

BHD Mode Matching

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1 AS Path

Table 1: Telescope design for AS path.

Component	AS1	AS2	AS3	AS4
Position z [m]	0.7192	1.2597	1.8658	2.5822
RoC [m]	2.8	Inf	-2.0	0.60

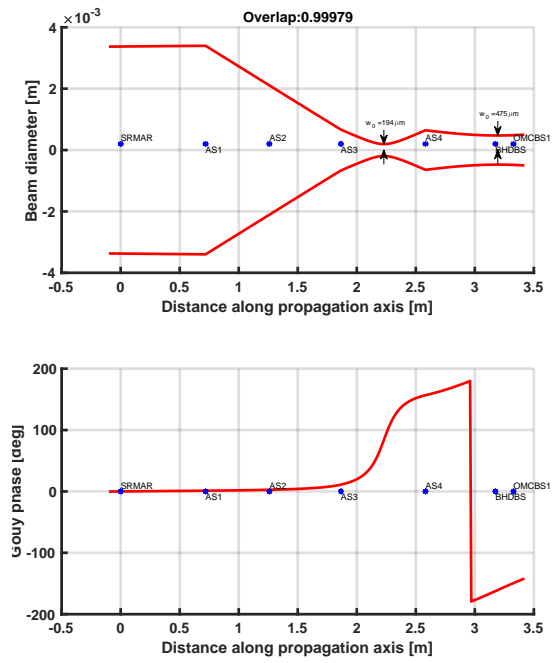
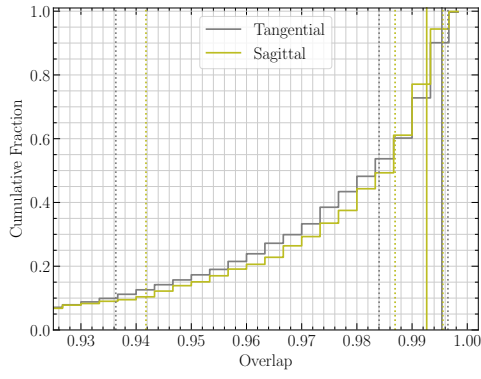
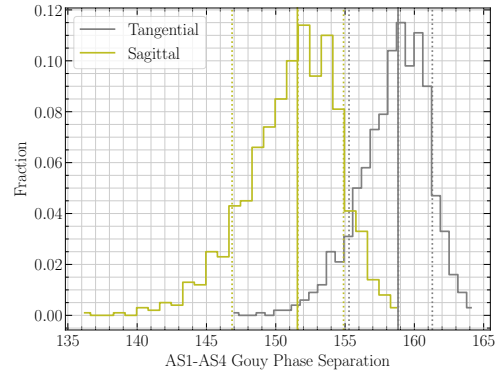


Figure 1: Beam profile for the AS path.



(a) Cumulative histogram of overlap.



(b) Histogram of Gouy phase separation.

Figure 2: Left: cumulative histogram of mode overlap. Right: histogram of gouy phase separation between the two actuator mirrors. In both plots, we use grey (olive) traces to represent the tangential (sagittal) plane. The solid-vertical lines are for the nominal values and the dotted ones are the (10, 50, 90) percentiles of the distribution. When generating the distribution, we have assumed a Gaussian error on the location z of each component $\sigma_z = 5$ mm, and a fractional error on the RoC $\sigma_{\text{RoC}} = 1\%$.

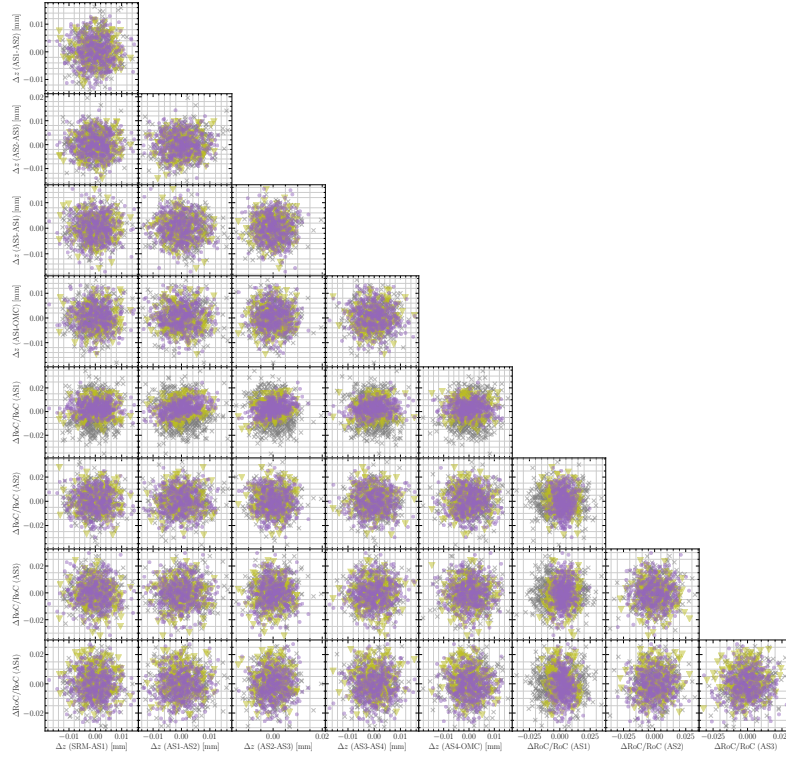


Figure 3: Scattering plots of the mode-matching (MM) vs. errors for the tangential plane. We color-coded the plots according to the MM. The purple dots corresponds to those with $MM > 0.99$, the olive triangles with $0.98 < MM \leq 0.99$, and grey crosses with $MM \leq 0.98$. The MM is most sensitive to the AS1 RoC error, and can be compensated by moving the distance between AS1-AS3.

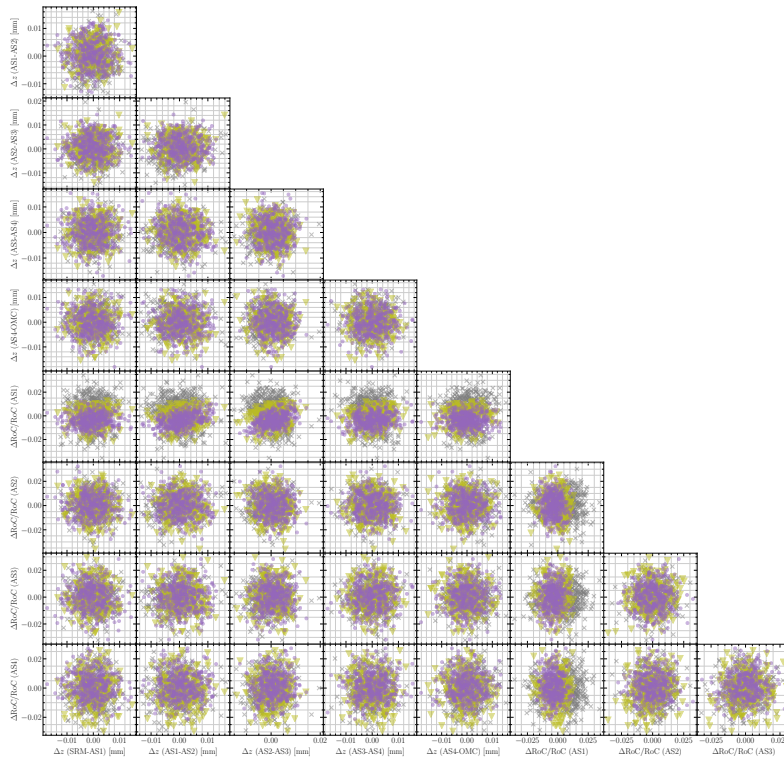


Figure 4: Similar to Fig. 3 but for the sagittal plane.

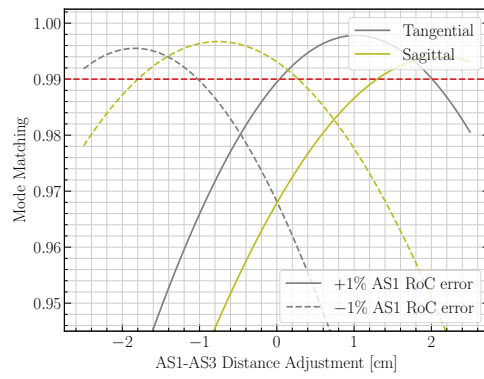


Figure 5: Assuming $\pm 1\%$ error on the AS1 RoC, the MM as a function of the AS1-AS3 distance adjustment.

2 LO Path

Table 2: Telescope design for LO path.

Component	LO1	LO2	LO3	LO4
Position z [m]	0.4027	2.9835	4.5955	4.8880
RoC [m]	6	1000	0.75	-0.45

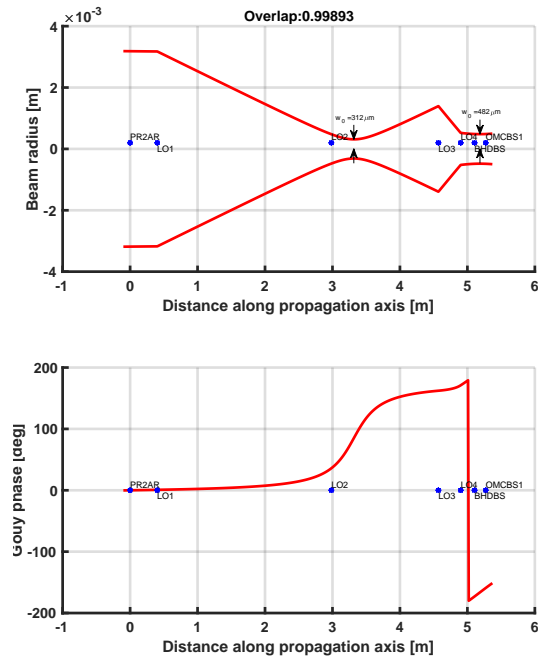
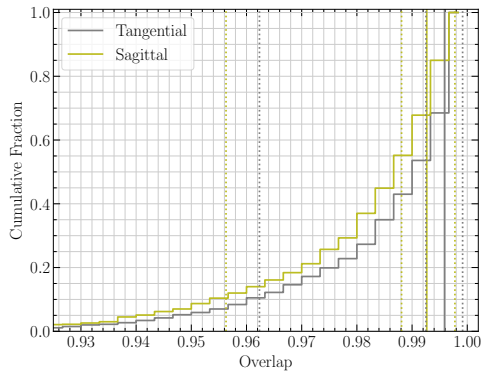
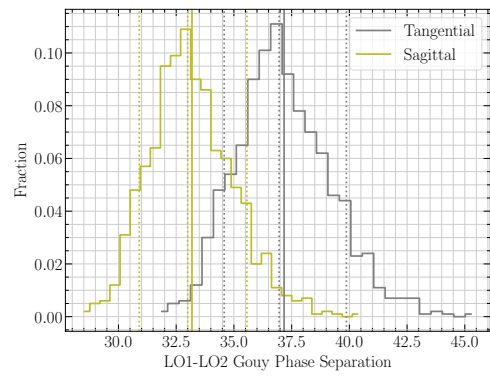


Figure 6: Beam profile for the LO path. The actuators needs to be LO1 and LO2 in this case.



(a) Cumulative histogram of overlap.



(b) Histogram of Gouy phase separation.

Figure 7: Similar to Fig. 2 but for LO path.

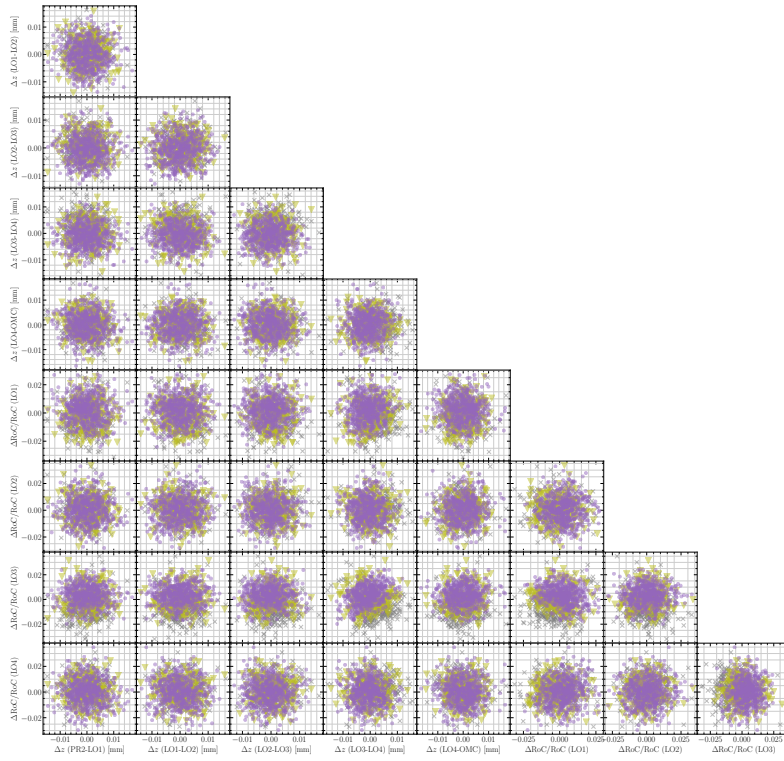


Figure 8: Similar to Fig. 3 but for the LO path, tangential plane. The MM is most sensitive to the LO3 RoC error and it can be corrected by moving the LO3-LO4 distance.

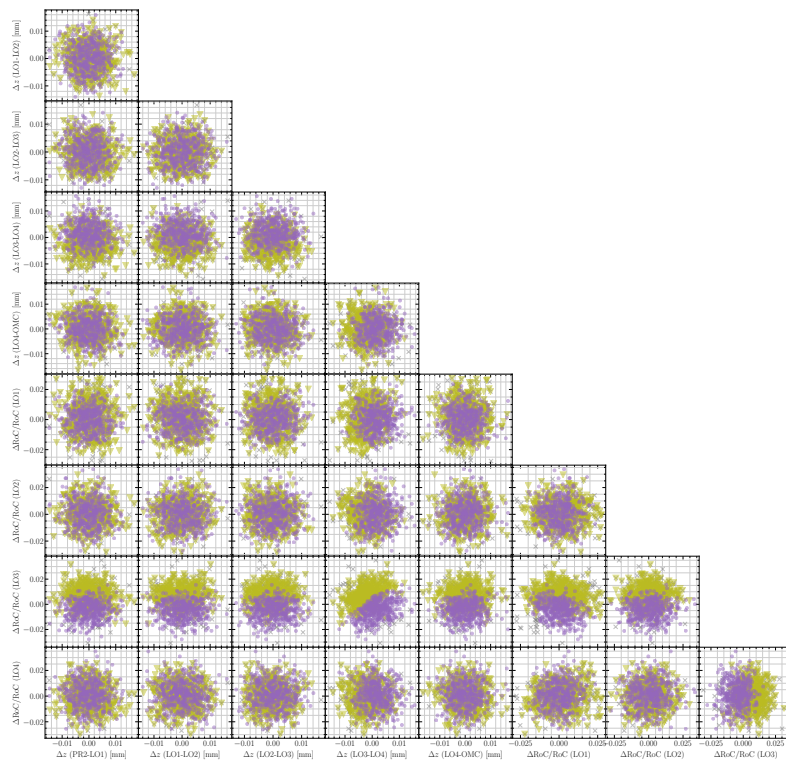


Figure 9: Similar to Fig. 8 but for the sagittal plane.

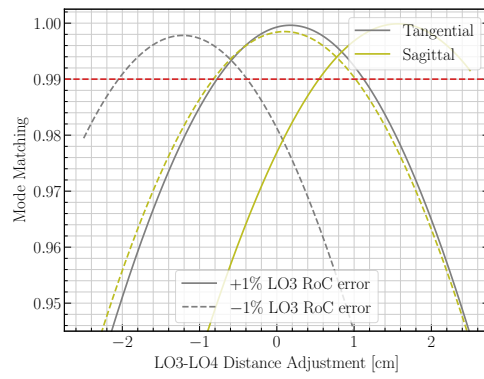


Figure 10: Assuming $\pm 1\%$ error on the LO3 RoC, the MM as a function of the LO3-LO4 distance adjustment.