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CP & RM Alignment Tolerance  
Re Scattered Light

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## 1 Introduction

The purpose of this technical note is to specify the maximum pitch and yaw hanging tolerance of the CP and RM so that the reflected ghost beams are not compromised.

The directions of the front surface ghost beam, GB1, which is the reflection of the recycling cavity beam from the BS direction, and the 1<sup>st</sup> internal ghost beam, which reflects from the CP surface and the ITM HR surface, as a function of the pitch and yaw tilt of the CP were determined using ZEMAX ray tracing.

The ghost beam mitigation strategy requires that those ghost beams either hit the surface of the PR3 and SR3 mirrors, in which case they will be re-directed to the PR2 and SR2 Scraper baffles, or that they hit the HAM2 table baffle in front of PR3 and the SR3 HR baffle in front of SR3.

## 2 Conclusion

The ghost beam diameter was modeled as the  $1/e^2$  recycling cavity beam diameter at the BS, 106 mm. The ITM wedge angle is 0.076 deg vertical, with the thick side down. The CP wedge angle is 0.069 deg horizontal, with the CP-x thick side in the  $-Y$  direction, and the CP-y thick side in the  $-X$  direction. The ideal alignment of the CP causes the CP back surface to be parallel to the ITM AR surface with a 20 mm gap. The pitch and yaw angular misalignment angles of the CP are measured from the ideal alignment position.

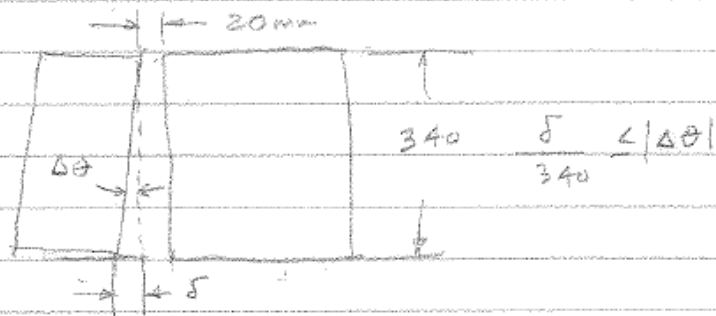
The alignment of the RM at the ETM is not critical.

The results of the analysis are shown in the following:

<b>CP Misalignment Rotation Direction</b>	<b>Maximum Misalignment Angle, deg (as seen from above)</b>	<b>CP-ITM Gap Error, mm</b>
Horizontal (Yaw)	-0.18 deg counter clockwise	1.0
	+0.08 deg clockwise	0.5
Vertical (Pitch)	-0.18 deg counter clockwise	1.0
	+0.08 deg clockwise	0.5

### **3 Details of the Analysis**

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CP Alignment Tolerance.maximum horizontal rotation

$$\delta \leq 340 \times 0.08 \text{ deg} \times \frac{\pi}{180}$$

$$\delta \leq 10.47 \text{ mm}$$

front surface GB GB AR1 max beam, 86 mm dia

horizontal rotation  $\left\{ \begin{array}{l} -0.2 \text{ hits SR3, PR2 scraper buf.} \\ +0.08 \text{ hits SR3 HR Buf, HAM2 table Buf,} \\ \text{SR2 scraper Buf} \end{array} \right.$

Internal GB GB AR3 max beam, 86 mm dia

horizontal rotation  $\left\{ \begin{array}{l} -0.18 \text{ hits SR2 scraper, hits PR2 scraper.} \\ +0.08 \text{ hits SR3 HR Buf, hits HAM2 table Buf.} \end{array} \right.$

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CP maximum vertical rotation

ETM Wedge = 0.076 deg

Internal GB GBAR3  $\frac{1}{2}$  beam, 106.4 mm dia

vert { -0.18, hits HAM2 baf, PR2 scraper baf  
           , hits SR3 HR baf  
 +0.08, hits HAM2 baf, PR2 scraper baf  
           , hits SR3 HR baf, SR2 scraper

Front surface GB GBAR1  $\frac{1}{2}$  beam, 106.4 mm dia.

vert { -0.18, hits HAM3 table baf, SR3 HR baf  
 +0.13, hits HAM2 table baf, SR3 HR baf

Summary: rotation of CP

horizontal - 0.18 deg counter - CW  
 + 0.08 deg Clock wise

Vertical - 0.18 deg counter - CW  
 + 0.08 deg clock wise

rotation of ETM RM is not critical