Report for the NOT STC on the FIES Spectrograph

(Supplement to the report dated 1998-09-10)

prepared by

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Introduction

By the time of the 1998 NOT meeting in Turkku we had a complete laboratory version of FIES, which we could show performed as designed. After some discussion NOT accepted that FIES could be installed as a user instrument at the telescope in the foreseen location at the side of the telescope pier. Subsequently funding was granted by the Danish Foundation for Support of Space Research (160.000 Dkr.) to complete the instrument to make it ready to be mounted at the NOT. FIES on the NOT is highly appropriate as a ground support instrument for the proposed Danish small satellite mission MONS (Measuring Oscillation in Nearby Stars).

The completion of the FIES instrument for installation at NOT is going ahead at all relevant levels. The different actions are being defined and worked on, and the last design issues are expected to be in place at the end of April 1999. Bo Lindberg will discuss the installation of FIES on NOT during a visit to La Palma in April with the local staff. The remaining work can be divided in various subjobs, and we present here a list of these jobs including a status of the work that has taken place and the expected time of completion.

CCD detector.

The present Loral chip can not be cooled below 0 degrees C. It stops working below this temperature. A revision of the camera house will be made and a better chip installed. The Loral replacement chip (W11-4) unfortunately need to be UV flooded, but otherwise it should be of good quality. It has been used at La Silla before.
The camera has been shipped back to Aarhus from Skellefteaa and the new chip will be installed either fairly soon or at the latest when the chips for the mosaic camera for NOT are installed late summer (August-September). The whole system will be tested and shipped back to Skellefteaa for the final, complete tests of the spectrograph before shipment to La Palma.

A final, scientifically acceptable chip will be acquired later. Either it can be bought in connection with a bargain by NOT for other chips, or perhaps in context with the development of the MONS camera, assuming the mission MONS is selected for launch (decision to take place in August). Funding depends on which scenario happens to be possible.

The computer control.

The computer control is fairly simple, as there are few operations involved. The commands will be added to the BIAS program, running the Copenhagen University Observatory (CUO) CCD controllers, making the user interface very similar to the interface of many of the other instruments.
The hardware is a set of small digital elements addressed through a serial port. This has been tested now and a complete set of C routines is being written to be integrated in the BIAS code running under LINUX.

The control system also includes the control of the calibration lamp unit, which we think can be placed under the optical table on the observing floor. This unit will be tested in parallel with the control system.

We are in the process of collecting all the parts to be controlled to complete the software and test the functionality. This takes place in Aarhus. We plan to complete this in June. The pieces will then be transported back to Skellefteaa and the code installed on the PC controlling FIES.

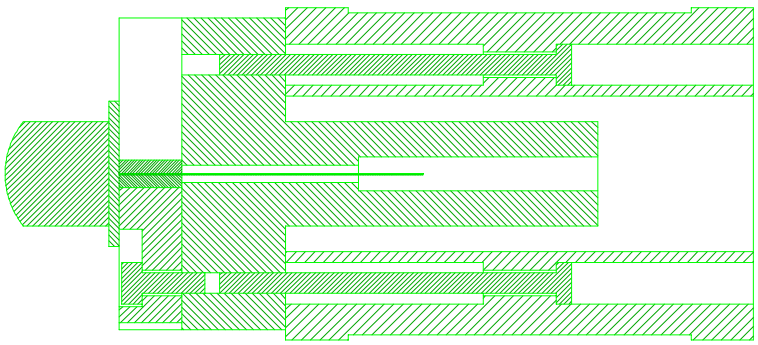
Fiber coupling

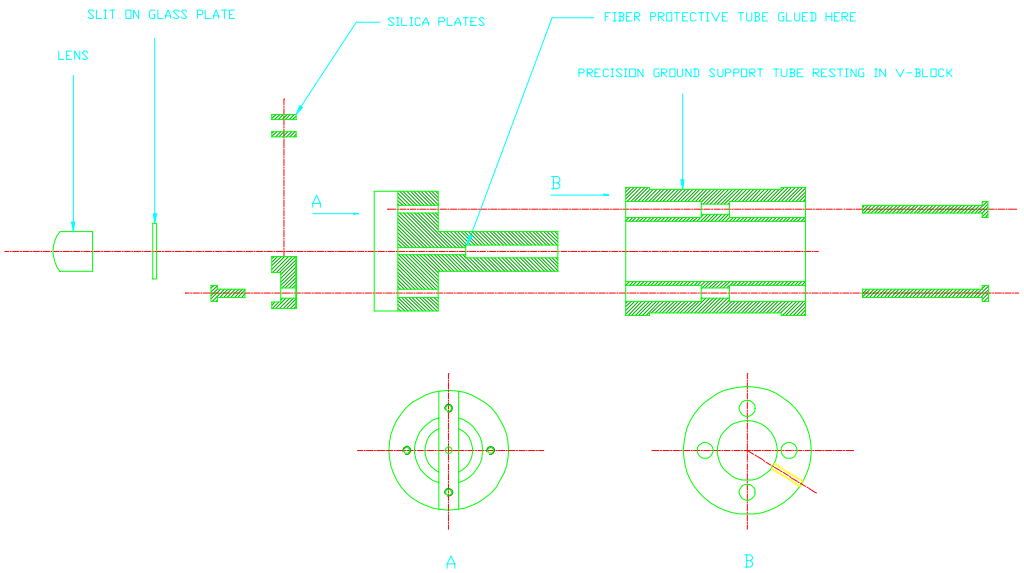
Some new ideas with regard to the fiber coupling was presented in the last report. The design of the fiber exit in the spectrograph is now made along those lines, and the parts are under production. The picture below shows the fiber exit. The picture below it shows an exploded view of the same.

The fiber ends (two fibers), slit, and focal extender is cemented together into one integrated unit. A precision ground tube acts as a carrier of the rest of the components, and this tube rests in a V-block that is also ground to a high precision. A slit plate of glass is cemented directly over the fiber ends under a microscope. The extender lens is cemented on top of the plate, and is also centred with help of the microscope. After that the whole package is attached to the carrier tube and a final centering operation is carried out.

In the V-block there is also a shutter, and a photometer. In front of the V-block there is space reserved for an Iodine cell. Because all parts are centered to within a few microns, new components, such as an image slicer, can be added in the V-block without any aligning operation. There are no set screws in the design.

The fiber type is not selected yet. A sample of the new STU type of fiber is ordered from PolyMicro. Gerardo Avila at ESO in Munich is going to characterise a set of fibers with ESO's test setup, within a couple of weeks, and he will test this one for us as well. If this fiber look promising we will use it instead of the original ones. (Poly-Micro FVP100110125 or FIP100110125).





Photometer

The photometer detector is a small 1 mm^2 PIN diode. The photometer is still under design to make sure it will work faint enough and with an acceptable dynamic range. The photometer will display the incoming flux level on the PC monitor. A small mirror is moved into the beam by a new BIAS command and the photometer is then activated. The whole assembly should be complete in June.

The adapter fiber unit.

The fiber unit that has been installed earlier in the NOT adapter will be used again, but with modifications of the fiber mount. Light will be reflected off the ferrule ends to the fiber camera instead of mounting fibers in holes in a mirror. Later, discussions about a modification of the whole unit will take place along with the plans for a new guide system for the telescope. Using the existing unit, the necessary software for the fiber entrance is already in place in the telescope control system. The final modifications will be made on the unit once the fibers has been chosen.

Cabling and enclosure.

An inner enclosure has been designed and some of the parts acquired. The CCD camera and fiber exit will be outside this enclosure, which is mainly a light and dust protection. Another outer enclosure will be constructed onsite at La Palma. Specifications for this are to be worked out during the visit to La Palma. This is a thermal enclosure with some regulation included.

The cabling will also be defined during the visit. There will be two cables between the spectrograph and the control room: a serial RS232 or RS485 cable and an optical cable for the CCD controller. On the observing floor there will be optical fibers connecting the adapter unit with the spectrograph and the calibration unit. After the meeting at La Palma, the work involved with the actual installation of FIES at La Palma will be scheduled.

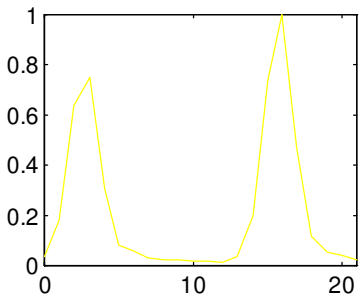
Resolution test with a Thorium lamp

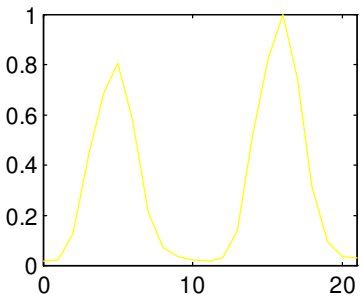
One more resolution test has been made. This time with a Thorium lamp. Since the CCD camera is not in function yet, we have used a cheap commercial CCD camera. This camera can not cover the whole field, so the test is made with just a couple of strong lines around 780 nm. The profiles of the two lines are seen below.

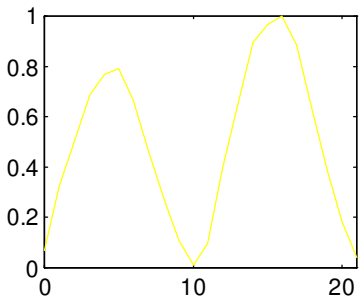
Three slit widths was used. The top right curve was made with a 90 micron slit. This is the nominal value specified in the design. To test the limiting resolution of the instrument one profile was taken with a slit size about a third of the specified value (top left). The bottom curve is made with the slit fully open. The slit size is here about 165 micron. All curves are normalized. The unit along the x-axis is pixels (size 8 microns).

The linewidths were found by fitting a Gaussian function to the left peak, and the width was taken to be the width of the fitted Gaussian. The linewidth of the lamp itself was neglected. The results are shown in the table below the curves. The spectral resolutions were calculated as described in the earlier report.

The conclusion is, as before, that the resolution target is reached. It also seems that the spectrograph has the capability of maybe 50% higher resolution if the slit is decreased. This value is achieved at one single point in the field with optimum focus in that point. In reality the focus varies over the field, so the figure might be a little optimistic, but a decrease of the slit should without doubt lead to a better resolution.







Slit size (microns)	FWHM Line width (Pixels)	FWHM Linewidth (microns)	Spectral Resolution
30	2.33	18.64	94000
90	3.44	27.52	64000
165	5.76	46.08	38000