Southern African Large Telescope
Prime Focus Imaging Spectrograph
Optical Integration and Testing Plan

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1. Scope

This document, the Optical Integration and Testing Plan describes the procedures for the integration and alignment of the main optics onto the PFIS structure. Alignment of the lenses within their cells and the inter-cell alignment of the camera and the main collimator group will be handled by the Pilot Group, described in the Opto-Mechanical CDR documentation.

2. Optics Breakdown

The main optical system breaks down into several sections, each of which will be integrated individually.

- Field Lens
- Main Collimator Group
- Fold Mirror
- Collimator Doublet
- Camera

3. Integration and Alignment

The integration and alignment plan for each of the above optics groups will be described in more detail in this section in the order in which they will be integrated. To aid in the alignment process, a laser alignment jig will be fabricated. This jig, which will also be used for the pupil illumination lamp, will mount to the bottom of PFIS, attaching to the Field Lens holder and matching the guider footprint. The laser beam will be centered in the collimator tube.

3.1. Main Collimator Group

The main collimator group barrel will be inserted first into the structure. This group will define the optical axis relative to the instrument axis. Alignment in tip-tilt and z will be adjusted by shims at the base of the barrel, while x-y positioning will be set using adjustable screws.

3.2 Field Lens

Once the main collimator group is inserted and aligned, the field lens will be set in place. The field lens has adjustments in 5 degrees of freedom. The tip, tilt, and piston adjustments are accomplished with three screws that bear kinematically in the axial direction. The centering adjustments are accomplished with two screws that bear in the radial direction and cells that are flexured for motion in the radial direction.
3.3 Fold Flat

The fold flat will then be attached and verified to lie centered up with the laser beam through the main collimator optics. The pupil illumination lamp will replace the laser beam and the beam footprint at the flat will be observed and any adjustments made to the optical alignment.

3.4 Collimator Doublet

The collimator doublet, like the field lens, has 5 degree of freedom adjustability. The fold flat will be adjusted so the laser is centered up in the doublet. Another flat can be inserted after the doublet to put the collimator into an auto-collimation setup.

A pinhole and camera system will be inserted into the focal plane and the return spot measured while adjusting the positioning of the collimator doublet. This will ensure the best possible collimation.

3.5 Camera

The camera will be received integrated into the camera tube. Once the articulation mechanism has been integrated onto the structure, the camera tube can be placed into the articulating cradle. Shim adjustments will be made at the contact points for tip-tilt and x-y adjustments.

3.6 Assorted Optics

Various optics will need to be inserted and aligned in their holders and associated mechanisms. These include the waveplates, the waveplate blanks, the gratings, the beamsplitter, and the filters.

The waveplates and waveplate blanks will be inserted into their holders with an RTV seal. The gratings will have adjustability in their holders.

After assembly of the main optics and the integration of the grating insertion mechanism, final alignment adjustments will be made on the gratings to ensure that the dispersed beam is centered in the camera.

Shim adjustments will be made to the beamsplitter and polarimetric tests performed to ensure proper alignment.

4. Required Laboratory Equipment

A calibration setup will be developed for aid in integration and alignment, as well as acceptance testing. This calibration setup will be a structure that mounts to the field lens assembly at the guider footprint. The structure will allow for the placement of a pupil illumination lamp at the entrance pupil. Additionally, a laser will be attached and centered up with respect to the center of field at the focal plane and the collimator tube, as mentioned above.
An autocollimation setup will consist of an input lamp, beamsplitter, and small CCD camera for imaging of the return spot. This setup will insert directly into the slitmask rollers attached to the bottom of the field lens assembly, ensuring a precise placement at the focal plane.