

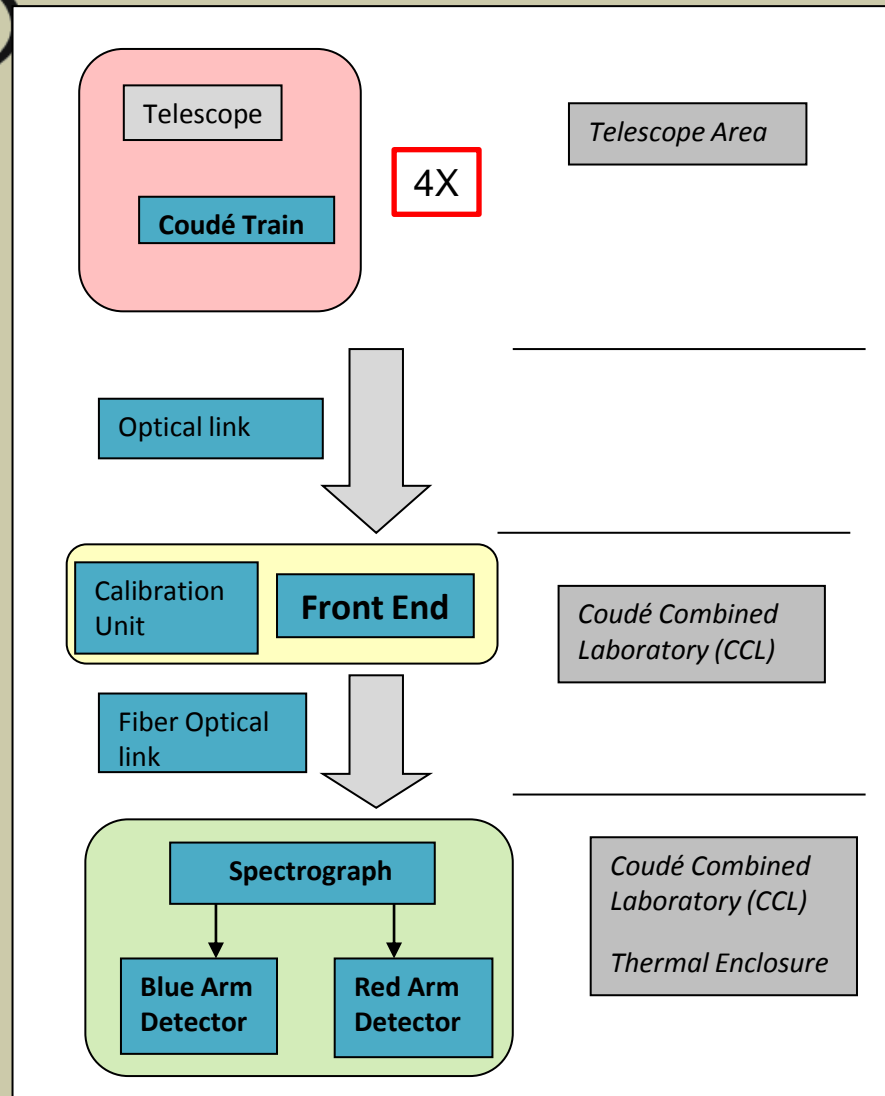


# *ESPRESSO - no limits*

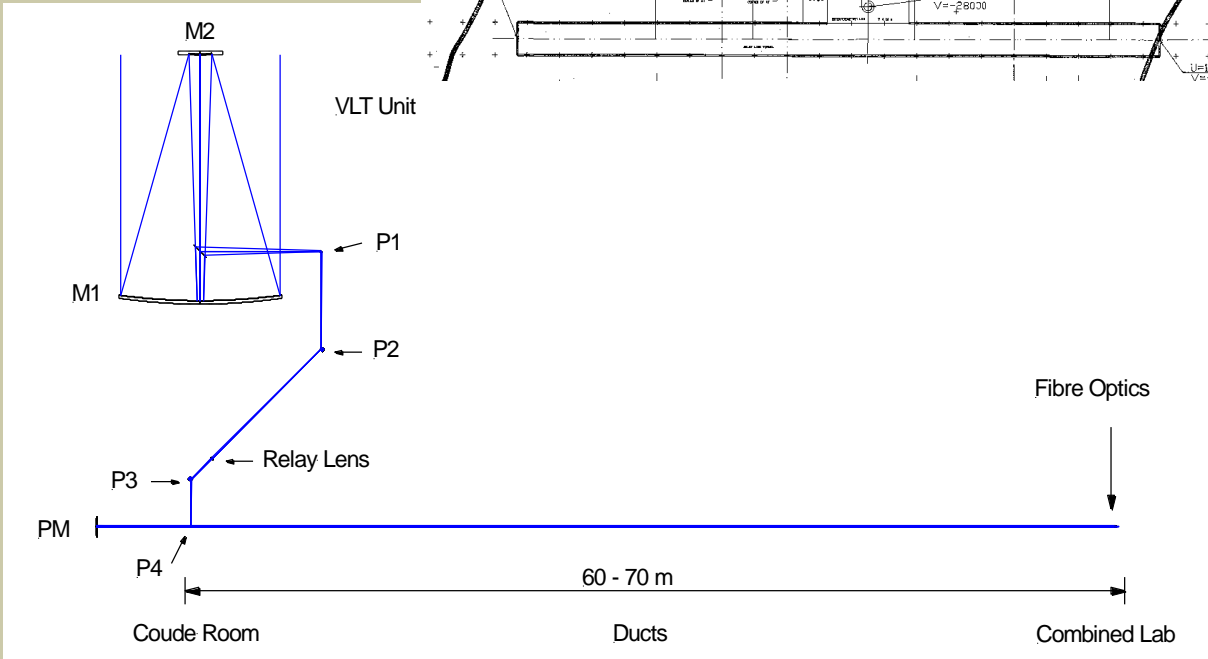
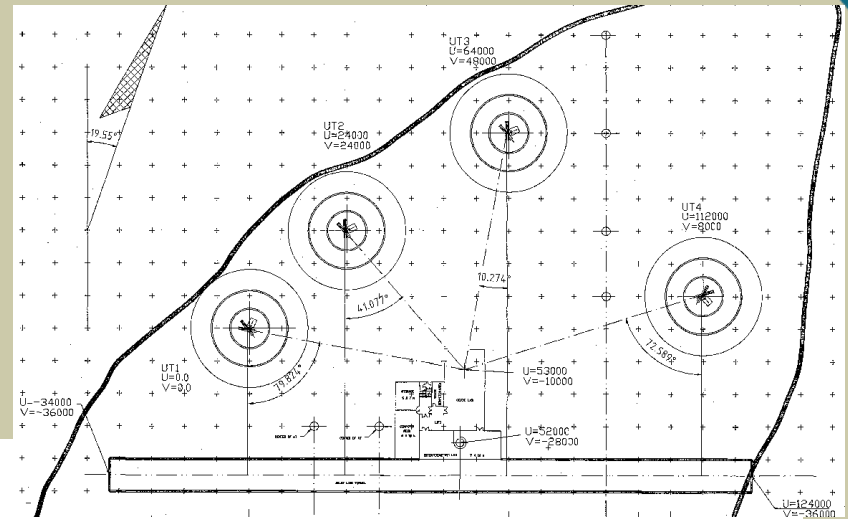
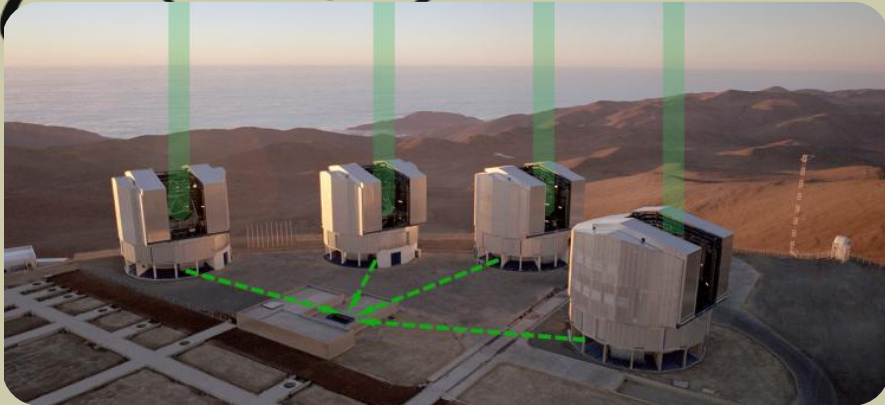
## *Technical Part*



# ESPRESSO light path



# The 4 VLT Telescopes and the CCL



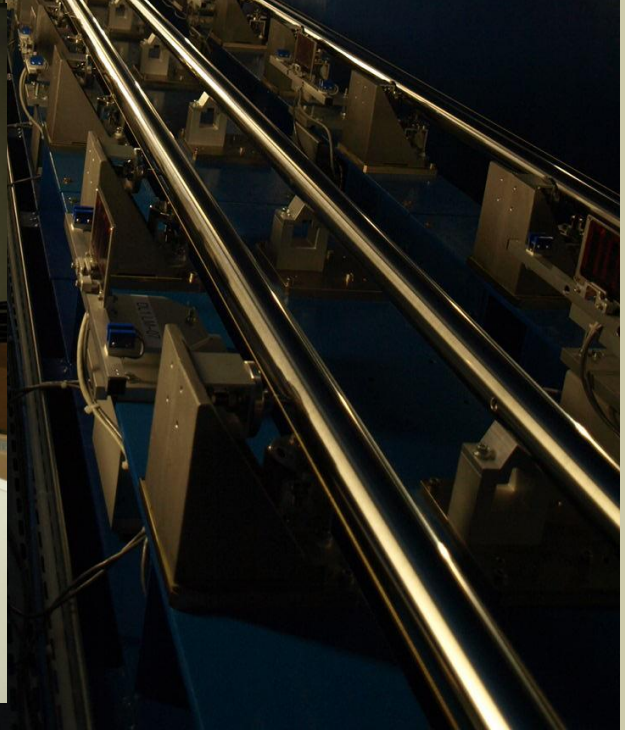
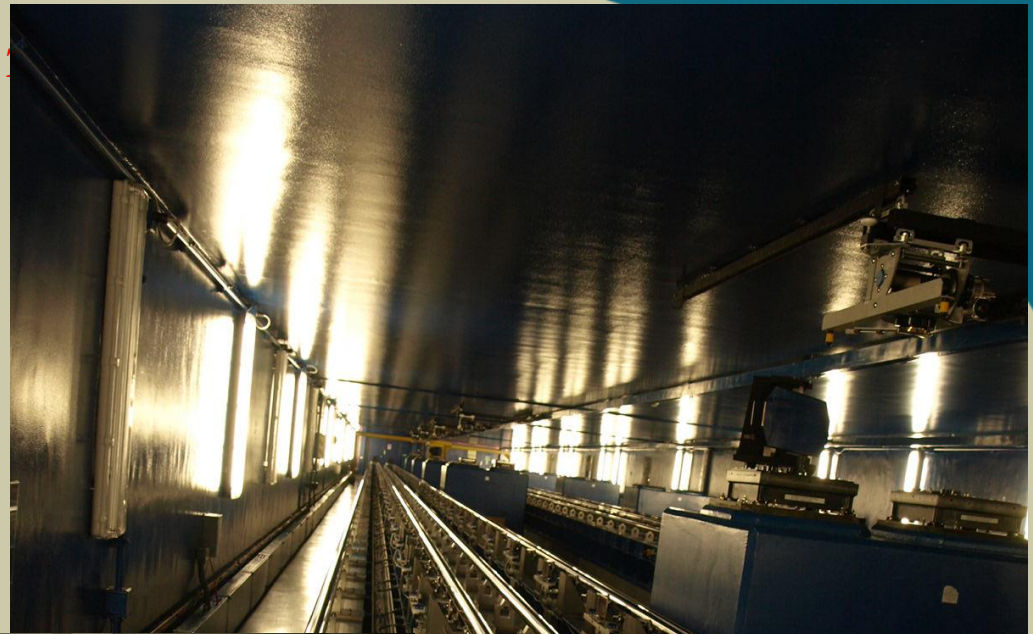
Distances to Combined Lab

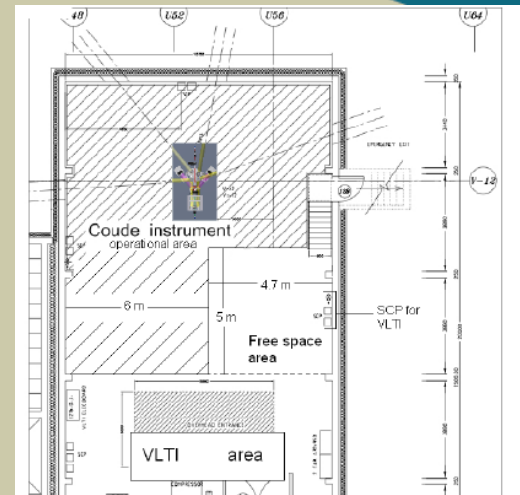
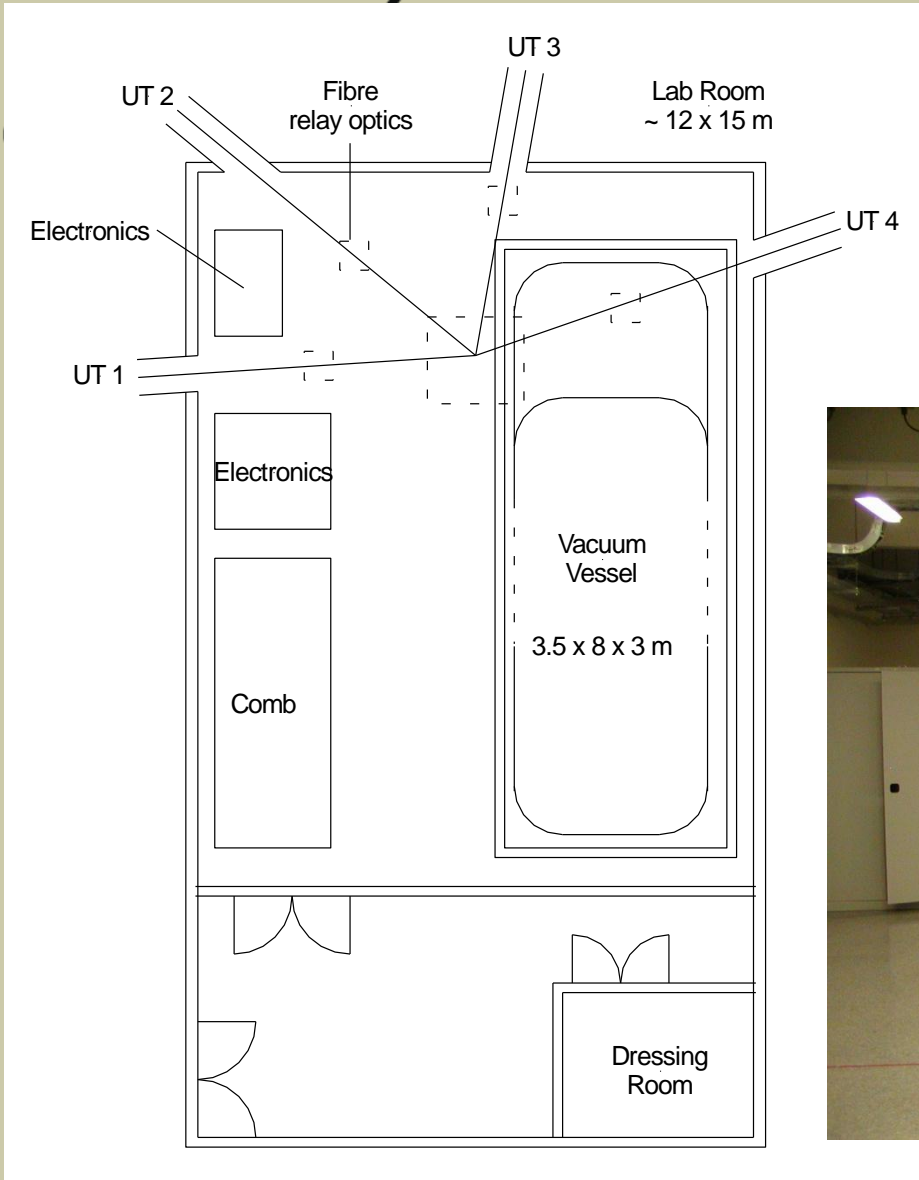
- UT 1 – 69 m
- UT 2 – 48 m
- UT 3 – 63 m
- UT 4 – 63 m

## *Coudé train*



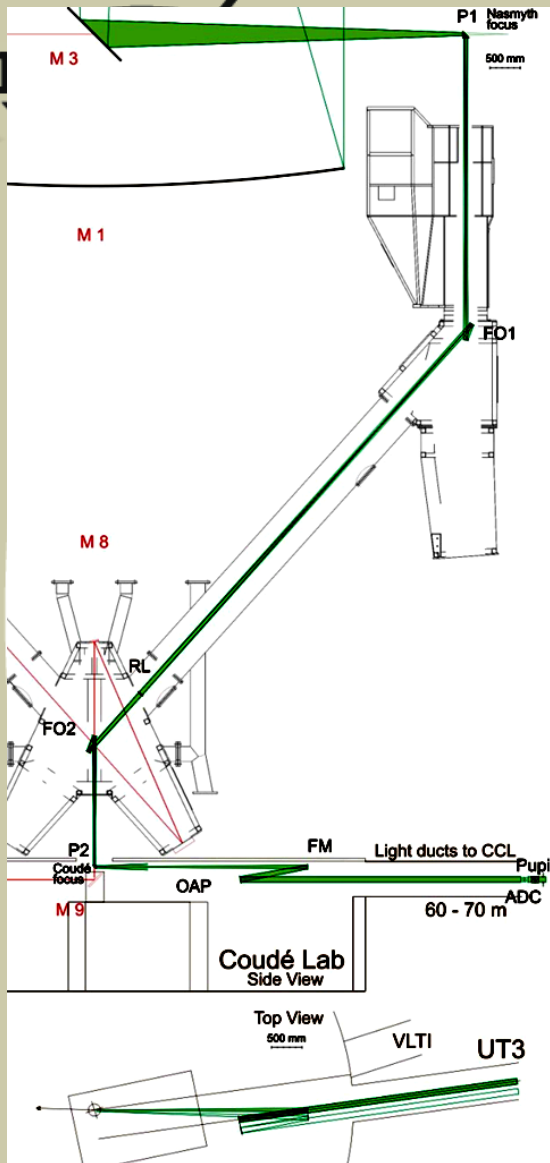




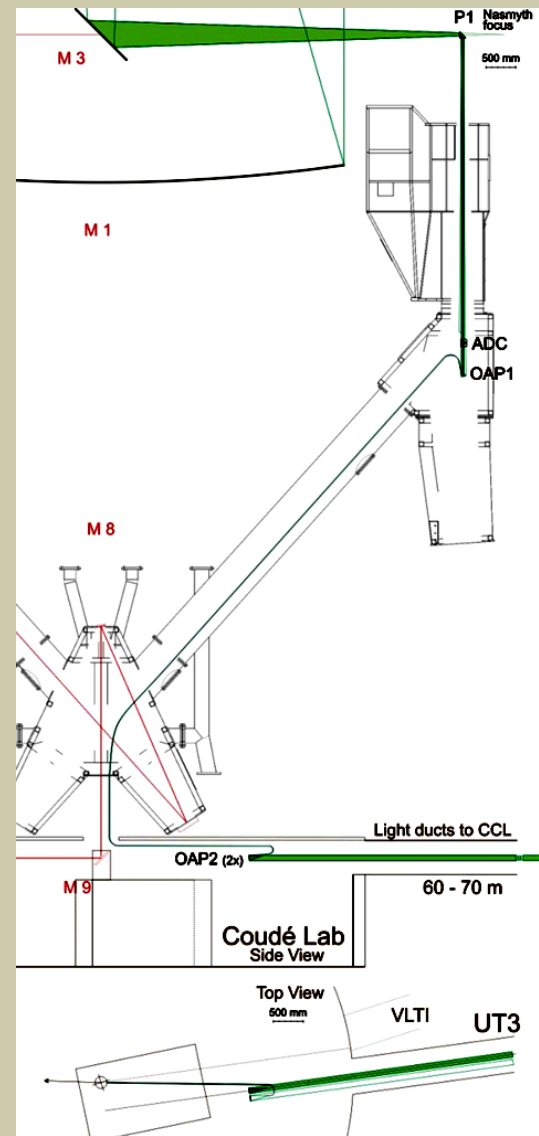




# Coudé train preliminary concepts



**Full Optics (FO)**



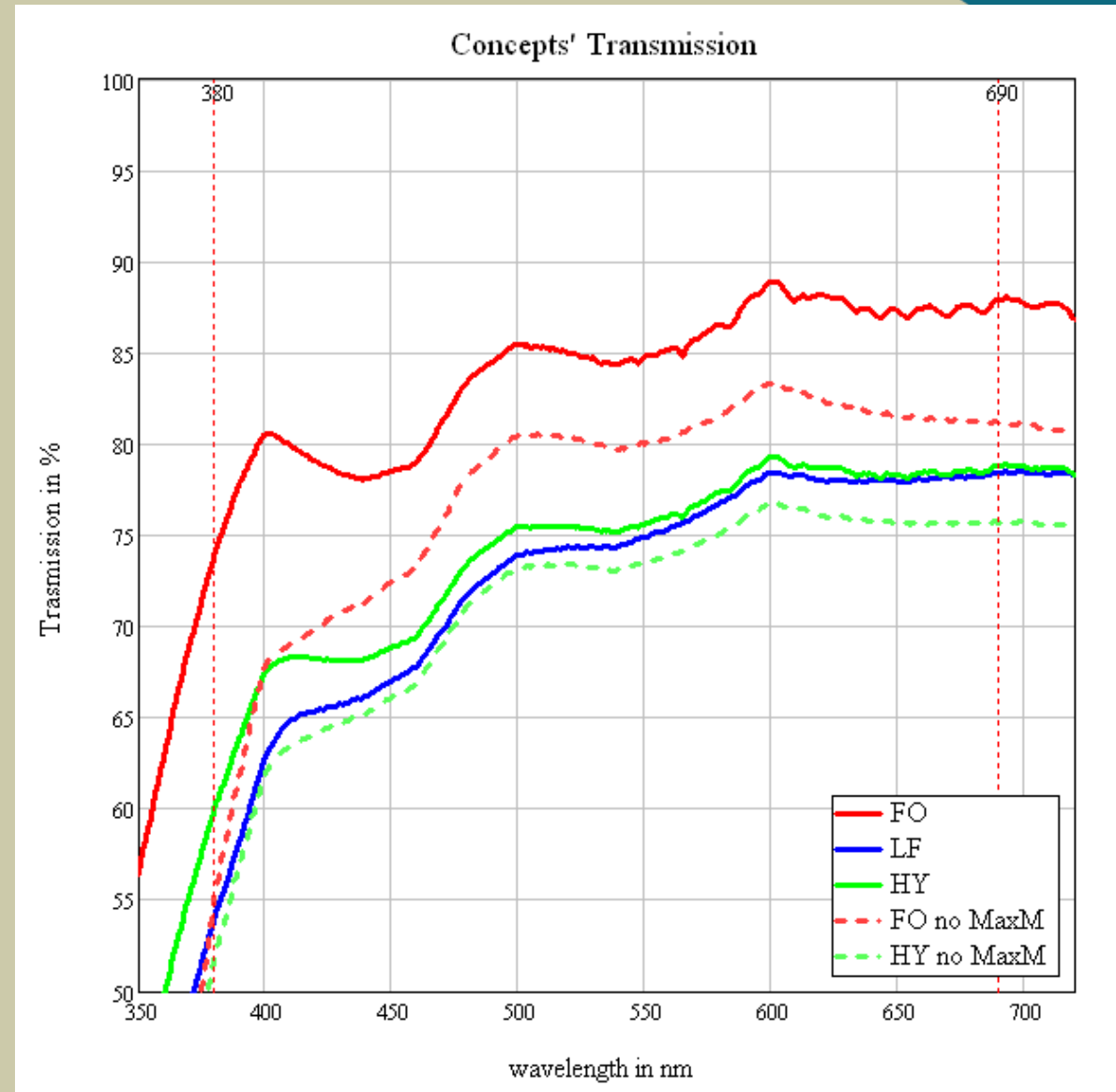
**Long Fibre (LF)**



## Concepts' throughput analysis

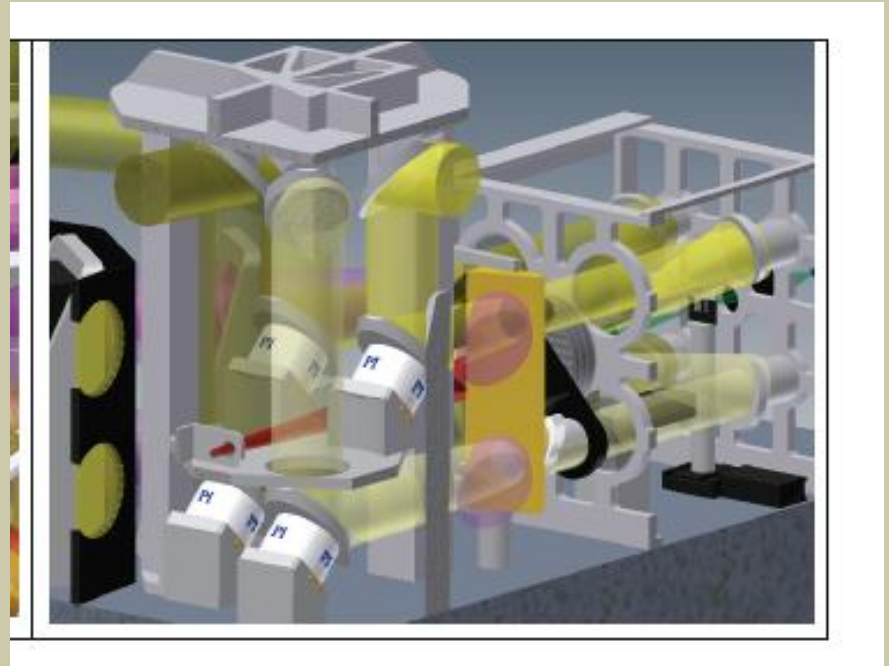
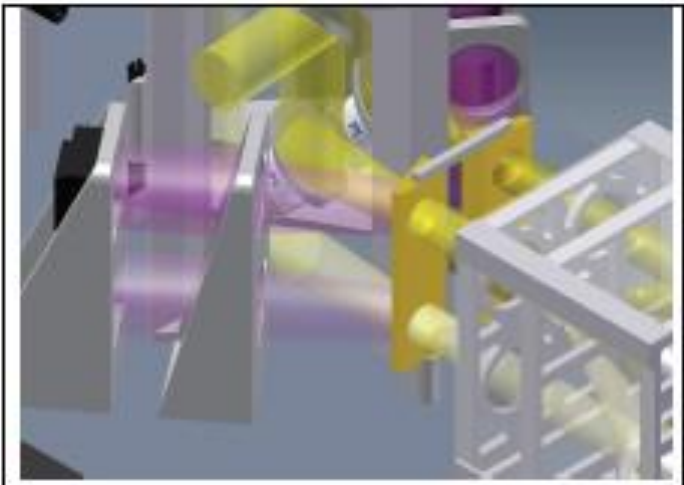
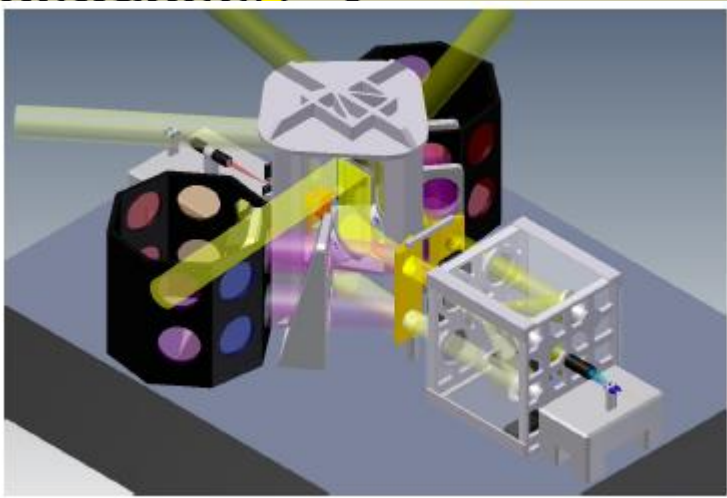
**Full Optics (FO)**

**Long Fibre (LF)**

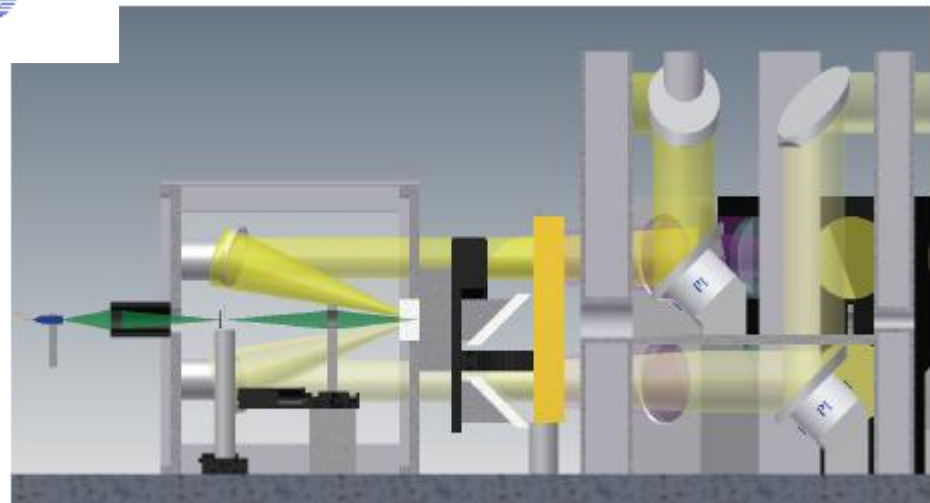
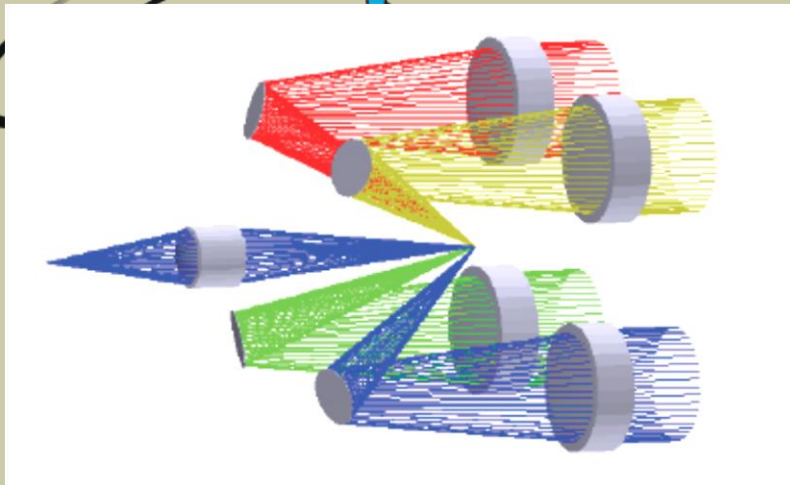




## *The Phase A' Front-end*



## *The Phase A' Front-end - 4UT*



**Figure 49. Location of the calibration in jecton mechnism in the 4-UT mode.**

## The Phase A' Front-End – 1 UT

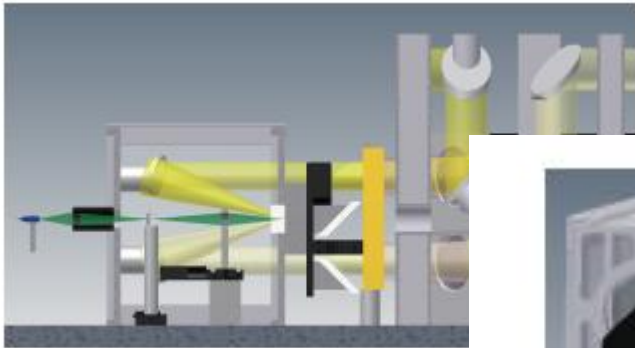
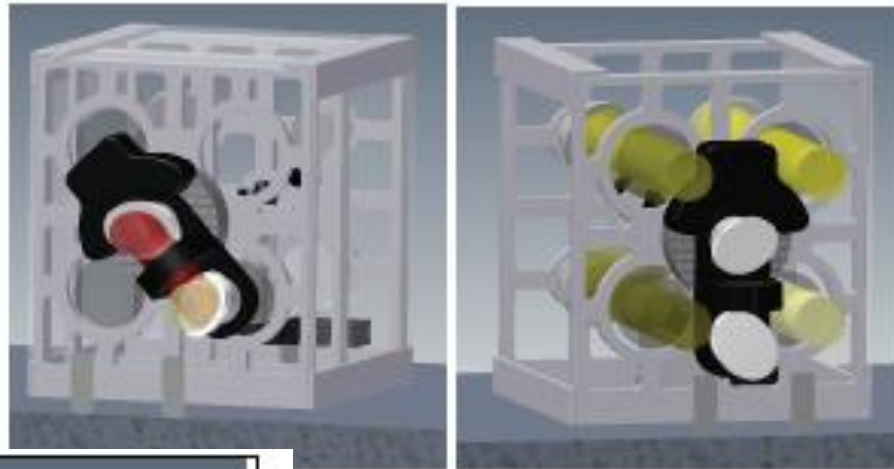
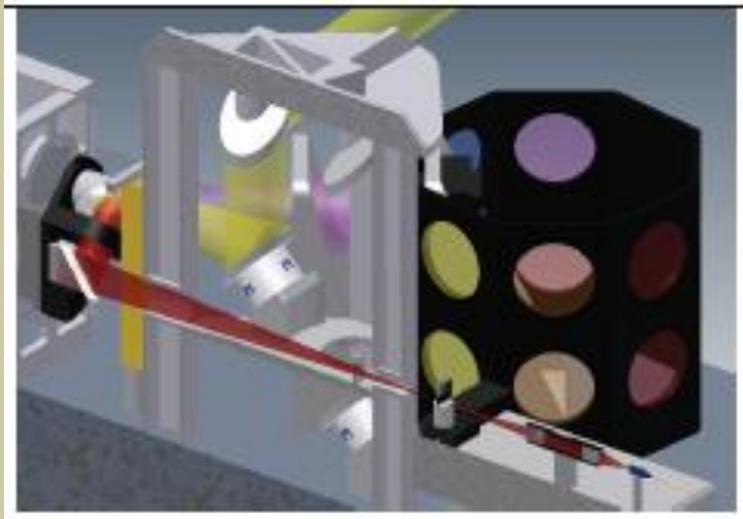


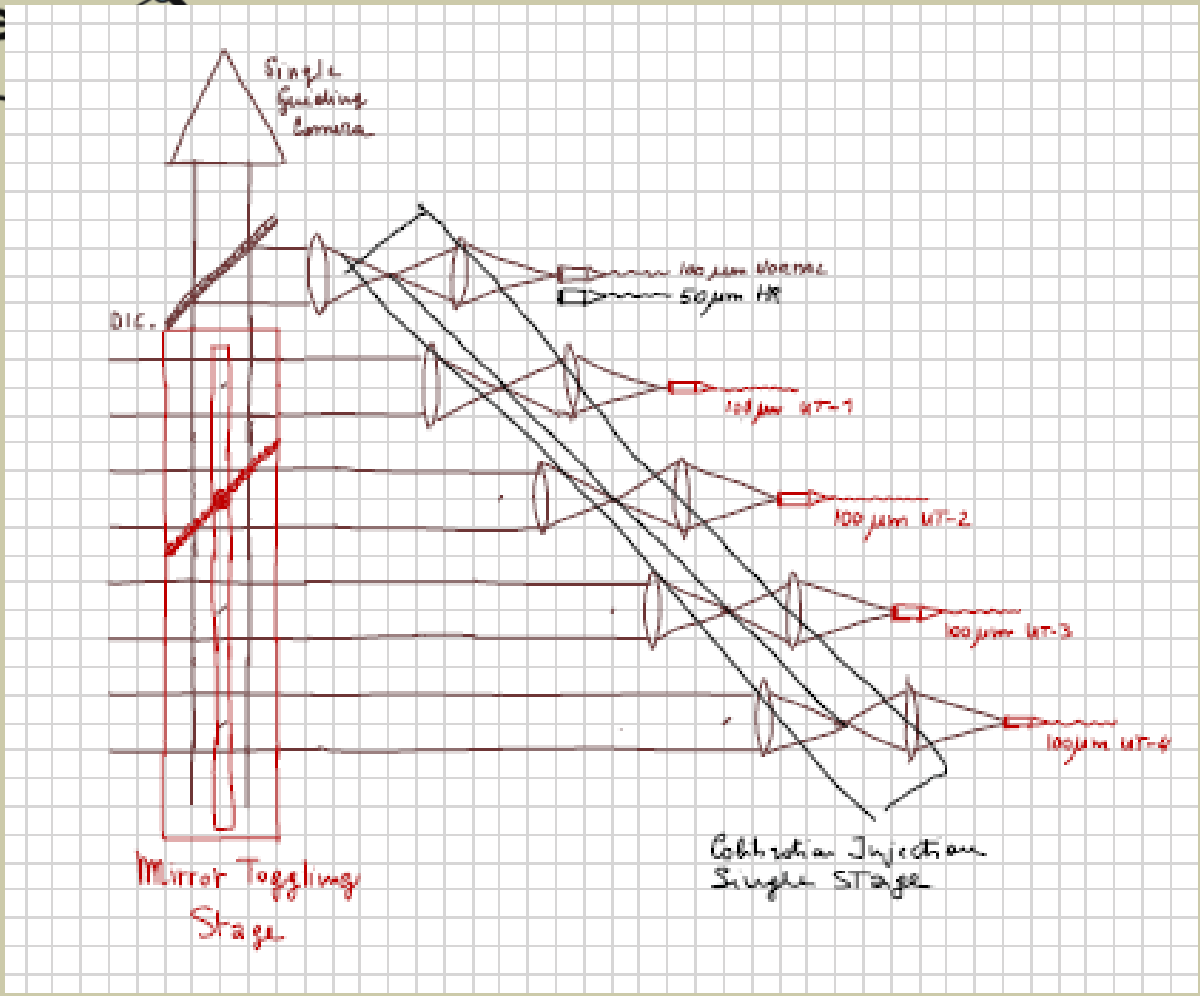
Figure 49. Location of the calibration in injection mechanism in



etary Mechanism to select the beam in 1 UT-mode

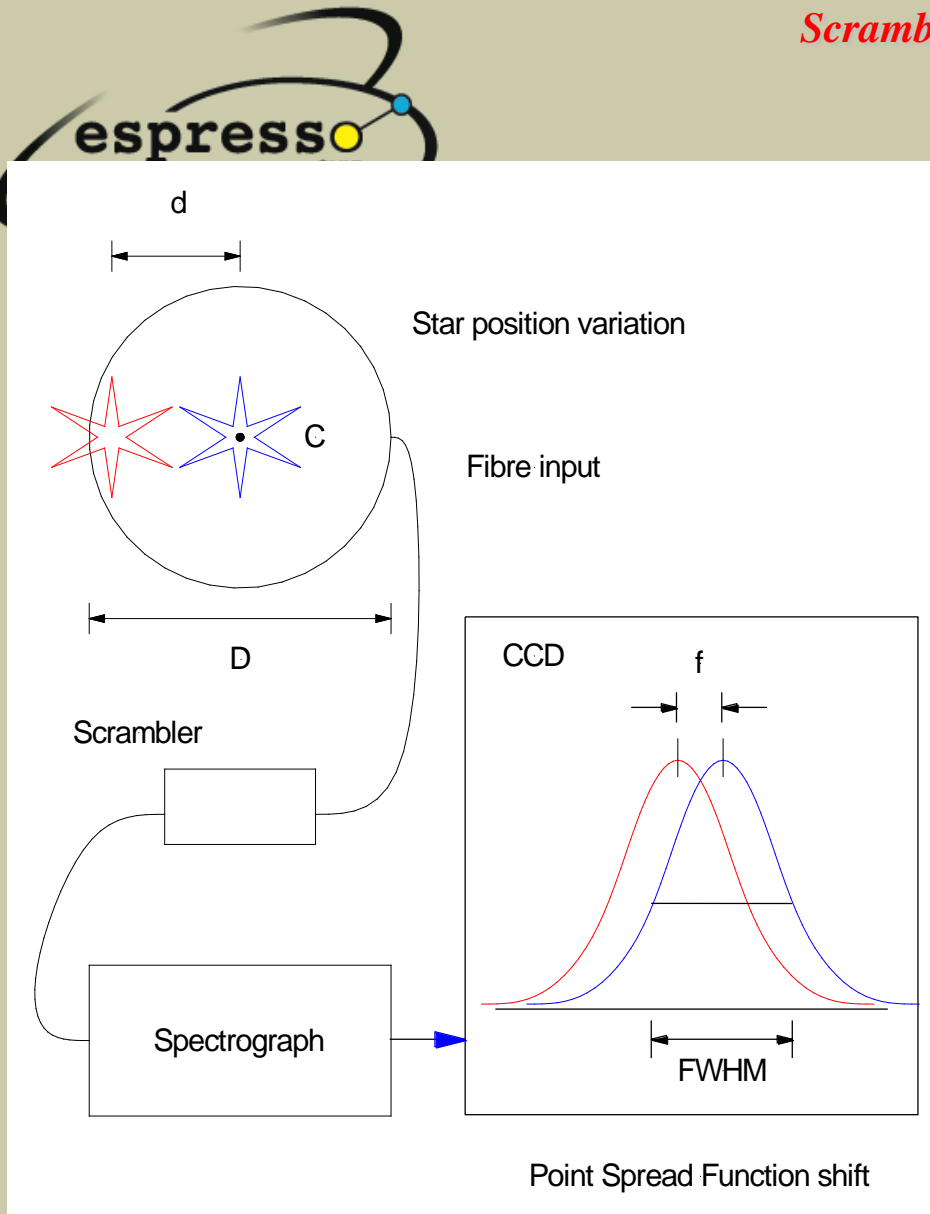


New design ☺





## Scrambler



Scrambling Gain:

$$G = \frac{d / D}{f / FWHM}$$

HARPS resolves 1 m/s  $R=10E5$  and  $d/D=1/5 \Rightarrow G = 100$

Requirement for CODEX:

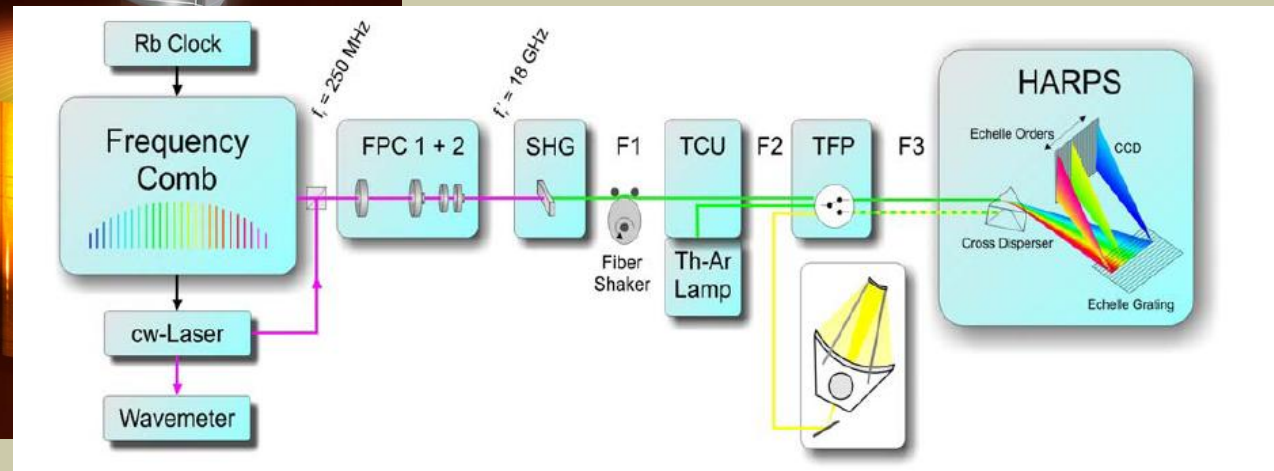
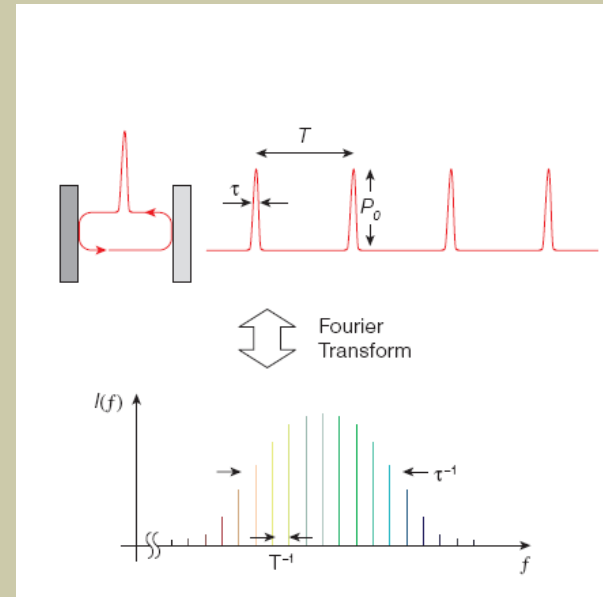
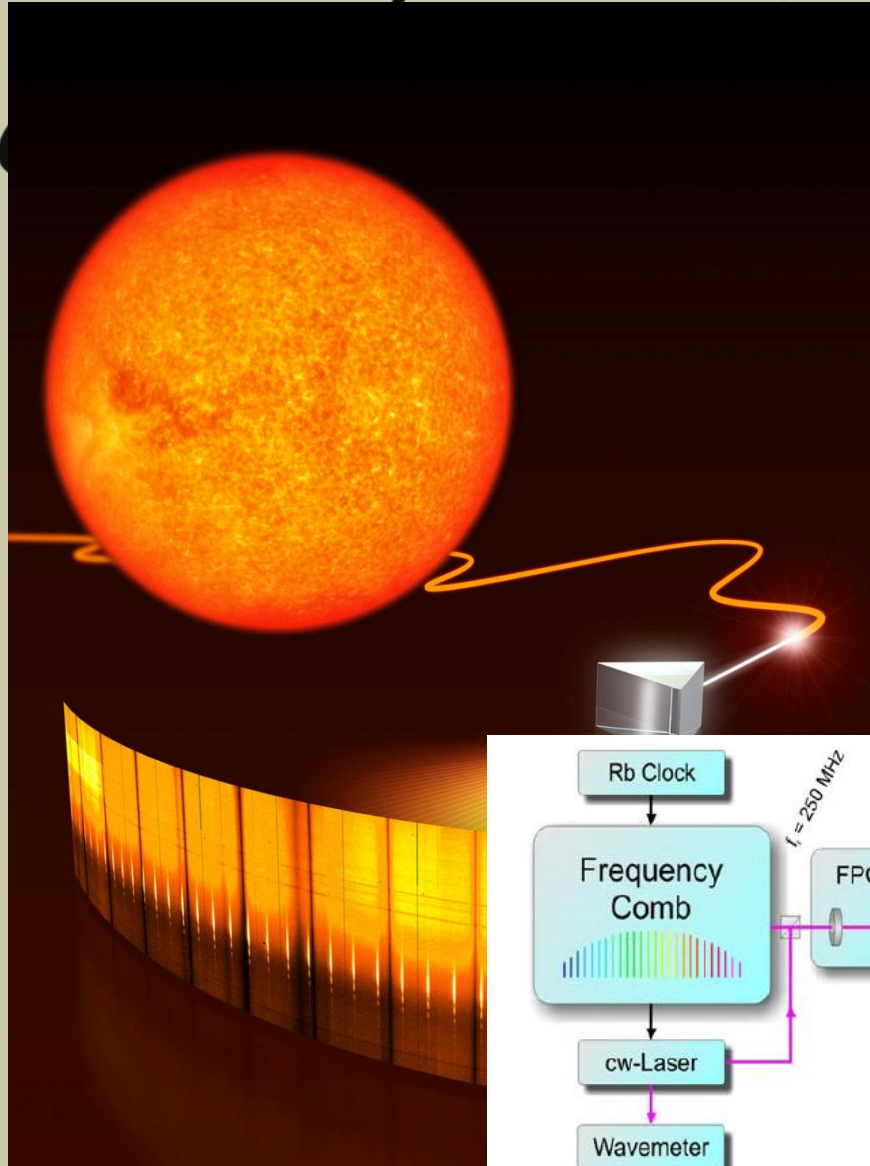
$G > 5\,000$

1cm/s ,  $d/D=1/20$ ,  $R\ 150\ E3$

*Mechanical scrambler*



# Laser Frequency comb @ HARPS

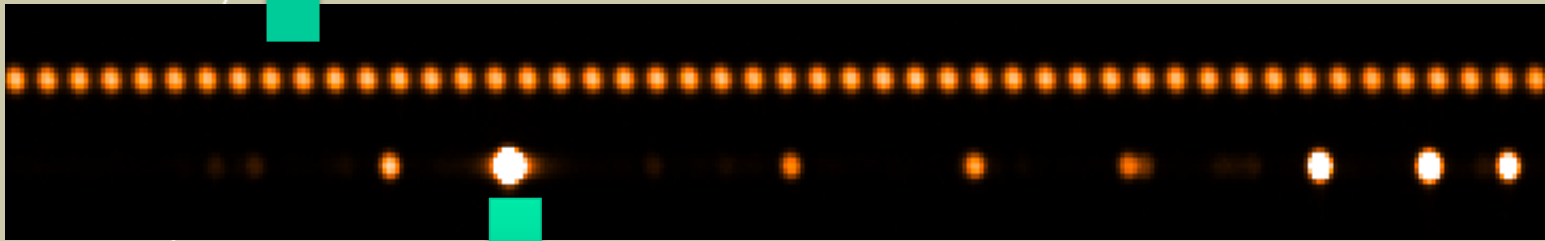


## Laser Frequency Comb



Astro-comb: ~450 lines per order

Th-Ar: ~ 150 lines per order



Th-Ar

Measure RV of 61 Vir using 30 wavelength calibration files on one stellar spectrum

	Comb RV mean	Th RV mean	Comb RV RMS	Th RV RMS
1 order	-7.73132km/s	-7.66583km/s	7.7cm/s	220cm/s
72 orders	-	-7.69770km/s	0.9/0.8cm/s *	24cm/s

\* Extrapolation to 72 orders



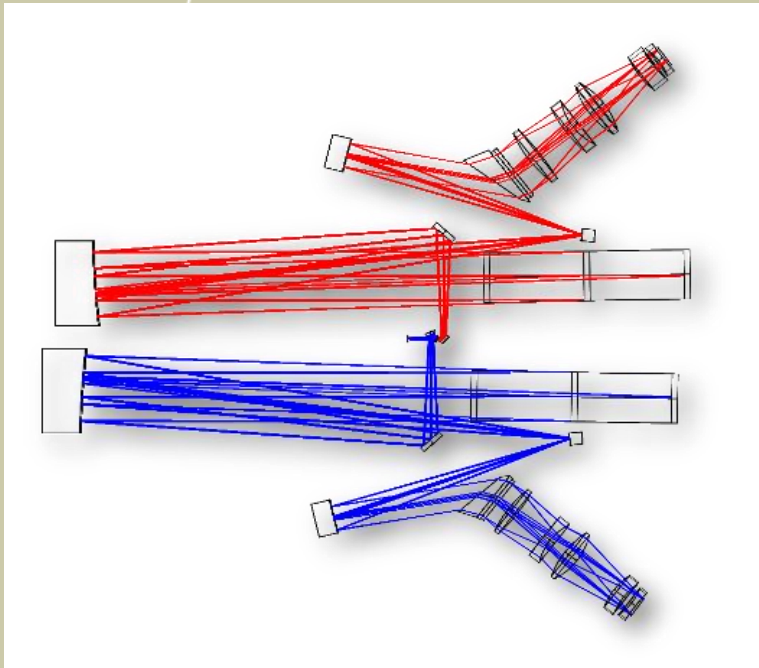
## Optics

Two solutions are now being explored, compared and optimized.

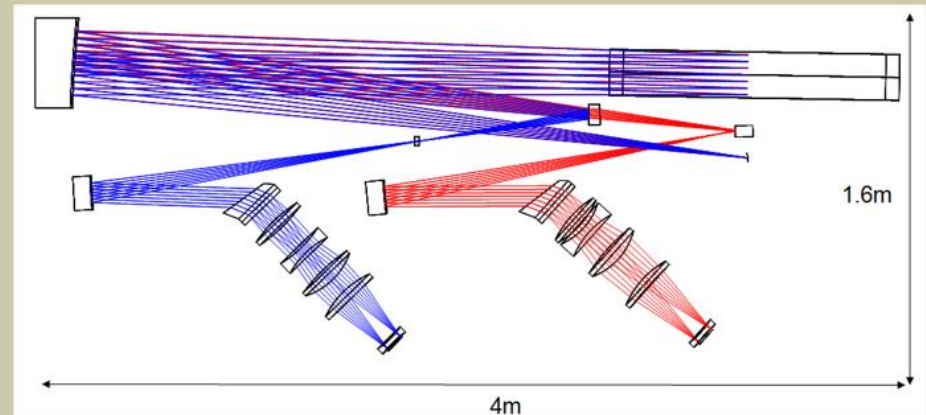
**Solution B:** 3x slices, 2x 2x1 echelle mosaic gratings, 2 full arms, 2 medium collimators

**Solution C:** 2x slices, 1x 3x1 echelle mosaic grating, 2 arms, 1 common path large collimator

### Solution B



### Solution C



## Anamorphic pupil slicer

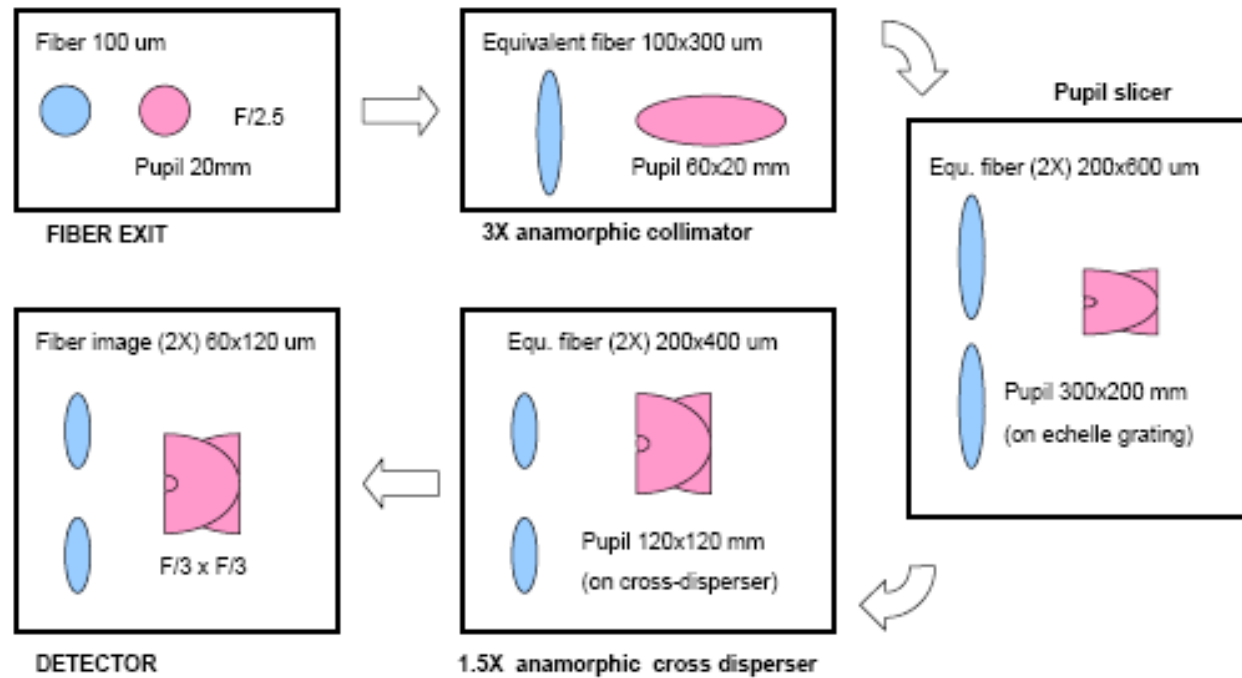


Figure 78. Paraxial image and pupil sizes along the spectrograph optics

## Detector spectral format

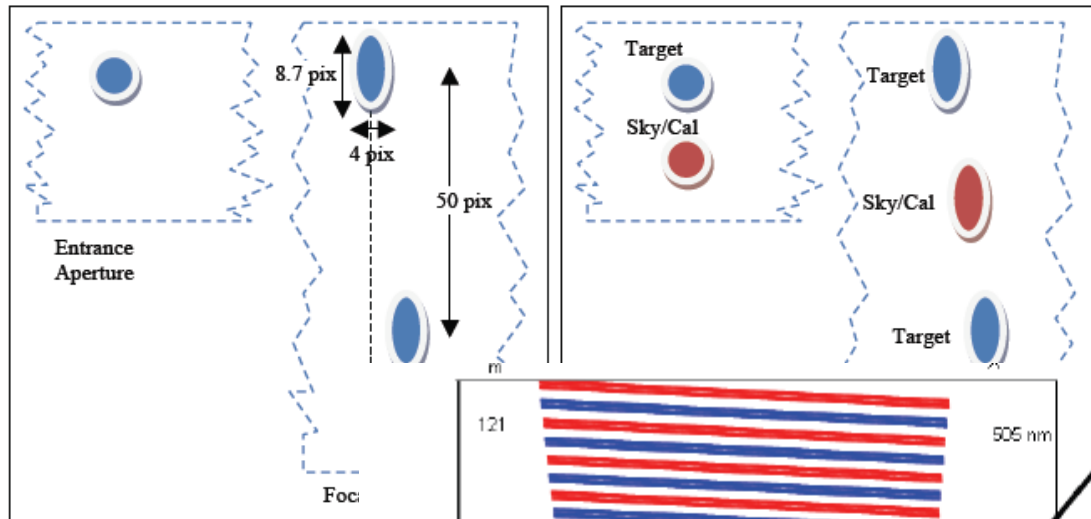


Figure 105. Projected images on

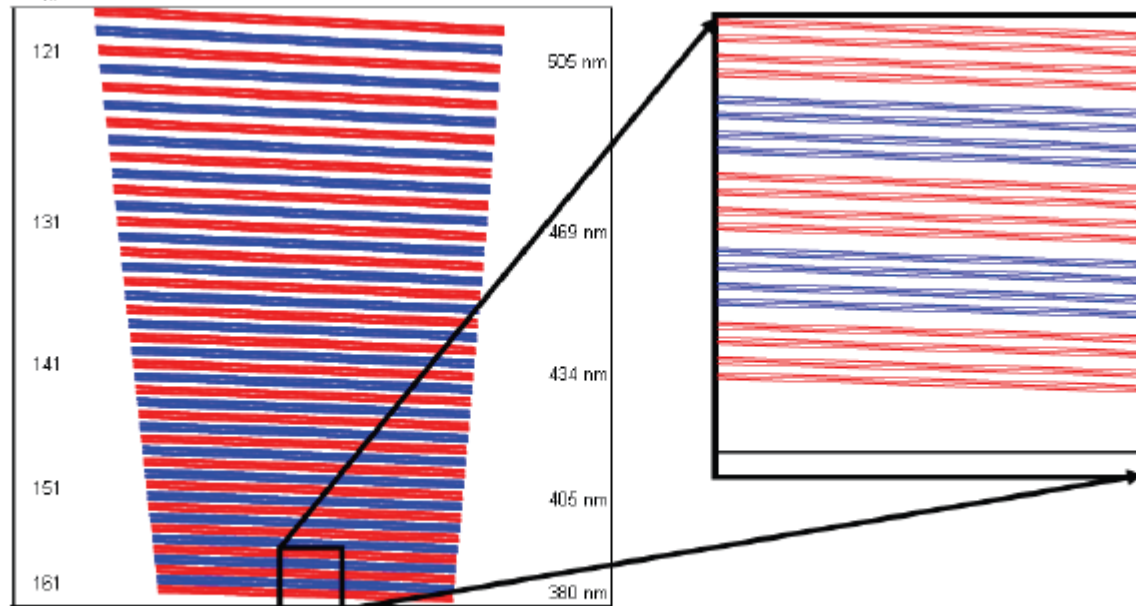


Figure 107. Blue spectral format. The box on the left represents the CCD area.

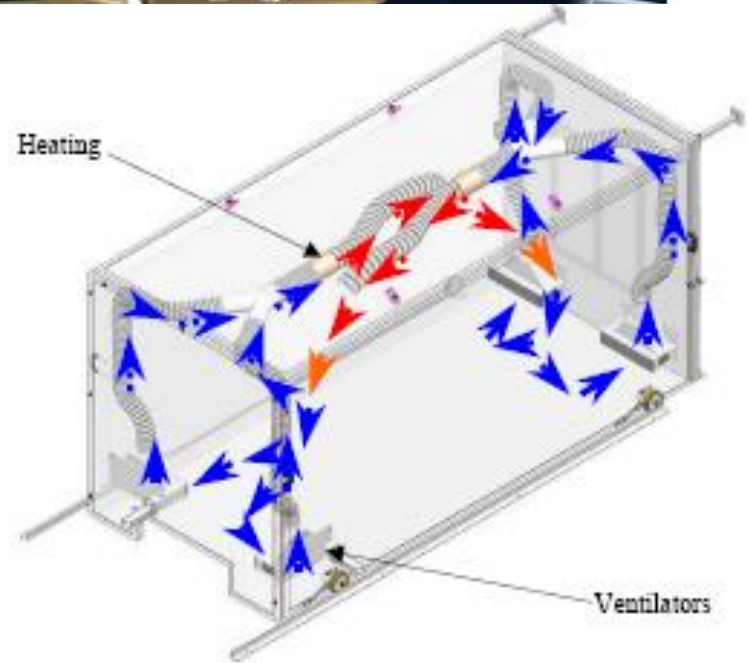
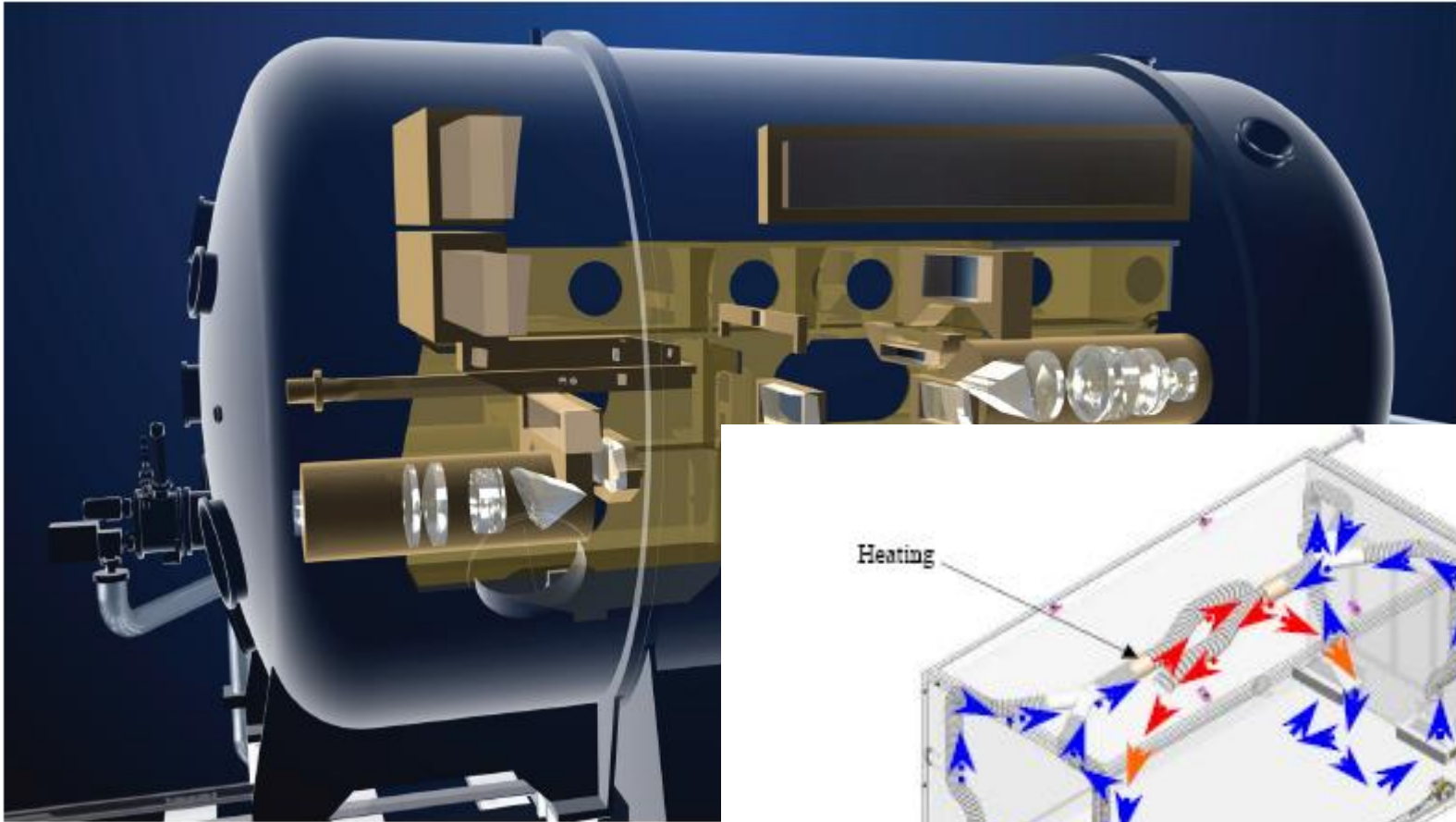


## ESPRESSO characteristics

Spectral Resolution		120000	120000	120000
Spectral scale factor	pixels	4	4	4
Spatial scale factor	pixels	8	6	8
Wavelength Coverage	nm	380-790	370-750 380-790	370-710 380-???
Average efficiency		>35%	>42%	>42%
Cumulated spectrum height (*)	pixels	16	18	16
Arrangement on Detector (???)		2 slices	3 slices	2 slices
Minimum interorder/interspectra spacing	pixels	12	TBD	TBD
Separation between fibers into the slit	um			
Gaps between adjacent orders	nm	>760	>760	>760 (TBC)
Tilt of the fiber image (+)	deg	4.7	TBD	TBD
Image Quality EE80 diam. (across the field ???)	pixels	<1.5	<1.5	<1.5
Axial Symmetry of spots diagrams		?	?	?
Thermal drift	pix/degC	<0.03	?	?
Thermal differential magnification	pix/degC	<0.2	?	?
Sensitivity of spectrum to flexures		?	?	?
PSF Stability in general	pix/??	??	??	??
Image and Pupil ghosts		no	TBC	TBC
Optical Manufacturing Complexity		high	medium-high	medium-low
Optical Alignment Complexity		high	medium-high	low
Mechanical Design Complexity		high	medium-low	medium-high
Dichroic		very complex	small, simple	mid-size, feasible
Vacuum vessel				
Long lead items, max. duration	months	24-30	18-24	15-24
Cost	M€	2-3	2.5-3	2-2.5
Detector binning (???)				
Camera F/num		F/3 x F/3	F/2.25 x F/4.5	F/3 x F/3



## *Mechanics*





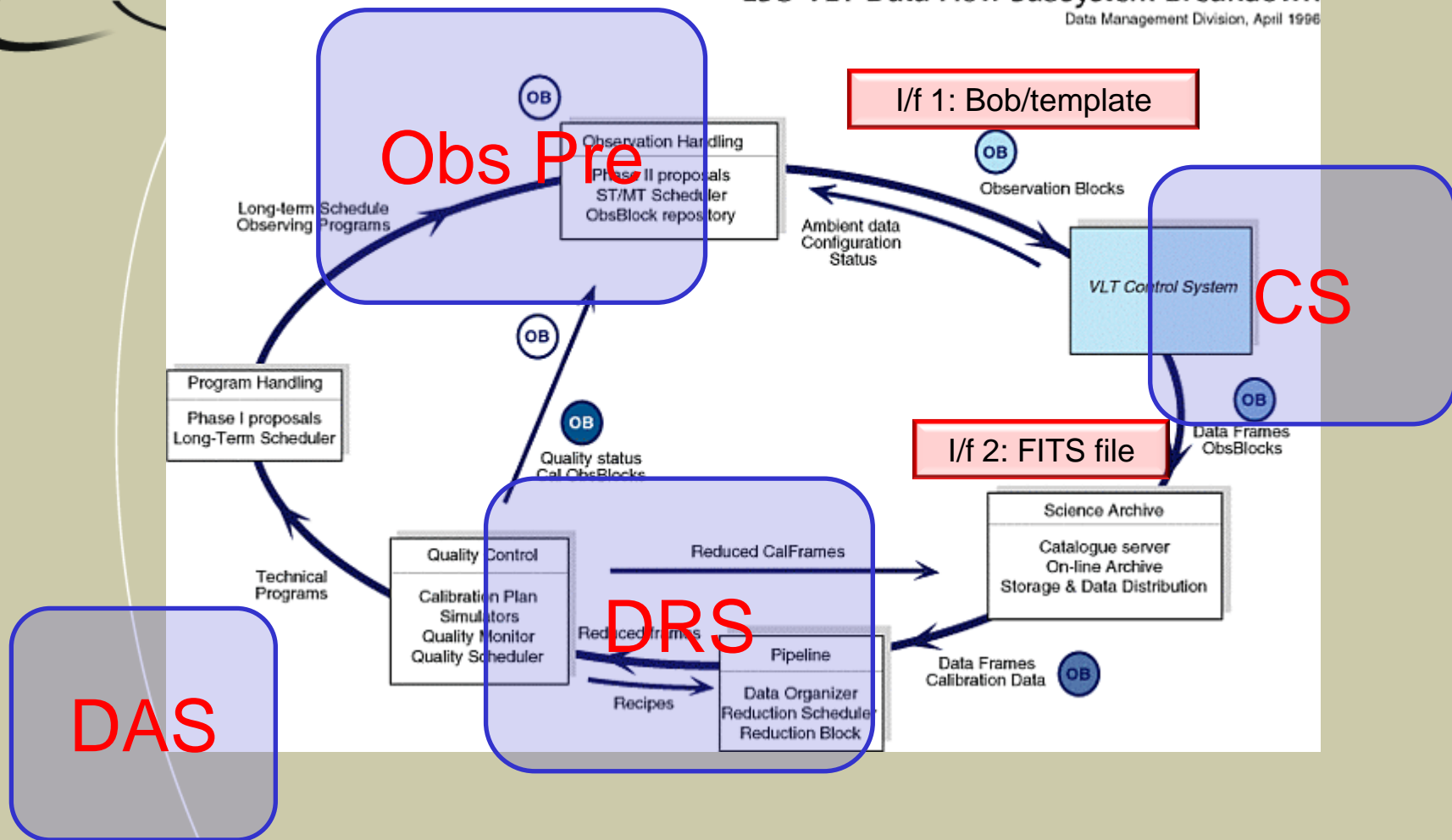
# *Software & Electronics*

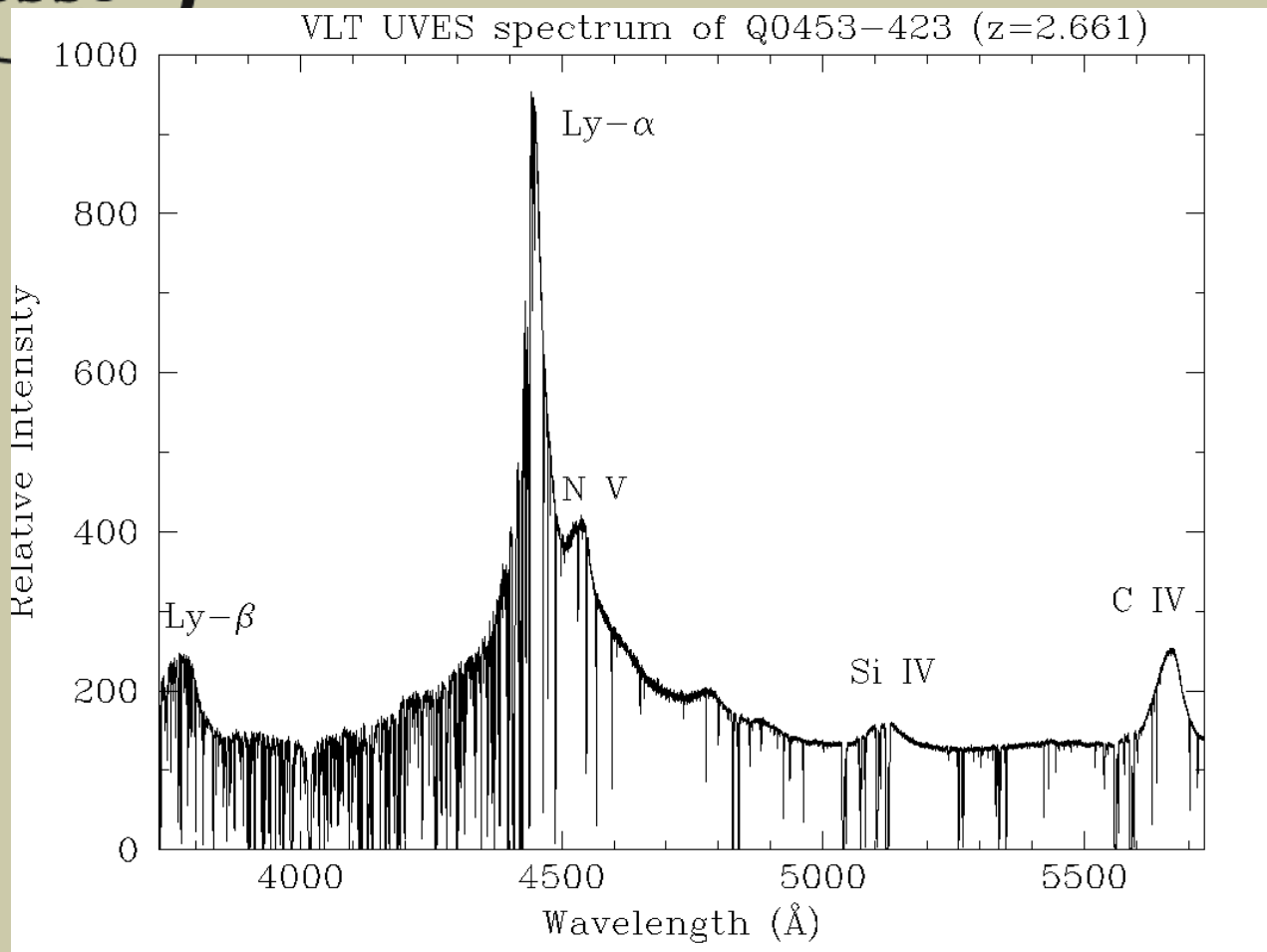
# ESO Data Flow System



## ESO VLT Data Flow Subsystem Breakdown

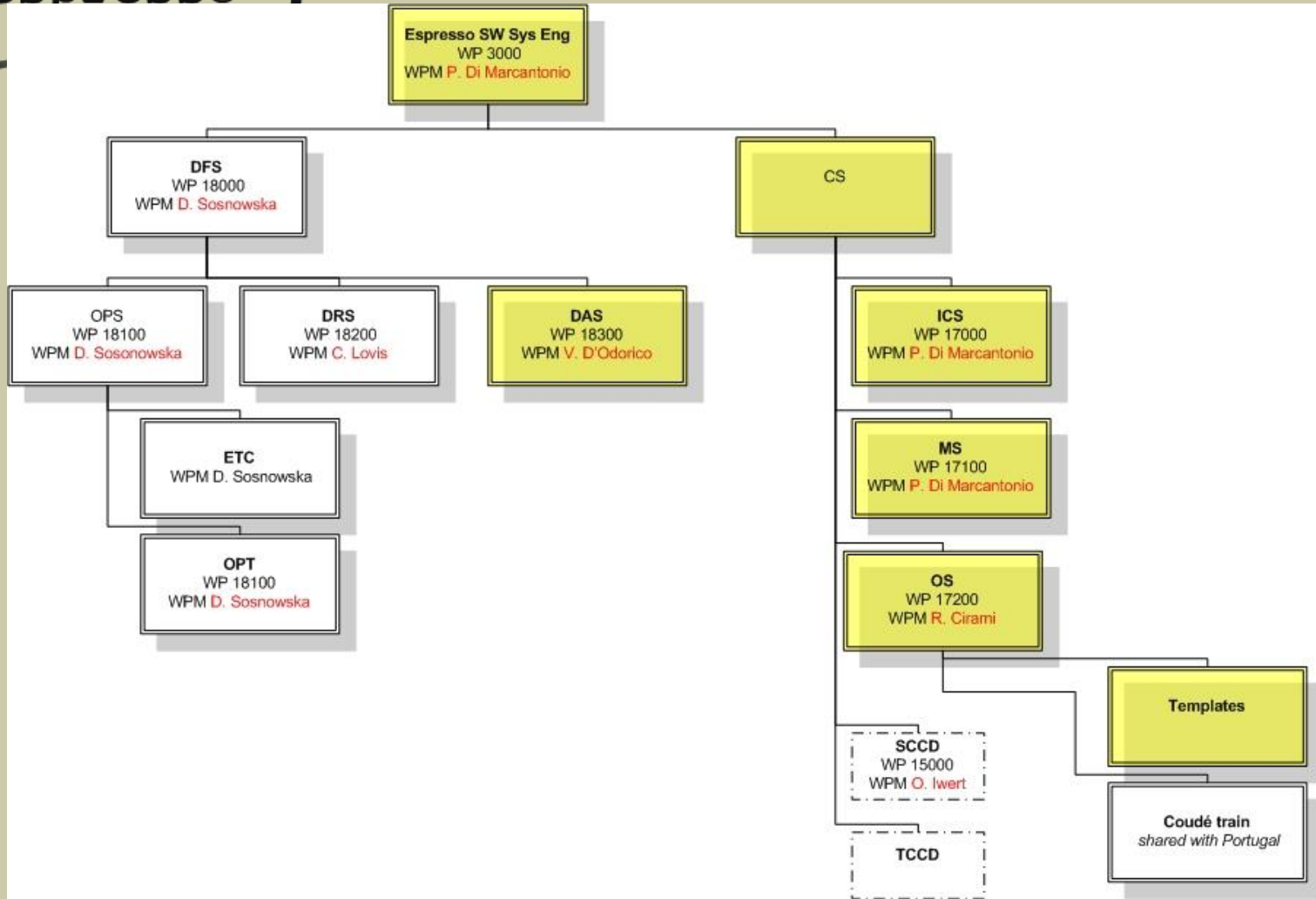
Data Management Division, April 1996







# Software WBS





# P2PP

The screenshot displays the P2PP V.2.8 60.A-9 software interface. The main window is titled 'ObsBlock: No Name: FLAMES'. The interface is divided into several sections:

- File Finding Charts:** Contains icons for 'New', 'Duplicate', and 'Verify'.
- Folders:** A tree view showing folders '60.A-9022(A)' and '60.A-9022(B)'. The latter is selected.
- Configuration Fields:**
  - Name: No Name
  - Status: (P)artiallyDefined
  - \* Execution Time: 00:00:00.000
  - User Priority: 1
  - OD Name: No Name
  - User Comments:
- Template Selection Table:**

Template Type	Template
acquisition	FLAMES_com_obs_exp
science	FLAMES_giraf_obs_exp
calib	FLAMES_uves_obs_exp
test	
- Observation Parameters Table:**

Parameter	Value
FLAMES_giraf_obs_exp	1
No. of Exp.	1
Exposure time	10
Central wavelength	L385.7
Simultaneous Th-Ar calib. lamp	L385.7
	L427.2
	L479.7
	L543.1
	L614.2
	L682.2
	L773.4
	L881.7
- Target Information:**
  - Target: Constraint Set | Time Intervals | Sidereal Time | Calibration Requirements
  - Name: No Name
  - Class: Unknown
  - Right Ascension: 00:00:00.000
  - Declination: 00:00:00.000
  - Equinox: 2000
  - Epoch: 2000.0
  - proper motion RA: 0.0
  - proper motion DEC: 0.0
  - Diff RA: 0.0
  - Diff DEC: 0.0

# Observation Blocks

```
xterm
DPR.CATG.VALUE "SCIENCE"; # Allocated value
DPR.CATG.LABEL "Data Product Category"; # Label used in P2PP

-----
TPL_PARAM "DPR_TECH"; # Next template parameter
DPR_TECH_TYPE "keyword"; # Keyword type
DPR_TECH_RANGE "ISF DPR_TECH_RANGE"; # Valid range
DPR_TECH_DEFAULT "ISF DPR_TECH_DEFAULT"; # Default value
DPR_TECH_VALUE "NOS"; # Allocated value
DPR_TECH_LABEL "Data Product Technique"; # Label used in P2PP

-----
TPL_PARAM "DPR_TYPE"; # Next template parameter
DPR_TYPE_TYPE "keyword"; # Keyword type
DPR_TYPE_RANGE "ISF DPR_TYPE_RANGE"; # Valid range
DPR_TYPE_DEFAULT "ISF DPR_TYPE_DEFAULT"; # Default value
DPR_TYPE_VALUE "OBJECT"; # Allocated value
DPR_TYPE_LABEL "used in P2PP

-----
TPL_PARAM "OCS2_DET1_EXP_TYPE"; # Next template parameter
OCS2_DET1_EXP_TYPE_TYPE "number"; # Keyword type
OCS2_DET1_EXP_TYPE_RANGE "ISF_DET1_EXP_TYPE_RANGE"; # Valid range
OCS2_DET1_EXP_TYPE_DEFAULT "ISF_DET1_EXP_TYPE_DEFAULT"; # Default value
OCS2_DET1_EXP_TYPE_VALUE "Normal"; # Allocated value
OCS2_DET1_EXP_TYPE_LABEL "Exposure type"; # Label used in P2PP

-----
TPL_PARAM "OCS2_DET1_WIN1_UTI1"; # Next template parameter
OCS2_DET1_WIN1_UTI1_TYPE "number"; # Keyword type
OCS2_DET1_WIN1_UTI1_RANGE "ISF_DET1_WIN1_UTI1_RANGE"; # Valid range
OCS2_DET1_WIN1_UTI1_DEFAULT "ISF_DET1_WIN1_UTI1_DEFAULT"; # Default value
OCS2_DET1_WIN1_UTI1_LABEL "Exposure time"; # Label used in P2PP
OCS2_DET1_WIN1_UTI1_MINIHELP "Exposure time in seconds"; # Short Help for keyw
ord

-----
TPL_PARAM "OCS2_INS_GRAT_MLEN"; # Next template parameter
OCS2_INS_GRAT_MLEN_TYPE "keyword"; # Keyword type
OCS2_INS_GRAT_MLEN_RANGE "ISF_GIRA_MLEN_RANGE"; # Valid range
OCS2_INS_GRAT_MLEN_DEFAULT "ISF_GIRA_MLEN_DEFAULT"; # Default value
OCS2_INS_GRAT_MLEN_LABEL "Central wavelength"; # Label used in P2PP
OCS2_INS_GRAT_MLEN_MINIHELP "Central wavelength in nm and resolution mode; L=L
ow, H=High"; # Short Help for keyword

-----
TPL_PARAM "OCS2_INS_REFOCUS"; # Next template parameter
OCS2_INS_REFOCUS_TYPE "boolean"; # Keyword type
OCS2_INS_REFOCUS_RANGE "T F"; # Valid range
OCS2_INS_REFOCUS_DEFAULT "T"; # Default value
OCS2_INS_REFOCUS_VALUE "T"; # Allocated value
OCS2_INS_REFOCUS_LABEL "Refocus"; # Label used in P2PP

-----
TPL_PARAM "OCS2_INS_SIMFLAG"; # Next template parameter
OCS2_INS_SIMFLAG_TYPE "keyword"; # Keyword type
OCS2_INS_SIMFLAG_RANGE "ON OFF"; # Valid range
OCS2_INS_SIMFLAG_DEFAULT "ON"; # Default value
OCS2_INS_SIMFLAG_LABEL "Simultaneous Th-Ar calib. lamp"; # Label used in P2PP
OCS2_INS_SIMFLAG_MINIHELP "Simultaneous Th-Ar calib. lamp"; # Short Help for k
eyword

-----
TPL_PARAM "OCS2_INS_SIMLAMP"; # Next template parameter
OCS2_INS_SIMLAMP_TYPE "keyword"; # Keyword type
OCS2_INS_SIMLAMP_LABEL "FLAMES_giraf_obs_exp.tsf"; # Label used in P2PP
OCS2_INS_SIMLAMP_MINIHELP "149L, 8741C"; # Short Help for keyword
134,1 82%
```

Template signature file

```
xterm
PAF_HDR.START; # Marks start of header
PAF_TYPE ""
PAF_ID ""
PAF_NAME ""
PAF_DESC ""
PAF_CRTE_NAME "P2PP"
PAF_CRTE_DAYTIM "2005-"
PAF_LCHG_NAME ""
PAF_LCHG_DAYTIM "2005-"
PAF_CHK_NAME ""
PAF_CHK_DAYTIM ""
PAF_CHK_CHECKSUM "" # Applic checking file
# Date of last check
PAF_HDR.END # Param file checksum

# Observation Block description follows

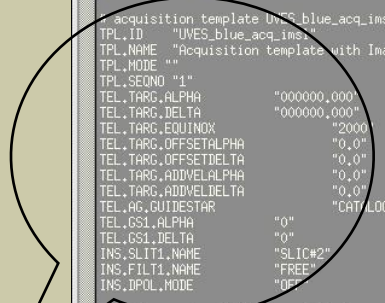
OBS_ID "-110812941103" # Observation block Id
OBS_NAME "pippo" # Observation block Name
OBS_GRP "0" # Unused
OBS_PROG_ID "60_A-9022(A)"
OBS_PI_COI_ID "52022"
OBS_PI_COI_NAME "UNKNOWN"
OBS_EXECTIME "0"
OBS_OBSERVER "UNKNOWN"
OBS_TARG_NAME "No-Name"

# acquisition template UVES_blue_acq_ims1
TPL_ID "UVES_blue_acq_ims1"
TPL_NAME "Acquisition template with Image Slicer"
TPL_MODE ""
TPL_SEQNO "1"
TEL_TARG_ALPHA "000000_000"
TEL_TARG_DELTA "000000_000"
TEL_TARG_EQUINOX "2000"
TEL_TARG_OFFSEALPHA "0,0"
TEL_TARG_OFFSELDelta "0,0"
TEL_TARG_ADDVELALPHA "0,0"
TEL_TARG_ADDVELDELTA "0,0"
TEL_AG_GUIDESTAR "CATALOGUE"
TEL_GS1_ALPHA "0"
TEL_GS1_DELTA "0"
INS_SLIT1_NAME "SLIC#2"
INS_FILT1_NAME "FREE"
INS_DPOL_MODE "DEF"

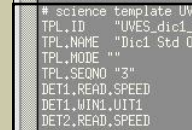
# calib template UVES_blue_cal_dark
TPL_ID "UVES_blue_cal_dark"
TPL_NAME "Blue Dark calibration"
TPL_MODE ""
TPL_SEQNO "2"
DET1_READ_SPEED "225kHz,1x1,low"
DET1_WIN1_UTI1 "10"
SEQ_NEXPO "1"

# science template UVES_dic1_obs_std
TPL_ID "UVES_dic1_obs_std"
TPL_NAME "Dic1 Std Observation"
TPL_MODE ""
TPL_SEQNO "3"
DET1_READ_SPEED "225kHz,1x1,low"
DET1_WIN1_UTI1 "10"
DET2_READ_SPEED "225kHz,1x1,low"
DET2_WIN1_UTI1 "10"
SEQ_NEXPOBLUE "1"
"paolo.obd" 73L, 2015C 1.1 Top
```

Observation Block Description

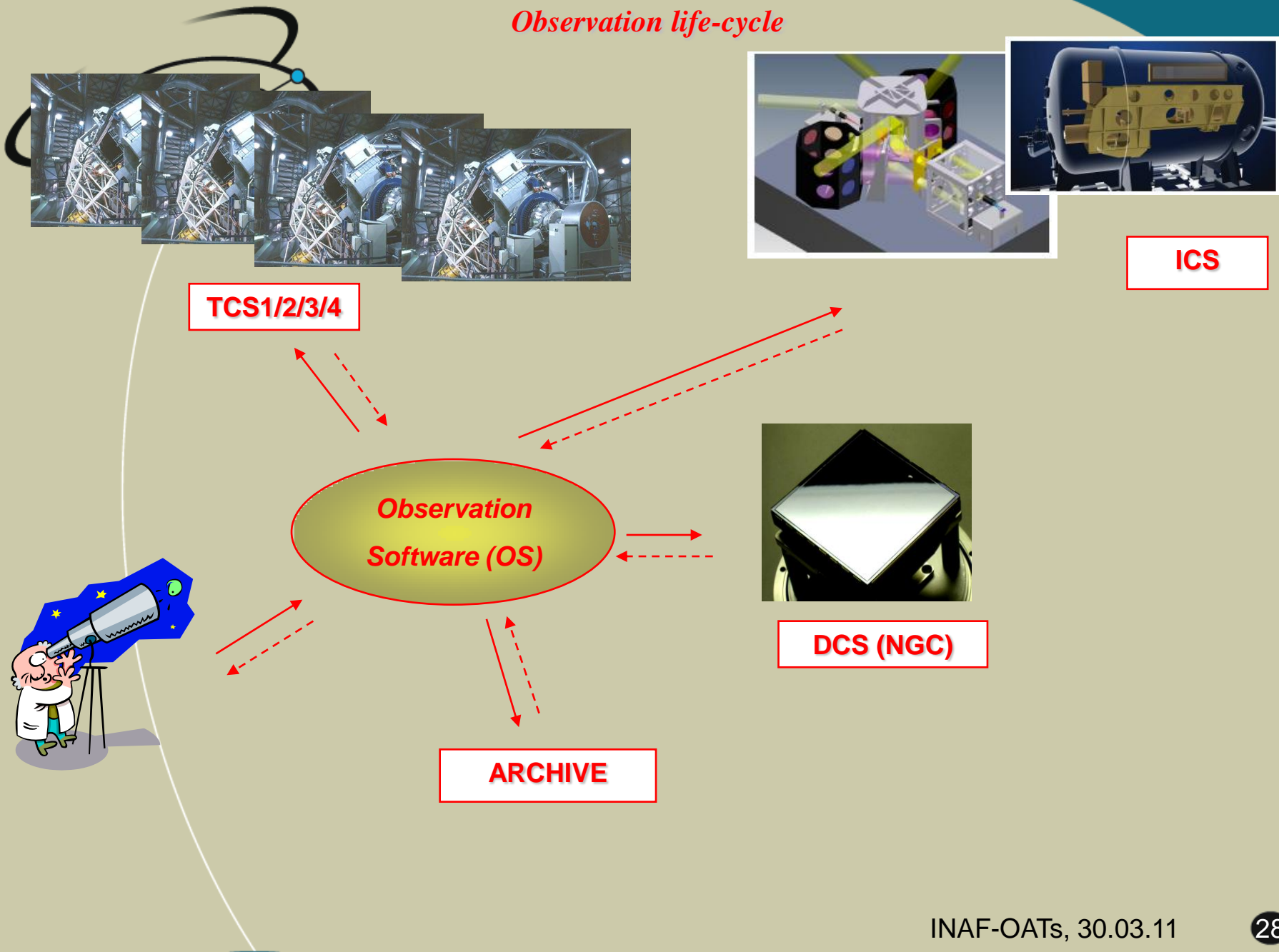


Acquisition



Setup

# Observation life-cycle



## ESPRESSO Phase A' Control Software Architecture

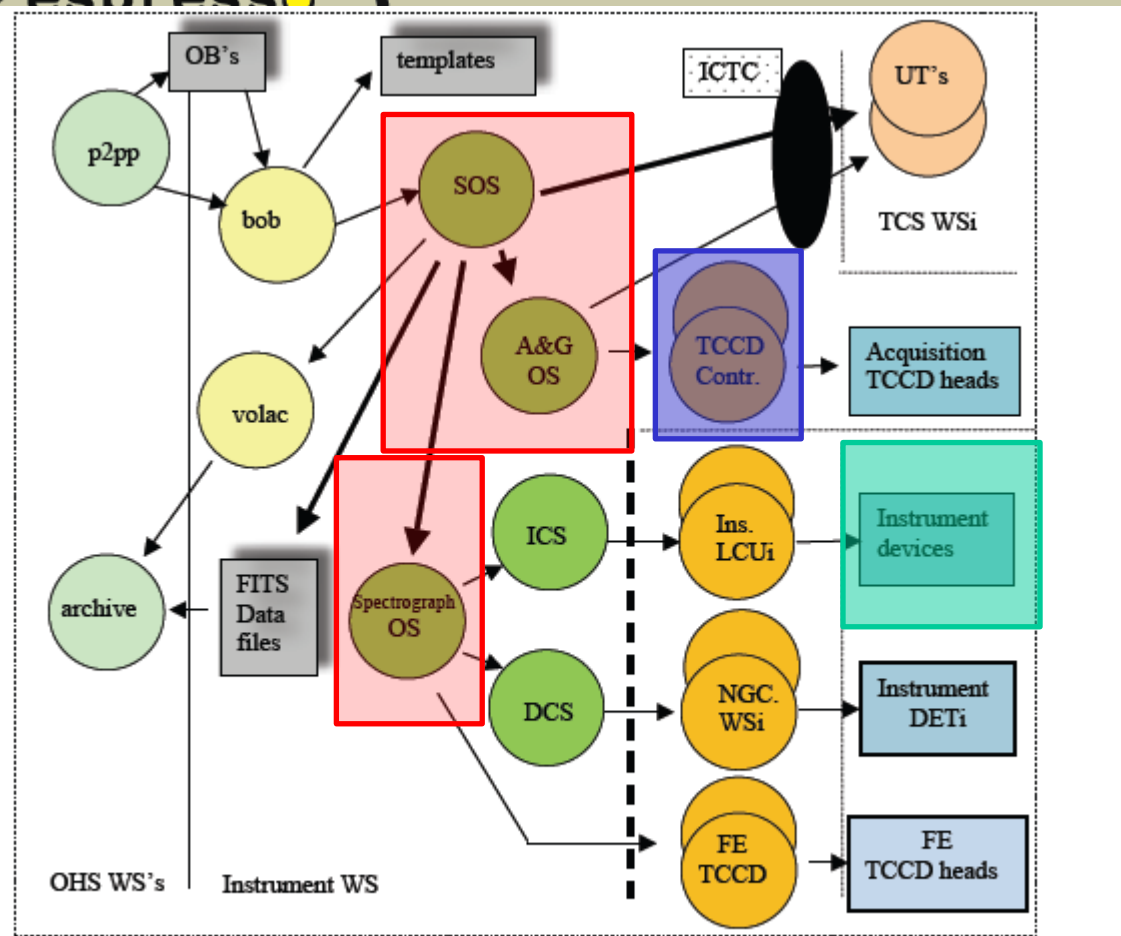


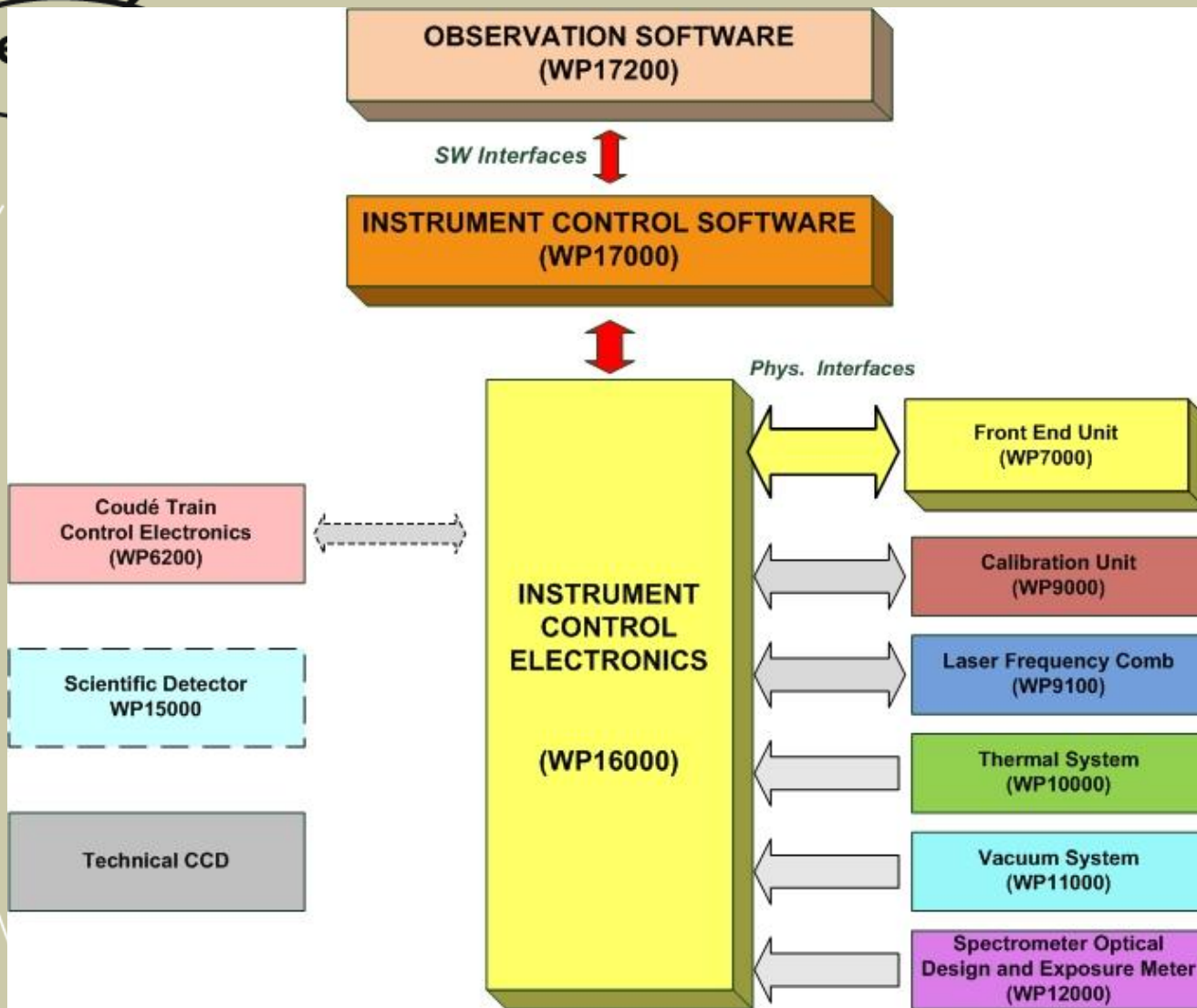
Figure 168. ESPRESSO software architecture

Some issues:

- handling of the 4 UT's;
- TCCDs;
- which electronics?

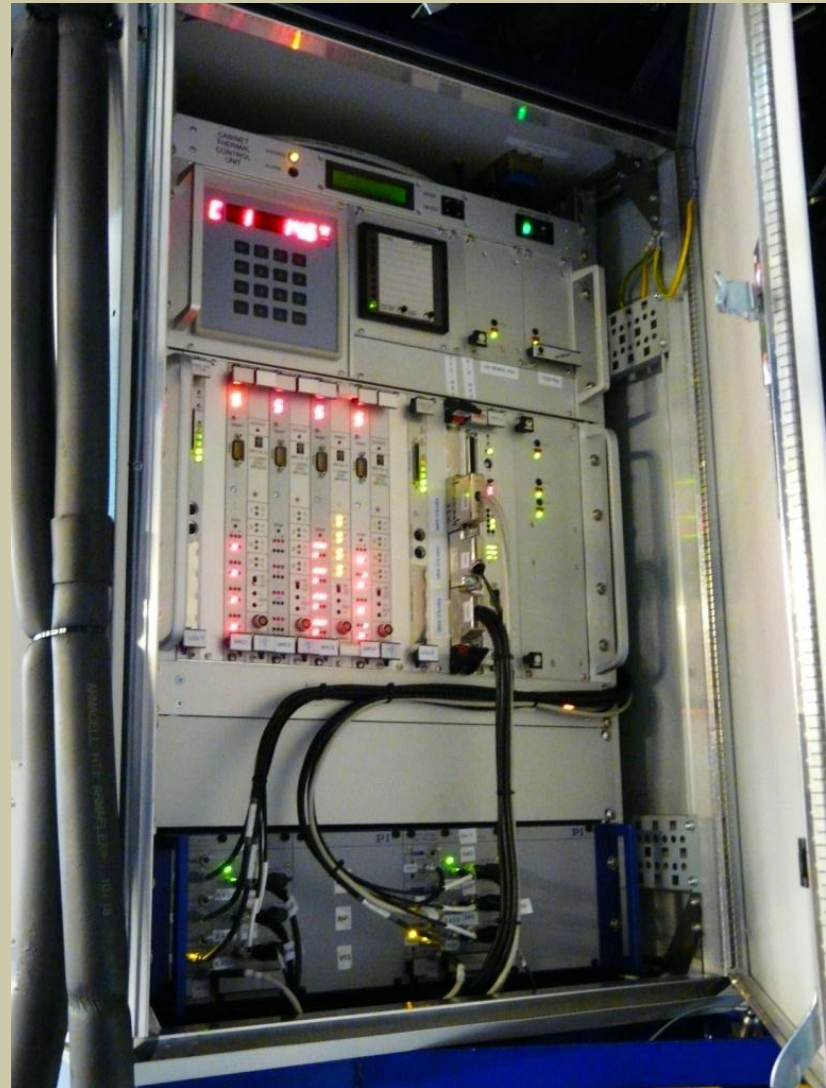


# ESPRESSO ICE I/f

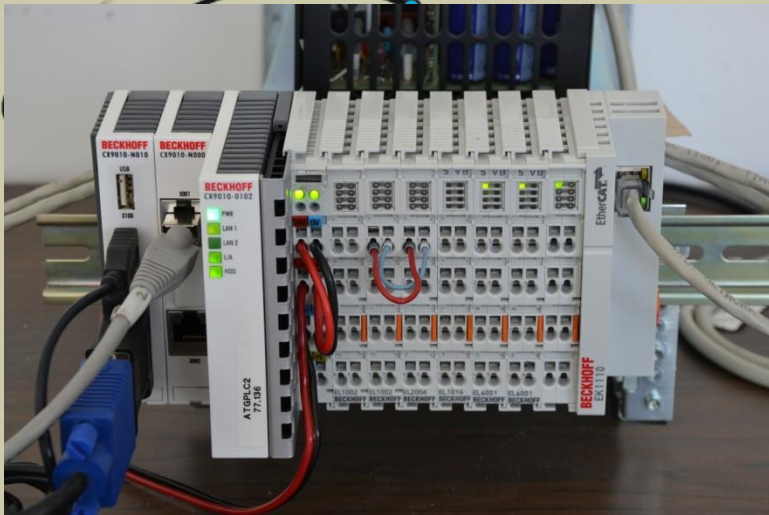




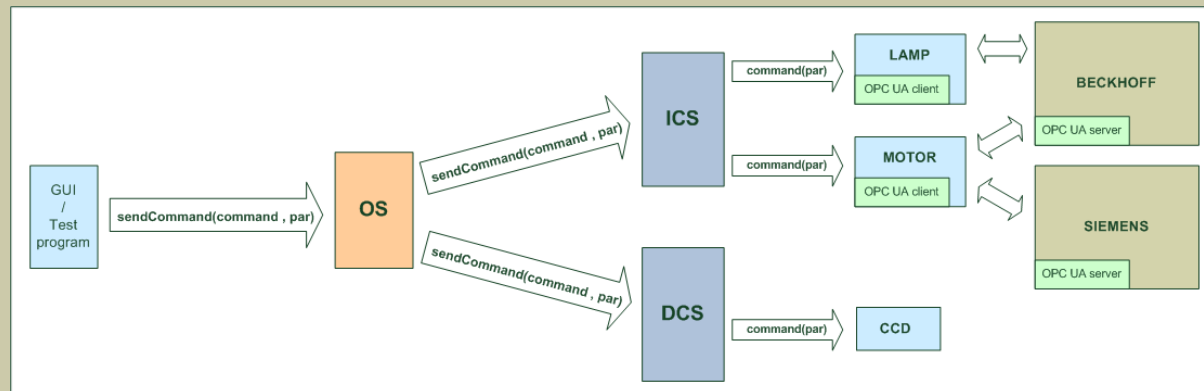
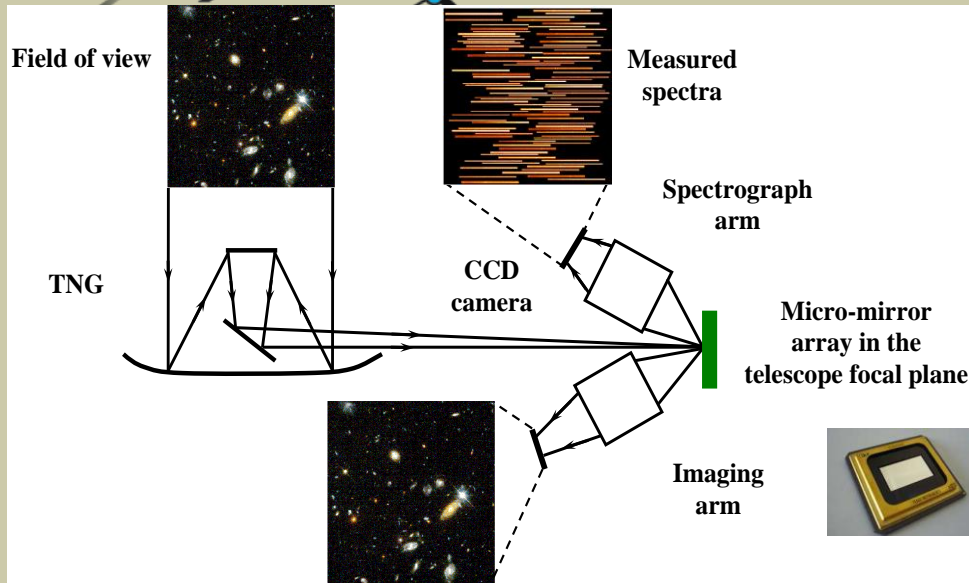
*LCUs*



PLCs

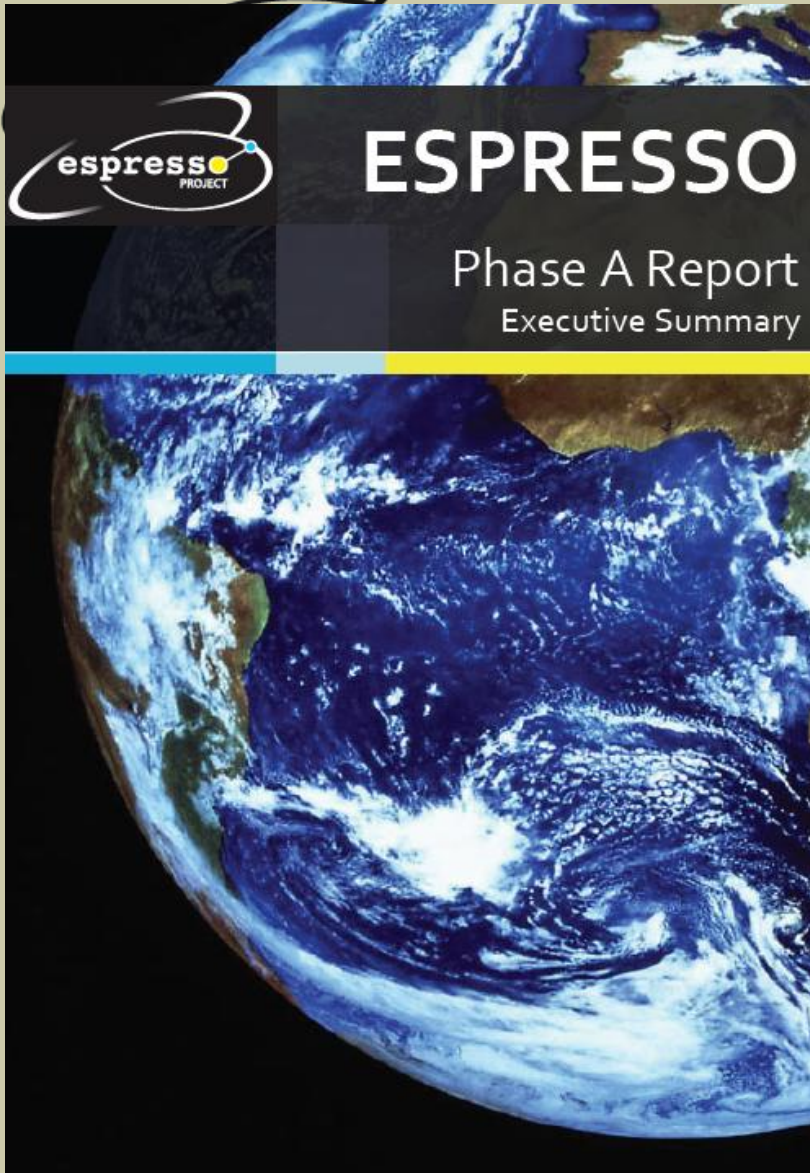


## Demo: E-ELT prototype





## Summary



**ESPRESSO:**  
*A super-HARPS on a 10 m-class telescope  
A spectral coverage from 380 to 800 nm in one shot  
The highest-resolution instrument on a 10 m-class telescope  
A wavelength calibration far more accurate than any other facility  
An instrument producing cleanest, best-quality spectra, both at high and low SNR  
A spectrograph on a 16 m telescope, the largest visible photon-collector until ELTs will be available  
An ultra-high resolution mode ( $R \sim 225,000$ ), far beyond other existing facilities on a 10 m-class telescope*

The ESPRESSO Consortium  
February 2010

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