LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY
- LIGO -
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Engineering Note	**LIGO-E0900126-01-I**	2009/05/08

LLO HAM6 AFWFS installation

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1 Required Equipment

2	Class A	DLC mount, 2" post, fork, hardware
1	Class A	FMP2 Fixed lens mount, 2.5" post, fork, hardware
1	Class A	(waivered) REO beamsplitter E040512-B3 (R = 90%)
1	Class A	CVI r=257mm plano convex lens
1	Class A	CVI 50/50% beam splitter
1	Class A	CVI R=97% beam splitter
1	Class A	CVI Y1 steering mirror
1	Class B	tools
		GDS workstation

2 Installation goals

This procedure will install AFWFS sensing on the OMC REFL beam path. There are two parts: a) control the OMC REFL power incident on the QPDs and b) set the relative Guoy phase at the two sensors. The first task is accomplished by a beam splitter which transmits a small fraction (3% or 10%) of the OMC REFL beam to the QPDs. The second task is accomplished by a single lens and appropriate positioning of the QPDs.

3 Power splitting

During S5, there was approximately 100 mW of light at the dark port during 7 W operation. With 28 W into the mode cleaner, we can expect 400 mW at the OMC REFL port. With the 10% beam splitter, each QPD will have a maximum of 20 mW of light – just about the perfect amount of light. The 3% splitter will also be good and extract a shot noise limited noise penalty of less than a factor of 2, with a factor of 3 more safety margin. The QPDs are protected by the same shutter system which protects the OMC.

4 Guoy phase

The waist sizes involved are all about 500 μm, with a corresponding Rayleigh range of 80 cm, so none of the QPD positions are particularly sensitive. The general principle is to set a lens so that there is a waist, and then place the QPDs symmetrically about the waist. This ensures that the beam size and thus the DC gain is approximately the same at each QPD. For the lens and waist sizes shown in Figure 1, the separation between QPDs is 73 cm, and the waist size at each QPD is 500 μm. The waist in between the QPDs is 350 μm. A layout which realizes this telescope is shown in Figure 2, however, the beam can be folded in anyway which fits on the existing table and mass arrangement.

From Zemax the distance from the OMC to the lens is 0.96 m. The waist of the AFWFS telescope is at 1.76 m, and the QPDs need to be spaced by about 75 cm around this waist

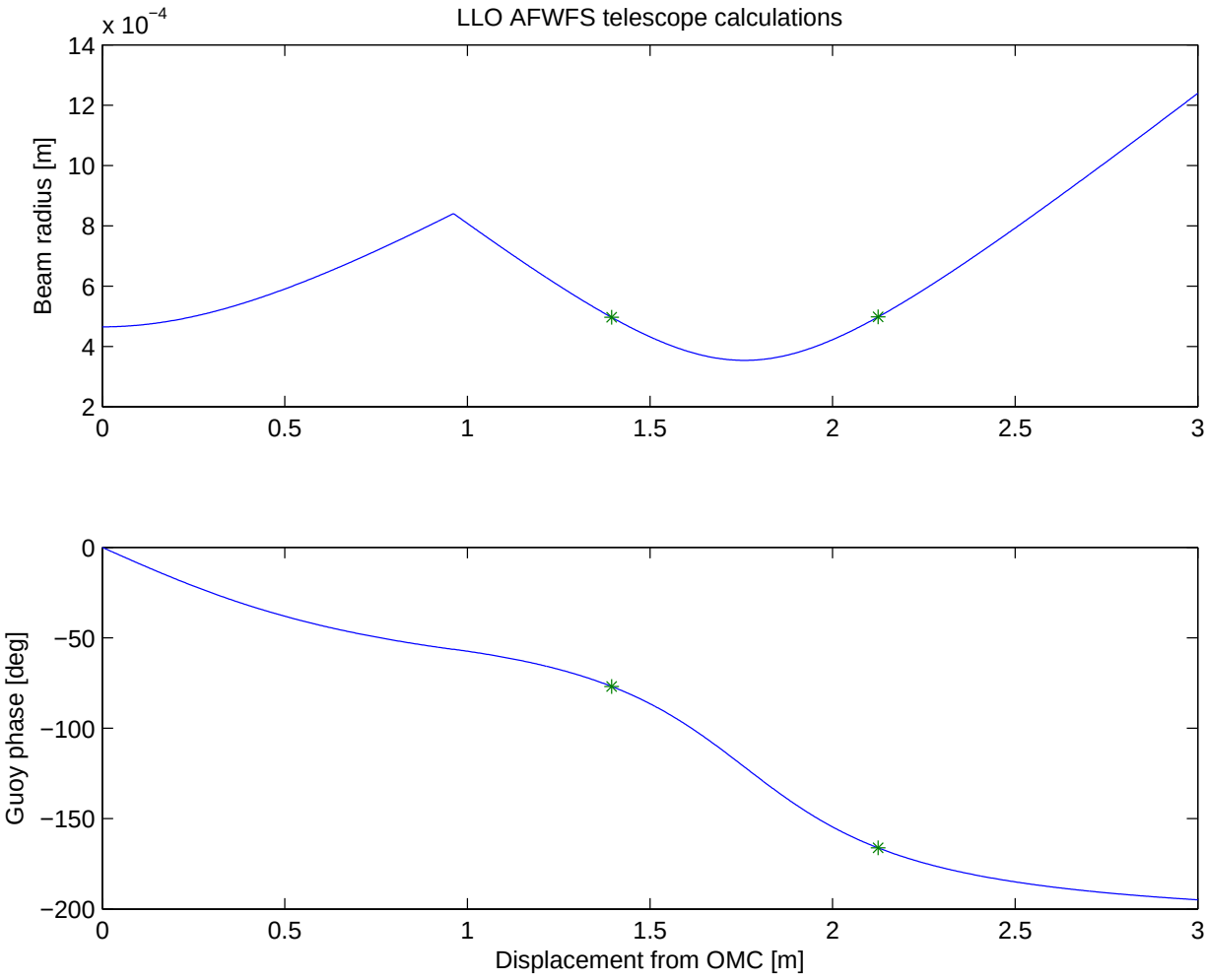

Figure 1: Existing HAM4 installation.

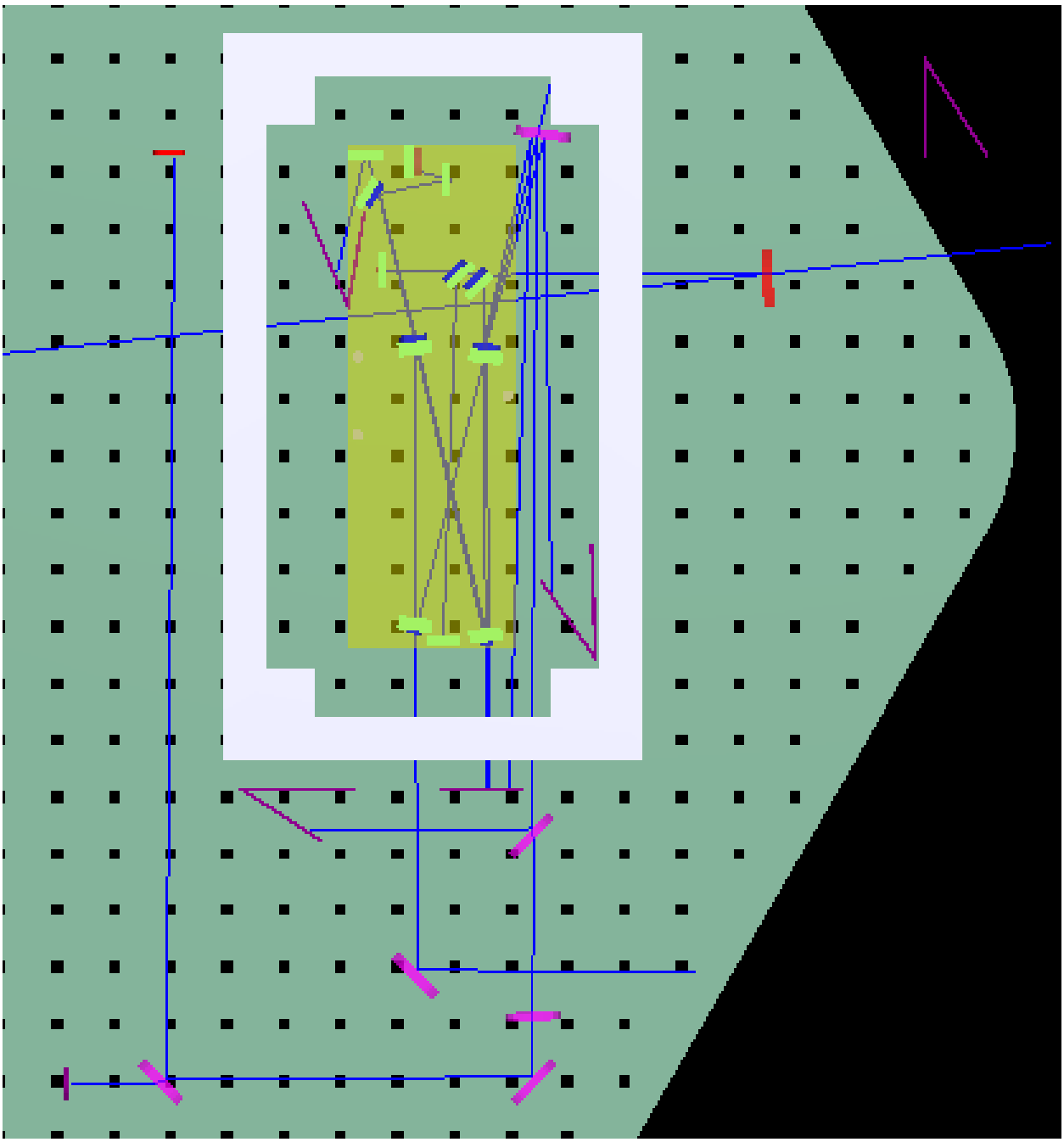

Figure 2: Existing HAM4 installation.

position. The waists at the QPDs will be about 500 microns. This puts QPD1 at 43 cm from the lens and QPD2 at 116 cm from the lens

5 Existing HAM6 installation

The OMC REFL path currently has a pick off extracting a part of the beam for the OMC REFL camera view. We need this DLC mount for our AFWFS installation. The pick off is replaced with the REO R=90% beamsplitter, and the beam dump rearranged appropriately. Two new DLC mounts are required, as well as the FMP fixed lens mount. Also, the OMC trans beam and the OMC REFL ghost beam that are currently dumped on a black glass V may need to be dumped on a single piece of black glass from the same mount, twisted at an angle.

6 Detailed procedure

1. Lock the input mode cleaner, and align the main IFO IR beam to the output mode cleaner QPDs.
2. Use the OMC R EFL beam to align the REFL path appropriately.
3. Check, think, and repeat.