

## FLAMINGOS Performance – IV

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22 February 2007

### 1. Introduction

This report is part of a continuing effort to characterize the performance of FLAMINGOS for both imaging and spectroscopic applications, concentrating on the investigation of spectral defocus.

### 2. Slit Image Quality

The first report (17 August 2006) was prompted by the discovery of a sudden change in the focus of the MOS wheel on the array during the Edwards run in June 2006. Previous spectroscopic runs (the most recent in February 2006) had shown the slits to be in good, although not perfect, focus during the imaging procedures involved in aligning the MOS masks to target fields. By contrast, the defocus of the MOS masks in the Edwards run was found by later experiments to be 2.0 – 2.5 mm, a very significant shift. Fortunately, the direction of the shift was such that the expedient of shimming the masks was sufficient to bring them into focus for following runs.

Another effect which may have appeared about the same time is a significant defocus of the OH lines seen in JH spectra at the long end of the H band. As with the slit focus, some of this was seen in archival data, but the magnitude of the effect appeared much greater as of June 2006.

In preparation for a block of both imaging and longslit spectroscopy at the 2.1-m, we investigated both the slit and spectral focus issues using a 2-pixel long slit on 21 February 2007. After going through the normal imaging setup and focus routine, we obtained “typical” image quality, with FWHM  $\sim 1.9 - 2.5$  pixels over the right three-quarters of the detector, degrading within the left quarter, particularly at the corners, where FWHM  $> 4.0$  pixels were seen. Within the “good” area, images were slightly worse ( $\sim 2.5$  pixels) at the top and bottom of the array.

Images of the two-pixel slit (Figure 1) confirmed this generally good image quality, as well as the continuing requirement for shimming the MOS masks up from the wheel (2.5 mm for this mask). There is some defocus of the slit at the bottom of the array, analogous to what is seen with stellar images and those taken through the pinhole array installed in a MOS mask.

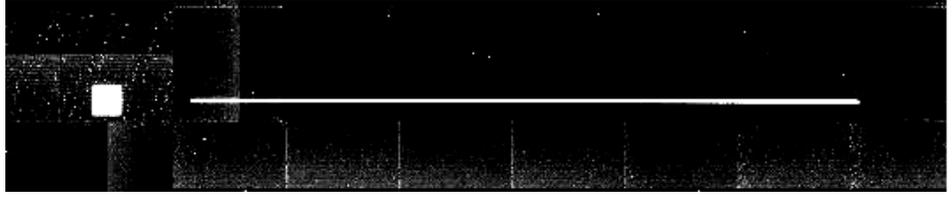


Figure 1: Image of custom NOAO 2-pixel longslit. The square acquisition box is near the center of the array and the hub end of the mask is to the right in the figure. FWHM of the slit ranged from 1.85 to 2.30 pixels as one moved from the center to the hub end.

### 3. Spectroscopic Focus

This issue was particularly noticeable during the Mercer run in July 2006, characterized by generally excellent focus of the OH lines in the J and short H bands (when doing JH spectroscopy) and significant degradation of the line width in the longer half of the H band. Spectra taken through the 2 pixel slit on 21 February 2007 show virtually identical effects (Figure 2).

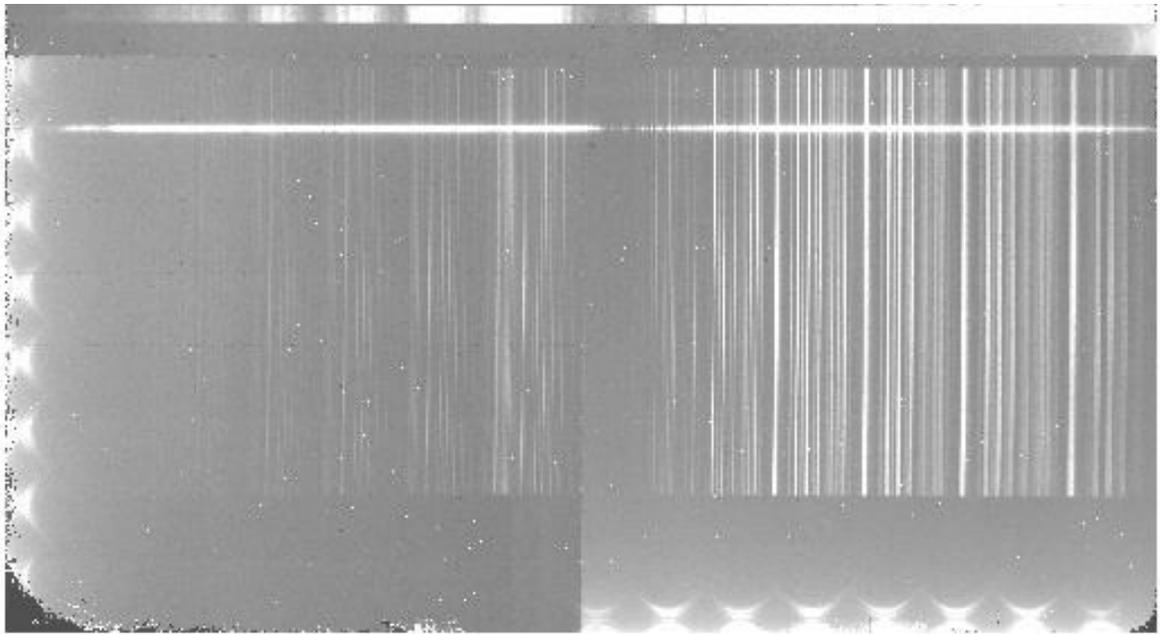


Figure 2. JH spectrum (180 s) through the longslit shown in Fig. 1. Note that the OH lines are in good focus through the J band and the short part of the H band but widen significantly at the long end of the H band.

The effect is quite large. The FWHM of unblended OH lines was typically 1.7 – 2.1 pixels through the J band to the second Q branch in the H band, but widened to 3.0, 6.5, and 8.0 pixels in the three longer wavelength R and P band regions. However, the spatial profile of the stellar spectrum does not appear to degrade noticeably over the JH region.

To investigate this further, a JH spectrum was taken through the pinhole mask. Although the five pinholes in each row will give a lot of overlapping OH 'spots', we get two-dimensional information about the spectroscopic image quality which a slit does not provide (Figure 3).

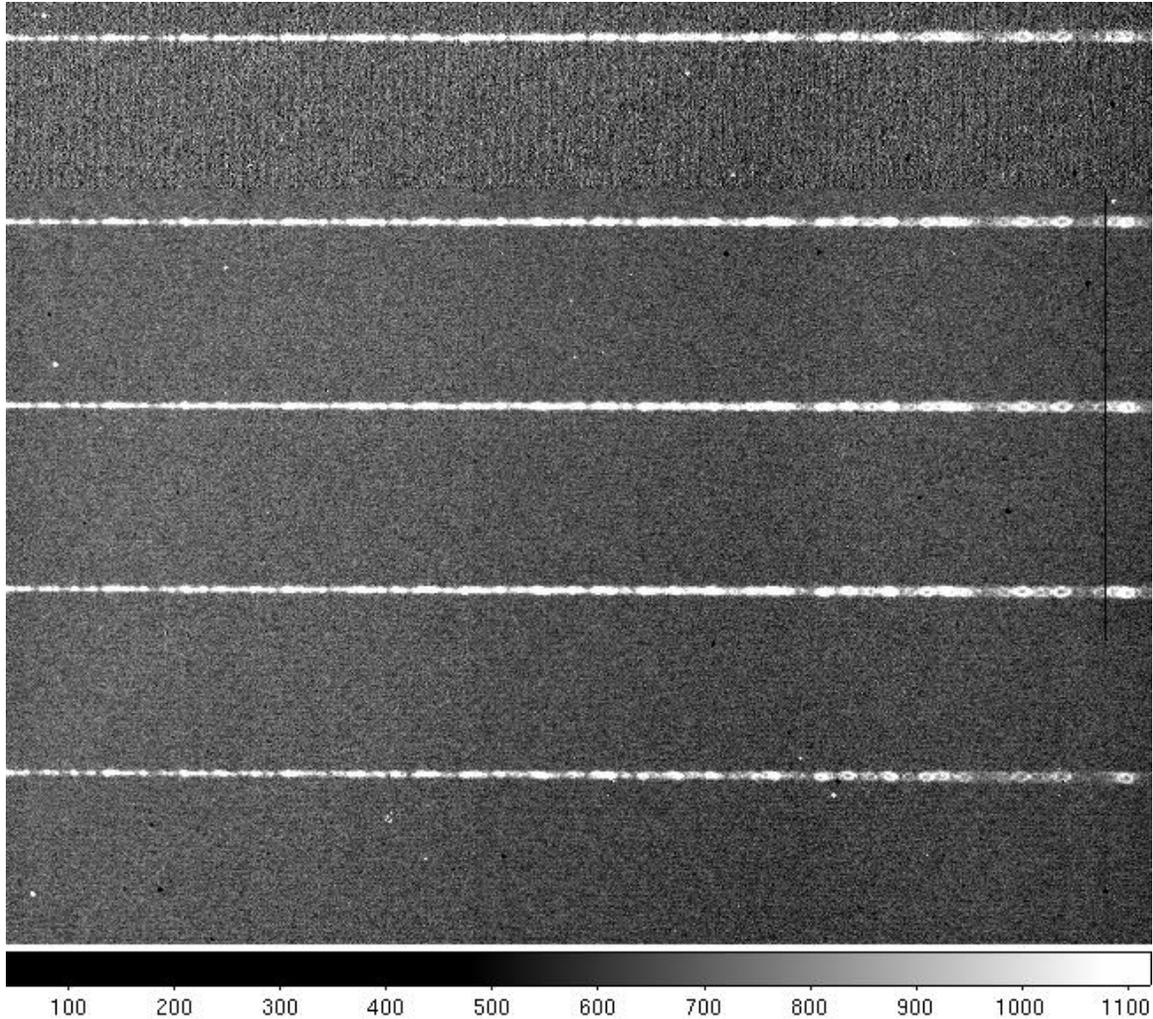


Figure 3. Sky spectrum in JH taken through the pinhole mask, extending approximately from column 1200 to 1950.

This spectrum clearly shows that the tight, circular OH spots near the center of the array (left side of Fig. 3) become defocused and highly astigmatic on the right side.

#### 4. Conclusions

The axially displaced focal plane (with respect to the camera dewar) and the degradation of the spectral resolution noted in June 2006 have remained unchanged. The pinhole spectra show the monochromatic spectral images to be highly astigmatic. The dispersion solution (wavelength vs. pixel) does not appear to have changed since we determined it several years ago.

A shift in one or more of the optical elements may be responsible for both of these effects, but it would require a visual inspection of the camera optics to determine this for certain. Modeling using the optical design might provide a clue whether such a shift could be responsible. A tilt of the array is an unlikely cause, since this would be inconsistent with the relatively uniform image quality over most of the array in imaging mode and would not explain the highly astigmatic monochromatic images in spectroscopy mode.

The stability of the system since June 2006 suggests that these changes are not a function of outside temperature or other environmental changes, but more likely the result of a sudden event which may have caused a change in the optical train. Since the spectroscopic performance is affected, this issue may deserve attention.