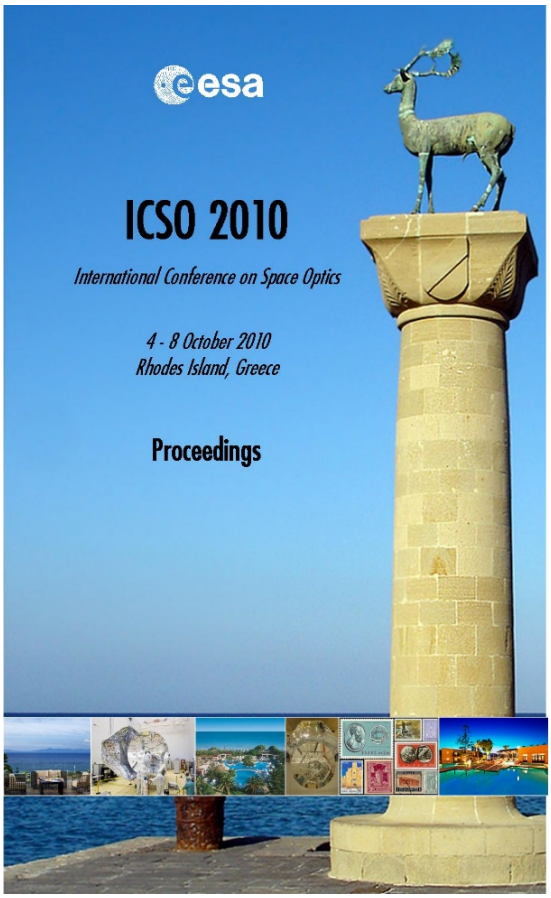
International Conference on Space Optics—ICSO 2010

Rhodes Island, Greece

4–8 October 2010



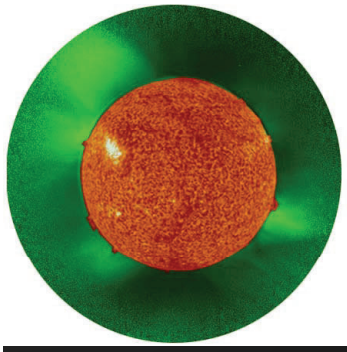
Edited by Errico Armandillo, Bruno Cugny, and Nikos Karafolas

Liquid-crystal tunable Lyot filter for solar corona spectro-polarimetry: tests and calibrations

G. Capobianco, L. Zangrilli, G. Massone, S. Fineschi, et al.

esa icso proceedings cnes

International Conference on Space Optics — ICSO 2010, edited by Errico Armandillo, Bruno Cugny, Nikos Karafolas, Proc. of SPIE Vol. 10565, 105655K · © 2010 ESA and CNES
CCC code: 0277-786X/17/$18 · doi: 10.1117/12.2552757



Liquid-crystal Tunable Lyot Filter for Solar Corona Spectro - Polarimetry: Tests and Calibrations

G. Capobianco[1], L. Zangrilli[1], G. Massone[1], S. Fineschi[1], A. Bemporad[1] ,V. Da Deppo[2], C. Benna[1]

[1]INAF-Osservatorio Astronomico di Torino, Italy
[2]CNR-IFN UOS Padova, Italy

Abstract

This presentation reports the laboratory tests and calibrations of a novel electro-optically tunable Lyot filter for imaging spectro - polarimetry. The filter's high-resolution bandpass ($\lambda/\Delta\lambda$ = 3.5 E+3) is centred on filter Fe XIV, 530.3 nm (green line) solar corona emission line. Performances of this Liquid Crystal Tunable-filter and Polarimeter (LCTP) are also compared with the performances of a classical very high-resolution ($\lambda/\Delta\lambda$ = 2.5 E+4) Fabry-Perot (F-P) etalon. The results of the tests show even if the F-P etalon has a higher instrumental resolution, the LCTP has the same effective spectral resolution thanks to its electro-optical fine-tuning capability in wavelength. In addition, the LCTP has the advantage over the F-P etalon of having no mechanically moving parts, polarimetric capability and to do imaging. This project is part of the ESA Startiger activities and part of the preliminary studies for the ASPIICS coronagraph for the PROBA-3 formation flying mission.

Device Description

The two devices are shown in Figure 1 and 2. The characteristics of both are resumed in Table 1.

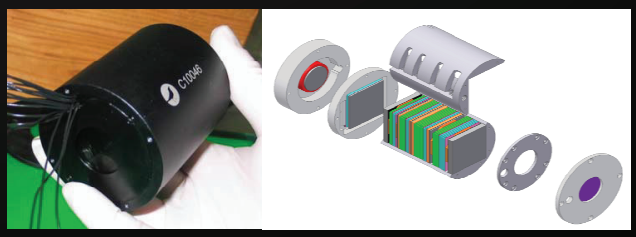


Figure 1 – Picture and schematic whole assembly of the LCTP

Filter	Etalon	LCTP
δλ *(nm)*	0.02	0.15
FSR (Δλ) (nm)	0.5	2.5
Finesse (F)	25	16
N° fringe at 20°	40	900 (Effective)
Spatial Res. (arcsec)	120	5
Trasmissivity	70%	35%
SNR/SNR_{F-P}	1	1.6

Table 1 – Comparison of some characteristics of the F-P etalon and the LCTP

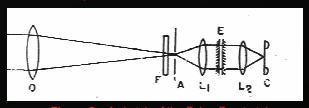


Figure 2 – A sketch of the Fabry-Perot etalon

The LCTP allows a full coronal image in the same bandpass at 530 [nm], the effective fringe number quoted in the table has to be compared with an etalon with the same performances.

Set-up Description

The set-up used for the calibrations is shown in Figure 3. The Detector is a 1024x 1024 pixels CCD Camera, with a pixel size of 25 micron and a resolution of 16bit. The camera lens L2 have a focal length of 1130 mm. The Bandpass of the monochromator is of 1A.

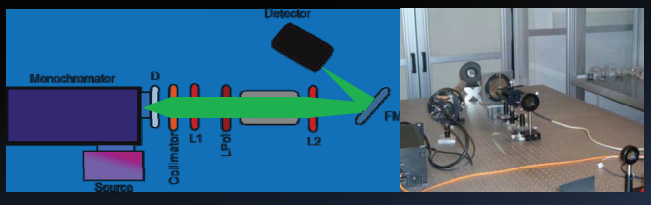
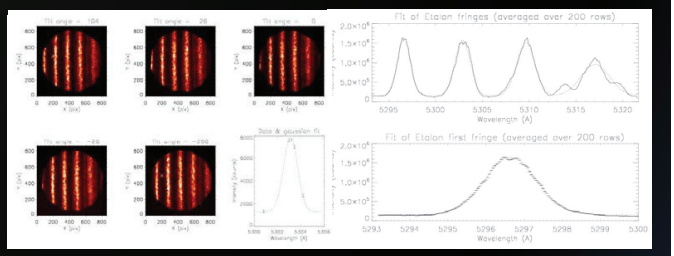


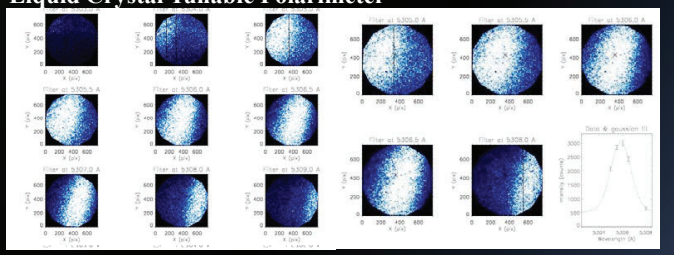
Figure 3 – Schematic view and a picture of the set-up used for the calibrations

Results

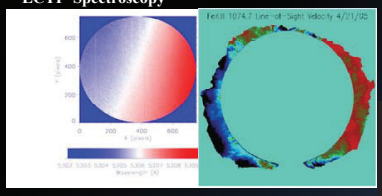
F-P Etalon



Liquid Crystal Tunable Polarimeter



LCTP Spectroscopy



The LCTP achieves all the spectroscopic performances expected with the F-P etalon

LCTP Polarimetry

The LCTP has additional science capabilities to respect the F-P etalon (e.g., polarimetry, simultaneous spectroscopy & high-res imaging) w/o requiring additional resources (i.e., mass and power)

Instrument	Fabry-Perot interferometer		Lyot filter	
N. of data	5	7	5	7
Δ(CW) (%)	~ 0.001	~ 0.0005	~ 0.001	~ 0.0005
Δ(FWHM) (%)	9-10	4-6	10-15	4-6
S/N range	~ 10-50		~ 8-40	
Countrate (s^{-1})	1.2 e+2		1. e+2	
*Dwell time (s)	~ 40-50		~ 50-60	

NB: uncertainties are 2-σ errors (95.4% confidence level)

* To derive the Gaussian profile's parameters with the above accuracy (i.e., above S/N range)

Aknowledgments

This research was funded under a grant of the ESA-Startiger Program

STARTIGER Formation Flying Coronagraph

ICSO 2010 – International Conference on Space Optics , 4th -7th October 2010 Rhodes, Greece