NIRSPEC

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NIRSPEC Optics Design Note 25.00
Front-end Distortion

1.   Introduction

The front-end optical design induces a non-axisymmetric distortion which depends on the relative orientations between OAP1 and OAP2. This document describes the amount and variation in the distortion.

2.   Distortion Plots

The following figures show a distortion grid. The grid is located in the object plane, i.e., in the sky. The "X's" show the location of the grid intersection points after being transmitted through the front-end optics. This diagram can seem confusing because the grid is in angular object space while the image points are in linear image space at the slit plane.

We can determine the relationship between the apparent box size in the grid pattern and actual physical extent at the slit plane. By listing the actual physical positions of the "X's" in Zemax, I have found that the object grid spacing covers about 2.0 pixels at the slit plane. So, the distortion creates a 2.5 pixel displacement in the y-direction for the extreme SCAM corner field points (46 X 46 arcseconds full field in the sky). By looking at subsequent figures, it appears that the "DC" distortion in Figure 1 is a good representative of the "radius" of the distortion wander. The distortion is less than 0.9% everywhere.

Note that this predicts that the distortion radius would be about a slit width in the SCAM corners. Of course, we don't have slits in that area, but this has implications for using an IR guide star which is in the corner of the SCAM field. Without correcting for this effect, we will not want to use guide stars so far on the edge of the field. Luckily, the distortion is a strong function of radius in the image plane, so much of the field near the center will be acceptable.

Figure 5 gives an average of the distortion radius as a function of field point. If we wanted to limit guide star-object motion to 0.1 resolution elements (slit widths), then we would require that the relative distortion wander be less than 0.28 pixels. This would limit the distance between the guide star and the object to within 10 arcseconds, unless we make explicit account of this distortion wander in the telescope/instrument pointing model.