HARPS HIGH EEFFICIENCY FIBRE HEAD OPTO-MECHANICAL DESIGN

Design document - **APPENDIX** 06 May 2005

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Measurement errors in the determination of the optimum fiber – lens alignement should be taken into account in the final error budget. We have already seen (section 2.3 of the opto-mechanical document) that the lens can be glued concentric to the fiber within 2μm. Back-illuminating the fiber with a laser (with a wavelength close to 550nm) and projecting the beam into a screen 20cm away from the fiber surface allows us to easily detect on the screen a 2μm offset of the lens with respect to the fiber. A ZEMAX simulation with the above parameters indicates that to a 2μm centering error of the fibre – lens system, corresponds a decentering of the beam spot in the test screen of 0.6mm. This decentering is easily measurable.
Figure 1 shows the decentering as seen in the test screen located 20cm away from the fiber – lens system for an offset of the lens with respect to the fiber of 5μm. The decentering is obvious.

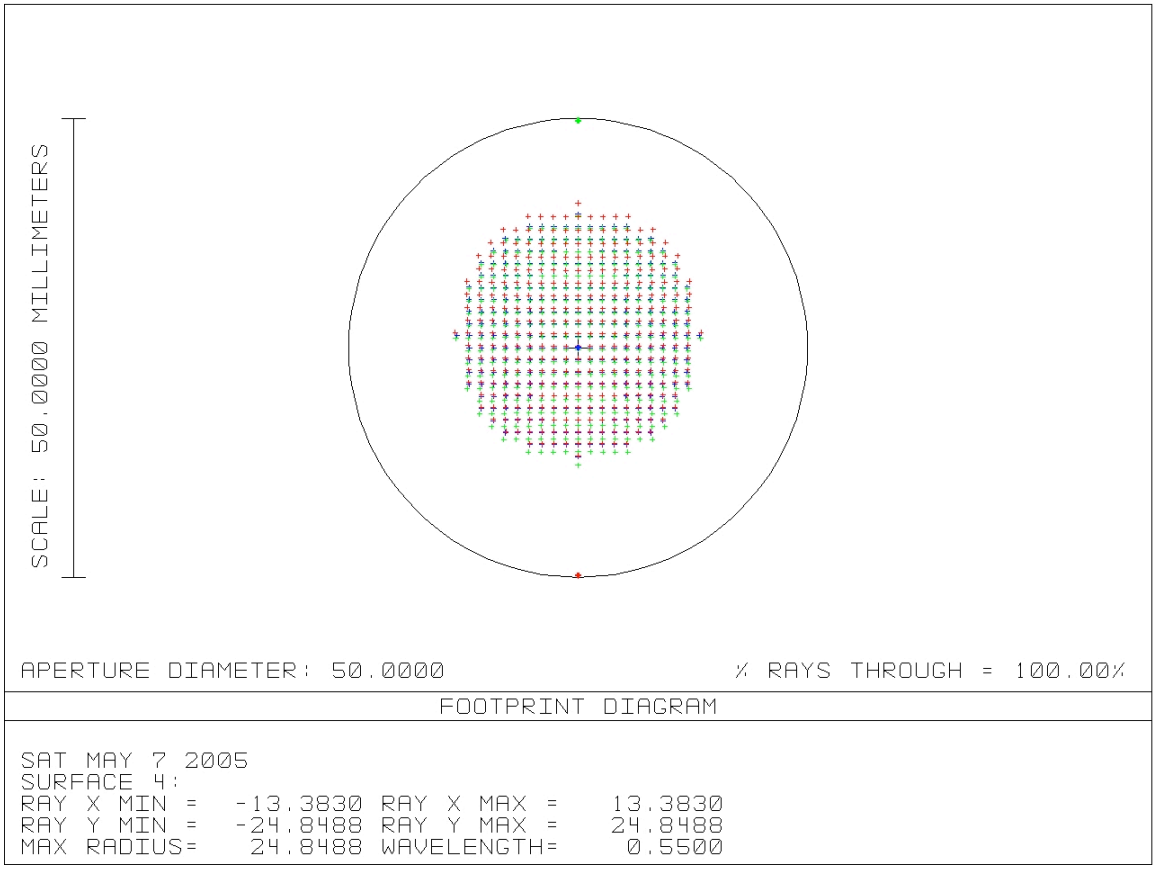

Figure 1: Footprint on a test screen 20cm away from the lens , due to a 5μm offset of the lens with respect to the fibre.

There is a degeneracy between the fibre-lens offset and the lens tilt. A small lens tilt (<10 degrees) produces a decentering on the test screen, similarly to the fibre-lens decentering case. A tilt of 0.25 degrees introduces a decentering on the screen of 0.5mm.

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The measurement error in the determination of the optimum alignement between the fibre-lens and the mirror hole is easier to calculate. The 100μm fiber has a footprint of (about) 200μm 770μm away from the lens, where the mirror plate is located. This in turn has a footprint of 5cm on a screen 20cm away from the lens. A 4μm misalignement of the fibre – lens with respect to the mirror plate hole corresponds to a 1mm vignetting on the test screen, which is easily measurable.

The alignement error computation performed here and in section 2.3 of the main document lead us to state that the losses at injection due to alignement will be below 10%. To this, losses due to reflection from the rod lens have to be added.