EUROPEAN SOUTHERN OBSERVATORY

Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral

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LA SILLA OBSERVATORY

Moving FEROS from the ESO 1.52m Telescope to the MPG/ESO 2.2m Telescope

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Prepared for Review - INTERNAL USE ONLY

	Name	Date	Signature
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Change Record

Issue/Rev.	Date	Who	Sect./Parag. affected	Reason/Initiation/ Documents/Remarks
0.1	13/03/2002	J.D.Pritchard	All	First release
0.2	17/06/2002	J.D.Pritchard	§3,4 & 5	Revision after DR-11/06
0.3	23/07/2002	J.D.Pritchard	§9	Preliminary detailed schedule
0.4	13/08/2002	J.D.Pritchard	§3 – 9	Revision after FDR-18/07 and Schedule ratification

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1 Introduction

FEROS, the **F**ibre-Fed, **E**xtended **R**ange, **O**ptical **S**pectragraph, will be moved from the ESO-1.52m Telescope to the MPG/ESO 2.2m Telescope during October 2002. The last night of scheduled observing at the ESO-1.52m is 2002-09-29/30 and FEROS has been advertised as being available from 2002-Nov.

FEROS has the highest subscription factor within ESO, higher even than all VLT instruments, except NAOS/CONICA! This fact demands that we make every effort ensure that FEROS at the MPG/ESO 2.2m is a success. If possible we should aim to enhance the performance of FEROS, or at least maintain its current levels.

1.1 Purpose

This document (2p2-PLA-ESO-22400-1) provides the overall plan and design for the relocation of FEROS to the MPG/ESO 2.2m Telescope.

1.2 Scope

This document is intended for observers and Telescope & Instrument Operators at the ESO-1.52m and MPG/ESO 2.2m telescopes and members of the 2p2 Team and other relevant ESO personel.

1.3 Applicable Documents

1.4 Reference Documents

1 LSO-PLA-ESO-00100-0005, Melnick: La Silla Observatory Goals and Objectives 2002

2 LSO-TRE-ESO-75441-002, Gilliotte: LED/Optics FEROS on 2p2 Telescope Conceptual Design Technical Report

3 Kaufer: Final Design Report, for the Fibre-Fed Extended Range Optical Spectrograph FEROS (June 13, 1997)

3 LSO-TRE-ESO-75441-003, Gilliotte: LED/Optics FEROS on 2p2 Vibration Study Technical Report

4 3M6-TRE-HAR-33101-0001, Weilenmann: HARPS Room Design Description

5 LSO-TRE-ESO-XXXXX-XXXX, Alonso, 2.2m Telescope FEROS Installation Control Electronics

6 LSO-SPE-ESO-80010-0001, Ibsen et al, Online Systems Accounts and Group ID Conventions

7 2p2-PLA-ESO-XXXXX-XXXX, Saviane, Moving FEROS from the ESO 1.52 Telescope to the MPG/ESO 2.2m Telescope: Commissioning Plan

1.5 Abbreviations and Acronyms

ADC	Atmospheric Dispersion Corrector
AI	Action Item
BOB	Broker of Observing Blocks
BIAS	Brorefeld Image Aquistion System
CCD	Charge-Coupled Device
DICB	Data Interface Control Board
DR-11/06	Design Review of 2002-06-11
DRS	Data Reduction System
ESO	European Southern Observatory
EUR	Euros (currency)
FCU	FEROS Calibration Unit
FCUS	FCU Shutter
FDR-18/06	Final Design Review of 2002-07-18
FEnv	FEROS Environmental monitoring
FEROS	Fibre-fed Extended Range Optical Spectrograph
FIERA	Fast Imager Electronic Readout Assembly
FWSM	FEROS/WFI Selector Mirror
FTCCD	FEROS TCCD
FWACU	FEROS/WFI Adapter & Calibration Unit
ISG	Infrastructure Support Group
LCU	Local Control Unit
LED	La Silla Engineering Department
LSO	La Silla Observatory
MET	Medium-Sized Telescopes Team
PC	Personal Computer
PDR	Preliminary Design Review
PLO	Paranal Observatory
RSM	Rotating Selection Mirror
RTD	Real Time Display
SciOps	La Silla Science Operations Department
SCSM	Sliding Calibration Switch Mirror
SWC	Software and Communications team at LSO
TBD	To Be Done/Discussed/Decided (as appropriate)
TCS	Telescope Control Software
TCCD	Technical CCD
TIO	Telescope & Instrument Operator
VLT	Very Large Telescope
VME	Versa Module Europe
WFI	Wide Field Imager
WS	Work Station

1.6 Release Notes

This, the fourth released version (version 0.4) is another draft release. It includes further updates made as a result of the Final Design Review held 2002-Jul-18 (FDR-18/07) as well as some corrections made to the schedule. It is intended to provide clarification and stimulate further discussion.

The third released version (version 0.3) was another draft release. It was only partially released, only the fleshed our schedule section based on the Final Design Review held 2002-Jul-18 (FDR-18/07) was released for ratification.

The second released version (version 0.2) was also a draft release. It included updates made as a result of the Design Review held 2002-Jun-11 (DR-11/06). It was intended to provide clarification and stimulate further discussion.

The first released version was verion 0.1, a draft release intended as a discussion document for the Design Review held 2002-Jun-11.

Please mail comments to `jpritcha@eso.org`.

1.7 General Philosopy

The philosophy to be adopted for this project is governed by two inescapable constraints:

1. We don't have much time to plan
2. We don't have much time to make the actual move (October!)

Without consideration of the above we might consider (at least) three options:

1. As-is
2. VLT-compliant
3. Hybrid: as-is for now, but planning for future VLT-compliance

We must also consider the reality that in terms of future support both for maintenance and improvements as well as future Service Mode Observing possibilities, VLT-compliance is highly desirable.

Given the above constraints and considerations it seems obvious that the best option is the Hybrid option. Lack of time means we must as much as possible move without making changes. But some changes are necessary, and in these case the changes should be made in a way that plans for future VLT-compliance.

All the above implies we ought to adopt the following moto:

> Get it there, get it working! Improvements should only be considered in relation to facets that must be changed anyway.
> BUT... what we do have to do, we do right! e.g. The FEROS room.

2 Administration

2.1 Principle Participants

The person principally responsible for each facet of the project are as follows:

Facet	Principal	Dept.
Project Manager	J.Pritchard	MET/SciOps
Project Scientist	I.Saviane	MET/SciOps
Optical Design	A.Gilliotte	LED
Mechanical Design	W.Echert	LED
FEROS Room Design	L.Aguila	ISG
FEROS Room Climate Control	L.Wendegast	LED
FEROS Software Integration	F.Gutierez	SWC
Techincal Adviser	A.Kaufer	PLO
Design Reviewer	L.Pasquini	ESO-HQ

Table 1: Principle participants.

2.2 Budget

According to Otmar Stahl of the Landessternwarte Hidelberg-Konigstuhl, as of 2002-Apr-30 the available budget is 40.210,04 EUR (>CLP 20.000.000,00). This money is left over from the original FEROS budget and is contolled by Otmar Stahl of the Landessternwarte Hidelberg-Konigstuhl.

As far as is know all of the 40.210,04 EUR is available to be used for the move but it should be considered to put some aside for future upgrades, e.g. WorkStations.

Purchasing a new FIERA is far beyond the scope of this budget.

The established procedure for making use of this money is:

1. The La Silla person involved collects all relevant "preliminary" documentation and finally obtains a Proforma.

2. The Proforma is provided to Project Manager for checking/acceptance and then is forwarded by the Project Manager it to Otmar Stahl, usually by FAX (+49-6221-509-202).

3. Based on the Proforma Otmar Stahl places the order, specifying the delivery address as per the Proforma (which in most cases will be the ESO-Garching Warehouse. Of course the invoice address will be Otmar Stahl, Landessternwarte Hidelberg-Konigstuhl.

4. Upon reciept of Invoice Landessternwarte Hidelberg-Konigstuhl pays it, forwarding a copy if the invoice to the Project Manager.

5. Of course any other documentation Otmar Stahl and/or Landessternwarte Hidelberg-Konigstuhl receive wrt an order should also be copied to the Project Manager.

In many cases items will be purchased on LSO/MET/SciOps budgets and these will be re-imbursed by purchases of equal value from the FEROS money held by the Landessternwarte Hidelberg-Konigstuhl.

2.3 LSO Goals & Objectives

The document *La Silla Observatory Goals and Objectives 2002* [1] lists the following:

- **High Level**: *Move FEROS to 2.2m* is listed as a high level goal, but not as a project despite that other comparable(?) projects (e.g. HARPS, TIMMI2 upgrade to full VLT compliance, Second Generation Instrument for NTT) are.
- **MET**: ***FEROS***. *A member of the team will be project scientist for the transfer of FEROS to the 2.2m. This project may include improvements such as a polarimetry mode, or others (CRITICAL).*
- **SWC**: ***FEROS at 2.2m***. This is one of 13 goals for SWC, none of them are graded.
- **LED**: ***FEROS to 2.2m telescope***. This is one of 20 goals for LED, none of them are graded.
- **ISG**: Moving FEROS is not listed as a goal for ISG.

In conversations between Rene Mendez and Jorge Melnick, Gaetano Andreoni and Olivier Hainaut, it is confirmed that Moving FEROS has the highest priority for projects currently underway within the observatory.

3 Location, Location, Location

Three possible location options[1] were considered. After consideration of the relative merits of the three options with respect to distance from the telescope[2], vibrational stabilty[3], climatic stability and the available space the choice of the TIOs office was in the end quite clear.

3.1 The 2.2m FEROS Room

When it became clear in May-2002 that FEROS would be installed in the 2.2m TIOs room, the 2.2m TIOs abandoned their room and since June this room is now known as the MPG/ESO 2.2m FEROS Room.

The 2.2m FEROS Room will house the 2.2m FEROS Climate Controled Room (FCCR) as well as the continuous flow Cryogenic CCD cooling system, the FEROS Technical CCD (FTCCD) LCU, the FEROS/WFI Adapter & Calibration Unit (FWACU) LCU, the FEROS Enviromental Monitoring (FEnv) LCU and the FEROS CCD Control PC. Four ethernet ports are therefore required to accomodate these three LCUs and one PC.

The FEROS Room must be air-conditioned independently of the FCCR to provide a first level of climate control for the FCCR. This is will also benefit the computers.

The layout of the FEROS Room will be as shown in figure 1.

To accomodate the 2.2m FEROS Climate Controled Room the exisiting FEROS Room must be modified extending the wall into the corridor.

The possibility to drill holes in the floor in order to install concrete piles directly to the bedrock below the 2.2m building on which to sit the FEROS spectrograph is considered undesirable as vibrations are liable to be transmitted through the bedrock to the spectrograph. Installation of a 'damping' material under the table legs (as suggested by Ugenio Ureta) is also considered undesirable under the argument that 'if it was that easy, why wouldn't the manufacturers supply the special damping material as a matter of course'[4].

Some minor work will be required to relocate the WFI DLT storage shelves to an as yet to be decided location and to relocate the two ethernet ports numbers #21 & #22 to next to the two ethernet ports numbers #23 & #24 and to add two new ethernet ports. At this time no further ethernet ports are forseen as these six will be adequate for the six computers forseen to be located in the FEROS Room.

3.2 The 2.2m FEROS Climate Controled Room

In discussions related to the design and specification of the FEROS Climate Controled Room (FCCR) it is important to bear in mind that FEROS is "not offered to the community as a 'Radial Velocity Machine"'. Other La Silla instruments are provided for that purpose (e.g. HARPS). Therefore despite the fact that observers are able to detect the affect of thermal variations on radial velocities down to a precision of perhaps $\sim 10\,\mathrm{m\,s^{-1}}$ Climate Control will be aimed only at providing an environment in which the original specification of radial velocity accuracy can be guaranteed, i.e. $< 50\,\mathrm{m\,s^{-1}}$.[5]

[1] Namely 'On the Pier', 'The TIOs office' and 'The Dome floor'.

[2] Relevant for optical fibre length considerations.

[3] See [3].

[4] O. Hainaut.

[5] In table 2.1 of the Final Design Report [3] the 'Expected Radial Velocity Accuracy' is listed as $< 25\,\mathrm{m/s}$, $< 5\,\mathrm{m/s}$ with Iodine cell (contract $< 50\,\mathrm{m/s}$).

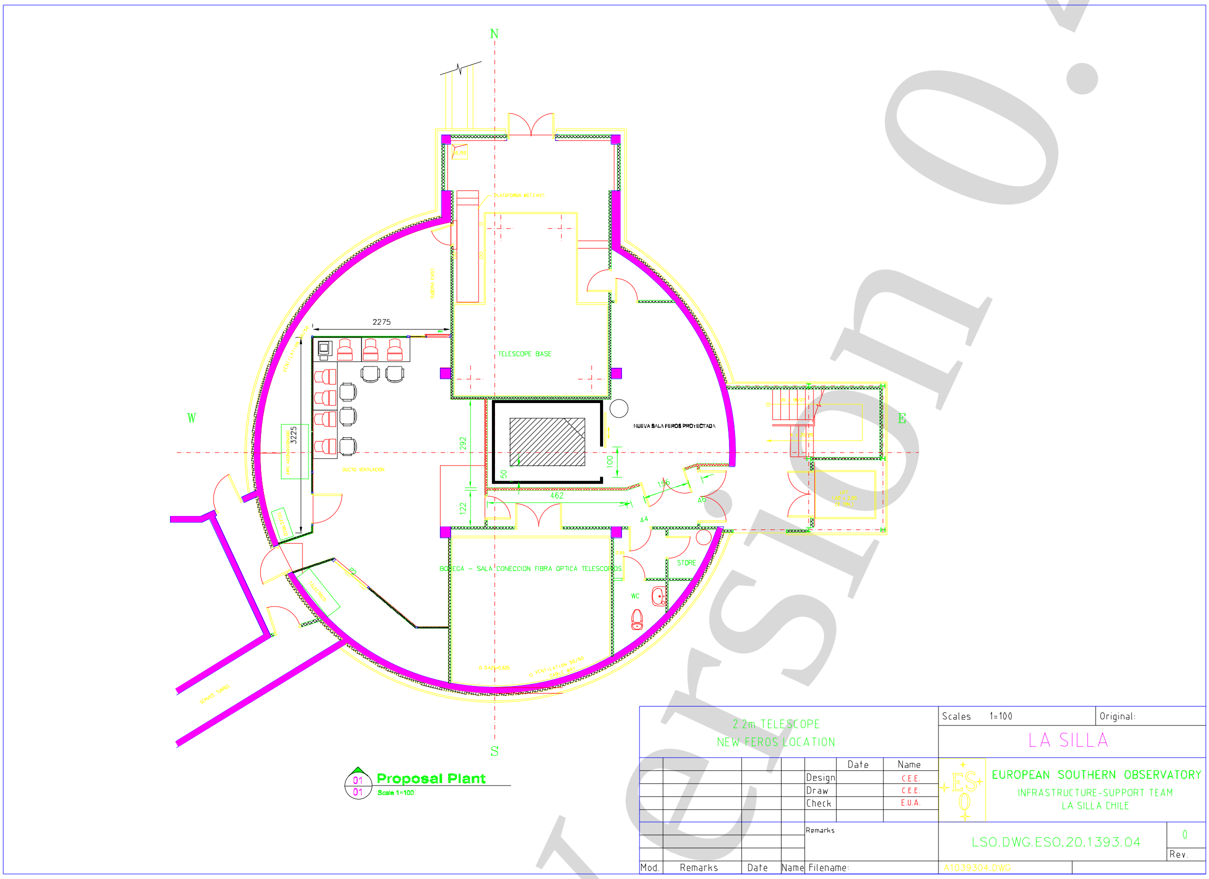

Figure 1: Plan of MPG/ESO 2.2m FEROS Room

The enclosure of the 2.2m FCCR will be of the same type as the HARPS room at the ESO-3.6m telescope, i.e. polystyrene insulated steel panels of 75mm thickness (the same type as used for refrigerated chambers). The dimensions of the room will be $2.5 \times 3.4 \times 2.0\,\mathrm{m}^3$.[6]

The air-conditioning system currently installed at the ESO-1.52m FEROS Room will be transplanted to the 2.2m for climate control of the 2.2m FCCR. The external contractor *Climatrol* will be contracted to install the climate control. The climate control specifications will be as detailed in table 2.

Parameter	Specification
RV stability	$< 50\,\mathrm{m\,s^{-1}}$
Temperature	$16 \pm 0.5\,^\circ\mathrm{C}$
Humidity	$30 < H < 60\%$

Table 2: FCCR Climate Control specifications.

As noted above the room will be located as presented in figures 1 and 2 in the 2.2m FEROS Room. The FEROS CC room will be a simple rectangle design, measuring $l \times w \times h = 3.5 \times 2.6 \times 2.0\,m^3$ which allows $0.5m$ of space around all four sides of the spectrograph.

Consideration must be given to the entrance/exit holes for the Nitrogen feed line, the FEROS Enviromental Monitoring cables, the two spectrograph science fibre optic cables and the two CCD controller fibre optic cables (and any others???). Insulation providing light and air tightness around the holes is essential.

[6] Height is a lower limit, 2 m provides 350 mm of clearance.

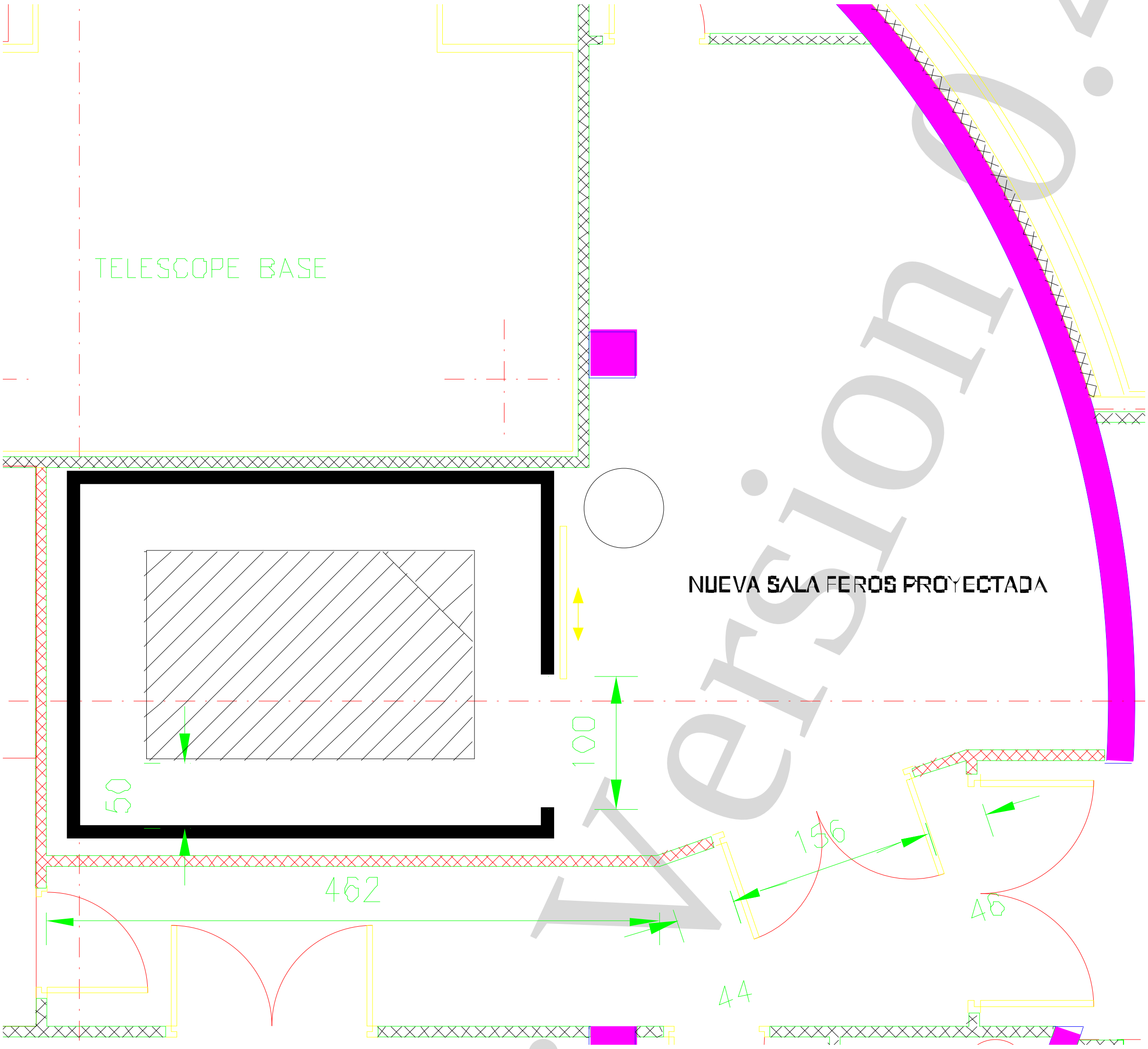

Figure 2: Plan of MPG/ESO 2.2m FEROS Room, detail of the the FEROS Room and all required changes.

UPS power supply must be provided for the CCD and beta-light.

A new 'support' independant of the optical table should be constructed to place the CCD electronics box on as this unit has cooling fans and these cause some vibrations.

Consideration should be given to the possibility to turn off temperature and/or humidity control at the observers descretion. The safest arrangement in this case would be that both systems are automatically turned on each morning at UT14:00 (i.e. either 10:00am or 11:00am local time depending on SummerTime or not). This suggestion results from the information that this is what is done at the Swiss-1m telescope when the highest precision radial velocities are being sought. Despite the fact that FEROS 'is not a radial velocit machine', projects requiring high RV precision, accuracy and stabilty do get approved. This maybe be a simple way to provide a more temperature stable instrument than is currently achieved with what will be the same equipement.

The load bearing capacity of the floor has been measured to be 190 to 210 Kg/cm^2 [AI#021] which is more than adequate to bear the load of FEROS.

The temperature and Humidty monitoring system currently in use at the ESO-1.52m will be installed in the MPG/ESO 2.2m FEROS CC Room to provide the same service, i.e. two temperature measures (Room and spectrograph) and one humidity (room).

Questions/issues still to be addressed:

1. Can we over pressurise?
2. Insulation for cable entrance/exit holes in walls.
3. AirCon in the FEROS Room.

4 The FEROS/WFI Adapter and Calibration Unit (FWACU)

The FEROS Adapter will consist of the FEROS/WFI Selector Mirror (FWSM) and associated arm assembly, the Fibre Head, the Fibre Head Viewer Camera Head, the Sliding Calibration Switch Mirror (SCSM) and the FEROS Calibration Unit Fibre Feed and the mechanical support for these components all mounted on the rotating adapter inside the Cassegrain hole of the MPG/ESO 2.2m telescope.

4.1 Optical Concept

The optical concept is presented in detail in [2].

The main features of the design are outlined here for completeness. The design consists of eight lenses (all but one of which are off-the-shelf) and two mirrors, and one in-house fabricated fibre head. Some of the lenses must be resized (Jean Fichou Optics). A remote/local controlled arm is used to place a the pick-off mirror in the beam of the 2.2m telescope allowing switching between FEROS and WFI without need of any manual intervention/instrument change etc. The beam is reflected directly onto the downward[7] facing, two fibre, reflecting fibre head. Calibration light sources (Wavelength and FlatField) will be fed to the fibre head via fibres from the FEROS Calibration Unit (FCU) which will be located in the FEROS Room, not on the telescope. The FibreHead will be imaged by a Fibre Head Viewer based on a standard 'small-format' ESO Technical CCD which will provide target acquisition. Guiding with the TCCD is not forseen at this time[8] though may be necessary in the future if and when WFI is decommissioned since for the moment the WFI Tracker Chip will be used for guiding during both WFI and FEROS observations.

Mounting the FEROS adapter on the already existing local controlled only rotating adapter allowing the field of view to be rotated in the case that unwanted light from a field star falls on the sky fibre in the default rotator position, or for whatever other reason this is desired (polarimetry?). It is also necessary to maintain the relative focus between Fibre Head and WFI Tracker Chip.

4.2 Opto-Mechanical Design

The mechanical components of the FEROS adapter will be fabricated by LED.

4.2.1 Fibre Head

The size of the two fibre entrance apertures is an important consideration as this size has a direct bearing on Resolving Power (R). In order to retain the current instrument R of ~ 48000 the two fibre entrance apertures must be 1.8" $= 154\,\mu$m in diameter[9] The choice of entrance aperture is a compromise between small apertures to match the image quality at the 2.2m telescope (median seeing $\sim$ 1.0" [10]) and to maintain R and large apertures so as to minimise losses due to differential refraction of the atmosphere over the 356–920 nm. In the end it was decided that maintaining the current R was the overriding concern and that the increased losses due to differential refraction of

[7] The major advantage of a downward facing fibre head is cleanliness

[8] Guiding is routinely performed at the ESO-3.6m telescope using the small-format TCCD despite the fact that the chip can NOT be readout in a windowed mode, apparently the full-chip readout time is not too great for guiding purposes.

[9] The resolving power is proportional to the product of fibre entrance aperture and Telescope Pupil Diameter, so to obtain the same resolving power at the 2.20m as at the 1.52m 2.7" $\times 1.52$ m $= 1.87$" $\times 2.20$ m.

[10] According to R.Mendez, private communication, see also `http://www.ls.eso.org/lasilla/Telescopes/2p2T/E2p2M/WFI/CalPlan/cgi-bin/plotiq.cgi`.

the atmosphere would have to be accepted. For an aperture of 1.8" the losses in the blue part of the spectrum become significant at an Airmass of 1.5 whereas for the 2.7" fibre entrances currently in use at the ESO-1.52m losses in the blue part of the spectrum become significant at an Airmass of 2.0. Therefore future possiblity of an Atmospheric Dispersion Corrector (ADC) is highly desirable and is being planned for in the mechanical design.

The two fibre entrance apertures will be separated by 3' = 16 mm and aligned EAST-WEST for the default orientation of the FEROS rotator.

The fibre head will have a curved surface with radius 400 mm to provide good image quality over the full field of view of the Fibre Head Viewer.

The fibre head will be fabricated by the LED from aluminium. A 'diamond polish' finish will be made by *Kugler GmbH*.

4.2.2 Fibres

Two new pairs of fibres must be procured. One pair for the FCU–FWACU (hereafter the Claibration fibres) to carry the calibration lights, the other for FWACU–FEROS[11] (hereafter the Science fibres) to carry the science light.

Initially it was forseen to use the existing fibres currently in service at the ESO-1.52m for the latter. However in this case, due to their ~13 m length the fibres would have to be passed through a hole in the dome floor into the FEROS Room. Given the safety concerns (for the fibres) of this arrangement, the loss of light (particularly in the blue) which would result from longer fibres was deemed of secondary importance. This instead the fibres will be routed from the FWACU in the Cassegrain hole to the telescope fork structure, to the telescope base and then to the FEROS Room, which according to measurements made by A.Gilliotte will require a length of ~16 m (including substantial allowance for telescope movement) [AI#004]. Science fibres should of course be of the highest possible quality that can be justified so as to minimise losses. The chosen fibre has a 100 μm core, and measures 125 μm including cladding and protection, plus a 3 mm pvc tubing sheath. A 100 m length of will be purchased, which will allow four 20 m fibres to be prepared, i.e. two for use and two for spare. The 20 m lengths will be further cut to the exact length required. The Procurement of the Science fibres is AI#025.

The calibration fibres need not be of the same quality, but again a 100 m length of will be purchased, allowing four 20 m fibres to be prepared and then cut to exact required length. The calibration fibres will have a core diameter of 300 μm. SMA905 connectors will be used for the calibration fibre connections.

Both fibres will be purchased from *Polymicro*.

4.2.3 Microlenses

Despite the clear advantages of a rod microlens design, the impossibility of having the required rod lens fabricated precludes that option.

Therefore the microlenses will consist of a saphire ball lens. Losses due to air-glass interfaces will be minimised through use of glue between ball lens and fibres.

Saphire ball microlenses of 'high quality'[12] are available of the shelf from *Edmund Industrial Optics of Barrington, New Jersey, USA*. These ball lenses allow an entrance aperture of up to 2.2".

[11] or more precisely FibreHead to FEROS.
[12] As attested by Gerardo Avilla, according to Alain Gilliotte.

The matching of the MicroLenses to the Science fibres will be done by A.Gilliotte.

4.2.4 FEROS/WFI Selector Arm and Mirror

Selection between FEROS and WFI observing modes will be achieved with a pick-off mirror mounted on an moveable arm. The arm will rotate into the central beam in the cassegrain hole of the 2.2m telescope. When not in use it will be positioned out of the WFI beam.

The arm will have two positions, `IN` (corresponding to FEROS) and `OUT` (corresponding to WFI). Motion control will be possible in both local and remote modes allowing both manual and computer control. A constant torque will hold the arm and mirror rigidly in position for all orientations, i.e. even in the worst case of gravity acting directly in the plane of motion. The rigid stability of the arm assembly is critical to the performance of the spectrograph.

The selector mirror of custom design will be supplied by ***???AGi***.

4.2.5 Fibre Head Viewer

The Fibre Head Viewer will be based on a standard ESO small-format Technical CCD[13] The TCCD, Ace-box and 24-V powersupply will be located on the telescope. The TCCD will of course be mounted on the FEROS adapter, while the ACE-box and powersupply will be fixed **where???**. Therefore the TCCD and ACE-box will need to be connected by a connector cable of 2.5 m in length. Proper functioning of the TCCD/ACE system with a 2.5 m cable is assured by Jaime Alonso.

A filter[14] will be used between the fibre head and fibre head viewer in order that target acquisition is not affected by atmospheric dispersion.

Cooling for the TCCD will be supplied by tapping into the already existing cooling system for the WFI LCU mounted on the telescope. Protection must be provided to ensure that there is absolutely NO risk of leaks from the TCCD cooling system interfering in any way with WFI.

4.3 The FEROS Calibration Unit

The existing FEROS Calibration Unit (FCU) (consisting of the lamp and optics box, and the power supplies) currently in use at the ESO-1.52m telescope will be adapted for use with FEROS at the 2.2m. An adapter unit, hereafter the FCU Adapter, consisting of the NDF, a shutter assembly, hereafter the calibration fibre selector shutter, allowing selection of which fibres are illuminated by the calibration lamps, lenses and fibre fixations will be fabricated by MEC to focus the columated light delivered by the current FCU onto the Calibration fibres.

The current Rotating Selection Mirror (RSM) will be replaced by a new unit which will be controlled by a VLT-standard LCU. A new Neutral Density Filter must also be implemented to be controlled by the same LCU. The lamp on/off functions functions of the FCU will also be taken over by the LCU. The CFM will not be implemented. Furthermore this same LCU will control the FEROS/WFI Selecting Mirror (FWSM) arm, the Sliding Calibration Switch Mirror (SCSM), the FCU shutter (FCUS – not to be implemented for the start of Period-70) and possibly the Atmospheric Dispersion Corrector (ADC – not to be implemented for Period-70, see below).

The FCU will be located in the FEROS Room, NOT on the telescope. The light will therefore be fed the fibrehead via fibres as per the Optical Concept design.

[13]The TCCD, ACE-box, LCU and associated cables etc have been obtained from various LSO sources, including the NTT and LED.

[14]e.g. Johnson V (a 'standard Schott filter').

Control of the RSM, lamps, NDF, FWSM and SCSM will be implemented within the standard VLT environment. FCU control software will be developed by Rolando Olivares. FCU electronics by Jaime Alonso.

The four position SCSM will allow selection between the four configurations as per table 4.3.

Position	**Fibre-1**	**Fibre-2**
0	Object/Sky	Sky/Object
1	Object/Sky	ThAr
2	ThAr	ThAr
3	ThAr	Object/Sky

A new FCU fibre adapter must be fabricated. The FCU fibre adapter will housed the NDF unit, two lenses (lenses to focus the calibration light on the calibration fibers) the FCUS unit, and the fibre adapters for the two calibration fibres.

4.4 Electronics

New electronics are required only for the FWSM. The accepted design was presented by J.Alonso at the DR-06/11 and is detailed in [5].

Electronics are designed, made and assembled by J.Alonso.

4.5 Software

Status of the FWACU must be provided to the WFI OS via standard VLT methods.

Both LCU and WS software are developed by R.Olivares. Currently the FCU is controlled by a PC. Therefore new WS software must be written to take over these functions, as well as incorporate FEnv reporting and control of the FWSM and SCSM, the new NDF and the calibration fibre selector shutter.

5 Integration at 2.2m

5.1 Computing

Table 3 summarises all the computers currently in use at the ESO-1.52m and MPG/ESO 2.2m telescopes as well as those that will be required when FEROS is installed at the MPG/ESO 2.2m telescope which are/will be involved in the data flow, end-to-end. Figures 6 – 8 provide the same info graphically.

The computing is a element of the project where, due to the fact that SWC is already overburdeded, as little as possible will be done to get the system up and running. Therefore little (if any) effort will be given to making the system VLT-like. This effort will be saved for a future date when a FIERA-CCD system is installed on FEROS and the system can be made truely VLT-Compliant.

Figure 8 presents the proposed data flow. The main objective will be to ensure that all internet communication from the BIAS-PC onward is at 100Mb which should provide a significant reduction in overheads. Tests suggest **???**.

The required changes to the existing WFI computing system in order to implement the proposed system are:

1. FWACU header info incorporated into WFI headers.
2. Management of the FTCCD by w2p2tcs (including point-and-click-target-to-fibre-acquisition via an *OliScript*™).
3. TCS info made available to BIAS.
4. Presetting to targets from TCS via VA supplied Co-ord catalogue files.
5. Creation of `ferosmgr` account on w2p2tcs for management of `feros` account and management of software associated with FEROS.
6. Creation of `feros` account on w2p2tcs for provision of tcs image header information and VA tcs object catalogue repository.
7. Creation of `ferosmgr` account on w2p2oh for administration of `feros` account and management of software associated with FEROS.
8. Creation of `feros` account on w2p2oh for VA, Support Astronomer and TIO running of FEROS Observing Environment (OE).
9. Creation of `ferosmgr` account on w2p2off for administration of `feros` account and management of software associated with FEROS.
10. Creation of `feros` account on w2p2off for VA, Support Astronomer and TIO running of FEROS DRS[15].
11. Implement procImage software on pferos1, w2p2off and w2p2drl to facilitate generation of archive copy of data.
12. Creation of `ferosmgr` account on w2p2drl for CD-Archive software management.
13. Installation and configuration of AutoCd software on w2p2drl.
14. Creation of `ferosarc` account on w2p2drl for Archive-CD-Copy.

[15]The FEROS DRS must be implemented within 'currently' supported SciSoft version of Midas.

15. Creation of `feros` account on w2p2drl for VA-CD-Copy.

The required changes to the existing FEROS computing system in order to implement the proposed system are:

1. Upgrade BIAS-PC ethernet cards to 100Mb.
2. Implement BIAS within a VLT-like environment, i.e. with users `ferosmgr` and `feros`.
3. Get BIAS under CMM Configuration Control, requires installation of VLTSW.
4. Configure BIAS to obtain FWACU and FEnv image header information direct from wfwacu.
5. Configure BIAS to obtain TCS image header information (and FTCCD images**???**) direct from w2p2tcs.
6. Installation and configuration of procImage software on BIAS-PC so as to deliver raw data with VLT-compliant filenames to w2p2off.
7. Reimplement data transfer routine from BIAS-PC to DRS host (i.e. w2p2off) so as to reduce overhead.

The new systems which must be implemented are as follows:

1. Implement FEROS Enviromental Monitoring LCU (FEnv-LCU).
2. Implement FEROS/WFI Adapter and Calibration Unit LCU (FWACU-LCU).
3. Implement FEROS Technical CCD LCU (FTCCD-LCU).
4. Implement wfwacu workstation.

The details of each of these changes and new requirements are given below.

5.1.1 VLT-Compliant FWACU & FEnv LCUs

FWACU and FEnv will be provided by separate LCUs but will both be managed by the same ICS HP-WS (wfwacu).

The VA and Engineering TCL/TK interfaces for the FWACU and FEnv will be developed by Rodrigo Olivares. These must be VLT-compliant in as much as they should provide the FITS header information to the WFI OS in the standard way and should accept setting commands from the WFI OS (though this is unlikely to be implemented within the WFI OS, except perhaps the WFI OS ought to be able to set/ensure FWSM `OUT` and LAMPS `OFF`**???**).

5.1.2 VLT-Compliant FTCCD LCU

FTCCD is provided by a dedicated LCU which should be managed by w2p2tcs. Using standard VLT components and *OliScripts*™ the FTCCD should be integrated into the exisiting TCS application in order to provide for point-and-click offsetting for target acquisition onto fibre entrance aperture.

A nice feature would be to be able to save/archive acquisition images from the FTCCD.

5.1.3 BIAS interface to TCS

A simple ASCII text file containing the TCS information (Object Name, Object RA, Object Dec, Epoch, LST, Telescope RA, Telescope Dec, Telescope HA, Telescope Zenith Distance and Airmass all at start of exposure, **Others???**) must be delivered by the TCS to the BIAS-PC upon request by BIAS. The exact format is not important since perl scripts can be run on the BIAS-PC to process the data into the appropriate format, however it would of course be much easier if the info was provided in a 'FITS-header ready' format.

Delivery could be as simple as (for example):
`ssh -l feros w2p2tcs cat /tmp/tcsstatus`
where `/tmp/tcsstatus` is a continuously updated file providing the required info (see above). The user account of course is not important but I suggest the creation of a new user account (ferosobs) so that no permission issues arise.

It is not essential that `ssh` be used, and indeed some investigation should be made to determine the fastest protocol for this purpose, since in principle this information should be obtained immediately before the exposure is started, and the exposure should wait for completion of the information fetch before proceeding.

To implement this the user accounts detailed in section 5.1.11 must be created on w2p2tcs.

5.1.4 TCS-catalogue files

FEROS observers will upload their TCS catalogues to `/vltdata/pointing/catalogs` on w2p2tcs.

5.1.5 Reconfiguration of INS

It is currently forseen that the existing FEROS INS (w1p5ins) is required for continued Boller & Chivens Spectrograph service at the ESO-1.52m through until the end of 2002. After this the machine will become the backup WS for the wfwacu (currently wfbc).

For Boller & Chivens service it will be necessary to implement the computer controlled Boller & Chivens Calibration Unit functions (if any) on this machine.

Therefore the current wfbc will become the wfwacu WS.

Under the standard VLT model, observations should be managed from the instrument INS WS, which for FEROS is of course wfwacu. However for convenience it is preferable if w2p2oh is used until wfwacu is upgraded to have 100Mb internet and 2-head display.

5.1.6 Reconfiguration of BIAS-PC

In the conventional VLT picture BIAS on the BIAS-PC provides the DCS.

Some developement of BIAS from its current state will be required. Additional image header information will need to be incorporated into each header. This should be a simple task since BIAS already provides a simple method for incorporating arbitrary header info into the image file.

We can take this opportunity to define a 'DICB' compliant set of image headers for FEROS. The current image header information is presented in appendix E.1 and the proposed new set of header information is presented in appendix E.2.

5.1.7 FEROS OS

There will be NO FEROS OS in the true VLT sense. BIAS plays this rôle.

5.1.8 Implementation of FEROS-OE on w2p2oh

The FEROS Observing Environment (OE) is defined as the BIAS environment (i.e. the *startb* window (xterm), the *BIAS CCD Status* window (xterm), the *BIAS CCD Control* window (xterm) and *SaoImage bias_ds9* real-time-display window) served from pferos and the FWACU+FEnv Tcl/Tk VA and/or Engineering panel served from wfwacu. A test consisting of displaying a FEROS image with ds9 from drl6 on a laptop with 100Mb connection between the two demonstarted perfectly adequate performance over the network.

The FEROS OE will run from w2p2oh, subject to tests of adequate performance over the network, in particular with respect to the BIAS ds9 RTD. When the VA logs in as `feros` the FEROS OE will start up automatically with the BIAS Environment on display w2p2oh:0.0 and the FWACU+FEnv VA panel on w2p2oh:0.1.

To implement this the user accounts detailed in section 5.1.11 must be created on w2p2oh.

5.1.9 Implementation of FEROS-DRS on w2p2off

The FEROS-DRS will be run on w2p2off under the at-all-times currently LS-SWC supported SciSoft version of Midas.

When the VA logs in the FEROS-DRS Midas environment will automatically startup on the w2p2off:0.1 display leaving the w2p2off:0.0 display free for other purposes (e.g. the procImage log window).

To implement this the user accounts detailed in section 5.1.11 must be created on w2p2off.

5.1.10 Archival: CD archive on DRL

The recently developed ability to provide VA copies of data on CD using the *AutoCd* software should be retained.

Initially this functionality will be provided by w2p2drl. But once w1p5drl becomes available (i.e. after the end of 2002 when its need at the ESO-1.52m has ended) this machine (renamed as w2p2dal – Data Archive Linux) should be used exclusively for Observatory Archive while w2p2drl is used for VA copy/offline reductions etc.

To implement this the user accounts detailed in section 5.1.11 must be created on w2p2off.

5.1.11 New user accounts and groups

To implement the above the following already defined user accounts [6][16] must be created on wfwacu, w2p2tcs, w2p2oh w2p2off & w2p2drl.

```
ferosmgr:x:471:50:FEROS Mgr:/home/ferosmgr:/usr/bin/bash
feros:x:525:50:FEROS VA:/home/feros:/usr/bin/bash
```

To facilitate the creation of Archive CDs a `ferosarc` account must be created on w2p2drl. In accordance with [6] perhaps the following:

[16] See also `http://wlsops2.ls.eso.org:8080/~swcmgr/Documents/LSO-SPE-ESO-80010-0001/Output/FrontCover.html`

```
ferosarc:x:526:50:FEROS Archiver:/home/ferosarc:/usr/bin/bash
```

5.1.12 Account management

Where appropriate, all FEROS specific, non VLT-standard software will be installed as user `ferosmgr` or (as in the case of BIAS) root. VAs will have access to the system ONLY via the `feros` accounts. All remote shells etc will be run as user `feros`. It is essential that the VA is not able to obtain access to the `ferosmgr` account on any machine.

All `feros` accounts[17] will be cleaned and re-installed with a default VA environment for EACH new VA (multiple VA's during one night (e.g. shared nights) will have to use the same `feros` account.[18] The `feros` account on each WS will be managed by the `ferosmgr` accounts on the same workstation using the *CleanUser* package already developed for the two 1.5m telescopes. A full VA environment reset will be provided for by a single command which will simply run the relevant scripts on each individual WS.

5.1.13 Configuration Control

All software will be under CMM configuration control when possible, and under CVS control when not (e.g. on the Linux workstations).

5.2 Network

Six ethernet ports for FWACU-LCU, FEnv-LCU, TCCD-LCU , the two BIAS-PCs and the FWACU-WS are required in the FEROS Room. As noted in section 3 four of these are already provided for, although some minor work is required to relocate two of them from their current location to new, more suitable locations. An additional two must therefore be added to the room.

Where ever possible ethernet connections should be 100M-bit. To accomplish this a new Ethernet cards must be purchased for two BIAS PCs (BIAS-PC (pferos1) plus backup (pferos2)).

5.3 Guiding

Guiding is forseen with the WFI tracker chip. In this case no modification of the existing system is forseen to be necessary.

[17]On BIAS-PC, wfwacu, w2p2tcs, w2p2oh, w2p2off, w2p2drl, w2p2dal

[18]**Thought must be given to the possibility of programme-ID delineation, at least in the Archive and for the VAs copy of the data.**

6 The Move

Moving FEROS from the ESO-1.52m to the MPG/ESO 2.2m consists of five phases, disassembly (2days), extraction, transportation, & insertion (all three together 1day), assembly & alignment (2-8days). The exact schedule is presented in section 7.3.

6.1 Disassembly

The individual opto-mechanical components of the FEROS instrument will all be removed from the table top surface. Detailed instructions for this have been provided by A.Kaufer (see appendix F.1).

Points still to be considered:

- A chili-bin for the thermally sensitive prism??
- Wood to protect table top.

6.2 Extraction

The individual opto-mechanical components can be carried by one individual, therefore they can carried from the ESO-1.52m CC room to the lift and down into a car. Similarly for the enclosure panels and structure and the table legs (SciOps).

The table top on the other hand weighs some ~600kg. As per the instructions in appendix F.1 the table top should be lowered onto 2 lifting tables which can then be used to move the table to the floor access hatch in the ESO-1.52m dome. The table top will thne be lowered by crane to the ground floor where it should be loaded onto a truck. The table top must be rotated to be vertical in order to fit through the access hatch (LED).

6.3 Transportation

The opto-mechanical components, enclosure panels and structure and the table legs will be transported from ESO-1.52m to MPG/ESO 2.2m by car driven *slowly* and *carefully*, not exceeding 20km/hr, by Sci-Ops.

The table top will be transported from ESO-1.52m to MPG/ESO 2.2m by truck driven *slowly* and *carefully*, not exceeding 20km/hr, by LED.

6.4 Insertion

The opto-mechanical components, enclosure panels and structure and the table legs can carried from the car to the MPG/ESO 2.2m FEROS Room (*not* the FEROS CC Room) by hand (SciOps). The opto-mechanical components must be stored out of the way of access/installation of the table top. It may be preferable to store the opto-mechanical components in the **plant/storage room**.

The details of moving the table top from truck to FEROS CC Room must still be worked out... at worst '10 big guys from the kitchen' can be used to man handle it. Upon arrival in the FEROS CC Room it should be put onto some sort of supports so that the four legs can be positioned under the table and then re-attached and then used to lift the table top off whatever it is it was resting on (LED).

6.5 Assembly & Alignment

See appendix F.2 (SciOps).

7 Schedule

This section presents the milestones of the schedule for the critical elements of the project. The complete schedule has been planned using MS Project.

The governing factor in determining the schedule is the fact that FEROS has been advertised as being available November 2002. Therefore we must aim to have FEROS ready for its first Visiting Astronomer, which could conceivable be November 1st. It is also predicated on the assumption that we will be give 7 nights of commissioning time (as we requested) and that those 7 nights will begin on November 18[19].

The general outline of the following schedule was realised during FDR-18/07. All present parties (in particular G.Andreoni on behalf of LED, F.Gutierrez on behalf of SWC and C.Ebensperger on behalf of ISG) commited to it at that time. The details presented below have been subsequently fleshed out by J.Pritchard. This more detailed version has as of August 1st been ratified by the relevant parties[20].

7.1 Opto-Mechanics

In order to complete within the allowable time and given the available resources the following schedule, which was agreed to by G.Andreoni, W.Eckert, J.Alonso and R.Olivares at the FDR-18/07, must be adherred to:

- **31/08:** W.Eckert will deliver the FWSM, SCSM and RSM[21] to J.Alonso and R.Olivares for cabling and software testing. The parts will be delivered on a test-bed.
- **30/09:** W.Eckert will take possession on FCU, dismounting it from the ESO-1.52m telescope.
- **30/09:** O.Lavin will deliver the NDFW and FCU shutter assemblies to R.Olivares for cabling and software testing. The parts will be delivered either on a test-bed or in the completed FCU adapter.
- **06/10:** R.Olivares will deliver the NDFW and FCU shutter assemblies and the RSM to W.Eckert for final assembly of FCU Adapter and installation of the RSM in the FCU.
- **06/10:** R.Olivares will deliver the FWSM and SCSM to W.Eckert for integration into the FEROS/WFI Adapter.
- **09/10:** W.Eckert will deliver the complete FCU including FCU Adapter to FEROS Room for installation.
- **18/10:** W.Eckert will deliver the fully integrated FEROS/WFI adapter and FEROS Calibration unit ready for installation on the 2.2m telescope.
- **18/10:** A.Gilliotte will deliver fully prepared Science and Calibration fibres for installation.
- **18/10:** LED will dismount WFI.
- **18/10:** W.Eckert will install the FEROS/WFI adapter on the 2.2m telescope.

[19] All dates in this section, unless explicitly stated otherwise, are 2002.

[20] G.Andreoni, W.Eckert, G.Ihle, A.Gilliotte, J.Alonso, R.Olivares, E.Ureta, C.Ebensperger, F.Gutierrez-Willer, A.Kaufer, I.Saviane.

[21] In fact the RSM was delivered to R.Olivares during 2001, it being originally considered essential to the ESO-1.52m upgrade project.

- **18/10:** LED will balance MPG/ESO 2.2m.
- **18/10:** Final Electronics/Software testing (J.Alonso & R.Olivares) and Optical alignment (A.Gilliotte) of complete FWACU system.
- **19/10:** LED will mount WFI.
- **19/10:** LED will balance MPG/ESO 2.2m.
- **19/10-24/10:** Commissioning (I.Saviane).

7.2 FEROS Room and FEROS Climate Controled Room

The FEROS CC Room must be ready by Oct 6th to allow time for final preparation (i.e. cleaning) of the room in advance of the arrival of FEROS on October 9th.

- **15/09:** LED+Climatrol delivers components of climate control sourceable from the existing system a the ESO-1.52m.
- **15/09:** ISG delivers completed FEROS Climate Controled Room *without* climate control to LED.
- **30/09:** LED+Climatrol transfers Climate Control components from ESO-1.52m to MPG/ESO 2.2m.
- **06/10:** LED delivers completed FEROS Climate Controled Room *including* climate control to SciOps.
- **09/10:** SciOps delivers clean and dry FEROS Climate Controled Room to LED for installation of FEROS table.

7.3 Actually Moving FEROS from ESO-1.52m to the MPG/ESO 2.2m

The actual move of the FEROS instrument from the ESO-1.52m to the MPG/ESO 2.2m will be carried out according to the following schedule:

- **30/09-08/10:** Disassembly according to the instructions provided by A.Kaufer (A.Gilliotte, I.Saviane, J.Pritchard). Note there is no reason this can not be started 30/09, using plenty of time to do a careful job would not be a time wasted.
- **09/10:** Extraction from ESO-1.52m (SciOps, LED), transportation from ESO-1.52m to MPG/ESO 2.2m (SciOps, LED), insertion at MPG/ESO 2.2m (SciOps, LED).
- **10/10-18/10:** Assembly and alignment (A.Gilliotte, A.Kaufer, I.Saviane, J.Pritchard).

7.4 Computing

The absolute final deadline for all aspects of the computing dependent on SWC (i.e. section 4.5) is **07/10**.

Preferably, as much as possible should be ready for preliminary testing during the MPG/ESO 2.2m September idle time.

8 Commissioning

The excerpt below is taken from the following email:

```
Subject:     P70 Req.for tech.time: v.2
   Date:     Tue, 07 May 2002 14:32:20 -0400
   From:     Olivier Hainaut <ohainaut@eso.org>
     To:     Visas <visas@eso.org>
```

Exceprt:

```
==2.2m====================================================

1- FEROS Commissioning: C1: 7 nights around Oct.Full Moon (the 7
nights are requested bc some stability/evolution tests on sky are
needed), C2: 2 nights around Nov.Full Moon.

THE INSTRUMENT COULD BE USED IN "SHARED RISK" FROM C1 TILL C2, and
fully offered after C2.
```

This request is based on the preliminary Commissioning Plan drawn up by Ivo Saviane.

The detailed Commissioning Plan is presented in a separate document [7]. Non exhaustive list of points that should be considered:

- Commissioning: Plan.
- Science verification
- Calibration of NDF for Object-Calibration mode.
- Exposure Time Calculator: integration into the ESO standard is preferable, throughputs must be provided.
- MPI time is December 11, 2002 → January 10 2003.
- Full moons: 21/10 & 20/11.
- Responsible: Sci-Ops

9 Documentation

A complete set of updated documentation must be ready for the first Visiting Astronomer including, but not limited to:

- New user manual
- New 'cook-book'

Therefore the deadline for this is 2002-Oct-31. SciOps is responsible.

Acknowledgements

I am deeply grateful to everyone who has worked so hard to make this project a success and has helped me find my way through my first project as manager, in particular I must thank Jorge M., Oli H., Gaetano, Wolfgang, Gerardo I., Alain, Andreas, Ivo, Rodrigo, Ueli, Flavio, Ismo, and Carlos.

A Effect of T variations on Science data

The effect of FEROS room temperature variations are shown in figure 3. The graphs and background info are provided by the following excerpt from the email Subject: Feros stability, Date: Thu, 31 Jan 2002 16:58:50 +0100, From: Francesco.Kienzle@obs.unige.ch, To: jpritcha@eso.org.

```
I attached to the present mail two figures showing FEROS temperature
variability and it's effect on the calibration fiber radial velocity.
File spectrT.eps shows FEROS room temperature (black dots, take from
TROOM header descriptor) and the "spectrograph" temperature (TSPEC
descriptor).  The troom.eps plot shows the room temperature vs. the
calibration fiber mean velocity. As you can see, there's a nice relation
between these variables.  However the hysteresis-like behaviour remains
somewhat a mystery to me.  Where does it comes from ? any idea ?

Another stange behaviour which comes out from our data reduction is that
the Vr drift of the calibration fiber is not the same for each
order. Although the global behaviour is similar, there are order to
order systematic variations in amplitudes of the radial velocity drift.
```

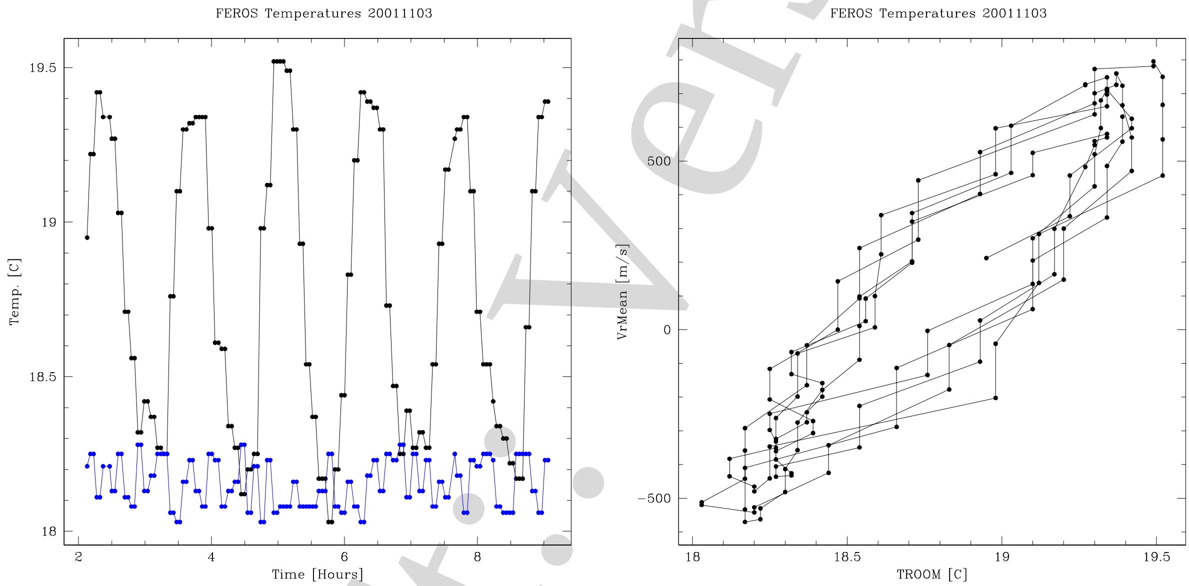

Figure 3: T_{Room} (black) and T_{FEROS} (blue) as a funtion of hour (left) and T_{Room} Vs. V_{r} (right). Data taken during the night of 20011103.

B Effect of H variations on Science data

Consideration of the affect on instrument stability caused by changes in humidity was made by Ivo Saviane. The graphs mentioned below are presented in figures 4 and 5.

Subject: FEROS vs. humidity
Date: Thu, 09 May 2002 00:45:54 -0400
From: Ivo Saviane <isaviane@eso.org>
To: John Pritchard <j.pritchard@eso.org>

Dear all:

I did some tests of how humidity can affect measurements with FEROS.

First of all, a bit of "theoretical" work.

The first 4 figures show the dependence of the refractive index of air vs. humidity and temperature, at wavelength = 300 nm and 900 nm.

The calculations vs. T have been made at 30% humidity, those vs. H have been made at 30 C.

The index is computed at an altitude of 2km, assuming a scale height of the atmosphere of 7km.

The figures show that

- n obviously depends on lambda

- the variations of n do not depend very much on lambda

- the dependence of n on T is ca. twice that on H, so

- since Herman Hensberge found a cycle of amplitude 600m/s and period of 30min, corresponding to the cycle in temperature of amplitude 1.5 K,

- we expect a change of the same size for a change of 3% in humidity (but changes in humidity do not cycle on such short timescales)

Just to have an idea of the effect. If a beam of light enters the Feros room with an inclination of 45deg, a change of 100% in humidity will deviate it by ca. 6 microns after a path of 10 meters.

Then the experimental work.

I put the control room humidifier inside the FEROS room, and took HeAr arcs while the humidity was increasing. The last 2 figures show the displacement of a line along the dispersion. I averaged the line along crossdispersion, and then for each arc I inserted its line into a new image, in a different position.

So the rows in the figure are pixels along the wavelength and the columns are the number of the arc, where rows up to 4 were taken at constant humidity ca. 14%, and then the humidity increases up to 44% at row 12.

One can see that a change of 30% in the humidity shifts the lines by roughly 1/2 pixel along the dispersion (i.e. 7 microns).

Cheers, Ivo.

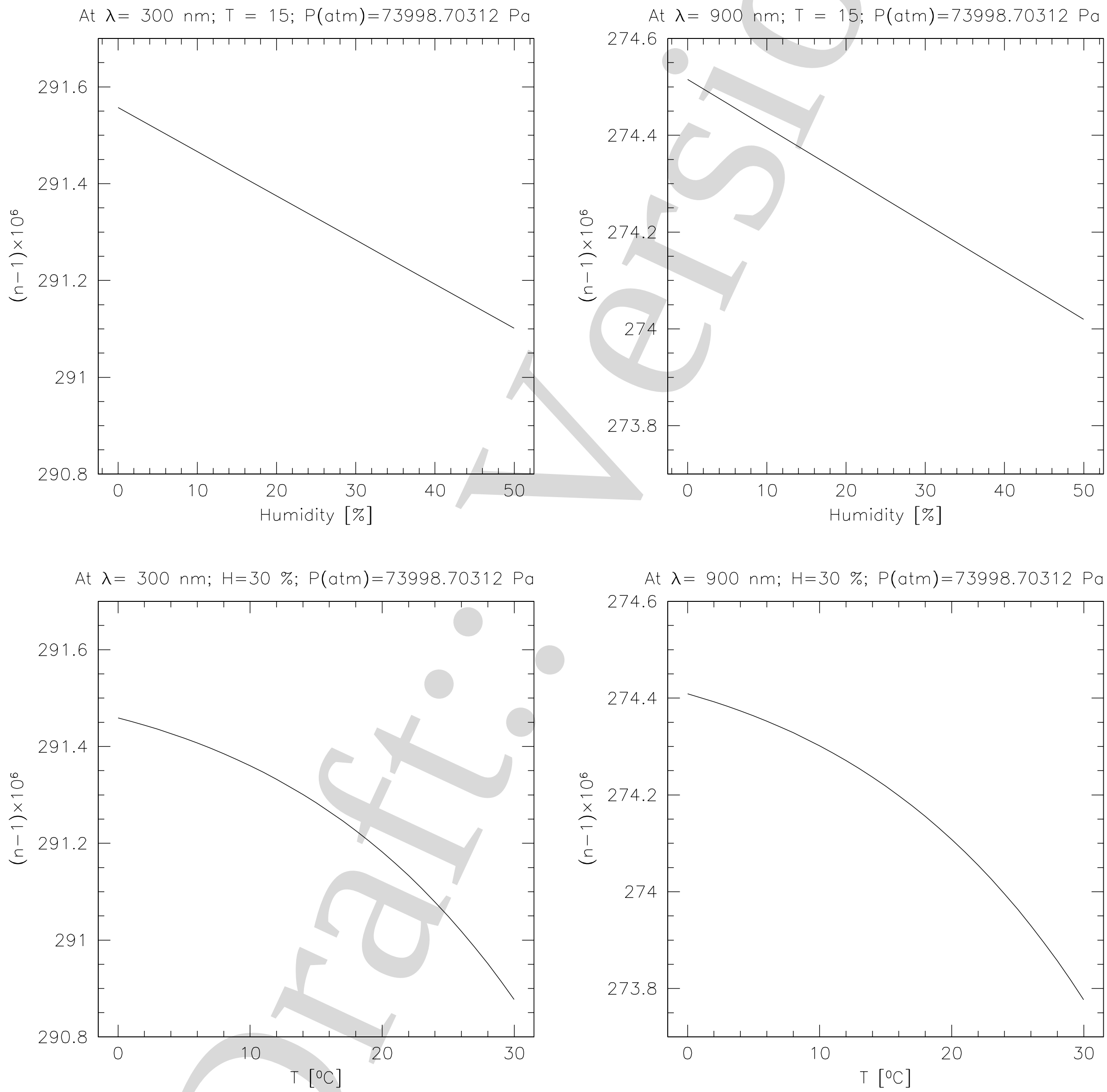

Figure 4: Refractive Index of air vs. Humidity (H) at constant Temperature (T) and atmospheric Pressure (P) at 300nm and 900nm (top panels) and vs. Temperature (T) at constant Humidity (H) and atmospheric Pressure (P) at 300nm and 900nm (bottom panels).

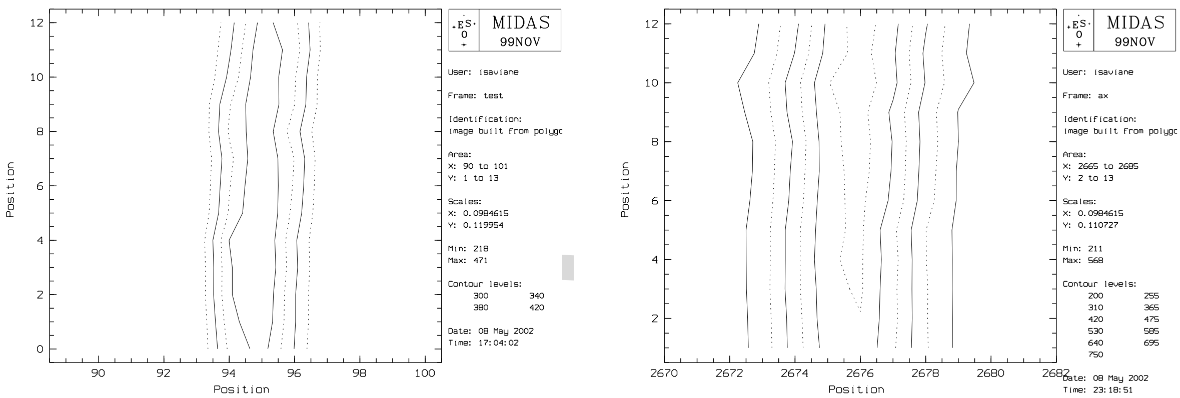

Figure 5: Line displacement vs. Humidity

C Involved Computers

Table 3 summarises all the computers currently in use at the ESO-1.52m and MPG/ESO 2.2m telescopes as well as those that will be required when FEROS is installed at the MPG/ESO 2.2m telescope which are/will be involved in the data flow, end-to-end.

Current Network Name	Proposed Network Name	Functional Name	Current Function/Purpose	Proposed Function/Purpose
???	lfenv	FEnv-LCU	Monitors Environment in FEROS Climate Controlled Room	Monitors Environment in FEROS Climate Controlled Room
None	lfwacu	FWACU-LCU	None	FEROS Adpater and Calibration Unit Control
None	lffhv	FTCCD-LCU	None	FEROS Fibre Head Viewer Technical CCD Control
???	**???**	TCS-LCU	MPG/ESO 2.2m TCS	MPG/ESO 2.2m TCS
pc1p5fer1	None	FEROS FCU-PC	FEROS Calibration Unit Control	None
wfbc	wfwacu	FWACU+FEnv-WS	FEROS Environmental Monitoring	FEROS Adapter & Calibration Unit Control and Environmental Monitoring
pc2p2tcs	pc2p2tcs	ESO-1.52m TCS-PC	ESO-1.52m Telescope Control	Required at ESO-1.52m till 01/2003, after that decomissioned
pc1p5fer2	pferos1	FEROS Bias-PC	FEROS CCD control and Image acquisition	FEROS CCD control and Image acquisition
???	**???**	WFI-Fiera	WFI Image acquisition	WFI Image acquisition
w1p5ins	w1p5ins	INS-WS	DRS, DAT+DLT archiving	Required at ESO-1.52m till 01/2003, then wfwacu backup?
w2p2ins	w2p2ins	2p2 INS-WS	WFI Operating System	WFI Operating System
w2p2dhs	w2p2dhs	2p2 DHS-WS	WFI Data Handling Server	WFI Data Handling Server
w2p2oh	w2p2oh	2p2 PL/OH-WS	WFI P2PP/OT	WFI P2PP/OT and FEROS Observing Environment
w2p2off	w2p2off	2p2 Off-line Reduction	WFI Offline Reduction	WFI Offline and FEROS Online Reduction (i.e. DRS)
w2p2nau	w2p2nau	2p2 NGAS-PC	WFI NGAS (New Generation Archiving Server)	WFI NGAS (New Generation Archiving Server)
w2p2nbu	w2p2nbu	2p2 NGAS-R-PC	WFI NGAS (New Generation Archiving Server) Replicator	WFI NGAS (New Generation Archiving Server) Replicator
w2p2drl	w2p2drl	2p2 DRL	Linux Offline Reduction, CD-Archiving	Linux Offline Reduction, CD-Archiving
w1p5drl	w2p2dal	FEROS Archive-PC	Offline Reduction, CD-Archiving	Required at ESO-1.52m till 01/2003, then FEROS CD-Archiving at MPG/ESO 2.2m

Table 3: Computers and the functions purposes

D Data Flow Diagrams

Figures 6 – 8 present graphically the end-to-end data flow for the current FEROS at the ESO-1.52m telescope and WFI at the MPG/ESO 2.2m telescope and the proposed data flow for FEROS and WFI at the MPG/ESO 2.2m telescope.

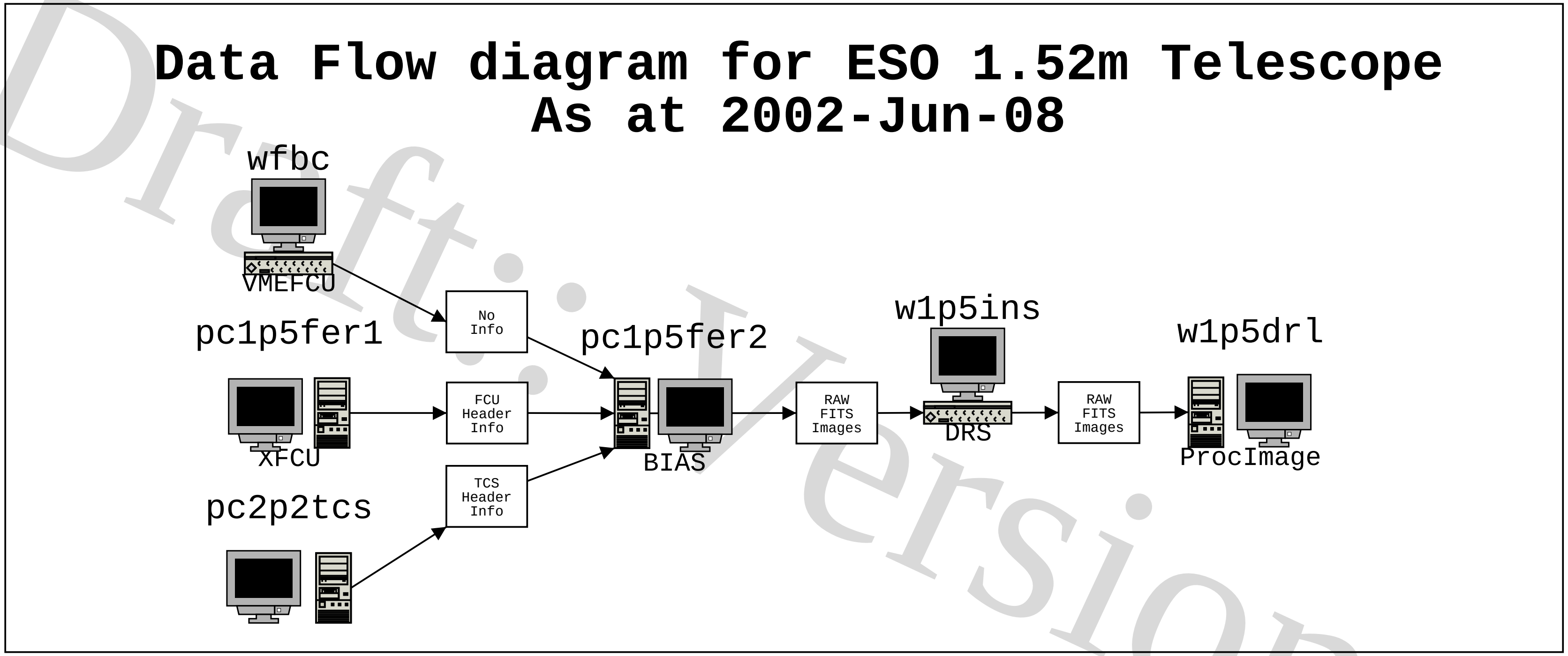

Figure 6: FEROS@1p5-DataFlow-Current.

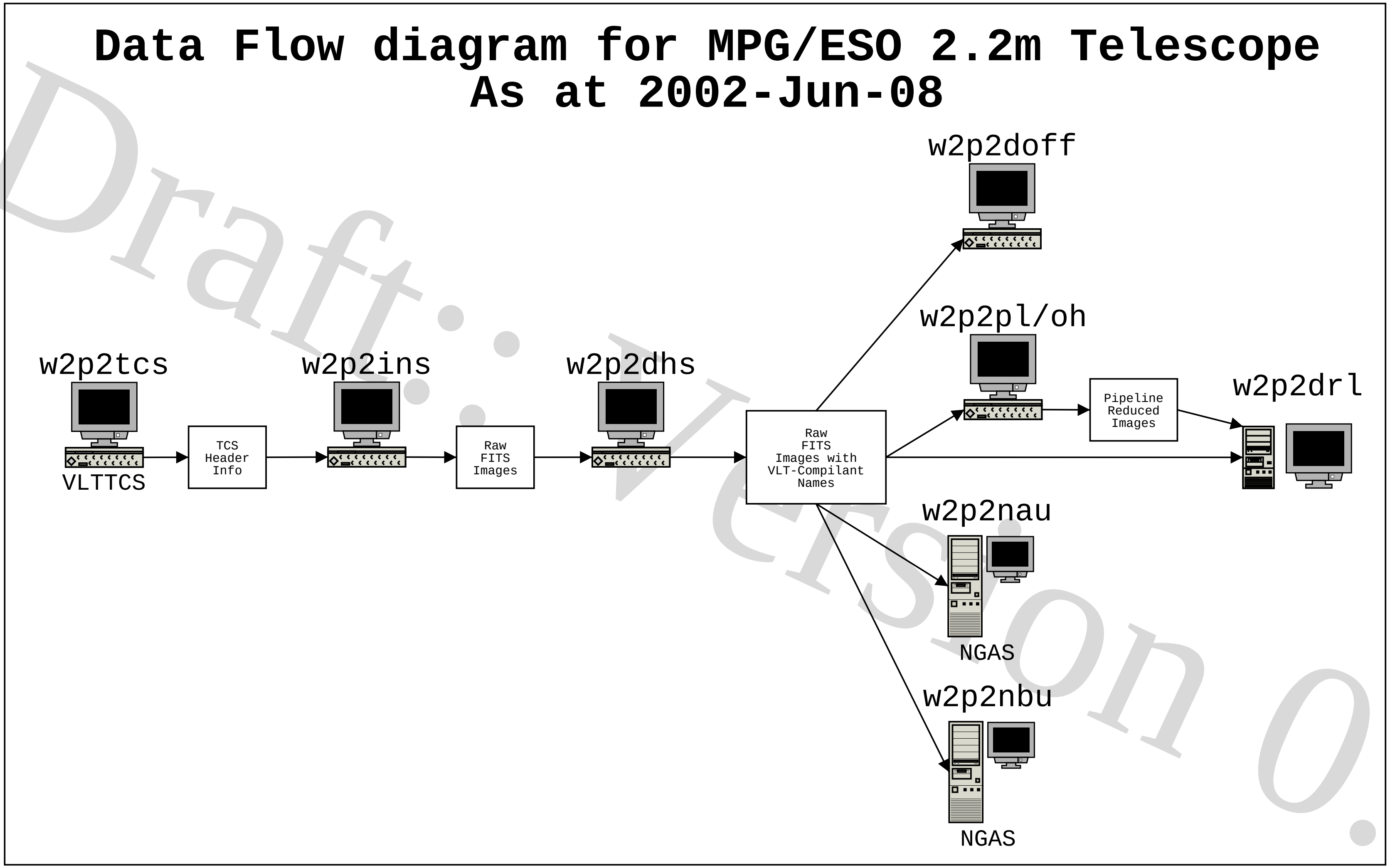

Figure 7: FEROS@2p2-DataFlow-Current.

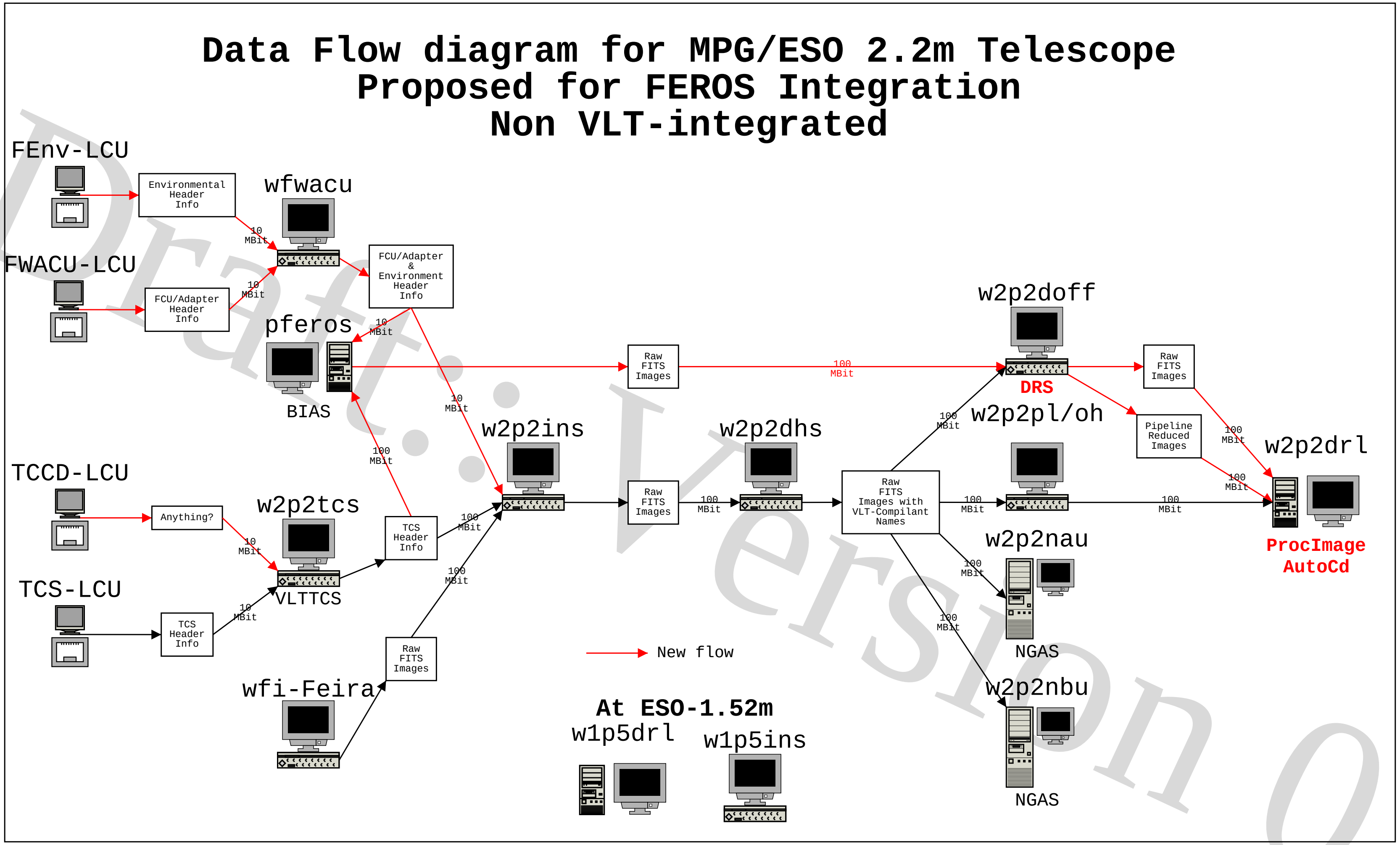

Figure 8: FEROS@2p2-DataFlow-Propsoed.

E FEROS Image Headers

E.1 Current

The current set of image headers as delivered by BIAS[22].

```
SIMPLE   =                    T / FITS STANDARD
BITPIX   =                   16 / FITS BITS/PIXEL
NAXIS    =                    2 / NUMBER OF AXES
NAXIS1   =                 2148 / X AXIS
NAXIS2   =                 4102 / Y AXIS
NAXIS3   =                    1 / Z AXIS
BSCALE   =              1.0E+00 / REAL = TAPE*BSCALE + BZERO
BZERO    =          32768.0E+00 /
ORIGIN   =  'ESO-LASILLA    '   /
OBSERVAT=  'ESO-LASILLA    '   /
TELESCOP=  'ESO-1.52   '   '   /
INSTRUME=  'FEROS          '   /
DETNAME =  'EEV 2k x 4k    '   /
DATE     =  '2002-06-24'        /
DATE-OBS=  '2002-06-24'        /
FILENAME= 'fero0075.mt'        /
OBJECT   =  'HR4468           ' /
EXPTIME =               60.000 /
TM_START=                 8988 / 02/29/48            UT start time
TM_END   =                 9204 / 02/33/24            UT end time
CRVAL1   =                    1 /
CRPIX1   =                    1 /
CDELT1   =                    1 /
CRVAL2   =                    1 /
CRPIX2   =                    1 /
CDELT2   =                    1 /
COMMENT =
COMMENT =
GAINM    =  'LOW     '          / High or Low
AMPLM    =  'B '                / A / B or AB
CCDTEMP =               -134.8 /
LN2TEMP =               -136.3 /
COMMENT =
MPP      =                    0 /
CHIPID   =  'EEV 2Kx4K, FEROS'  /
DATAMIN =                  205 /
DATAMAX =                  217 /
XOVERSC =                    0 /
YOVERSC =                    0 /
P_DEWAR =              1.6E-06 /
TM-START=                 8988 / 02/29/48            UT start time
SHSTAT   =  'OPEN           '   /
INSTR    =              'FEROS' / Slit  Configuration
F_MODE   =                 'OS' / Fiber Configuration
```

[22] From image FEROS.2002-06-24T02:29:48.000.fits

```
EXPTYPE =           'SCIENCE' / Exposure Type
CFM_POS =               'OUT' / Calibration Mirror
RSM_POS =                'S2' / Calib. Source Mirror
FFU     =               'OFF' / Flatfield lamp
WCU1    =               'OFF' / Thorium-Argon lamp
WCU2    =               'OFF' / Helium-Argon lamp
NDFW    =               1.012 / Neutral Density Filter
CIDENT  =  '         HR4468  ' / Object name from catalogue
RA-OBJ  =  '        113640.91' / Object Right Ascension
DE-OBJ  =  '        -948 8.10' / Object Declination
CEPOCH  =          2000.00000 / Epoch
ST      =            15.92753 / Sidereal time at start
RA      =           174.19157 / Telescope Right ascension at start
DEC     =            -9.82670 / Telescope Declination at start
HA      =            64.72137 / Telescope Hour Angle at start
ZDIST   =            63.11842 / Telescope Zenith distance at start
TSPEC   =               17.23 / Temperature of Spectrograph
TROOM   =               17.79 / Temperature of Room
RHROOM  =               12.69 / rel.Humidity of Room
MTIME   = 'Jun 24 2002, 02:29' / UTC DATE-TIME  of T/RH Measurement
```

E.2 Proposed

The Image header information for FEROS at the MPG/ESO 2.2m MUST be a super-set of that currently provided inorder to retain FULL compatibility with the current system.

```
SIMPLE   =                    T / FITS STANDARD
BITPIX   =                   16 / FITS BITS/PIXEL
NAXIS    =                    2 / NUMBER OF AXES
NAXIS1   =                 2148 / X AXIS
NAXIS2   =                 4102 / Y AXIS
NAXIS3   =                    1 / Z AXIS
BSCALE   =              1.0E+00 / REAL = TAPE*BSCALE + BZERO
BZERO    =          32768.0E+00 /
ORIGIN   =  'ESO-LASILLA    '   /
OBSERVAT=  'ESO-LASILLA    '   /
TELESCOP=  'ESO-1.52   '    '   /
INSTRUME=  'FEROS          '   /
DETNAME =  'EEV 2k x 4k    '   /
DATE     =  '2002-06-24'        /
DATE-OBS=  '2002-06-24'        /
FILENAME= 'fero0075.mt'        /
OBJECT   =  'HR4468           ' /
EXPTIME =               60.000 /
TM_START=                 8988 / 02/29/48          UT start time
TM_END   =                 9204 / 02/33/24          UT end time
CRVAL1   =                    1 /
CRPIX1   =                    1 /
CDELT1   =                    1 /
CRVAL2   =                    1 /
CRPIX2   =                    1 /
```

```
CDELT2  =                    1 /
COMMENT =
COMMENT =
GAINM   =  'LOW     '          / High or Low
AMPLM   =  'B '                / A / B or AB
CCDTEMP =               -134.8 /
LN2TEMP =               -136.3 /
COMMENT =
MPP     =                    0 /
CHIPID  =  'EEV 2Kx4K, FEROS'  /
DATAMIN =                  205 /
DATAMAX =                  217 /
XOVERSC =                    0 /
YOVERSC =                    0 /
P_DEWAR =              1.6E-06 /
TM-START=                 8988 / 02/29/48           UT start time
SHSTAT  =  'OPEN           '   /
INSTR   =              'FEROS' / Slit  Configuration
F_MODE  =                 'OS' / Fiber Configuration
EXPTYPE =            'SCIENCE' / Exposure Type
CFM_POS =                'OUT' / Calibration Mirror
RSM_POS =                 'S2' / Calib. Source Mirror
FFU     =                'OFF' / Flatfield lamp
WCU1    =                'OFF' / Thorium-Argon lamp
WCU2    =                'OFF' / Helium-Argon lamp
NDFW    =                1.012 / Neutral Density Filter
CIDENT  =  '         HR4468   ' / Object name from catalogue
RA-OBJ  =  '        113640.91' / Object Right Ascension
DE-OBJ  =  '        -948 8.10' / Object Declination
CEPOCH  =           2000.00000 / Epoch
ST      =             15.92753 / Sidereal time at start
RA      =            174.19157 / Telescope Right ascension at start
DEC     =             -9.82670 / Telescope Declination at start
HA      =             64.72137 / Telescope Hour Angle at start
ZDIST   =             63.11842 / Telescope Zenith distance at start
TSPEC   =                17.23 / Temperature of Spectrograph
TROOM   =                17.79 / Temperature of Room
RHROOM  =                12.69 / rel.Humidity of Room
MTIME   = 'Jun 24 2002, 02:29' / UTC DATE-TIME  of T/RH Measurement
```

E.3 Example UVES headers

E.3.1 file UVES_RED_FLAT202_0003.fits

```
SIMPLE  =                    T          / Standard FITS format (NOST-100.0)
BITPIX  =                   16          / # of bits storing pix values
NAXIS   =                    2          / # of axes in frame
NAXIS1  =                 4296          / # pixels/axis
NAXIS2  =                 4096          / # pixels/axis
ORIGIN  = 'ESO     '                    / European Southern Observatory
DATE    = '2002-07-21T09:41:56.823'     / UT date when this file was written
```

```
CRVAL1  =                  1.0          / value of ref pixel
CRPIX1  =                  1.0          / Ref. pixel of center of rotation
CDELT1  =                  1.0          / Binning factor
CTYPE1  = 'PIXEL   '                    / Pixel coordinate system
CRVAL2  =                  1.0          / value of ref pixel
CRPIX2  =                  1.0          / Ref. pixel of center of rotation
CDELT2  =                  1.0          / Binning factor
CTYPE2  = 'PIXEL   '                    / Pixel coordinate system
BSCALE  =                  1.0          / pixel=FITS*BSCALE+BZERO
BZERO   =              32768.0          / pixel=FITS*BSCALE+BZERO
MJD-OBS =       52476.40370690          / MJD start (2002-07-21T09:41:20.276)
DATE-OBS= '2002-07-21T09:41:20.275'     / Date of observation
EXPTIME =              35.2904          / Total integration time
EXTEND  =                    F          / Extension may be present
INSTRUME= 'UVES    '                    / Instrument used.
OBJECT  = '        '                    / Original target.
OBSERVER= '        '                    / Name of observer.
PI-COI  = '        '                    / Name of PI-COI.
TELESCOP= 'ESO-VLT-U2'                  / ESO Telescope Name
RA      =            11.034516          / 00:44:08.2 RA (J2000) pointing (deg)
DEC     =            -27.74692          / -27:44:48.9 DEC (J2000) pointing (deg)
EQUINOX =                2000.          / Standard FK5 (years)
RADECSYS= 'FK5     '                    / Coordinate reference frame
LST     =             3333.446          / 00:55:33.446 LST at start (sec)
UTC     =            34874.000          / 09:41:14.000 UTC at start (sec)
HIERARCH ESO OBS DID         = 'ESO-VLT-DIC.OBS-1.7' / OBS Dictionary
HIERARCH ESO OBS PI-COI NAME = 'UVES Operation Team' / PI-COI name
HIERARCH ESO OBS PI-COI ID   =        52022 / ESO internal PI-COI ID
HIERARCH ESO OBS GRP         = '0       '   / linked blocks
HIERARCH ESO OBS NAME        = 'Calibration' / OB name
HIERARCH ESO OBS ID          =    200115615 / Observation block ID
HIERARCH ESO OBS PROG ID     = '60.A-9022(A)' / ESO program identification
HIERARCH ESO OBS START       = '2002-07-21T08:49:35' / OB start time
HIERARCH ESO OBS TPLNO       =           17 / Template number within OB
HIERARCH ESO TPL DID         = 'ESO-VLT-DIC.TPL-1.4' / Data dictionary for TPL
HIERARCH ESO TPL ID          = 'UVES_red_cal_flatfree' / Template signature ID
HIERARCH ESO TPL NAME        = 'Red Free Flat Calibration' / Template name
HIERARCH ESO TPL PRESEQ      = 'UVES_red_cal_free.seq' / Sequencer script
HIERARCH ESO TPL START       = '2002-07-21T09:37:46' / TPL start time
HIERARCH ESO TPL VERSION     = '@(#) $Revision: 2.39 $' / Version of the templat
HIERARCH ESO TPL NEXP        =           10 / Number of exposures within templat
HIERARCH ESO TPL EXPNO       =            3 / Exposure number within template
HIERARCH ESO DPR TECH        = 'ECHELLE '   / Observation technique
HIERARCH ESO DPR TYPE        = 'LAMP,FLAT'  / Observation type
HIERARCH ESO DPR CATG        = 'CALIB   '   / Observation category
HIERARCH ESO TEL DID         = 'ESO-VLT-DIC.TCS' / Data dictionary for TEL
HIERARCH ESO TEL ID          = 'v 1.433+'   / TCS version number
HIERARCH ESO TEL DATE        = '2002-05-19T18:41:37.000' / TCS installation date
HIERARCH ESO TEL ALT         =       88.997 / Alt angle at start (deg)
HIERARCH ESO TEL AZ          =      270.502 / Az angle at start (deg) S=0,W=90
HIERARCH ESO TEL GEOELEV     =        2648. / Elevation above sea level (m)
```

```
HIERARCH ESO TEL GEOLAT      =     -24.6254 / Tel geo latitute (+=North) (deg)
HIERARCH ESO TEL GEOLON      =     -70.4030 / Tel geo longitude (+=East) (deg)
HIERARCH ESO TEL OPER        = 'I, Condor'  / Telescope Operator
HIERARCH ESO TEL FOCU ID     = 'NB      '   / Telescope focus station ID
HIERARCH ESO TEL FOCU LEN    =      120.000 / Focal length (m)
HIERARCH ESO TEL FOCU SCALE  =        1.718 / Focal scale (arcsec/mm)
HIERARCH ESO TEL FOCU VALUE  =      -28.657 / M2 setting (mm)
HIERARCH ESO TEL PARANG START=        0.000 / Parallactic angle at start (deg)
HIERARCH ESO TEL AIRM START  =        1.000 / Airmass at start
HIERARCH ESO TEL AMBI FWHM START=     -1.00 / Observatory Seeing queried from AS
HIERARCH ESO TEL AMBI PRES START=    742.48 / Observatory ambient air pressure q
HIERARCH ESO TEL AMBI WINDSP =         5.21 / Observatory ambient wind speed que
HIERARCH ESO TEL AMBI WINDDIR=          290. / Observatory ambient wind directio
HIERARCH ESO TEL AMBI RHUM   =           76. / Observatory ambient relative humi
HIERARCH ESO TEL AMBI TEMP   =         2.12 / Observatory ambient temperature qu
HIERARCH ESO TEL MOON RA     = 172304.241991 / ~~:~~:~~.~ RA (J2000) (deg)
HIERARCH ESO TEL MOON DEC    = -231031.23474 / -~~:~~:~~.~ DEC (J2000) (deg)
HIERARCH ESO TEL TH M1 TEMP  =         6.24 / M1 superficial temperature
HIERARCH ESO TEL TRAK STATUS = 'OFF     '   / Tracking status
HIERARCH ESO TEL DOME STATUS = 'VIGNETTED'  / Dome status
HIERARCH ESO TEL CHOP ST     =            F / True when chopping is active
HIERARCH ESO TEL PARANG END  =        0.000 / Parallactic angle at end (deg)
HIERARCH ESO TEL AIRM END    =        1.000 / Airmass at end
HIERARCH ESO TEL AMBI FWHM END=       -1.00 / Observatory Seeing queried from AS
HIERARCH ESO TEL AMBI PRES END=      742.48 / Observatory ambient air pressure q
HIERARCH ESO ADA ABSROT START=      0.00000 / Abs rot angle at exp start (deg)
HIERARCH ESO ADA POSANG      =      0.00000 / Position angle at start
HIERARCH ESO ADA GUID STATUS = 'OFF     '   / Status of autoguider
HIERARCH ESO ADA ABSROT END  =      0.00000 / Abs rot angle at exp end (deg)
HIERARCH ESO INS ID          = 'UVES    '   / Instrument ID.
HIERARCH ESO INS DID         = 'UVES_ICS'   / Data dictionary for INS.
HIERARCH ESO INS SOFW ID     = '$Revision: 1.100 $' / Instrument SW.
HIERARCH ESO INS SOFW MODE   = 'NORMAL  '   / Simulation mode.
HIERARCH ESO INS PATH        = 'RED     '   / Optical path used.
HIERARCH ESO INS MODE        = 'RED     '   / Instrument mode used.
HIERARCH ESO INS MIRR1 ID    = 'CMIR1   '   / Mirror unique ID.
HIERARCH ESO INS MIRR1 NAME  = 'SPHERE  '   / Mirror common name.
HIERARCH ESO INS MIRR1 NO    =            2 / Mirror slide position.
HIERARCH ESO INS OPTI1 ID    = '1       '   / General Optical device unique ID.
HIERARCH ESO INS OPTI1 NAME  = 'OUT     '   / General Optical device common name
HIERARCH ESO INS OPTI1 NO    =            1 / Slot number.
HIERARCH ESO INS OPTI1 TYPE  = 'FREE    '   / General Optical device Element.
HIERARCH ESO INS SLIT1 NAME  = 'FREE    '   / Slit common name.
HIERARCH ESO INS SLIT1 NO    =            1 / Slide position.
HIERARCH ESO INS SLIT1 WID   =         0.00 / Slit width [arcsec].
HIERARCH ESO INS SLIT1 LEN   =         0.00 / Slit length [arcsec].
HIERARCH ESO INS DROT MODE   = 'STAT    '   / Instrument derotator mode.
HIERARCH ESO INS DROT RA     =  4702.664104 / ~~:~~:~~.~ RA (J2000) pointing [de
HIERARCH ESO INS DROT DEC    = -281030.707049 / -~~:~~:~~.~ DEC (J2000) pointing
HIERARCH ESO INS DROT POSANG =       0.0000 / Position angle [deg].
HIERARCH ESO INS DROT BEGIN  =       0.0006 / Physical position at start [deg].
```

```
HIERARCH ESO INS DPOL MODE   = 'OFF     '   / Instrument depolarizer mode.
HIERARCH ESO INS DPOS NAME   = 'OUT     '   / Instrument depolarizer slide posit
HIERARCH ESO INS DPOS NO     =            1 / Depolarizer slide position.
HIERARCH ESO INS ADC MODE    = 'OFF     '   / ADC mode.
HIERARCH ESO INS ADCS NAME   = 'OUT     '   / ADC slide position.
HIERARCH ESO INS ADCS NO     =            1 / ADC slide position.
HIERARCH ESO INS ADC1 MODE   = 'OFF     '   / ADC mode.
HIERARCH ESO INS ADC1 RA     =  4702.664104 / ~~:~~:~~.~ RA (J2000) pointing [de
HIERARCH ESO INS ADC1 DEC    = -281030.707049 / -~~:~~:~~.~ DEC (J2000) pointing
HIERARCH ESO INS ADC2 MODE   = 'OFF     '   / ADC mode.
HIERARCH ESO INS ADC2 RA     =  4702.664104 / ~~:~~:~~.~ RA (J2000) pointing [de
HIERARCH ESO INS ADC2 DEC    = -281030.707049 / -~~:~~:~~.~ DEC (J2000) pointing
HIERARCH ESO INS FILT1 ID    = 'FREE    '   / Filter unique id.
HIERARCH ESO INS FILT1 NAME  = 'FREE    '   / Filter common name.
HIERARCH ESO INS FILT1 NO    =           13 / Filter wheel position index.
HIERARCH ESO INS OPTI2 ID    = 'DIAPHR.27MM' / General Optical device unique ID.
HIERARCH ESO INS OPTI2 NAME  = 'OVRSIZ  '   / General Optical device common name
HIERARCH ESO INS OPTI2 NO    =            3 / Slot number.
HIERARCH ESO INS OPTI2 TYPE  = 'SLIDE   '   / General Optical device Element.
HIERARCH ESO INS MIRR2 ID    = 'RED#1   '   / Mirror unique ID.
HIERARCH ESO INS MIRR2 NAME  = 'RED     '   / Mirror common name.
HIERARCH ESO INS MIRR2 NO    =            1 / Mirror slide position.
HIERARCH ESO INS SHUT1 ID    = 'TSH     '   / Shutter ID.
HIERARCH ESO INS SHUT1 NAME  = 'TEL_SHUTTER' / Shutter name.
HIERARCH ESO INS SHUT2 ID    = 'SPSH    '   / Shutter ID.
HIERARCH ESO INS SHUT2 NAME  = 'Int. sphere shutter' / Shutter name.
HIERARCH ESO INS SHUT2 ST    =            T / Shutter open.
HIERARCH ESO INS SHUT3 ID    = 'TSH3    '   / Shutter ID.
HIERARCH ESO INS SHUT3 NAME  = 'D2L_SHUTTER' / Shutter name.
HIERARCH ESO INS SHUT4 ID    = 'TSH4    '   / Shutter ID.
HIERARCH ESO INS SHUT4 NAME  = 'THAR_SHUTTER' / Shutter name.
HIERARCH ESO INS LAMP6 NAME  = 'FF lamp 4'  / Lamp name.
HIERARCH ESO INS LAMP6 ST    =            T / Calibration lamp activated.
HIERARCH ESO INS SLIT3 WID   =         0.70 / Slit width [arcsec].
HIERARCH ESO INS SLIT3 Y1FRML= 'ENC=OFFST+RESOL*acos(WID-(MAX+MIN)/(MAX-MIN))' /
HIERARCH ESO INS SLIT3 Y1OFFST=      4750.0 / Offset in Formula.
HIERARCH ESO INS SLIT3 Y1RESOL=        40.0 / Resolution in encoder steps.
HIERARCH ESO INS SLIT3 Y1MIN =        0.062 / Minimum slit width [arcsec].
HIERARCH ESO INS SLIT3 Y1MAX =        5.572 / Maximum slit width [arcsec].
HIERARCH ESO INS SLIT3 Y2FRML= 'ENC=OFFST+RESOL*acos(WID-(MAX+MIN)/(MAX-MIN))' /
HIERARCH ESO INS SLIT3 Y2OFFST=      4560.0 / Offset in Formula.
HIERARCH ESO INS SLIT3 Y2RESOL=        40.0 / Resolution in encoder steps.
HIERARCH ESO INS SLIT3 Y2MIN =        0.050 / Minimum slit width [arcsec].
HIERARCH ESO INS SLIT3 Y2MAX =        5.513 / Maximum slit width [arcsec].
HIERARCH ESO INS SLIT3 Y1ENC =        10893 / Slit Vertical top motor absolute e
HIERARCH ESO INS SLIT3 Y2ENC =        10676 / Slit Vertical bottom motor absolut
HIERARCH ESO INS SLIT3 LEN   =        16.00 / Slit length [arcsec].
HIERARCH ESO INS SLIT3 X1FRML= 'ENC=OFFST+RESOL*acos(LEN-(MAX+MIN)/(MAX-MIN))' /
HIERARCH ESO INS SLIT3 X1OFFST=      2381.0 / Offset in Formula.
HIERARCH ESO INS SLIT3 X1RESOL=        40.0 / Resolution in encoder steps.
HIERARCH ESO INS SLIT3 X1MIN =        0.087 / Minimum slit length [arcsec].
```

```
HIERARCH ESO INS SLIT3 X1MAX =       15.752 / Maximum slit length [arcsec].
HIERARCH ESO INS SLIT3 X2FRML= 'ENC=OFFST+RESOL*acos(LEN-(MAX+MIN)/(MAX-MIN))' /
HIERARCH ESO INS SLIT3 X2OFFST=      2307.0 / Offset in Formula.
HIERARCH ESO INS SLIT3 X2RESOL=        40.0 / Resolution in encoder steps.
HIERARCH ESO INS SLIT3 X2MIN =        0.064 / Minimum slit length [arcsec].
HIERARCH ESO INS SLIT3 X2MAX =       15.833 / Maximum slit length [arcsec].
HIERARCH ESO INS SLIT3 X1ENC =         5957 / Slit Horizontal left motor absolut
HIERARCH ESO INS SLIT3 X2ENC =         5892 / Slit Horizontal right motor absolu
HIERARCH ESO INS FILT3 ID    = 'BS9     '   / Filter unique id.
HIERARCH ESO INS FILT3 NAME  = 'BK7_5   '   / Filter common name.
HIERARCH ESO INS FILT3 NO    =            9 / Filter wheel position index.
HIERARCH ESO INS DET6 NAME   = 'Red exp. meter PMT' / detector name.
HIERARCH ESO INS DET6 CTMIN  =     3133129. / Minimum count during exposure.
HIERARCH ESO INS DET6 CTMAX  =     3158569. / Maximum count during exposure.
HIERARCH ESO INS DET6 CTMEAN =    3143588.8 / Average counts during exposure.
HIERARCH ESO INS DET6 CTRMS  =      7504.21 / RMS of counts during exposure.
HIERARCH ESO INS DET6 TMMEAN =         0.49 / Normalised mean exposure time.
HIERARCH ESO INS DET6 CTTOT  =   113143953. / Total counts during exposure.
HIERARCH ESO INS DET6 UIT    =        1.000 / User defined Integration time [sec
HIERARCH ESO INS DET6 OFFDRK =           0. / Average dark background counts.
HIERARCH ESO INS DET6 OFFSKY =           1. / Average sky background counts.
HIERARCH ESO INS SHUT6 ID    = 'REXS    '   / Shutter ID.
HIERARCH ESO INS SHUT6 NAME  = 'Red exp. meter sh.' / Shutter name.
HIERARCH ESO INS SHUT6 ST    =            T / Shutter open.
HIERARCH ESO INS GRAT2 ID    = 'CD#3    '   / Grating unique ID.
HIERARCH ESO INS GRAT2 NAME  = 'CD#3    '   / Grating common name.
HIERARCH ESO INS PIXSCALE    =        0.182 / Pixel scale [arcsec].
HIERARCH ESO INS GRAT2 X     =       2048.0 / X pixel for central wavelength.
HIERARCH ESO INS GRAT2 Y     =       2048.0 / Y pixel for central wavelength.
HIERARCH ESO INS GRAT2 FRML  = 'ENC=OFFST+RESOL*ASIN(WLEN*GRV/(2*COS(ROT)))' / C
HIERARCH ESO INS GRAT2 OFFST =    3845390.0 / Offset in Formula.
HIERARCH ESO INS GRAT2 RESOL =      15000.0 / Resolution in encoder steps.
HIERARCH ESO INS GRAT2 GRV   =    0.0006000 / Grating grooves/nm.
HIERARCH ESO INS GRAT2 ROT   =       22.668 / Grating rot angle [deg].
HIERARCH ESO INS GRAT2 NO    =            1 / Grating wheel position index.
HIERARCH ESO INS GRAT2 WLEN  =        655.0 / Grating central wavelength [nm].
HIERARCH ESO INS GRAT2 DISP  =          0.1 / Grating dispersion [nm/mm].
HIERARCH ESO INS GRAT2 ENC   =      4029729 / Grating absolute encoder position.
HIERARCH ESO INS TILT2 POS   =          0.0 / Science camera tilt (pixels).
HIERARCH ESO INS TILT2 FRML  = 'ENC=OFFST+RESOL*ASIN(2*POS-(MAX+MIN)/(MAX-MIN))'
HIERARCH ESO INS TILT2 OFFST =      16000.0 / Offset in Formula.
HIERARCH ESO INS TILT2 RESOL =       -100.0 / Resolution in encoder steps.
HIERARCH ESO INS TILT2 POSMIN=       -222.0 / Minimum camera tilt (pixels).
HIERARCH ESO INS TILT2 POSMAX=        222.0 / Maximum camera tilt (pixels).
HIERARCH ESO INS TILT2 ENC   =        16043 / Camera tilt absolute encoder posit
HIERARCH ESO INS SHUT7 ID    = 'FPSH    '   / Shutter ID.
HIERARCH ESO INS SHUT7 NAME  = 'FIBRPROJSHUTTER' / Shutter name.
HIERARCH ESO INS DROT END    =       0.0006 / Physical position at end [deg].
HIERARCH ESO INS TEMP31 NAME = 'Iodine cell temp.' / Temperature sensor name.
HIERARCH ESO INS TEMP31 START=          7.7 / Temperature at start [C].
HIERARCH ESO INS TEMP31 STOP =          7.7 / Temperature at end [C].
```

```
HIERARCH ESO INS TEMP31 MIN  =          7.7 / Minimum temperature [C].
HIERARCH ESO INS TEMP31 MAX  =          7.7 / Maximum temperature [C].
HIERARCH ESO INS TEMP31 MEAN =          7.7 / Average temperature [C].
HIERARCH ESO INS TEMP1 NAME  = 'Temp. blue camera' / Temperature sensor name.
HIERARCH ESO INS TEMP1 START =          7.9 / Temperature at start [C].
HIERARCH ESO INS TEMP1 STOP  =          7.9 / Temperature at end [C].
HIERARCH ESO INS TEMP1 MIN   =          7.9 / Minimum temperature [C].
HIERARCH ESO INS TEMP1 MAX   =          7.9 / Maximum temperature [C].
HIERARCH ESO INS TEMP1 MEAN  =          7.9 / Average temperature [C].
HIERARCH ESO INS TEMP2 NAME  = 'Temp. red camera' / Temperature sensor name.
HIERARCH ESO INS TEMP2 START =          7.8 / Temperature at start [C].
HIERARCH ESO INS TEMP2 STOP  =          7.8 / Temperature at end [C].
HIERARCH ESO INS TEMP2 MIN   =          7.8 / Minimum temperature [C].
HIERARCH ESO INS TEMP2 MAX   =          7.8 / Maximum temperature [C].
HIERARCH ESO INS TEMP2 MEAN  =          7.8 / Average temperature [C].
HIERARCH ESO INS TEMP3 NAME  = 'Temp. table' / Temperature sensor name.
HIERARCH ESO INS TEMP3 START =          8.9 / Temperature at start [C].
HIERARCH ESO INS TEMP3 STOP  =          8.9 / Temperature at end [C].
HIERARCH ESO INS TEMP3 MIN   =          8.9 / Minimum temperature [C].
HIERARCH ESO INS TEMP3 MAX   =          8.9 / Maximum temperature [C].
HIERARCH ESO INS TEMP3 MEAN  =          8.9 / Average temperature [C].
HIERARCH ESO INS TEMP4 NAME  = 'Temp. inside air' / Temperature sensor name.
HIERARCH ESO INS TEMP4 START =          8.8 / Temperature at start [C].
HIERARCH ESO INS TEMP4 STOP  =          8.8 / Temperature at end [C].
HIERARCH ESO INS TEMP4 MIN   =          8.8 / Minimum temperature [C].
HIERARCH ESO INS TEMP4 MAX   =          8.8 / Maximum temperature [C].
HIERARCH ESO INS TEMP4 MEAN  =          8.8 / Average temperature [C].
HIERARCH ESO INS SENS26 NAME = 'Barometer pressure' / sensor common name.
HIERARCH ESO INS SENS26 START=        741.7 / sensor value at start.
HIERARCH ESO INS SENS26 STOP =        741.7 / sensor value at end.
HIERARCH ESO INS SENS26 MIN  =        741.7 / Minimum sensor value.
HIERARCH ESO INS SENS26 MAX  =        741.7 / Maximum sensor value.
HIERARCH ESO INS SENS26 MEAN =        741.7 / Average sensor vlaue.
HIERARCH ESO DET ID          = 'CCD FIERA - Rev 2.87' / Detector system Id
HIERARCH ESO DET NAME        = 'ccdUvR - ccdUvr' / Name of detector system
HIERARCH ESO DET DATE        = '09-07-1998' / Installation date
HIERARCH ESO DET DID         = 'ESO-VLT-DIC.CCDDCS,ESO-VLT-DIC.FCDDCS' / Diction
HIERARCH ESO DET BITS        =           16 / Bits per pixel readout
HIERARCH ESO DET RA          =  11.89768950 / Apparent 00:47:35.4 RA at start
HIERARCH ESO DET DEC         = -28.23915473 / Apparent -28:14:20.9 DEC at start
HIERARCH ESO DET SOFW MODE   = 'Normal  '   / CCD sw operational mode
HIERARCH ESO DET CHIPS       =            2 / # of chips in detector array
HIERARCH ESO DET CHIP1 ID    = 'CCID-20 '   / Detector chip identification
HIERARCH ESO DET CHIP1 NAME  = 'MIT/LL, EEV' / Detector chip name
HIERARCH ESO DET CHIP1 DATE  = '09-07-1998' / Date of installation [YYYY-MM-DD]
HIERARCH ESO DET CHIP1 X     =            1 / X location in array
HIERARCH ESO DET CHIP1 Y     =            1 / Y location in array
HIERARCH ESO DET CHIP1 NX    =         2048 / # of pixels along X
HIERARCH ESO DET CHIP1 NY    =         4096 / # of pixels along Y
HIERARCH ESO DET CHIP1 PSZX  =         15.0 / Size of pixel in X
HIERARCH ESO DET CHIP1 PSZY  =         15.0 / Size of pixel in Y
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HIERARCH ESO DET CHIP2 ID    = 'CCD-44  '   / Detector chip identification
HIERARCH ESO DET CHIP2 NAME  = 'MIT/LL, EEV' / Detector chip name
HIERARCH ESO DET CHIP2 DATE  = '09-07-1998' / Date of installation [YYYY-MM-DD]
HIERARCH ESO DET CHIP2 X     =            2 / X location in array
HIERARCH ESO DET CHIP2 Y     =            1 / Y location in array
HIERARCH ESO DET CHIP2 NX    =         2048 / # of pixels along X
HIERARCH ESO DET CHIP2 NY    =         4096 / # of pixels along Y
HIERARCH ESO DET CHIP2 PSZX  =         15.0 / Size of pixel in X
HIERARCH ESO DET CHIP2 PSZY  =         15.0 / Size of pixel in Y
HIERARCH ESO DET EXP NO      =         9891 / Unique exposure ID number
HIERARCH ESO DET EXP TYPE    = 'Normal  '   / Exposure type
HIERARCH ESO DET EXP DUMDIT  =            0 / # of dummy readouts
HIERARCH ESO DET EXP RDTTIME =       39.605 / image readout time
HIERARCH ESO DET EXP XFERTIM =       39.628 / image transfer time
HIERARCH ESO DET READ MODE   = 'normal  '   / Readout method
HIERARCH ESO DET READ SPEED  = '2pts/225kHz/lg' / Readout speed
HIERARCH ESO DET READ CLOCK  = '225kHz/2ports/l' / Readout clock pattern used
HIERARCH ESO DET OUTPUTS     =            2 / # of outputs
HIERARCH ESO DET OUTREF      =            0 / reference output
HIERARCH ESO DET OUT1 ID     = 'L       '   / Output ID as from manufacturer
HIERARCH ESO DET OUT1 NAME   = 'L       '   / Description of output
HIERARCH ESO DET OUT1 CHIP   =            1 / Chip to which the output belongs
HIERARCH ESO DET OUT1 X      =            1 / X location of output
HIERARCH ESO DET OUT1 Y      =            1 / Y location of output
HIERARCH ESO DET OUT1 NX     =         2048 / valid pixels along X
HIERARCH ESO DET OUT1 NY     =         4096 / valid pixels along Y
HIERARCH ESO DET OUT1 PRSCX  =           50 / Prescan region in X
HIERARCH ESO DET OUT1 OVSCX  =           50 / Overscan region in X
HIERARCH ESO DET OUT1 CONAD  =         1.46 / Conversion from ADUs to electrons
HIERARCH ESO DET OUT1 RON    =         3.69 / Readout noise per output (e-)
HIERARCH ESO DET OUT1 GAIN   =         0.68 / Conversion from electrons to ADU
HIERARCH ESO DET OUT4 ID     = 'R       '   / Output ID as from manufacturer
HIERARCH ESO DET OUT4 NAME   = 'R       '   / Description of output
HIERARCH ESO DET OUT4 CHIP   =            2 / Chip to which the output belongs
HIERARCH ESO DET OUT4 X      =         4096 / X location of output
HIERARCH ESO DET OUT4 Y      =            1 / Y location of output
HIERARCH ESO DET OUT4 NX     =         2048 / valid pixels along X
HIERARCH ESO DET OUT4 NY     =         4096 / valid pixels along Y
HIERARCH ESO DET OUT4 PRSCX  =           50 / Prescan region in X
HIERARCH ESO DET OUT4 OVSCX  =           50 / Overscan region in X
HIERARCH ESO DET OUT4 CONAD  =         1.59 / Conversion from ADUs to electrons
HIERARCH ESO DET OUT4 RON    =         3.42 / Readout noise per output (e-)
HIERARCH ESO DET OUT4 GAIN   =         0.63 / Conversion from electrons to ADU
HIERARCH ESO DET FRAM ID     =            1 / Image sequencial number
HIERARCH ESO DET FRAM TYPE   = 'Normal  '   / Type of frame
HIERARCH ESO DET WINDOWS     =            1 / # of windows readout
HIERARCH ESO DET WIN1 STRX   =            1 / Lower left pixel in X
HIERARCH ESO DET WIN1 STRY   =            1 / Lower left pixel in Y
HIERARCH ESO DET WIN1 NX     =         4296 / # of pixels along X
HIERARCH ESO DET WIN1 NY     =         4096 / # of pixels along Y
HIERARCH ESO DET WIN1 BINX   =            1 / Binning factor along X
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HIERARCH ESO DET WIN1 BINY   =            1 / Binning factor along Y
HIERARCH ESO DET WIN1 NDIT   =            1 / # of subintegrations
HIERARCH ESO DET WIN1 UIT1   =    35.290000 / user defined subintegration time
HIERARCH ESO DET WIN1 DIT1   =    35.290365 / actual subintegration time
HIERARCH ESO DET WIN1 DKTM   =      35.9428 / Dark current time
HIERARCH ESO DET SHUT TYPE   = 'Slit    '   / type of shutter
HIERARCH ESO DET SHUT ID     = 'ccdUvr shutter' / Shutter unique identifier
HIERARCH ESO DET SHUT TMOPEN =        0.035 / Time taken to open shutter
HIERARCH ESO DET SHUT TMCLOS =        0.036 / Time taken to close shutter
HIERARCH ESO DET TELE INT    =         60.0 / Interval between two successive te
HIERARCH ESO DET TELE NO     =            3 / # of sources active
HIERARCH ESO DET TLM1 NAME   = 'CCD T1  '   / Description of telemetry param.
HIERARCH ESO DET TLM1 ID     = 'CCD Sensor1' / ID of telemetry sensor
HIERARCH ESO DET TLM1 START  =       135.00 / Telemetry value at read start
HIERARCH ESO DET TLM1 END    =       135.00 / Telemetry value at read completion
HIERARCH ESO DET TLM2 NAME   = 'CCD T2  '   / Description of telemetry param.
HIERARCH ESO DET TLM2 ID     = 'CCD Sensor2' / ID of telemetry sensor
HIERARCH ESO DET TLM2 START  =       137.20 / Telemetry value at read start
HIERARCH ESO DET TLM2 END    =       137.20 / Telemetry value at read completion
HIERARCH ESO DET TLM3 NAME   = 'EBOX T  '   / Description of telemetry param.
HIERARCH ESO DET TLM3 ID     = 'Box Temp'   / ID of telemetry sensor
HIERARCH ESO DET TLM3 START  =       282.30 / Telemetry value at read start
HIERARCH ESO DET TLM3 END    =       282.30 / Telemetry value at read completion
HIERARCH ESO OCS SIMCAL      =            0 / Simultaneous Calibration flag
```

E.3.2 file UVES_RED_OBS202_0010.fits

```
SIMPLE  =                    T          / Standard FITS format (NOST-100.0)
BITPIX  =                   16          / # of bits storing pix values
NAXIS   =                    2          / # of axes in frame
NAXIS1  =                 4296          / # pixels/axis
NAXIS2  =                 4096          / # pixels/axis
ORIGIN  = 'ESO     '                    / European Southern Observatory
DATE    = '2002-07-21T05:39:56.106'     / UT date when this file was written
CRVAL1  =                  1.0          / value of ref pixel
CRPIX1  =                  1.0          / Ref. pixel of center of rotation
CDELT1  =                  1.0          / Binning factor
CTYPE1  = 'PIXEL   '                    / Pixel coordinate system
CRVAL2  =                  1.0          / value of ref pixel
CRPIX2  =                  1.0          / Ref. pixel of center of rotation
CDELT2  =                  1.0          / Binning factor
CTYPE2  = 'PIXEL   '                    / Pixel coordinate system
BSCALE  =                  1.0          / pixel=FITS*BSCALE+BZERO
BZERO   =              32768.0          / pixel=FITS*BSCALE+BZERO
MJD-OBS =       52476.21521798          / MJD start (2002-07-21T05:09:54.833)
DATE-OBS= '2002-07-21T05:09:54.833'     / Date of observation
EXPTIME =            1800.0004          / Total integration time
EXTEND  =                    F          / Extension may be present
INSTRUME= 'UVES    '                    / Instrument used.
OBJECT  = 'OBJECT,POINT'                / Original target.
OBSERVER= 'UNKNOWN '                    / Name of observer.
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PI-COI  = 'UNKNOWN '                    / Name of PI-COI.
TELESCOP= 'ESO-VLT-U2'                  / ESO Telescope Name
RA      =           270.922158          / 18:03:41.3 RA (J2000) pointing (deg)
DEC     =            -29.99823          / -29:59:53.6 DEC (J2000) pointing (deg)
EQUINOX =                2000.          / Standard FK5 (years)
RADECSYS= 'FK5     '                    / Coordinate reference frame
LST     =            73403.858          / 20:23:23.858 LST at start (sec)
UTC     =            18589.000          / 05:09:49.000 UTC at start (sec)
HIERARCH ESO OBS DID         = 'ESO-VLT-DIC.OBS-1.7' / OBS Dictionary
HIERARCH ESO OBS OBSERVER    = 'UNKNOWN '   / Observer Name
HIERARCH ESO OBS PI-COI NAME = 'UNKNOWN '   / PI-COI name
HIERARCH ESO OBS PI-COI ID   =         6240 / ESO internal PI-COI ID
HIERARCH ESO OBS TARG NAME   = 'I-140   '   / OB target name
HIERARCH ESO OBS GRP         = '0       '   / linked blocks
HIERARCH ESO OBS NAME        = 'I-140-imslice' / OB name
HIERARCH ESO OBS ID          =    200119543 / Observation block ID
HIERARCH ESO OBS PROG ID     = '69.B-0277(A)' / ESO program identification
HIERARCH ESO OBS START       = '2002-07-21T04:35:47' / OB start time
HIERARCH ESO OBS TPLNO       =            2 / Template number within OB
HIERARCH ESO TPL DID         = 'ESO-VLT-DIC.TPL-1.4' / Data dictionary for TPL
HIERARCH ESO TPL ID          = 'UVES_red_obs_expfree' / Template signature ID
HIERARCH ESO TPL NAME        = 'Red Free Observation' / Template name
HIERARCH ESO TPL PRESEQ      = 'UVES_red_obs.seq' / Sequencer script
HIERARCH ESO TPL START       = '2002-07-21T04:38:30' / TPL start time
HIERARCH ESO TPL VERSION     = '@(#) $Revision: 2.39 $' / Version of the templat
HIERARCH ESO TPL NEXP        =            3 / Number of exposures within templat
HIERARCH ESO TPL EXPNO       =            2 / Exposure number within template
HIERARCH ESO DPR TECH        = 'ECHELLE,SLIC#1' / Observation technique
HIERARCH ESO DPR TYPE        = 'OBJECT,POINT' / Observation type
HIERARCH ESO DPR CATG        = 'SCIENCE '   / Observation category
HIERARCH ESO TEL DID         = 'ESO-VLT-DIC.TCS' / Data dictionary for TEL
HIERARCH ESO TEL ID          = 'v 1.433+'   / TCS version number
HIERARCH ESO TEL DATE        = '2002-05-19T18:41:37.000' / TCS installation date
HIERARCH ESO TEL ALT         =       58.672 / Alt angle at start (deg)
HIERARCH ESO TEL AZ          =       72.258 / Az angle at start (deg) S=0,W=90
HIERARCH ESO TEL GEOELEV     =        2648. / Elevation above sea level (m)
HIERARCH ESO TEL GEOLAT      =     -24.6254 / Tel geo latitute (+=North) (deg)
HIERARCH ESO TEL GEOLON      =     -70.4030 / Tel geo longitude (+=East) (deg)
HIERARCH ESO TEL OPER        = 'I, Condor'  / Telescope Operator
HIERARCH ESO TEL FOCU ID     = 'NB      '   / Telescope focus station ID
HIERARCH ESO TEL FOCU LEN    =      120.000 / Focal length (m)
HIERARCH ESO TEL FOCU SCALE  =        1.718 / Focal scale (arcsec/mm)
HIERARCH ESO TEL FOCU VALUE  =      -28.668 / M2 setting (mm)
HIERARCH ESO TEL PARANG START=       88.677 / Parallactic angle at start (deg)
HIERARCH ESO TEL AIRM START  =        1.170 / Airmass at start
HIERARCH ESO TEL AMBI FWHM START=      1.70 / Observatory Seeing queried from AS
HIERARCH ESO TEL AMBI PRES START=    743.00 / Observatory ambient air pressure q
HIERARCH ESO TEL AMBI WINDSP =         5.97 / Observatory ambient wind speed que
HIERARCH ESO TEL AMBI WINDDIR=         286. / Observatory ambient wind directio
HIERARCH ESO TEL AMBI RHUM   =          60. / Observatory ambient relative humi
HIERARCH ESO TEL AMBI TEMP   =         4.50 / Observatory ambient temperature qu
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HIERARCH ESO TEL MOON RA     = 171250.917976 / ~~:~~:~~.~ RA (J2000) (deg)
HIERARCH ESO TEL MOON DEC    = -230833.34614 / -~~:~~:~~.~ DEC (J2000) (deg)
HIERARCH ESO TEL TH M1 TEMP  =         6.10 / M1 superficial temperature
HIERARCH ESO TEL TRAK STATUS = 'NORMAL  '   / Tracking status
HIERARCH ESO TEL DOME STATUS = 'FULLY-OPEN' / Dome status
HIERARCH ESO TEL CHOP ST     =            F / True when chopping is active
HIERARCH ESO TEL PARANG END  =       92.373 / Parallactic angle at end (deg)
HIERARCH ESO TEL AIRM END    =        1.266 / Airmass at end
HIERARCH ESO TEL AMBI FWHM END=        2.38 / Observatory Seeing queried from AS
HIERARCH ESO TEL AMBI PRES END=      742.78 / Observatory ambient air pressure q
HIERARCH ESO ADA ABSROT START=     32.60975 / Abs rot angle at exp start (deg)
HIERARCH ESO ADA POSANG      =      0.00000 / Position angle at start
HIERARCH ESO ADA GUID STATUS = 'ON      '   / Status of autoguider
HIERARCH ESO ADA GUID RA     =     0.000000 / 00:00:00.0 Guide star RA J2000
HIERARCH ESO ADA GUID DEC    =      0.00000 / 00:00:00.0 Guide star DEC J2000
HIERARCH ESO ADA ABSROT END  =     35.45104 / Abs rot angle at exp end (deg)
HIERARCH ESO INS ID          = 'UVES    '   / Instrument ID.
HIERARCH ESO INS DID         = 'UVES_ICS'   / Data dictionary for INS.
HIERARCH ESO INS SOFW ID     = '$Revision: 1.100 $' / Instrument SW.
HIERARCH ESO INS SOFW MODE   = 'NORMAL  '   / Simulation mode.
HIERARCH ESO INS PATH        = 'RED     '   / Optical path used.
HIERARCH ESO INS MODE        = 'RED     '   / Instrument mode used.
HIERARCH ESO INS MIRR1 ID    = 'FREE    '   / Mirror unique ID.
HIERARCH ESO INS MIRR1 NAME  = 'FREE    '   / Mirror common name.
HIERARCH ESO INS MIRR1 NO    =            1 / Mirror slide position.
HIERARCH ESO INS OPTI1 ID    = '1       '   / General Optical device unique ID.
HIERARCH ESO INS OPTI1 NAME  = 'OUT     '   / General Optical device common name
HIERARCH ESO INS OPTI1 NO    =            1 / Slot number.
HIERARCH ESO INS OPTI1 TYPE  = 'FREE    '   / General Optical device Element.
HIERARCH ESO INS SLIT1 NAME  = 'SLIC#1  '   / Slit common name.
HIERARCH ESO INS SLIT1 NO    =            2 / Slide position.
HIERARCH ESO INS SLIT1 WID   =         0.00 / Slit width [arcsec].
HIERARCH ESO INS SLIT1 LEN   =         0.00 / Slit length [arcsec].
HIERARCH ESO INS DROT MODE   = 'STAT    '   / Instrument derotator mode.
HIERARCH ESO INS DROT RA     = 180341.327174 / ~~:~~:~~.~ RA (J2000) pointing [d
HIERARCH ESO INS DROT DEC    = -295953.573060 / -~~:~~:~~.~ DEC (J2000) pointing
HIERARCH ESO INS DROT POSANG =       0.0000 / Position angle [deg].
HIERARCH ESO INS DROT BEGIN  =      90.3005 / Physical position at start [deg].
HIERARCH ESO INS DPOL MODE   = 'OFF     '   / Instrument depolarizer mode.
HIERARCH ESO INS DPOS NAME   = 'OUT     '   / Instrument depolarizer slide posit
HIERARCH ESO INS DPOS NO     =            1 / Depolarizer slide position.
HIERARCH ESO INS ADC MODE    = 'OFF     '   / ADC mode.
HIERARCH ESO INS ADCS NAME   = 'OUT     '   / ADC slide position.
HIERARCH ESO INS ADCS NO     =            1 / ADC slide position.
HIERARCH ESO INS ADC1 MODE   = 'OFF     '   / ADC mode.
HIERARCH ESO INS ADC1 RA     = 180341.327174 / ~~:~~:~~.~ RA (J2000) pointing [d
HIERARCH ESO INS ADC1 DEC    = -295953.573060 / -~~:~~:~~.~ DEC (J2000) pointing
HIERARCH ESO INS ADC2 MODE   = 'OFF     '   / ADC mode.
HIERARCH ESO INS ADC2 RA     = 180341.327174 / ~~:~~:~~.~ RA (J2000) pointing [d
HIERARCH ESO INS ADC2 DEC    = -295953.573060 / -~~:~~:~~.~ DEC (J2000) pointing
HIERARCH ESO INS FILT1 ID    = 'FREE    '   / Filter unique id.
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HIERARCH ESO INS FILT1 NAME  = 'FREE    '   / Filter common name.
HIERARCH ESO INS FILT1 NO    =           13 / Filter wheel position index.
HIERARCH ESO INS OPTI2 ID    = 'DIAPHR.27MM' / General Optical device unique ID.
HIERARCH ESO INS OPTI2 NAME  = 'OVRSIZ  '   / General Optical device common name
HIERARCH ESO INS OPTI2 NO    =            3 / Slot number.
HIERARCH ESO INS OPTI2 TYPE  = 'SLIDE   '   / General Optical device Element.
HIERARCH ESO INS MIRR2 ID    = 'RED#1   '   / Mirror unique ID.
HIERARCH ESO INS MIRR2 NAME  = 'RED     '   / Mirror common name.
HIERARCH ESO INS MIRR2 NO    =            1 / Mirror slide position.
HIERARCH ESO INS SHUT1 ID    = 'TSH     '   / Shutter ID.
HIERARCH ESO INS SHUT1 NAME  = 'Telescope shutter' / Shutter name.
HIERARCH ESO INS SHUT1 ST    =            T / Shutter open.
HIERARCH ESO INS SHUT2 ID    = 'SPSH    '   / Shutter ID.
HIERARCH ESO INS SHUT2 NAME  = 'SPHERE_SHUTTER' / Shutter name.
HIERARCH ESO INS SHUT3 ID    = 'TSH3    '   / Shutter ID.
HIERARCH ESO INS SHUT3 NAME  = 'D2L_SHUTTER' / Shutter name.
HIERARCH ESO INS SHUT4 ID    = 'TSH4    '   / Shutter ID.
HIERARCH ESO INS SHUT4 NAME  = 'THAR_SHUTTER' / Shutter name.
HIERARCH ESO INS SLIT3 WID   =         0.70 / Slit width [arcsec].
HIERARCH ESO INS SLIT3 Y1FRML= 'ENC=OFFST+RESOL*acos(WID-(MAX+MIN)/(MAX-MIN))' /
HIERARCH ESO INS SLIT3 Y1OFFST=      4750.0 / Offset in Formula.
HIERARCH ESO INS SLIT3 Y1RESOL=        40.0 / Resolution in encoder steps.
HIERARCH ESO INS SLIT3 Y1MIN =        0.062 / Minimum slit width [arcsec].
HIERARCH ESO INS SLIT3 Y1MAX =        5.572 / Maximum slit width [arcsec].
HIERARCH ESO INS SLIT3 Y2FRML= 'ENC=OFFST+RESOL*acos(WID-(MAX+MIN)/(MAX-MIN))' /
HIERARCH ESO INS SLIT3 Y2OFFST=      4560.0 / Offset in Formula.
HIERARCH ESO INS SLIT3 Y2RESOL=        40.0 / Resolution in encoder steps.
HIERARCH ESO INS SLIT3 Y2MIN =        0.050 / Minimum slit width [arcsec].
HIERARCH ESO INS SLIT3 Y2MAX =        5.513 / Maximum slit width [arcsec].
HIERARCH ESO INS SLIT3 Y1ENC =        10893 / Slit Vertical top motor absolute e
HIERARCH ESO INS SLIT3 Y2ENC =        10676 / Slit Vertical bottom motor absolut
HIERARCH ESO INS SLIT3 LEN   =        16.00 / Slit length [arcsec].
HIERARCH ESO INS SLIT3 X1FRML= 'ENC=OFFST+RESOL*acos(LEN-(MAX+MIN)/(MAX-MIN))' /
HIERARCH ESO INS SLIT3 X1OFFST=      2381.0 / Offset in Formula.
HIERARCH ESO INS SLIT3 X1RESOL=        40.0 / Resolution in encoder steps.
HIERARCH ESO INS SLIT3 X1MIN =        0.087 / Minimum slit length [arcsec].
HIERARCH ESO INS SLIT3 X1MAX =       15.752 / Maximum slit length [arcsec].
HIERARCH ESO INS SLIT3 X2FRML= 'ENC=OFFST+RESOL*acos(LEN-(MAX+MIN)/(MAX-MIN))' /
HIERARCH ESO INS SLIT3 X2OFFST=      2307.0 / Offset in Formula.
HIERARCH ESO INS SLIT3 X2RESOL=        40.0 / Resolution in encoder steps.
HIERARCH ESO INS SLIT3 X2MIN =        0.064 / Minimum slit length [arcsec].
HIERARCH ESO INS SLIT3 X2MAX =       15.833 / Maximum slit length [arcsec].
HIERARCH ESO INS SLIT3 X1ENC =         5957 / Slit Horizontal left motor absolut
HIERARCH ESO INS SLIT3 X2ENC =         5892 / Slit Horizontal right motor absolu
HIERARCH ESO INS FILT3 ID    = 'BS9     '   / Filter unique id.
HIERARCH ESO INS FILT3 NAME  = 'BK7_5   '   / Filter common name.
HIERARCH ESO INS FILT3 NO    =            9 / Filter wheel position index.
HIERARCH ESO INS DET6 NAME   = 'Red exp. meter PMT' / detector name.
HIERARCH ESO INS DET6 CTMIN  =         182. / Minimum count during exposure.
HIERARCH ESO INS DET6 CTMAX  =         342. / Maximum count during exposure.
HIERARCH ESO INS DET6 CTMEAN =        266.8 / Average counts during exposure.
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HIERARCH ESO INS DET6 CTRMS  =        27.19 / RMS of counts during exposure.
HIERARCH ESO INS DET6 TMMEAN =         0.50 / Normalised mean exposure time.
HIERARCH ESO INS DET6 CTTOT  =      476889. / Total counts during exposure.
HIERARCH ESO INS DET6 UIT    =        1.000 / User defined Integration time [sec
HIERARCH ESO INS DET6 OFFDRK =           0. / Average dark background counts.
HIERARCH ESO INS DET6 OFFSKY =           1. / Average sky background counts.
HIERARCH ESO INS SHUT6 ID    = 'REXS    '   / Shutter ID.
HIERARCH ESO INS SHUT6 NAME  = 'Red exp. meter sh.' / Shutter name.
HIERARCH ESO INS SHUT6 ST    =            T / Shutter open.
HIERARCH ESO INS GRAT2 ID    = 'CD#3    '   / Grating unique ID.
HIERARCH ESO INS GRAT2 NAME  = 'CD#3    '   / Grating common name.
HIERARCH ESO INS PIXSCALE    =        0.182 / Pixel scale [arcsec].
HIERARCH ESO INS GRAT2 X     =       2048.0 / X pixel for central wavelength.
HIERARCH ESO INS GRAT2 Y     =       2048.0 / Y pixel for central wavelength.
HIERARCH ESO INS GRAT2 FRML  = 'ENC=OFFST+RESOL*ASIN(WLEN*GRV/(2*COS(ROT)))' / C
HIERARCH ESO INS GRAT2 OFFST =    3845390.0 / Offset in Formula.
HIERARCH ESO INS GRAT2 RESOL =      15000.0 / Resolution in encoder steps.
HIERARCH ESO INS GRAT2 GRV   =    0.0006000 / Grating grooves/nm.
HIERARCH ESO INS GRAT2 ROT   =       22.668 / Grating rot angle [deg].
HIERARCH ESO INS GRAT2 NO    =            1 / Grating wheel position index.
HIERARCH ESO INS GRAT2 WLEN  =        655.0 / Grating central wavelength [nm].
HIERARCH ESO INS GRAT2 DISP  =          0.1 / Grating dispersion [nm/mm].
HIERARCH ESO INS GRAT2 ENC   =      4029745 / Grating absolute encoder position.
HIERARCH ESO INS TILT2 POS   =          0.0 / Science camera tilt (pixels).
HIERARCH ESO INS TILT2 FRML  = 'ENC=OFFST+RESOL*ASIN(2*POS-(MAX+MIN)/(MAX-MIN))'
HIERARCH ESO INS TILT2 OFFST =      16000.0 / Offset in Formula.
HIERARCH ESO INS TILT2 RESOL =       -100.0 / Resolution in encoder steps.
HIERARCH ESO INS TILT2 POSMIN=       -222.0 / Minimum camera tilt (pixels).
HIERARCH ESO INS TILT2 POSMAX=        222.0 / Maximum camera tilt (pixels).
HIERARCH ESO INS TILT2 ENC   =        16037 / Camera tilt absolute encoder posit
HIERARCH ESO INS SHUT7 ID    = 'FPSH    '   / Shutter ID.
HIERARCH ESO INS SHUT7 NAME  = 'FIBRPROJSHUTTER' / Shutter name.
HIERARCH ESO INS DROT END    =      90.3005 / Physical position at end [deg].
HIERARCH ESO INS TEMP31 NAME = 'Iodine cell temp.' / Temperature sensor name.
HIERARCH ESO INS TEMP31 START=          9.1 / Temperature at start [C].
HIERARCH ESO INS TEMP31 STOP =          8.9 / Temperature at end [C].
HIERARCH ESO INS TEMP31 MIN  =          8.9 / Minimum temperature [C].
HIERARCH ESO INS TEMP31 MAX  =          9.2 / Maximum temperature [C].
HIERARCH ESO INS TEMP31 MEAN =          9.0 / Average temperature [C].
HIERARCH ESO INS TEMP1 NAME  = 'Temp. blue camera' / Temperature sensor name.
HIERARCH ESO INS TEMP1 START =          8.6 / Temperature at start [C].
HIERARCH ESO INS TEMP1 STOP  =          8.4 / Temperature at end [C].
HIERARCH ESO INS TEMP1 MIN   =          8.4 / Minimum temperature [C].
HIERARCH ESO INS TEMP1 MAX   =          8.6 / Maximum temperature [C].
HIERARCH ESO INS TEMP1 MEAN  =          8.5 / Average temperature [C].
HIERARCH ESO INS TEMP2 NAME  = 'Temp. red camera' / Temperature sensor name.
HIERARCH ESO INS TEMP2 START =          8.5 / Temperature at start [C].
HIERARCH ESO INS TEMP2 STOP  =          8.4 / Temperature at end [C].
HIERARCH ESO INS TEMP2 MIN   =          8.4 / Minimum temperature [C].
HIERARCH ESO INS TEMP2 MAX   =          8.5 / Maximum temperature [C].
HIERARCH ESO INS TEMP2 MEAN  =          8.5 / Average temperature [C].
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HIERARCH ESO INS TEMP3 NAME  = 'Temp. table' / Temperature sensor name.
HIERARCH ESO INS TEMP3 START =          9.6 / Temperature at start [C].
HIERARCH ESO INS TEMP3 STOP  =          9.5 / Temperature at end [C].
HIERARCH ESO INS TEMP3 MIN   =          9.5 / Minimum temperature [C].
HIERARCH ESO INS TEMP3 MAX   =          9.6 / Maximum temperature [C].
HIERARCH ESO INS TEMP3 MEAN  =          9.6 / Average temperature [C].
HIERARCH ESO INS TEMP4 NAME  = 'Temp. inside air' / Temperature sensor name.
HIERARCH ESO INS TEMP4 START =          9.3 / Temperature at start [C].
HIERARCH ESO INS TEMP4 STOP  =          9.2 / Temperature at end [C].
HIERARCH ESO INS TEMP4 MIN   =          9.2 / Minimum temperature [C].
HIERARCH ESO INS TEMP4 MAX   =          9.3 / Maximum temperature [C].
HIERARCH ESO INS TEMP4 MEAN  =          9.2 / Average temperature [C].
HIERARCH ESO INS SENS26 NAME = 'Barometer pressure' / sensor common name.
HIERARCH ESO INS SENS26 START=        742.2 / sensor value at start.
HIERARCH ESO INS SENS26 STOP =        742.1 / sensor value at end.
HIERARCH ESO INS SENS26 MIN  =        742.1 / Minimum sensor value.
HIERARCH ESO INS SENS26 MAX  =        742.2 / Maximum sensor value.
HIERARCH ESO INS SENS26 MEAN =        742.2 / Average sensor vlaue.
HIERARCH ESO DET ID          = 'CCD FIERA - Rev 2.87' / Detector system Id
HIERARCH ESO DET NAME        = 'ccdUvR - ccdUvr' / Name of detector system
HIERARCH ESO DET DATE        = '09-07-1998' / Installation date
HIERARCH ESO DET DID         = 'ESO-VLT-DIC.CCDDCS,ESO-VLT-DIC.FCDDCS' / Diction
HIERARCH ESO DET BITS        =           16 / Bits per pixel readout
HIERARCH ESO DET RA          = 270.92219670 / Apparent 18:03:41.3 RA at start
HIERARCH ESO DET DEC         = -29.99821469 / Apparent -29:59:53.5 DEC at start
HIERARCH ESO DET SOFW MODE   = 'Normal  '   / CCD sw operational mode
HIERARCH ESO DET CHIPS       =            2 / # of chips in detector array
HIERARCH ESO DET CHIP1 ID    = 'CCID-20 '   / Detector chip identification
HIERARCH ESO DET CHIP1 NAME  = 'MIT/LL, EEV' / Detector chip name
HIERARCH ESO DET CHIP1 DATE  = '09-07-1998' / Date of installation [YYYY-MM-DD]
HIERARCH ESO DET CHIP1 X     =            1 / X location in array
HIERARCH ESO DET CHIP1 Y     =            1 / Y location in array
HIERARCH ESO DET CHIP1 NX    =         2048 / # of pixels along X
HIERARCH ESO DET CHIP1 NY    =         4096 / # of pixels along Y
HIERARCH ESO DET CHIP1 PSZX  =         15.0 / Size of pixel in X
HIERARCH ESO DET CHIP1 PSZY  =         15.0 / Size of pixel in Y
HIERARCH ESO DET CHIP2 ID    = 'CCD-44  '   / Detector chip identification
HIERARCH ESO DET CHIP2 NAME  = 'MIT/LL, EEV' / Detector chip name
HIERARCH ESO DET CHIP2 DATE  = '09-07-1998' / Date of installation [YYYY-MM-DD]
HIERARCH ESO DET CHIP2 X     =            2 / X location in array
HIERARCH ESO DET CHIP2 Y     =            1 / Y location in array
HIERARCH ESO DET CHIP2 NX    =         2048 / # of pixels along X
HIERARCH ESO DET CHIP2 NY    =         4096 / # of pixels along Y
HIERARCH ESO DET CHIP2 PSZX  =         15.0 / Size of pixel in X
HIERARCH ESO DET CHIP2 PSZY  =         15.0 / Size of pixel in Y
HIERARCH ESO DET EXP NO      =         9571 / Unique exposure ID number
HIERARCH ESO DET EXP TYPE    = 'Normal  '   / Exposure type
HIERARCH ESO DET EXP DUMDIT  =            0 / # of dummy readouts
HIERARCH ESO DET EXP RDTTIME =       39.605 / image readout time
HIERARCH ESO DET EXP XFERTIM =       39.629 / image transfer time
HIERARCH ESO DET READ MODE   = 'normal  '   / Readout method
```

```
HIERARCH ESO DET READ SPEED  = '2pts/225kHz/lg' / Readout speed
HIERARCH ESO DET READ CLOCK  = '225kHz/2ports/l' / Readout clock pattern used
HIERARCH ESO DET OUTPUTS     =              2 / # of outputs
HIERARCH ESO DET OUTREF      =              0 / reference output
HIERARCH ESO DET OUT1 ID     = 'L       '   / Output ID as from manufacturer
HIERARCH ESO DET OUT1 NAME   = 'L       '   / Description of output
HIERARCH ESO DET OUT1 CHIP   =              1 / Chip to which the output belongs
HIERARCH ESO DET OUT1 X      =              1 / X location of output
HIERARCH ESO DET OUT1 Y      =              1 / Y location of output
HIERARCH ESO DET OUT1 NX     =           2048 / valid pixels along X
HIERARCH ESO DET OUT1 NY     =           4096 / valid pixels along Y
HIERARCH ESO DET OUT1 PRSCX  =             50 / Prescan region in X
HIERARCH ESO DET OUT1 OVSCX  =             50 / Overscan region in X
HIERARCH ESO DET OUT1 CONAD  =           1.46 / Conversion from ADUs to electrons
HIERARCH ESO DET OUT1 RON    =           3.69 / Readout noise per output (e-)
HIERARCH ESO DET OUT1 GAIN   =           0.68 / Conversion from electrons to ADU
HIERARCH ESO DET OUT4 ID     = 'R       '   / Output ID as from manufacturer
HIERARCH ESO DET OUT4 NAME   = 'R       '   / Description of output
HIERARCH ESO DET OUT4 CHIP   =              2 / Chip to which the output belongs
HIERARCH ESO DET OUT4 X      =           4096 / X location of output
HIERARCH ESO DET OUT4 Y      =              1 / Y location of output
HIERARCH ESO DET OUT4 NX     =           2048 / valid pixels along X
HIERARCH ESO DET OUT4 NY     =           4096 / valid pixels along Y
HIERARCH ESO DET OUT4 PRSCX  =             50 / Prescan region in X
HIERARCH ESO DET OUT4 OVSCX  =             50 / Overscan region in X
HIERARCH ESO DET OUT4 CONAD  =           1.59 / Conversion from ADUs to electrons
HIERARCH ESO DET OUT4 RON    =           3.42 / Readout noise per output (e-)
HIERARCH ESO DET OUT4 GAIN   =           0.63 / Conversion from electrons to ADU
HIERARCH ESO DET FRAM ID     =              1 / Image sequencial number
HIERARCH ESO DET FRAM TYPE   = 'Normal  '   / Type of frame
HIERARCH ESO DET WINDOWS     =              1 / # of windows readout
HIERARCH ESO DET WIN1 STRX   =              1 / Lower left pixel in X
HIERARCH ESO DET WIN1 STRY   =              1 / Lower left pixel in Y
HIERARCH ESO DET WIN1 NX     =           4296 / # of pixels along X
HIERARCH ESO DET WIN1 NY     =           4096 / # of pixels along Y
HIERARCH ESO DET WIN1 BINX   =              1 / Binning factor along X
HIERARCH ESO DET WIN1 BINY   =              1 / Binning factor along Y
HIERARCH ESO DET WIN1 NDIT   =              1 / # of subintegrations
HIERARCH ESO DET WIN1 UIT1   =    1800.000000 / user defined subintegration time
HIERARCH ESO DET WIN1 DIT1   =    1800.000404 / actual subintegration time
HIERARCH ESO DET WIN1 DKTM   =      1800.6543 / Dark current time
HIERARCH ESO DET SHUT TYPE   = 'Slit    '   / type of shutter
HIERARCH ESO DET SHUT ID     = 'ccdUvr shutter' / Shutter unique identifier
HIERARCH ESO DET SHUT TMOPEN =          0.035 / Time taken to open shutter
HIERARCH ESO DET SHUT TMCLOS =          0.036 / Time taken to close shutter
HIERARCH ESO DET TELE INT    =           60.0 / Interval between two successive te
HIERARCH ESO DET TELE NO     =              3 / # of sources active
HIERARCH ESO DET TLM1 NAME   = 'CCD T1  '   / Description of telemetry param.
HIERARCH ESO DET TLM1 ID     = 'CCD Sensor1' / ID of telemetry sensor
HIERARCH ESO DET TLM1 START  =         135.00 / Telemetry value at read start
HIERARCH ESO DET TLM1 END    =         135.00 / Telemetry value at read completion
```

```
HIERARCH ESO DET TLM2 NAME   = 'CCD T2  '   / Description of telemetry param.
HIERARCH ESO DET TLM2 ID     = 'CCD Sensor2' / ID of telemetry sensor
HIERARCH ESO DET TLM2 START  =       137.20 / Telemetry value at read start
HIERARCH ESO DET TLM2 END    =       137.20 / Telemetry value at read completion
HIERARCH ESO DET TLM3 NAME   = 'EBOX T  '   / Description of telemetry param.
HIERARCH ESO DET TLM3 ID     = 'Box Temp'   / ID of telemetry sensor
HIERARCH ESO DET TLM3 START  =       282.20 / Telemetry value at read start
HIERARCH ESO DET TLM3 END    =       281.90 / Telemetry value at read completion
HIERARCH ESO OCS SIMCAL      =            0 / Simultaneous Calibration flag
```

F Procedures

F.1 Disassembly of FEROS

The following procedure was provided by A.Kaufer in an email dated Sun, 21 Jul 2002 02:27:50 +0400,

```
Subject:    FEROS dismount procedure
   Date:    Sun, 21 Jul 2002 02:27:50 +0400
   From:    Andreas Kaufer <akaufer@eso.org>
     To:    "Gilliotte, Alain" <agilliot@eso.org>
     CC:     John Pritchard <jpritcha@eso.org>, Ivo Saviane <isaviane@eso.org>

Hi Alain, John, Ivo,

below you'll find a kind of procedure for the dismounting of FEROS at the 1.52.
Everything is written from my (rather bad) memory, so some details will surely
be missing. But the basic sequence and steps should be ok. Let me know if
anything is not clear.

Cheers
Andreas
```

F.1.1 General remarks

- Red Screws are to dismount components;
- Blue screws are for alignment and should not be touched;
- Black screws should not be opened.

F.1.2 The procedure

1. Take Flatfield and ThAr exposures as reference before move to 2.2.
2. Disconnect CCD LN2, warmup CCD (1 or 2 days in advance)
3. Disconnect CCD electronics, fiber link, put shorts (in FEROS closet) on CCD connectors
4. Remove enclosure side panels
5. Mount all red plastic covers for optical components:
   - Main Collimator: red plastic slide + black plastic screw
   - Transfer Collimator: red plastic slide + black plastic screw
   - Flat Folding mirror: red plastic slide + black plastic screw
   - Echelle: red plastic cover + several black plastic screws
   - Prism: first note and mark the angle position on the turntable; then mount the red plastic cover. This cover are two plastic plates with a flexible ancle. Carefully slide the covers over the prism top and bottom plates, fix the plates with the black plastic screws. NOTE: the prism surfaces are coated with a soft coating which cannot be cleaned easily. Therefore, the surfaces must not be touched !!!
   - Camera: the camera has a white plastic cover for the front lens

6. Fiber projector:
   (a) Take off the red plastic cover
   (b) Open the red screws on the fiber-exit head (fibers, F/N system, image slicer), remove the fiber-exit head, place it in the table and secure it with the cover.
7. Close all side covers again
8. Clean the top of the enclosure with vacuum cleaner, wet towel
9. Remove all enclosure panels (sides and top)
10. Take care of the cabling of the lamps inside the enclosure; probably needs to be dismounted
11. Remove the black enclosure panel mounted between CCD and camera. Be careful, this panel also holds the CCD shutter, a rubber tube connects this panel to the CCD entrance window.
12. Dismount enclosure structure; try to leave as big structures as possible:
    (a) keep the top as one piece
    (b) then remove the vertial rails
    (c) leave the base structure, i.e. leave the rails directly mounted to the table top!!!
13. Removal of opto-mecahnical components.
    The basic idea is to maintain the alignment as good as possible, i.e. to keep the table clamps as reference on the table. Each component is mounted via its baseplate to the table top with four clamps, three of them with adjustment pins which define the position of the component on the table. The fourth is only to fix the component on the table. ONLY this clamp should be removed from the table if really needed. All other clamps should just be released and the component removed. Before, the actual position of the components should be marked on the table.
    (a) Collimators, Flat Folding Mirror: as described above. After removal the collimators should be stored lying on their back.
    (b) Prism: after marking the rotation angle, the prism should be rotated to be parallel to the long side of the baseplate; after removal from the table the prism unit can be stored lying on its back. Note, that the prism must not be exposed to strong thermal shock.
    (c) Fiber exit unit: after the fiber-exit head was removed (cf. above) this is a purely mechanical unit; still, there is a lot of alinment involved, therefore, this unit should just be transported upright as it was standing on the table. Dont lay it on the sides.
    (d) Echelle: the echelle basement has an additional adjustment to define the rotation angle of the baseplate. This adjustment of the rotation should be maintained. Therefore, only release ONE of the two pins defining the rotation position to remove the echelle. Note, that the echelle has to be moved vertically first because inside the baseplate a rotation point is installed which prevents horizontal movements.
    (e) Camera + CCD unit: Camera and CCD are mounted and aligned to each other on a rectangular breadboard. Camera and CCD should stay mounted and aligned on the breadboard and only moved as one unit. This unit is heavy. The best is to bring a lifting table aside the table and slide the breadboard with CCD and Camera onto the lifting table. Note, that under the breadboard three pads are mounted which must not be damaged when moving the unit.
    (f) Fiber-exit head: take off the red plastic cover.
    Remove the two fiberes:

i. The two fibers are just clamped to a socket on the rotating plate. Open the four screw which fixes the plate to the basement. The fibers are lying between two rubber pads, probably they are taped with Scotch tape to one of the rubber pads. Remove the tape, the fiber ends should be freed now.

ii. Unscew the two SMA fiber connectors which mount the fiber cables to the fiber-exit head. Slowly take out the blank fibers through the SMA connectors. The blank fiber cables should be protected e.g. by some thin platic tubes, e.g. shrinking tubes (dont shrink them of course).

iii. Mount back the fiber-exit head to the fiber-exit unit and cover it with the red plastic cover to protect the FN and image slicer optics.

iv. The two fiber cables are protected by a shower cable which is connected to the enclosure plate. Now this shower cable connector can be opened and the fiber cables removed from the spectragraph.

14. After all components have been removed from the table top, table should be left with the clamps and the base rails of the enclosure. The table surface and the clamps should be protected now. Best solution would be to put some wooden bars on the unused parts of the table and to cover the complete surface with a wooden plate. The plate could be fixed using the 25mm grid of holes on the table top.

15. The fours legs of the table are screwed to the table bottom. The screws must be openend. Then the table could be lowered on 2 lifting tables by releasing the air pressure from the legs. If not enough clearance is gained by this, the adjustment screws of the legs can be used to lower them. Special tools to turn the screws are available in the FEROS closet. Then the fours legs can be removed from below the table. Make sure that the table top is aways secured in case of earthquakes...

F.2 Re-assembly and Alignment of FEROS

The original installation and alignment procedure (which is on the FEROS CDROM) and the installation log of the original installation and commissioning[23] can be used as guides for re-assembly and alignment.

[23] See `http://www.ls.eso.org/lasilla/Telescopes/2p2T/E1p5M/FEROS/Installation.html`

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