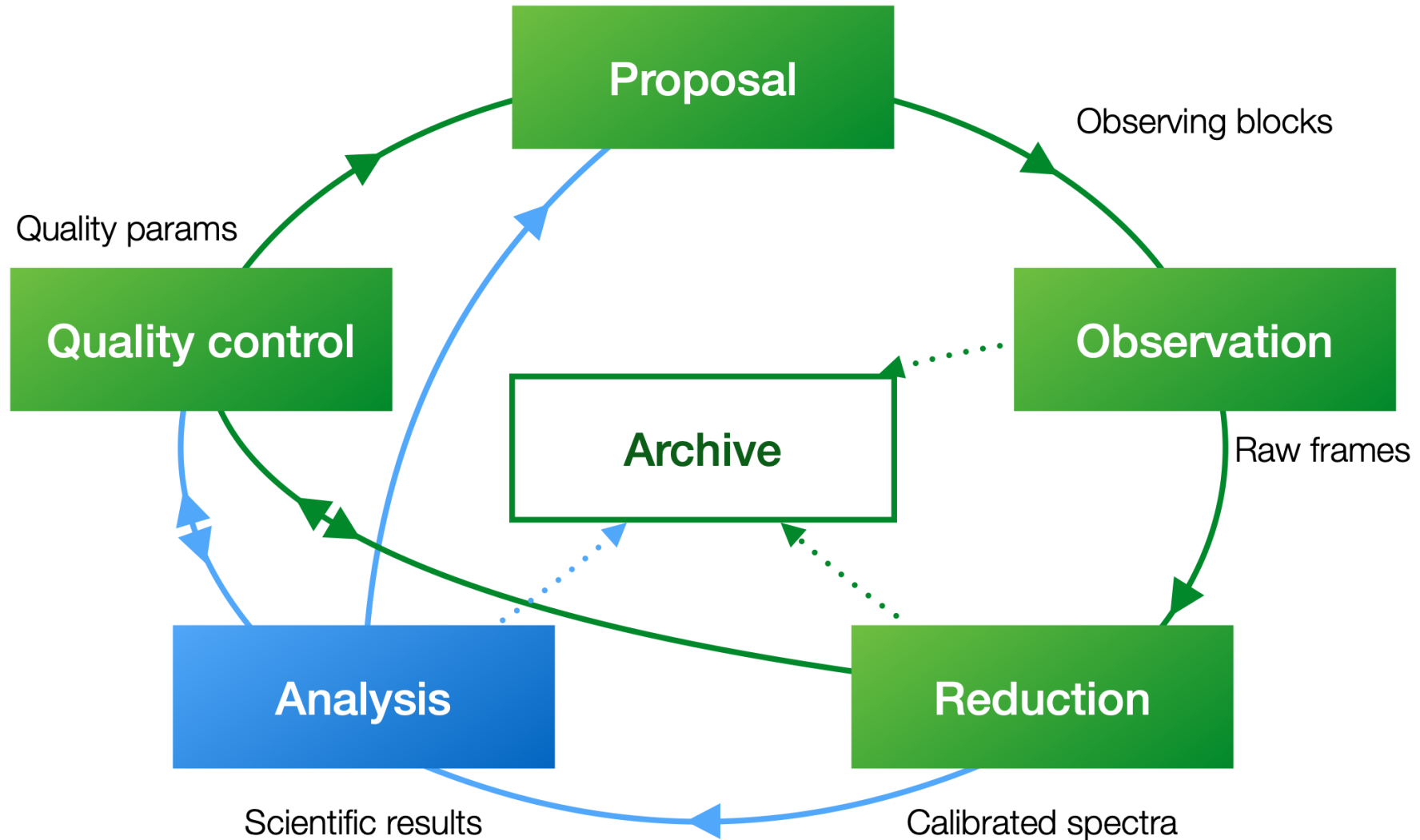
- Specification of the reduction steps
- Identification of the critical algorithms
- Definition of the interfaces
 - Calibration WP
 - ICS & templates
 - Science cases

HIRES

DAS

Guido Cupani (INAF-OATs)

Role of the DAS



Science cases addressed

Exoplanets and circumstellar disks (WG1)	Exoplanet atmospheres in transmission	1	
	Exoplanet atmospheres in reflection	3	
	Characterization of the physics of protoplanetary disks	(~3)	
	Planet formation in protoplanetary disks	(3)	
	Exoplanet mass determination	(4)	
	Radial velocity search for exoplanets around M-dwarfs	(~4)	
	Planetary debris on white dwarfs		
Stars and stellar populations (WG2)	Characterization of cool stars	(1)	✓
	Investigation and characterization of primitive stars	(2)	✓
	Characterization of stellar atmospheres	(3)	✓
Formation and evolution of galaxies and intergalactic medium (WG3)	Detection and investigation of near pristine gas	(~1)	✓
	Reionization of the Universe	(1)	✓
	3D reconstruction of the CGM	(~1)	✓
	Extragalactic transients	(~1)	✓
	Search for low mass black holes	(3)	
	Galaxy evolution		✓
	3D mapping of the IGM and metallicity		✓
Cosmology and fundamental physics (WG4)	Variation of fundamental constants	2	✓
	Variation of CMB temperature	(2)	✓
	Determination of the deuterium abundance	(2)	✓
	Sandage test	4	✓

A changing ecosystem

The screenshot displays the 'ESPRESSO DAS WORKFLOW - Quasar system identification' interface. On the left, a sidebar contains a search bar and a tree view of ontologies and folders. The main area features a workflow diagram with stages: 'Data Organisation and Selection' (Initialize, Inspect previous analysis, Choose Datasets, Initialize Datasets) and 'Data Processing' (Coadd Spectrum, Mask Spectrum, Derive Lines). Below the diagram, a table lists configuration parameters for 'Basic setup' and 'Advanced setup'. At the bottom, a section for 'Auxiliary parameters (do not change)' lists various system and user-defined variables.

file:/Users/guido/ESO/svn/espdap/reflex/espda_qsol_wkf.xml

Components Data Outline

Search Components

All Ontologies and Folders

- Components
- Disciplines
- Projects
- Demos
- Actors
- DataTurbine
- Directors
- Esoflex
- Job
- Opendap
- Outreach
- R

0 results found.

ESPRESSO DAS WORKFLOW - Quasar system identification

This workflow is designed to analyze spectra of Quasars previously reduced via the ESPRESSO data reduction pipeline. It co-adds multiple spectra, detects absorption lines. By recognizing the most common doublets, it identifies absorption systems at different redshifts falling along the line of sight. The main final products of the workflow are the co-added and rebinned quasar spectrum, the estimate of the continuum, and the quasar redshift.

Basic setup:

- ROOT_DATA_DIR: ROOT_DATA_PATH_TO_REPLACE (Root directory)
- RAW_DATA_DIR: \$ROOT_DATA_DIR/reflex_input/espda/ (Source data directory)
- END_PRODUCTS_DIR: \$ROOT_DATA_DIR/reflex_end_products/espda/ (End products directory)
- MODE: MR (Mode (HR/MR))
- WAVEL_MIN: 370 (Minimum wavelength [nm])
- WAVEL_MAX: 790 (Maximum wavelength [nm])

Advanced setup:

- CALIB_DATA_DIR: CALIB_DATA_PATH (Calibration data directory)
- BOOKKEEPING_DIR: \$ROOT_DATA_DIR/bookkeeping (Bookkeeping directory)
- LOGS_DIR: \$ROOT_DATA_DIR/logs (Log directory)
- TMP_PRODUCTS_DIR: \$ROOT_DATA_DIR/tmp_products (Temporary products directory)
- BOOKKEEPING_DB: \$BOOKKEEPING_DB (Bookkeeping database)
- RecipeFailureMode: Ask (Recipe failure mode)
- EraseDirs: false (Erase directories)
- FITS_VIEWER: fv (FITS viewer)
- ProductExplorerMode: Triggered (Product explorer mode)
- SelectDatasetMethod: Interactive (Dataset selection method)

Data Organisation and Selection

Initialize → Inspect previous analysis → Choose Datasets → Initialize Datasets

Data Processing

Coadd Spectrum → Mask Spectrum → Derive Lines

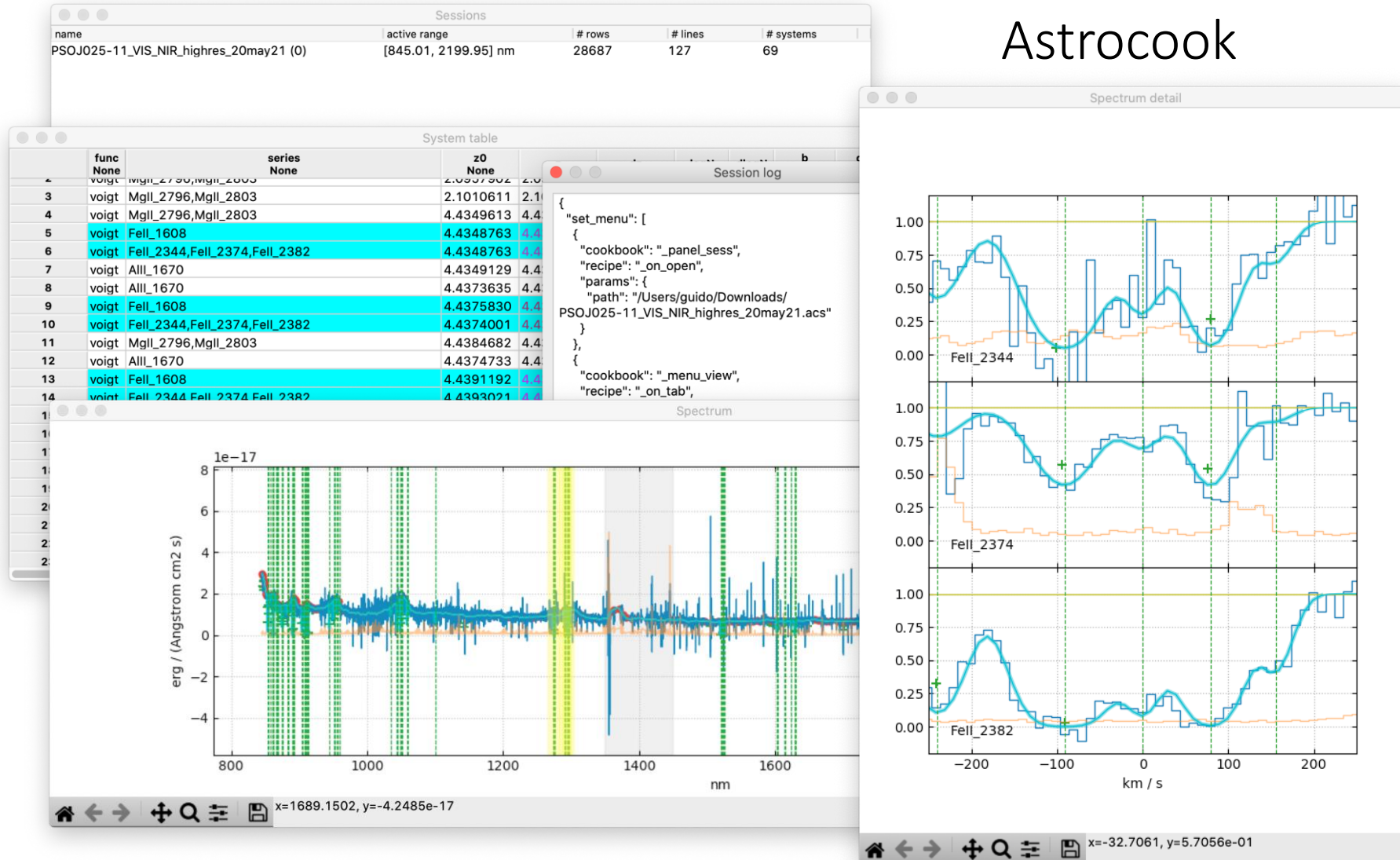
Auxiliary parameters (do not change):

- GLOBAL_TIMESTAMP: 2020-07-24T14:40:19
- END_PRODUCTS_SUBDIR: ESPRESSO_S1D_FINAL_A_OBJ-PP/2020-07-24T14:40:19
- ESORExArg: --suppress-err
- adopted_resolution: 70000
- VEL_STEP_UHR: 0.5
- VEL_STEP_MR: 1.4
- GLOB_VEL_STEP: 1.4
- VEL_STEP_HR: 0.7
- RESOL_HR: 140000

from Reflex to the EDPS...

A changing ecosystem

Astrocook



HIRES

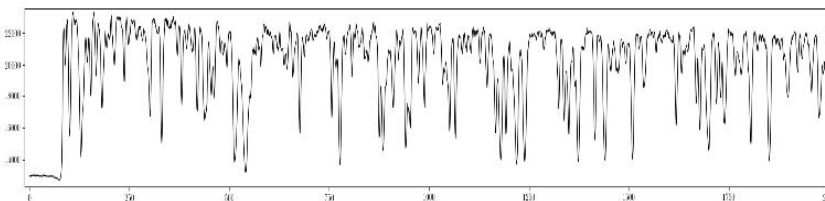
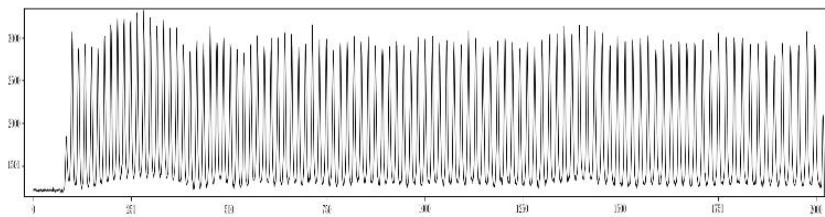
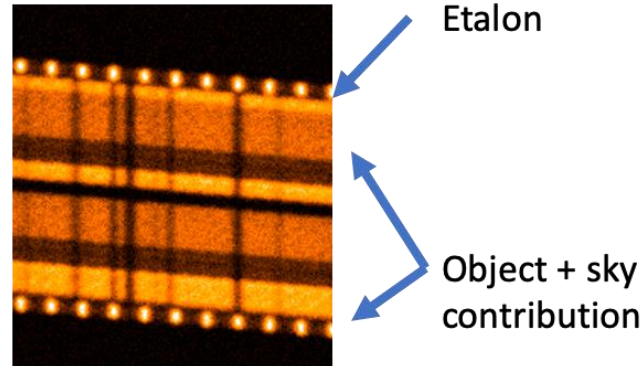
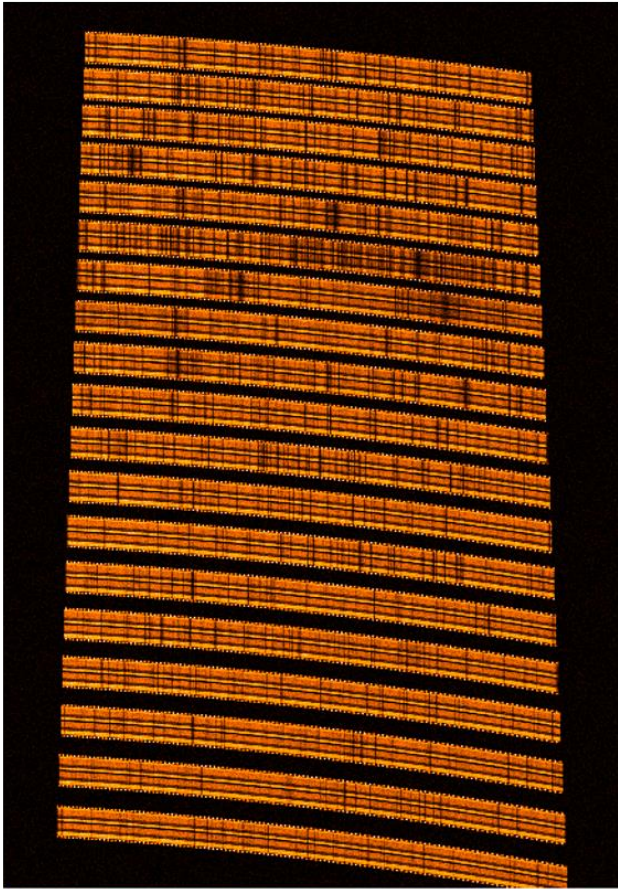
End-to-end

Marco Landoni (INAF-Brera Observatory)

Recap from Phase A

- Definition of the internal interfaces between people involved in this WP. **Completed**
- Definition of the external interfaces and identification of WPs that will provide inputs to E2E (e.g. detectors, telescope, calibration-unit, etc.) **Completed**
- Collect the contribution (spectrum, images, ...) from the team's contributor. **Completed**
- Development of the image simulator module core. **Completed**
- Feed the DRS with simulated frames closing the loop. **Completed**

Recap from Phase A



We closed the loop with the CRIRES-2 beta pipeline with Thomas and Danuta.

Next Steps for Phase B and beyond

End-to-end system point of view

- Go back to the source code to re-engineering some part of it, with the aim to improve the stability and usability of E2E in Phase B
- Include effects from high orders aberrations from the Zemax.
- Make the whole system more stable and user friendly (although it cannot be offered at large due to computational complexity of the simulation itself).

HIRES Consortium point of view

- Define simulation scenarios with the science/tech teams
- Define next steps for DRS interfaces in order to make E2E useful during this and the next phases.
- Improve interfaces in order to simulate as much effects as possible.

HIRES

ETC

Nicoletta Sana (INAF-OAA)

HIRES Exposure Time Calculator

The ETC is a tool (Fortran code) to predict the performances of the spectrometer for different parameters and environmental conditions.

Several parameters can be modified to evaluate their effect.

It works wavelength per wavelength: no SED or spectral type.

ETC versions 1.1-1.5 for Phase A design.

ETC seeing-limited mode version 2.0 updated for post-Phase A design (Sept. 2020)

<http://hires.inaf.it/etc.html>

HIRES Exposure Time Calculator

The ETC computes:

- the limiting magnitude (in AB units) achievable at a given wavelength, in a given exposure time and at a given signal to noise ratio and the limiting surface brightness (in AB mag/arcsec²) achievable at a given wavelength, in a given exposure time and at a given signal to noise ratio

http://tirgo.arcetri.inaf.it/nicoletta/etc_hires_mag.html

- the signal to noise ratio achievable for a compact source at a given wavelength, in a given exposure time and at a given AB magnitude

http://tirgo.arcetri.inaf.it/nicoletta/etc_hires_sn_com.html

- the signal to noise ratio achievable for an extended source at a given wavelength, in a given exposure time and at a given surface brightness

http://tirgo.arcetri.inaf.it/nicoletta/etc_hires_sn_ext.html

Next steps: writing the code in python and updating it according to the design (if needed)

Next?

- Work with the System and Science Teams for the user requirements
- Continue to follow closely the development of the ELT ICS FW