Nordic Optical Telescope Scientific Association

CASSEGRAIN ADAPTOR

for the

Nordic 2.5 m Telesope

Functions and how to use them

August 1989

Ralph Florentin Nielsen

Revision 1

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The instrument adapter interfaces the auxiliary instruments to the telescope and serve some functions that are common to all the instruments. The adapter contains an intensified CCD (ICCD) camera acting as a low light level TV camera. That camera is hereafter referred to as the "TV camera" to prevent confusion with the CCD camera mounted on one side of the adapter and which is an auxiliary instrument for direct imaging.

The TV camera is used for field viewing and autoguiding and - at a later stage also for monitoring the seeing.

The TV camera contains a channel plate image intensifier, which gives a very high sensitivity to faint light. In order not to harm the intensifier THE TV CAMERA MUST BE SWITCHED OFF WHEN THERE IS LIGHT IN THE DOME (i.e. at the observing floor).

The TV camera and its probe mirror are mounted on an X,Y carriage - ref. figure 1. Therefore the field of view of the TV camera can be selected by moving this probe.

The travel in the x-direction is 240 mm, symmetric w.r.t. the optical axis of the telescope, i.e. 120 mm to each side of the optical axis. As the telescope scale is 7.5 arcsec/mm the total travel in x therefore corresponds to 30 arcminutes.

The travel in the y-direction is 160 mm. With the probe in its mid-x position the y motion is radially into the field of the telescope. The travel is up to 40 mm passed the optical

axis, so the y travel covers from 120 mm to one side of the optical axis to 40 mm to the opposite side of the optical axis. The total travel in the y-direction, 160 mm corresponds to 20 arcminutes.

The guide probe (=X,Y carriage) is moved and controlled in steps of 1/1024 mm (=0.9765625 microns) corresponding to 0.0073.. arcsec.

The range of this probe has tentatively been determined to 725 - 243000 units of 1/1024 mm in X - low numbers are towards the orientation labelled West in figure 1, and 1000 -162000 in Y - low numbers are towards the South (towards the TV camera). Refer also to figure 2.

To view a star on the optical axis the guide probe should be brought to the following tentative coordinates:

x(c) = 121860 , y(c) = 121750.

To view a star in the focal plane aperture of an auxiliary instrument (e.g. a photometer) the Periscope mirror should be switched IN and the the guide probe set to (tentatively)

x(p) = x(c) - 90 * 1024 = 92160

y(p) = y(c) + 35 * 1024 = 157590

as the periscope return beam is located 90 mm to the west of the optical axis, and the periscope mirror is located 35 mm

behind the guide probe mirror. When having finnished using the periscope facility remember to command the periscope out (otherwise the periscope mirror will vignet the field of view of the TV camera.

To bring a star into the entrance aperture of the fiber optically fed photometer (from Tromsö) which is permanently mounted on the adapter, first center the star in the field of view of the TV camera. Then make an offset of the guide probe of delta x = + 38 * 1024 = + 38912
delta y = 0

These offsets must, however, be calibrated when the photometer is mounted.

The guide probe can be focussed to compensate for the following effects:
1. All auxiliary instruments may not have exactly identical back focal distance (nominally 210 mm from the instrument mounting flange to the focal plane of the telescope).
2. The optimum focal surface is not a plane but rather a spherical surface, the field curvature being 949 mm.
3. Various filters may be used in front of the TV camera. The optical path length is different for the different filters.

Re 1: This introduces a fixed offset that has to be calibrated for each auxiliary instrument.

Re 2: The farther away from the optical axis of the telescope the guide probe looks the farther the focus mooves towards the primary mirror. The resulting focus offset, delta f becomes:

delta f = R - sqrt(R^2 - ((delta x)^2 + (delta y)^2))

where R is the radius of curvature of the focal surface, = 949 mm

delta x = x(c) - x(set) guide probe's x distance from axis.

delta y = y(c) - y(set) - - y - - -

Re 3: delta f = - (n-1)/n * t(f)

where n = is the refractive index of the filter at its effective wavelength, and t(f) is the thickness of the filter. For the filters installed February 1989 this amounts to the values listed below.

Filters for TV camera serve to guide at a similar effective wavelength that the observations are carried out at. Thereby the effect of changes in the atmospheric dispersion during long exposures are minimized. Also for identification purposes the observer can choose e.g. to view his field in Blue and Red - corresponding to the blue and red ESO and Palomar Sky Survey charts.

The range of the focus setting of thew guide probe is 155 -

3847 focus units and covers a focussing range of nominally 50 mm. Hence, the scale 73.8 units/mm of focus travel. High numbered limit means that the focus setting is towards the primary mirror. One focus unit displaces the focus by 0.0135 mm, and the resulting effect is 0.009 arcsec change in the diameter of a stellar image per focus unit.

Number in filterwheel	Filter	delta f	Comment
1	Open	0	No filter
2	ND1.5	0.68mm	Grey filter, delta m = 3.8
3	Closed	0	Black brass plate.
4	3mm RG610	1.05mm	Red
5	3mm GG495	1.05mm	Yellow-Green
6	1.5mm BG12	0.52mm	Blue

NB: Nyt filter. →

Filters are circular 25.2 mm +/- 0.2 mm.

The filterwheel will accept filters up to a maximum thickness of 3 mm.

When the telescope is not in use or when the telescope is mooving from one field in the sky to another THE CLOSED

POSITION SHOULD ALWAYS BE SELECTED. This is to prevent accidentally overloading the TV camera. - the telescope might just moove across the full Moon during a position change.

The guide probe is equipped with an autocollimator for verifying the allignment of the telescope optics. Besides a lamp house with filter collimator and illuminated crosswire it consists of a beamsplitter that can be brought in and out of the field of view of the TV camera. The total autocollimation set-up also includes little spherical mirrors on the secondary and primary mirrors. It is used by switching the autocollimator on and mooving the beamsplitter in (by calling these functions in the adapter menu of the telescope control system).
The guide probe position for this test is tentatively:

x(a) = 122500 , y(a) = 120000.

Remember to switch off the autocollimator and moove the periscope out when finished with the autocollimation test.

Finally the instrument adapter contains a fast electromagnetic shutter and a filterwheel for the instrument CCD camera which will be permanently mounted at one side of the adapter - see separate description. This CCD camera is selected by commanding the CCD-camera-probe IN. Thereby a 45° optical flat deflects the central part of the telescope field onto the 512 x 512 pixel Tektronix CCD chip. In the preflash position

of the CCD-camera-probe a number of differently coloured Light emitting diodes is brought up in front of the CCD camera enabling a predefined preflash to be carried out.

When the CCD camera is not in use the CCD-camera-probe should be OUT, thereby admitting the telescope field to be sent to its normal Cassegrain position.

One filterwheel for the CCD camera (Filterwheel A) contains a set of standard filters listed below:

Position	Name	50% Wavelengths	Appearance
1	B(F)	BP 390 - 500	Blue
2	V(F)	BP 480 - 600	Green-Yellow
3	R(F)	BP 610 - 710	Red
4	I(F)	BP 760 - 880	Dark Red
5	Z(F)	LWP 850	Black
6	Open	No filter	(Clear)

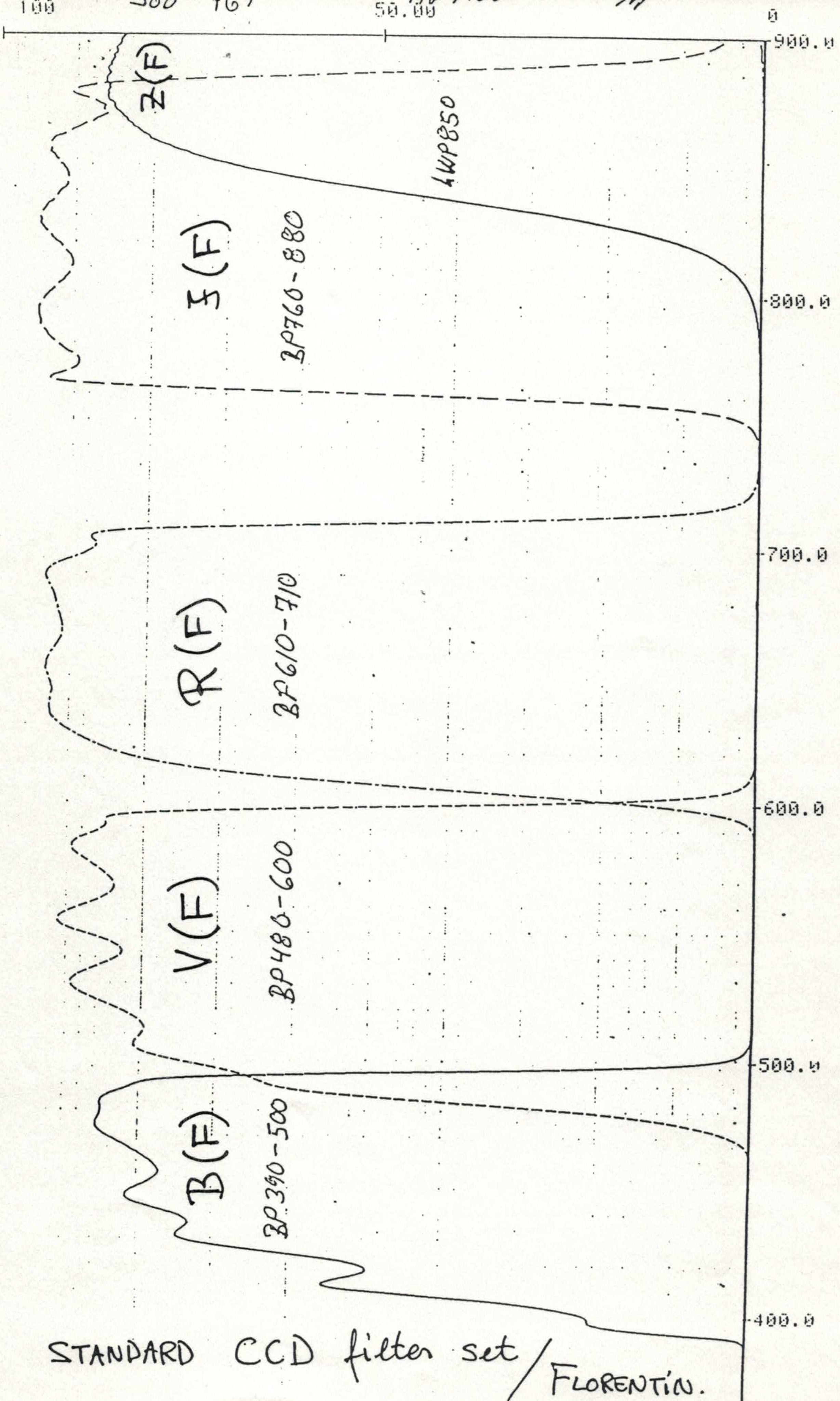
Filters are: BP = Band Pass, LWP = Long Wave Pass
Wavelengths are in nanometers (nm).
The filters are designed so that their spectral pass bands convolved with the CCD spectral response function approximates Johnson B & V and Gunn R, I & Z.
Filters have a thickness of 4.0 mm, and delta (f) = 1.4 mm.

Additionally four filterwheels, labelled B,C,D and E can be

equipped with filters to be supplied by the observer. Filters must be circular, diameter 25.0 - 25.4 mm and with a maximum thickness of 5 mm.

The fast shutter immediately in front of the CCD camera is intended for use as an ordinary timing shutter, but also to be used with the on-line seeing monitor (operating at the TV video signal - software not yet implemented) so that short periods of inferior seeing can be excluded from the CCD exposure. Thereby "better-than-seeing" images may hopefully be obtained.

SAMPLE ; S88-767 , DATE ; 7/3-1988 ANALYST ;



STANDARD CCD filter set / FLORENTIN.

Spectral Response
of CCD camera.