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EUROPEAN SOUTHERN OBSERVATORY

Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral

Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

LA SILLA OBSERVATORY

LED / Optics

FEROS on 2p2 Telescope

New ADC Design

Technical Report

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	Name	Date	Signature
Prepared	A. Gilliotte	05/2003	
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Issue 1.0 Issue 2.0	Feb, 2003 May 2003	All	New design using a double prisms

1 Purpose.

After moving the Feros instrument from the 1m50 telescope to the 2m20, the instrument will use a sky aperture of 1.96 arcsec equivalent to 0.17 mm. For larger telescope Zenithal Distance (ZD) the atmospheric dispersion effect is important and part of the star light will be lost in a chromatic dependence. An Atmospheric Dispersion Corrector (ADC) is required and we present on this document a way to design it.
This document will be used as conceptual design to be reviewed accordingly.

2 Requirements

2.1 Conditions

For ZD larger than 35 deg, the dispersed light of the star is as long as the aperture diameter and losses will occur forward. Adding the seeing effect will even degrade the throughput with relative chromatic contributions. The single prism ADC element is not optimum to correct the chromatic effect until 60 deg ZD. A new double prisms ADC has been defined. A rotation ability on both prisms must be performed to match the telescope parallactic and the zenith distance angles. The ADC correction range will concern ZD angles from 30 deg to 60 deg.
Due to a reduced available space for the ADC mounting, the prisms must be as small as possible correcting only the chromatic dispersion for the science aperture of the fiber head.
The prism will require three functions to be added on the present adapter, an in/out and the two prism rotations. The rotation precision requires from 2 to 5 deg position error to simplify the position encoder choice.

2.2 Constraints.

Three constraints on the design:

- smaller size : 12.5mm diameter for a F/8 beam of 8mm not covering the second aperture hole at 16mm
- small distance from the fiber head: 54mm from the exit prism surface.
- defocus compensated to avoid telescope focus correction for in/out ADC.

Several ADC prism designs have been done in the past and the glass combination selected has been fully tested on other designs. The instrument wavelength range is not reduced by the glass selected, the UBK7 and LLF6.
The prism position angles are to be adjusted according the parallactic and zenith distance angles of the telescope available on the TCS. A tracking in rotation is required following the angle variations according the Zenithal Distance and the Parallactic angle. Close to zenith observations will not require the ADC. An automatic mode will have to be implemented to insert the ADC for ZD higher than 30 deg.

3 Design

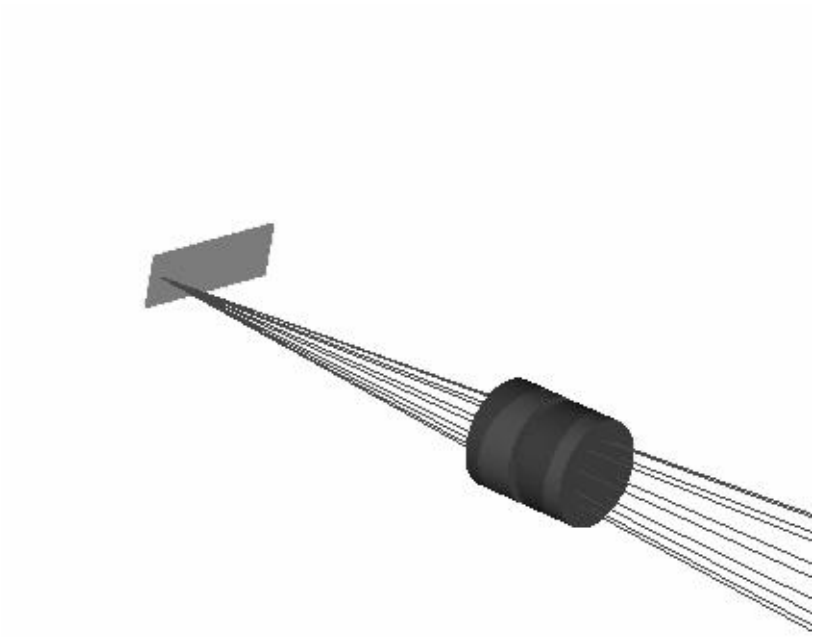
The prism sizes 12.5 mm diameter with an on axis thickness of 6mm. The “back focal “position is 54 mm from the fiber head (from the exit surface). The two prism separation is 1mm. The last surface is curved with a radius of 310 mm to compensate the prisms defocus. The both prism angle is 10.758 deg.
The prism is decentered by 8mm to fit the science aperture of the fiber head. The corresponding field offset is 1 arcmn 34 arcsec.
The opto-mechanical design must be with a minimum obstruction on the Prism area and not produce vignetting on the optical beam from M3. The WFI field must be also un-vignetted when the ADC support will be in park position.
A delay of 4 months at least must be expected for the prism delivery.

The lens data prescription of the ADC is presented below:

SURFACE DATA SUMMARY:

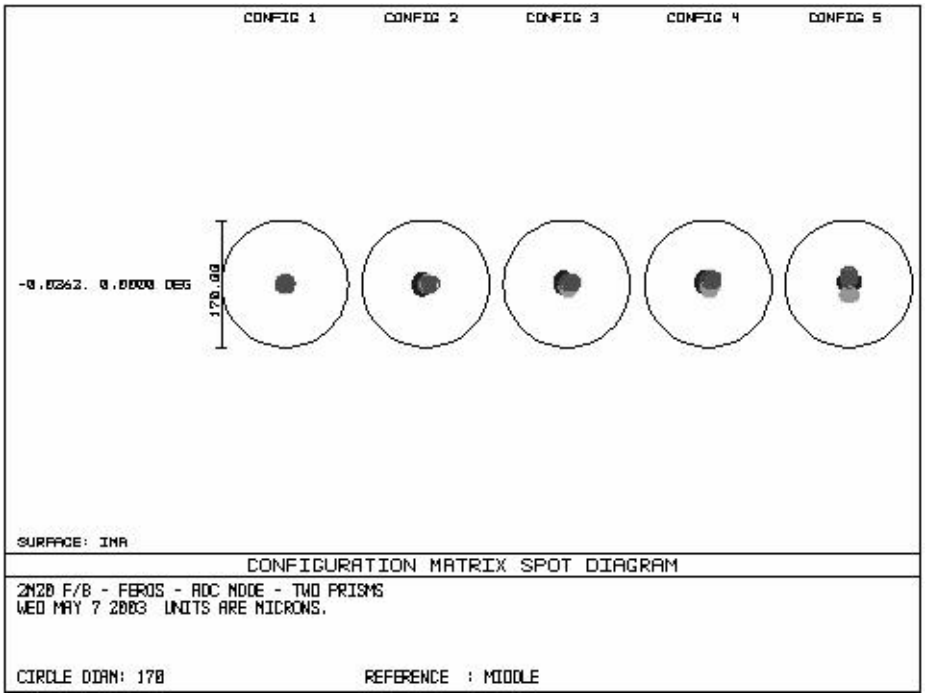
Surf	Type	Comment	Radius	Thickness	Glass	Diameter	Conic
OBJ	STANDARD		Infinity	Infinity		0	0
1	ATMOSPHR	ATMOSP. DISP	Infinity	0		2204.564	0
2	STANDARD		Infinity	5000		800	0
STO	STANDARD	MAIN MIRROR	-13200	-4475.071	MIRROR	2210	-1.134444
4	STANDARD	M2	-6816	5084.647	MIRROR	800	-6.5379
5	STANDARD	NEW SPACER	Infinity	20		0	0
6	STANDARD	M3	Infinity	-480	MIRROR	100	0
7	COORDBRK	DECENTER A	-	0		-	-
8	COORDBRK	ROTATION PRISM 1	-	0		-	-
9	STANDARD	ADC PRISM 1	Infinity	-3	UBK7	12	0
10	TILTSURF	PRISM ANGLE	-	-3	LLF6	12	-
11	STANDARD		Infinity	0		12	0
12	COORDBRK		-	-1		-	-
13	COORDBRK	ROTATION PRISM 2	-	0		-	-
14	STANDARD	ADC PRISM 2	Infinity	-3	UBK7	12	0
15	TILTSURF	PRISM ANGLE	-	-3	LLF6	12	-
16	STANDARD		310	0		12	0
17	COORDBRK		-	0		-	-
18	COORDBRK	DECENTER -A	-	-47		-	-
IMA	STANDARD		Infinity			16.05691	0

We also present below a shaded model view of the prism and fiber head area:



The two prisms are clearly presented above. Only the science beam reaching the science fiber aperture on the head is presented as specified.
The prism angle setting corresponds to a Zenithal Distance of 40 deg with respective angles of +- 29 deg.

On the next figure, the corrective effect of the prism is presented.



5 different configurations of the prism setting are presented.
The first one shows the star image at Zenith without the ADC prisms corrector.
The simulation is done for a temperature of 20degC, a Pressure 780 mbar as nominal condition for la Silla.
Starting at the second to the fifth simulations the telescope Zenithal distance change from 0, 30, 40 and 60 deg.
By the blur effect on the images the tolerance of 0.2 arcsec separation of the wavelength range edge images is not reached. At least 80% of Encircled energy is within 0.020 mm or 0.25 arcsec.
As expected a small spherical aberration is noticed with blurred images. A value of 0.23 arcsec d80%EE is obtained by the telescope focus position matching the WFI focal plane. The Feros focus position was optimized to match the same WFI telescope focus.

4 Conclusion

The double ADC prisms can be used for the atmospheric dispersion correction. The reached quality is enough with a zenithal distance of 60 deg.
A quotation request will be issued to estimate cost and delivery time.

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__ **J. Melnick** ESO La Silla Director

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