

Introduction

Order Separating Filters

Latest Update: 20 Nov 2004

The Hectochelle is, at present, a single order, multiobject spectrograph where overlapping orders are separated with narrow band filters. These filters have, in general, been designed with a full width, half maximum (FWHM) passband equal to the free spectral range (FSR) of each diffractive order. The center wavelength (CWL) of the pass is not that of the CWL at blaze, since this inevitably leads to some important wavelengths lying at the margins of the FSR. Instead, we have tried to center as many astrophysically interesting wavelength within the filter passbands, The diffraction grating is mounted on a precision rotary stage, making it possible to tilt the grating to arbitrary angles of incidence. The opening angle between the incident beam and the center of the diffracted beam is fixed at 15° . Operating slightly off blaze occasionally leads to a small loss in system efficiency, but offer big gains in efficiency in important spectral regions.

At present the Hectochelle has 11 order separating filters. Their relevant parameters are tabulated in Table tbd and their transmission curves appear in Figs tbd – tbd. Both the narrow band transmission curve and the broad band out of band blocking performance at shown. While the efficiency of the Hectochelle as a function of wavelength can be calculated with other information in the Hectochelle Manual (in prep.), a good figure of merit for system efficiency is the filter transmission-CCD quantum efficiency product, also tabulated in Table tbd.

The FSR of order 31 (~ 510 nm) is the same size as the CCD format. Orders blueward of order 31 are smaller than the CCD format; order redward overfill the focal plane. It is possible that lines redward of 510 nm will require a special tilt of the grating to move them onto the focal plane, a feature that is not currently implemented on Hectochelle. Consultation with the PI is advised if you are planning on working at line that is not reasonably well centered in the filter transmission curve. You may, however, calculate the position on the focal plane with the grating equation and the following parameters of the Hectochelle:

- Grating pitch: $\rho = 110$ lines/mm
- Blaze angle of incidence: $\alpha = 72^\circ$
- Blaze diffraction angle: $\beta = 57^\circ$
- Camera focal length: 25.3 inches
- Pixel size: 13.5μ
- Size of detector, dispersion direction: 2304 pixels, half width.

The filters with “OB” designators have been designed to match the FSR at blaze with minor adjustment to center scientifically important wavelengths. Na D, Ca H&K the

infrared Ca triplet required a significant recentering, so they have special designators. The RV filter has been designed explicitly for radial velocity studies.

A significant omission is a filter that covers the OI 630 nm line. This situation is due to a typographical error in the procurement process (hence the anomalous passband of the OB26 filter). A new filter has been order and should be available 2nd trimester of 2005.

An additional filter that is used in conjunction with a iodine vapour cell for precision radial velocity studies is also available, but this mode is still in development and the PI should be consulted before proposing observations in this mode.

| Filter | CWL | FWHM | Trans | Trans·CCD QE | Vendor | Included Features |
|--------|-------|------|-------|--------------|--------|---------------------|
| Ca 19 | 858.0 | 45.0 | 0.96 | 0.38 | Omega | Ca Triplet |
| OB 21 | 774.8 | 36.9 | 0.92 | 0.53 | Omega | |
| OB 24 | 670.7 | 28.2 | 0.92 | 0.71 | Omega | Li, [S II], He II |
| OB 25 | 656.3 | 26.0 | 0.89 | 0.71 | Omega | H α , [N II] |
| OB 26 | 663.2 | 24.1 | 0.89 | 0.71 | Omega | |
| Na 28 | 589.2 | 20.8 | 0.87 | 0.73 | Omega | Na D, He I |
| RV 31 | 523.0 | 16.0 | 0.94 | 0.78 | Barr | Radial velocity |
| OB 32 | 500.7 | 15.9 | 0.87 | 0.73 | Barr | [O III] |
| OB 33 | 486.1 | 14.9 | 0.93 | 0.78 | Barr | H β |
| OB 37 | 435.1 | 11.9 | 0.98 | 0.79 | Barr | [O III], H γ |
| Ca 41 | 395.0 | 9.6 | 0.96 | 0.72 | Barr | Ca H&K |

Table 1: Order separating filter properties

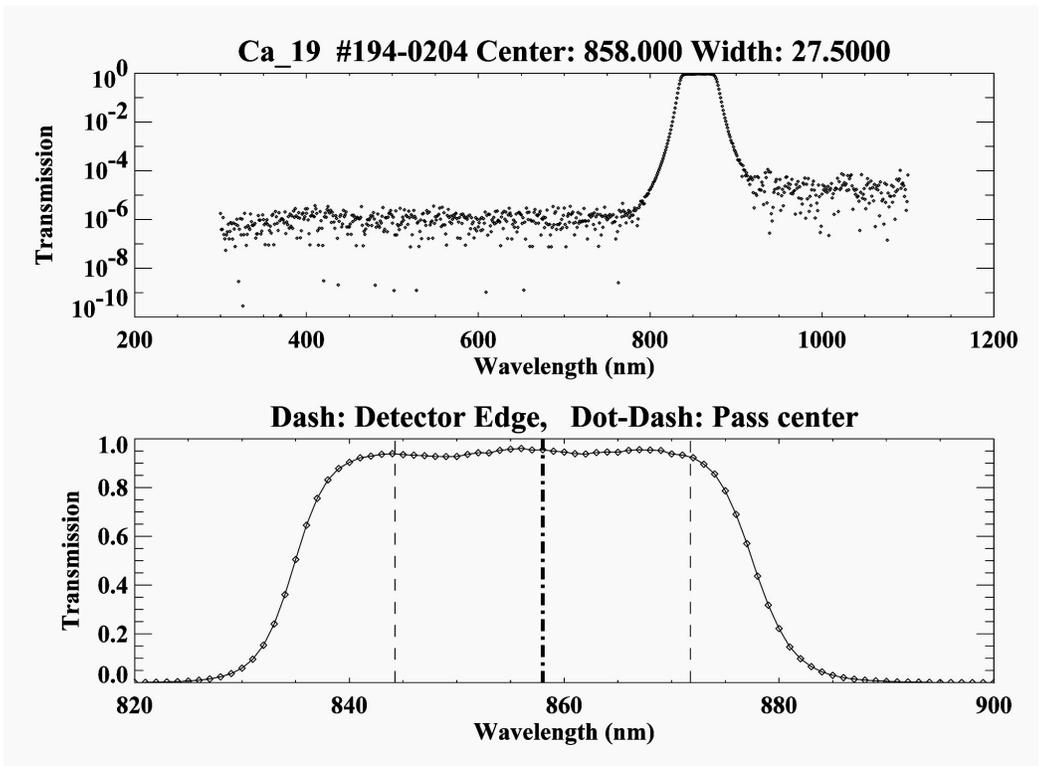


Figure 1: Transmission for Ca 19 filter. Upper panel shows out of band blocking, whilst lower panel shows detailed characteristics of this filter near pass center.

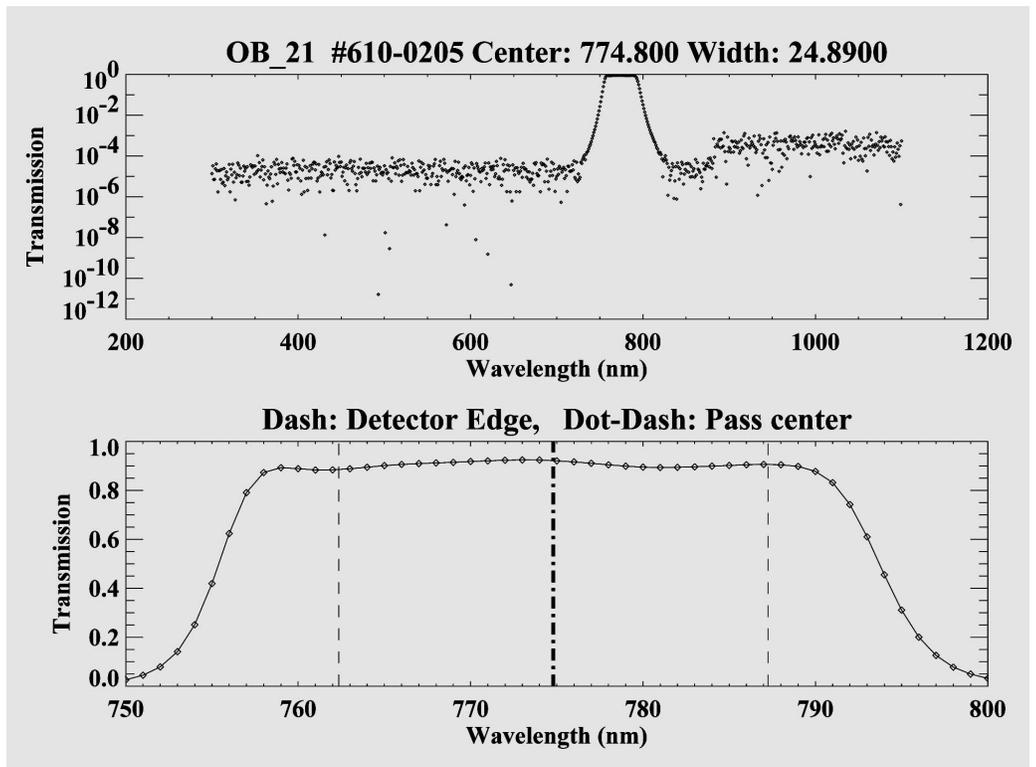


Figure 2: OB 21 filter transmission.

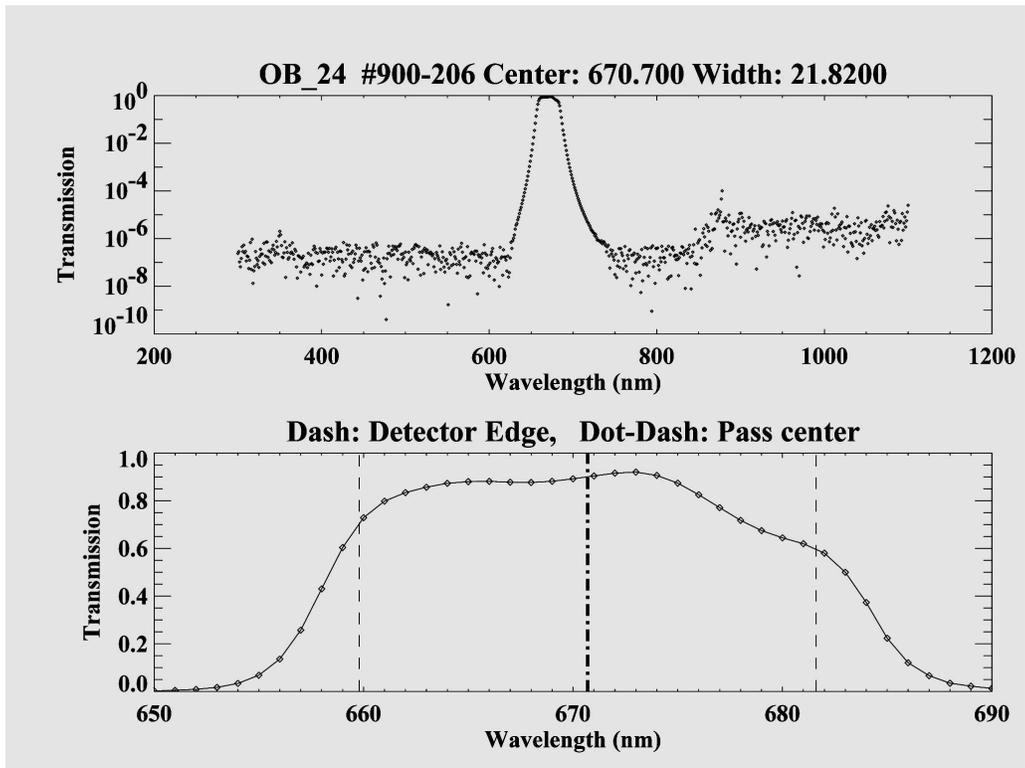


Figure 3: OB 24 filter transmission.

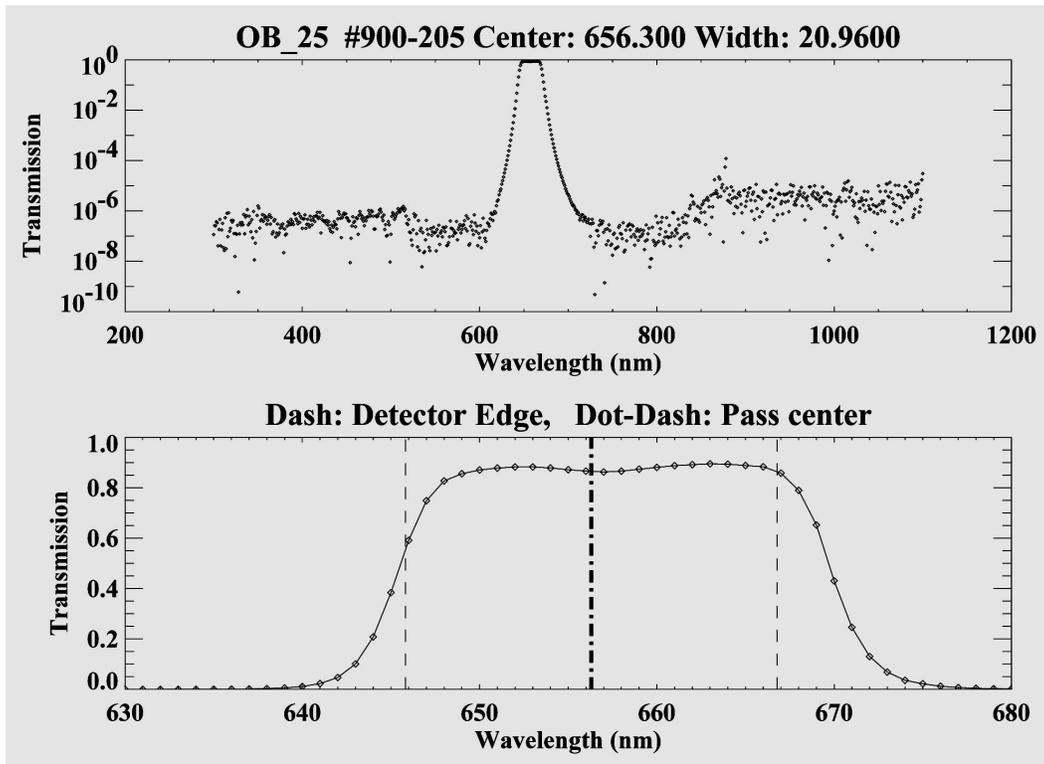


Figure 4: OB 25 filter transmission.

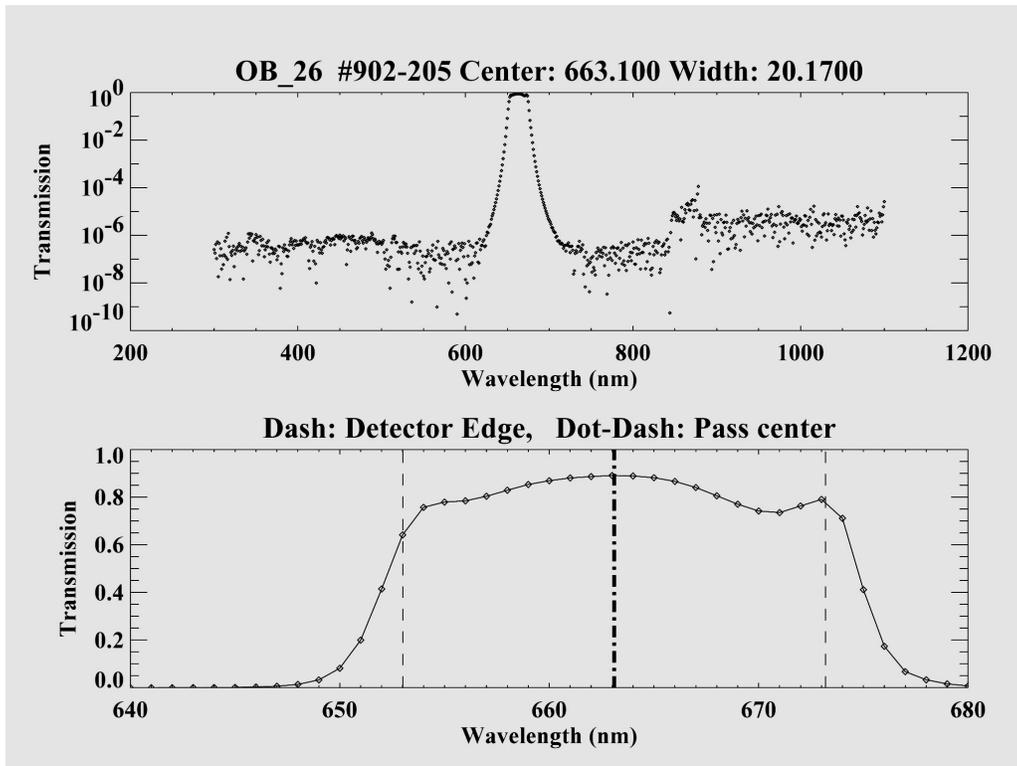


Figure 5: OB 26 filter transmission.

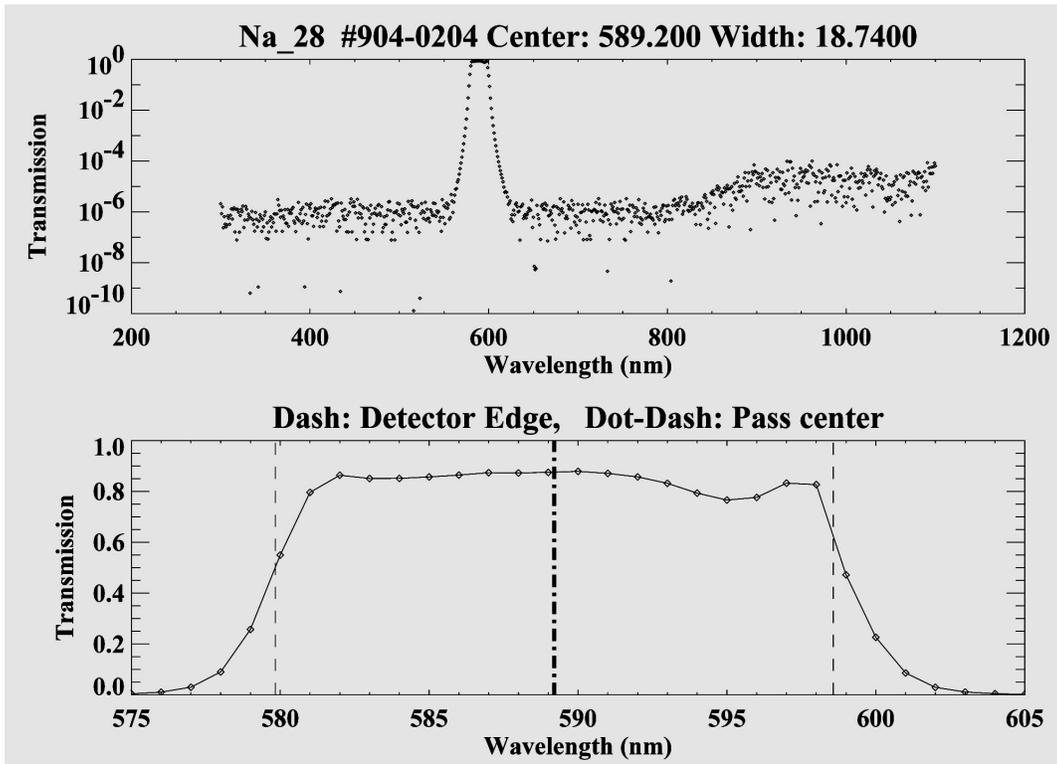


Figure 6: Na 28 filter transmission.

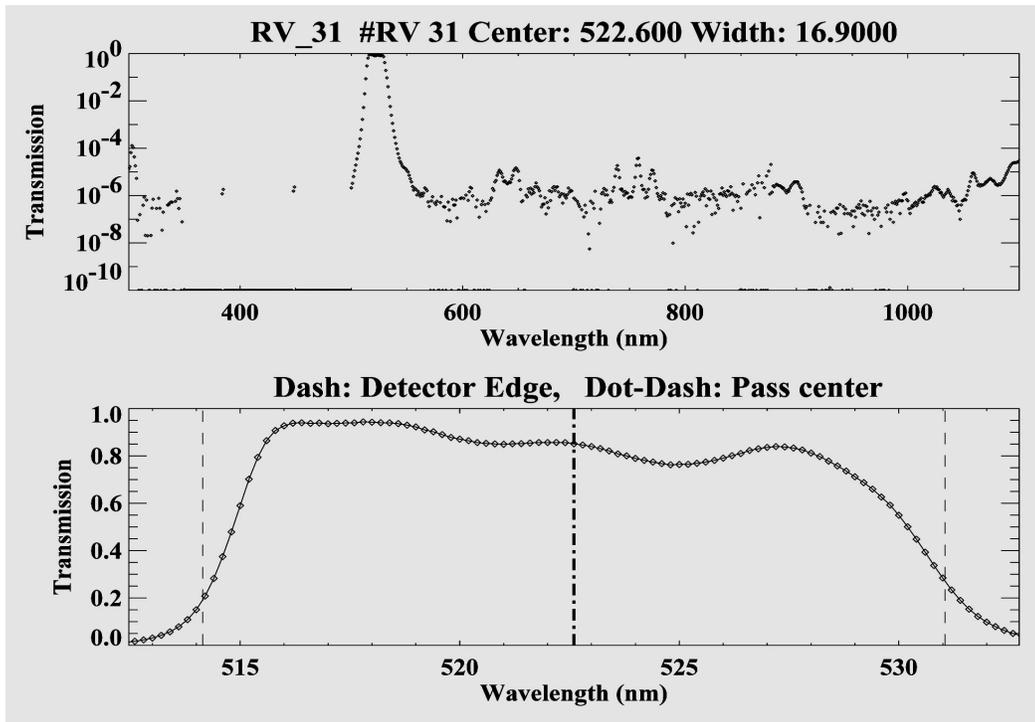


Figure 7: RV31 filter transmission.

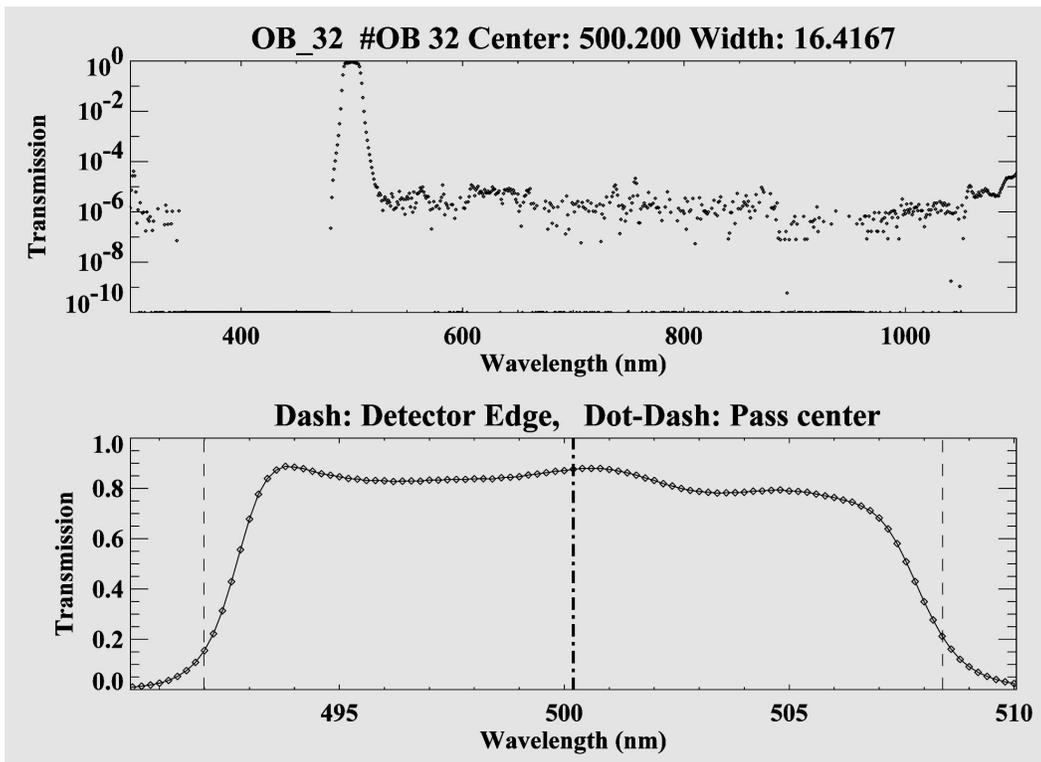


Figure 8: OB 32 filter transmission.

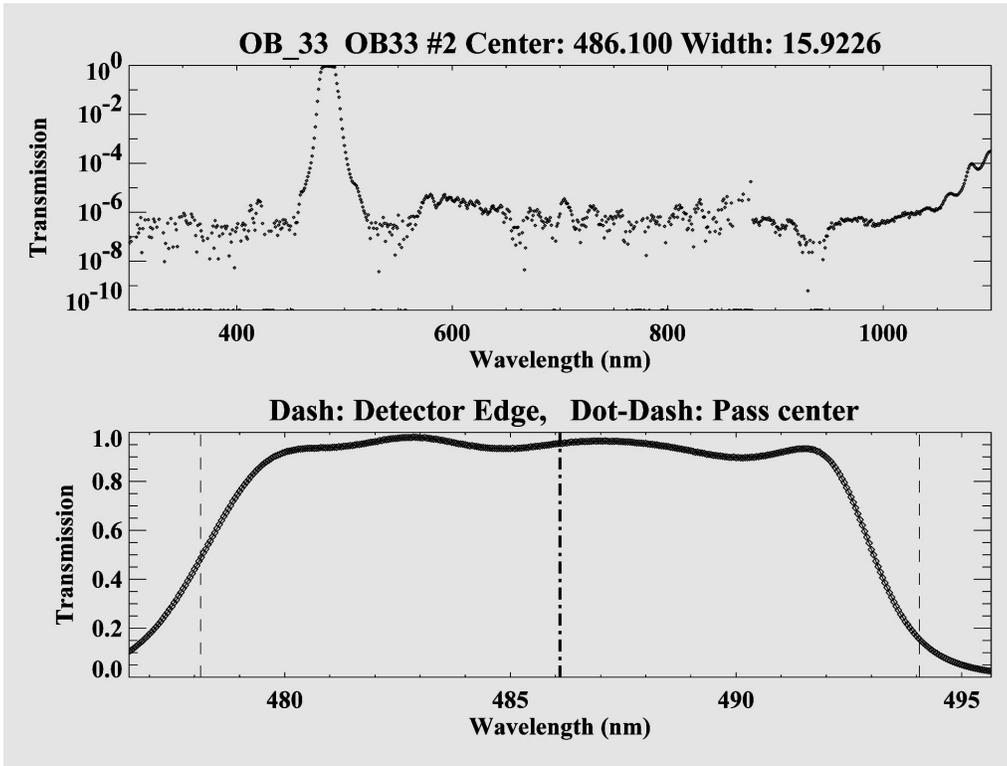


Figure 9: OB33 filter transmission.

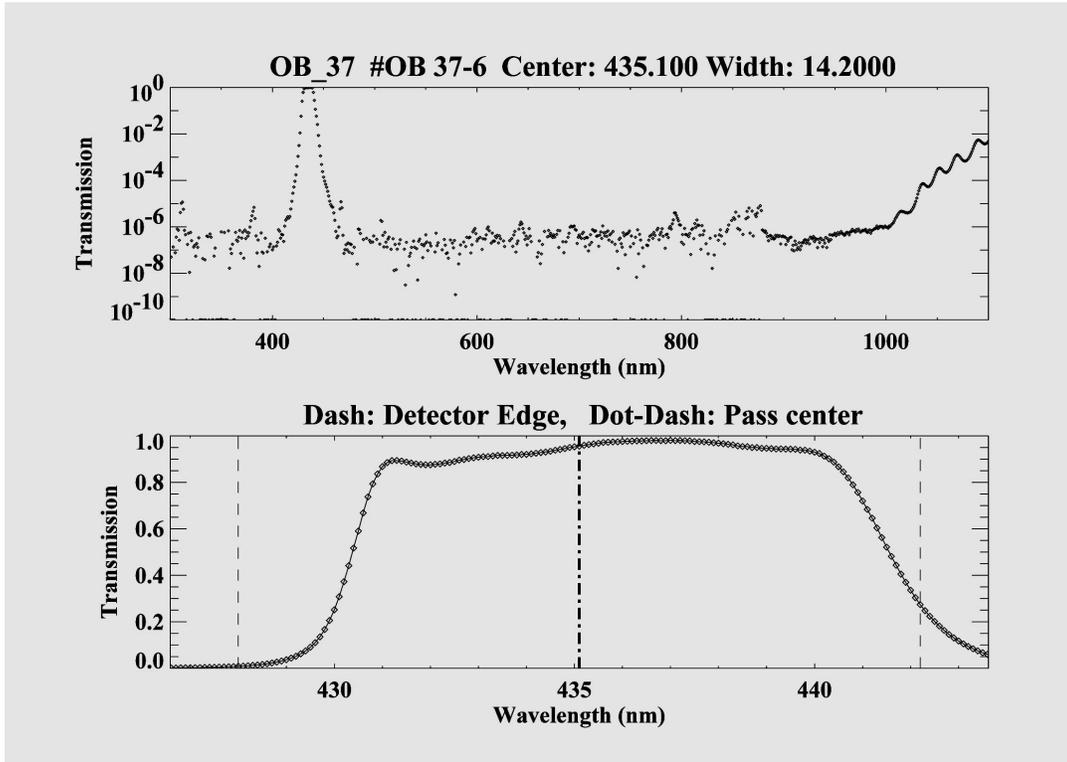


Figure 10: OB 37 filter transmission.

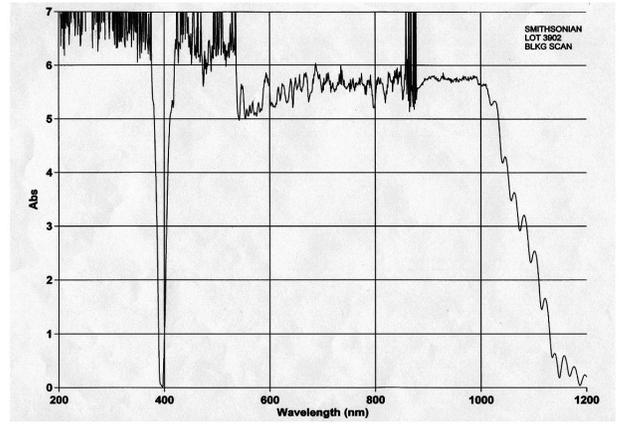
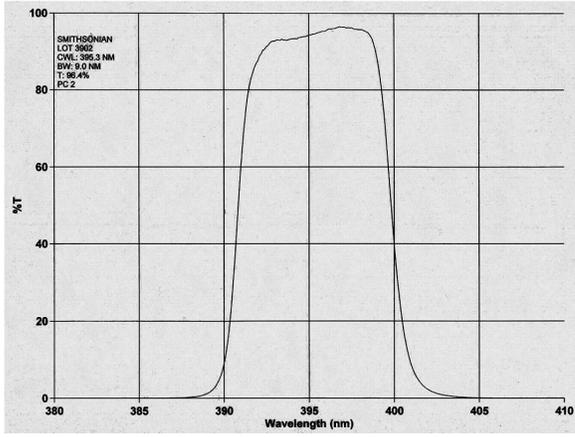


Figure 11: Ca 41 filter transmission.