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LCGT
bLCGT Recycling Cavity Baffles Conceptual Design

Michael Smith

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This is an internal working note
of the LIGO Laboratory.

California Institute of Technology
LIGO Project – MS 18-34
1200 E. California Blvd.
Pasadena, CA 91125
Phone (626) 395-2129
Fax (626) 304-9834
E-mail: info@ligo.caltech.edu

Massachusetts Institute of Technology
LIGO Project – NW22-295
185 Albany St
Cambridge, MA 02139
Phone (617) 253-4824
Fax (617) 253-7014
E-mail: info@ligo.mit.edu

LIGO Hanford Observatory
P.O. Box 159
Richland WA 99352
Phone 509-372-8106
Fax 509-372-8137

LIGO Livingston Observatory
P.O. Box 940
Livingston, LA 70754
Phone 225-686-3100
Fax 225-686-7189

http://www.ligo.caltech.edu/

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1 INTRODUCTION

This document presents a conceptual design for the bLCGT Recycling Cavity Baffles.

1.1 Applicable Documents

2 WEDGE ANGLES

The ITM and BS wedge angles determine the positions of the recycling cavity baffles.

The symmetric BS wedge angle = 0.050 deg is chosen so that the POX beam, which reflects from the AT surface of the BS, will hit the SR3 HR surface and separate from the main IFO beam at the vicinity of SR2, where the POX pick-off mirror will be located. The thick side of the BS mirror faces toward the arms of the IFO.

The ITM wedge angle = 0.025 deg is chosen so that the ITMY GBAR3 hits the PR3 mirror. The thick side of ITMX faces in the –Y direction; the thick side of ITMY faces in the +X direction

3 RECYCLING CAVITY BAFFLES

3.1 Power Recycling Cavity

3.1.1 PR3

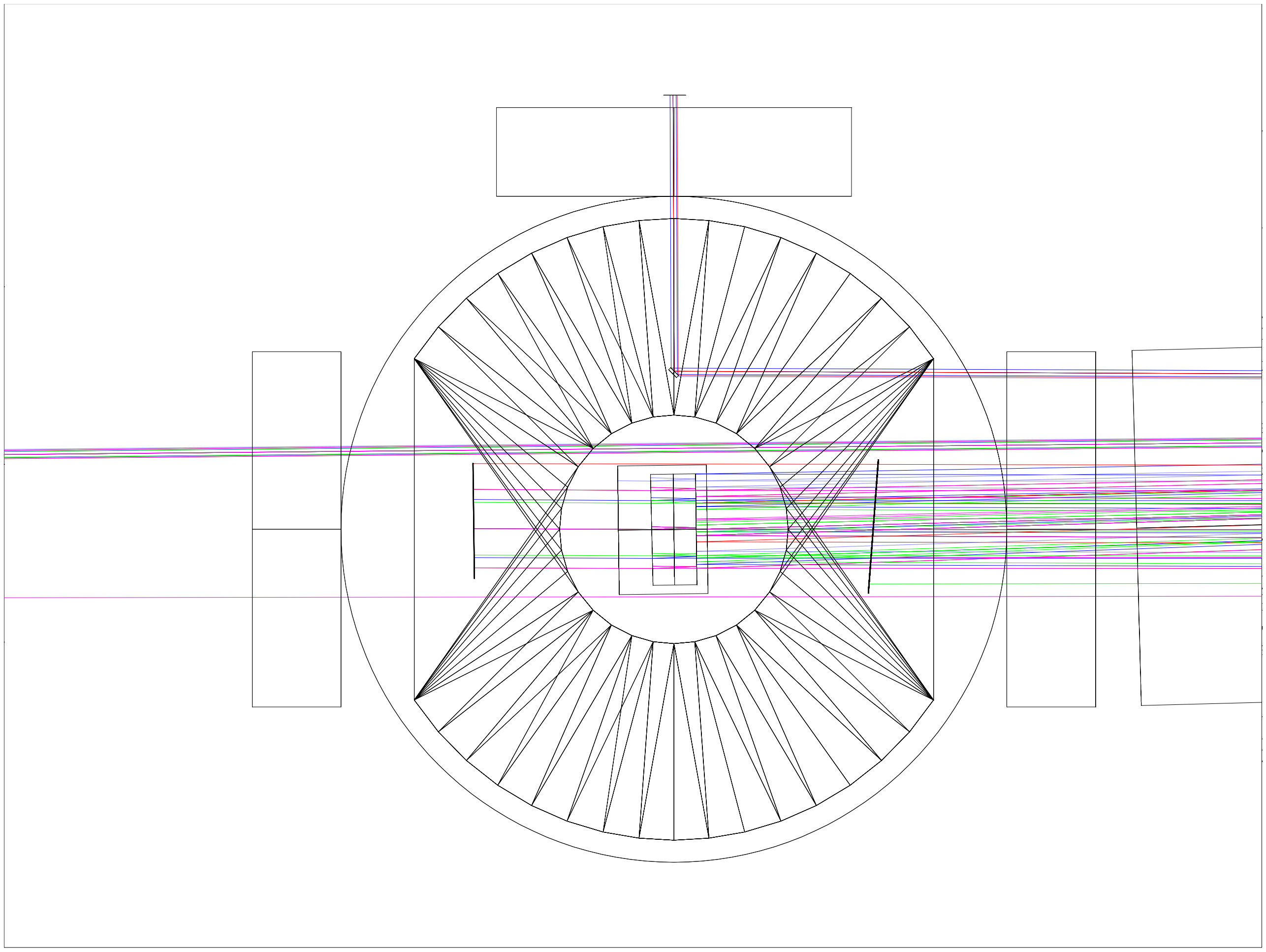

Figure 1: PR3 HR and PR3AR Baffles; POY Pick-off Beam

3.1.2 PR2

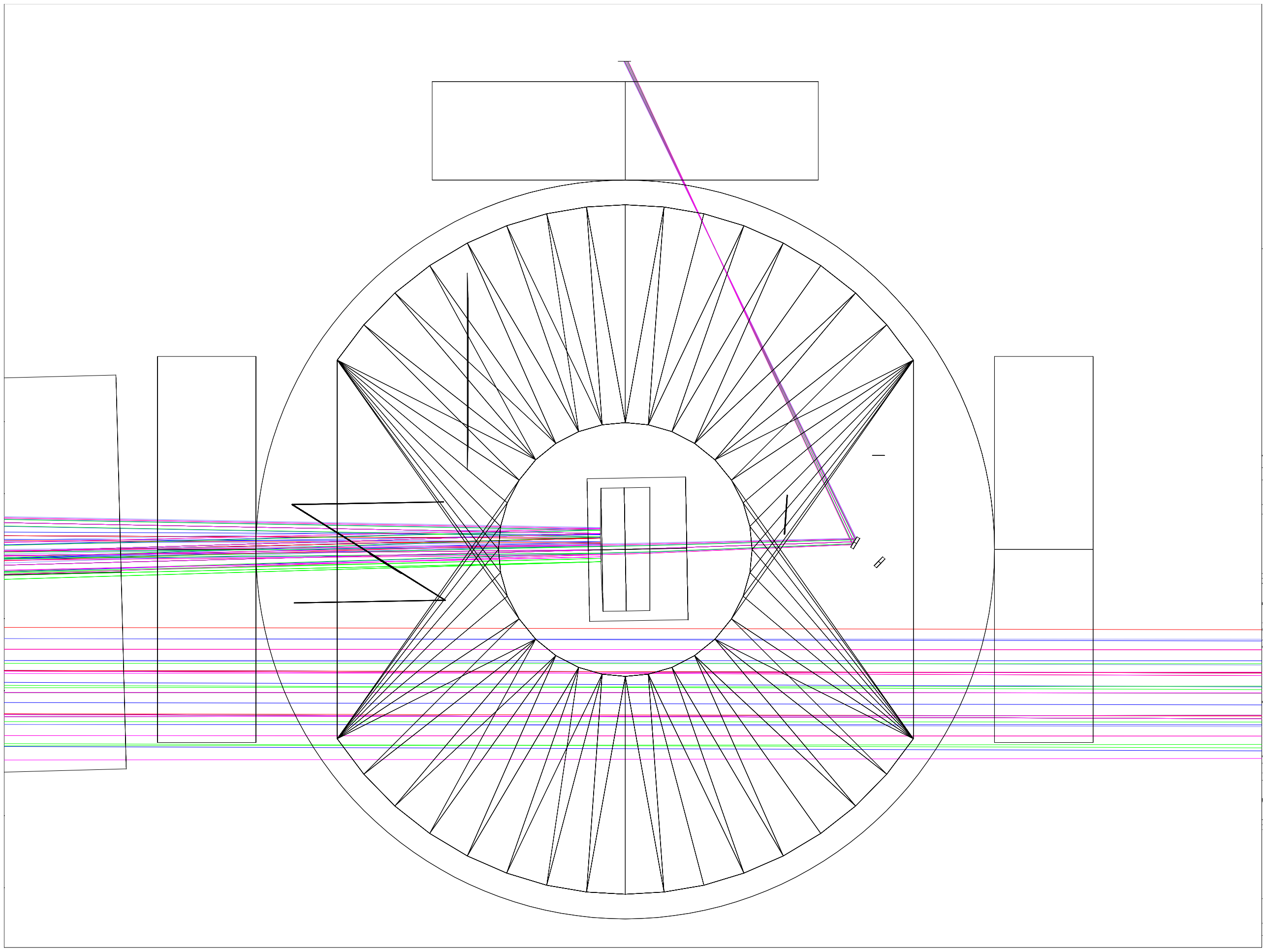

Figure 2: PR2 HR, PR2 Scraper Baffle, POB Pick-off Beam

3.1.3 PRM

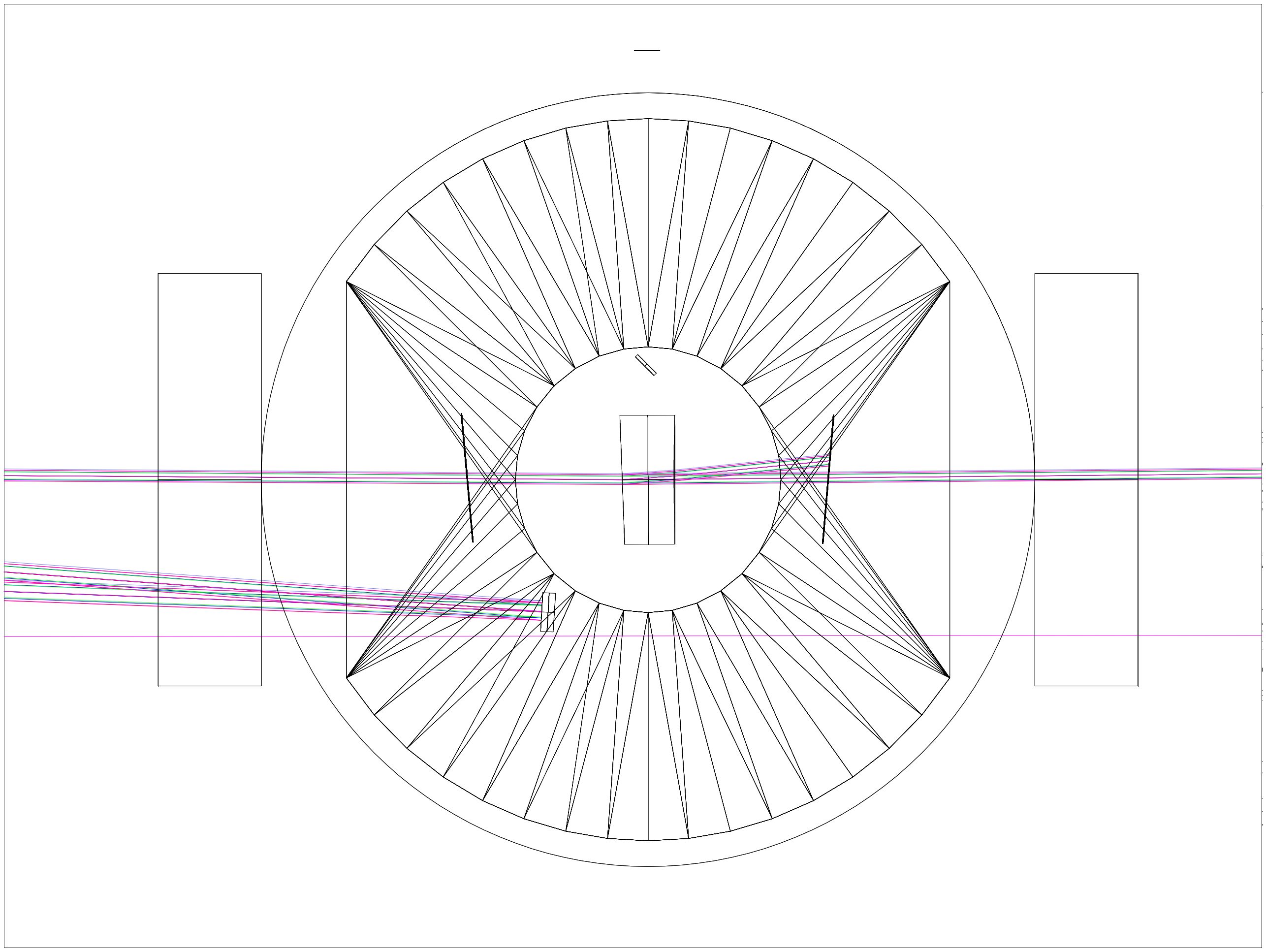

Figure 3: PRM HR and AR Baffles

3.2 Signal Recycling Cavity

3.2.1 SR3

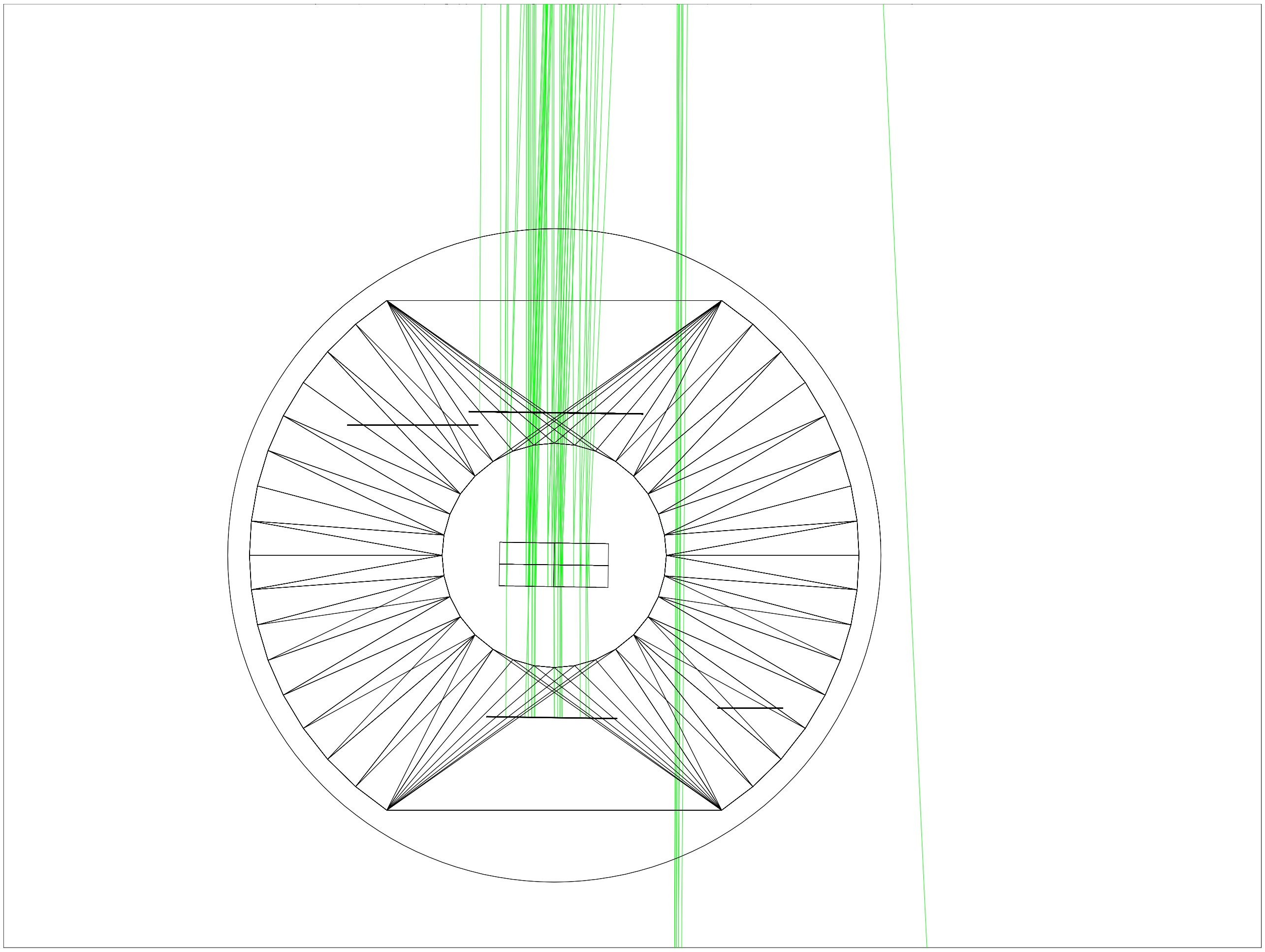

Figure 4: SR3 HR and AR Baffles

3.2.2 SR2

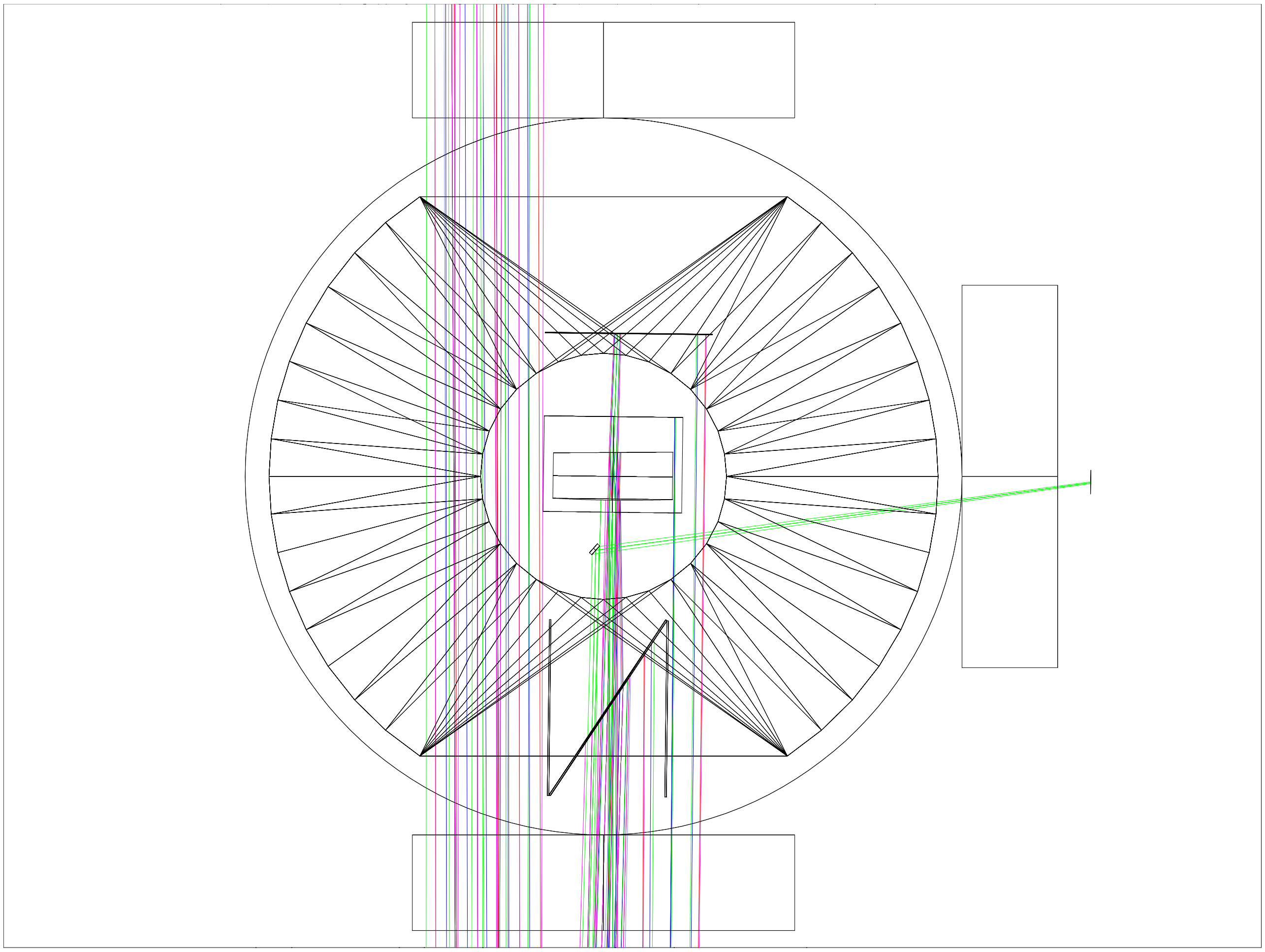

Figure 5: SR2 Scraper Baffle, SR2AR Baffle; POX Pick-off Beam

3.2.3 SRM

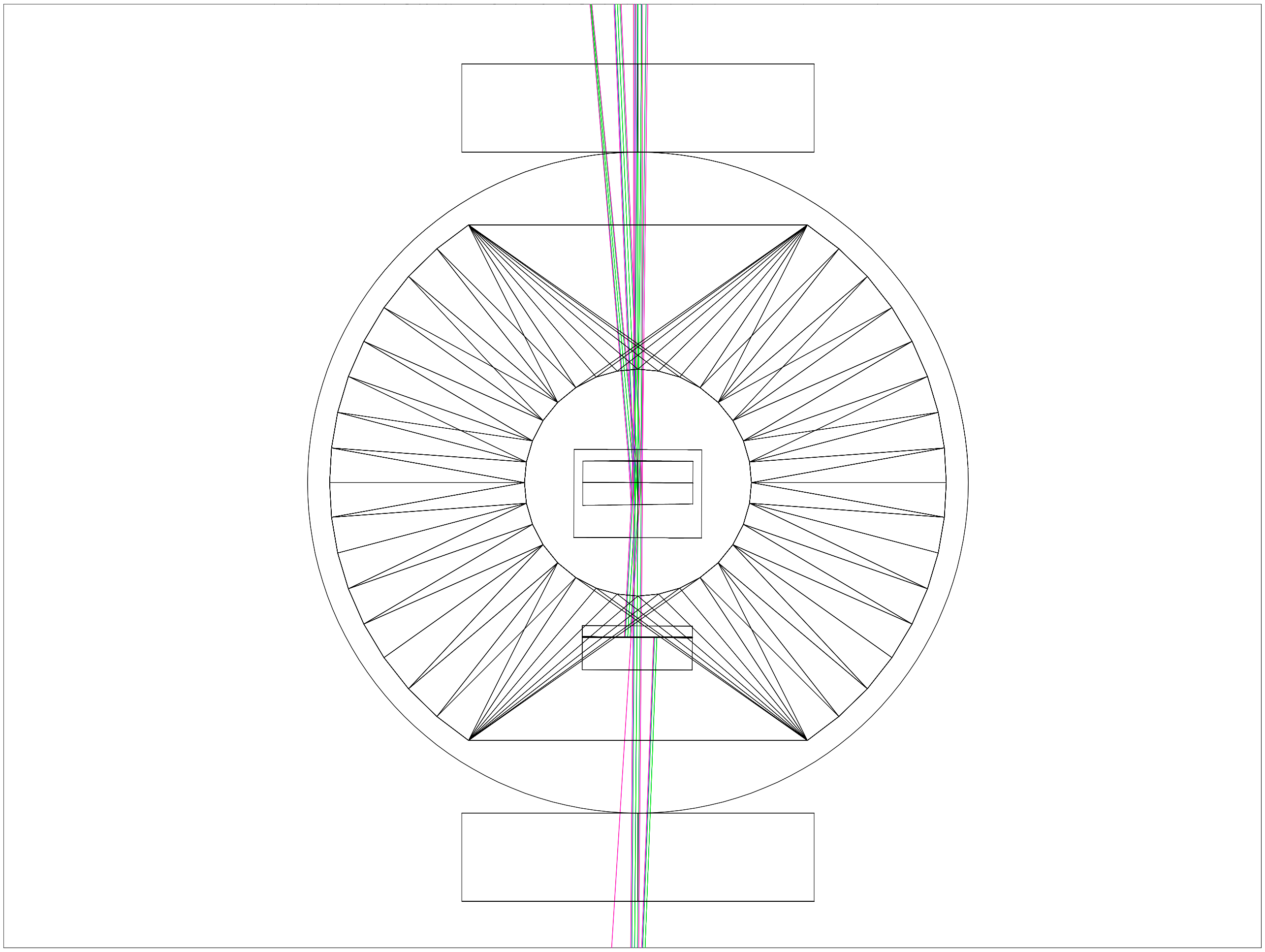

Figure 6: SRM, SRM AR Baffles

3.2.4 Output Faraday Isolator

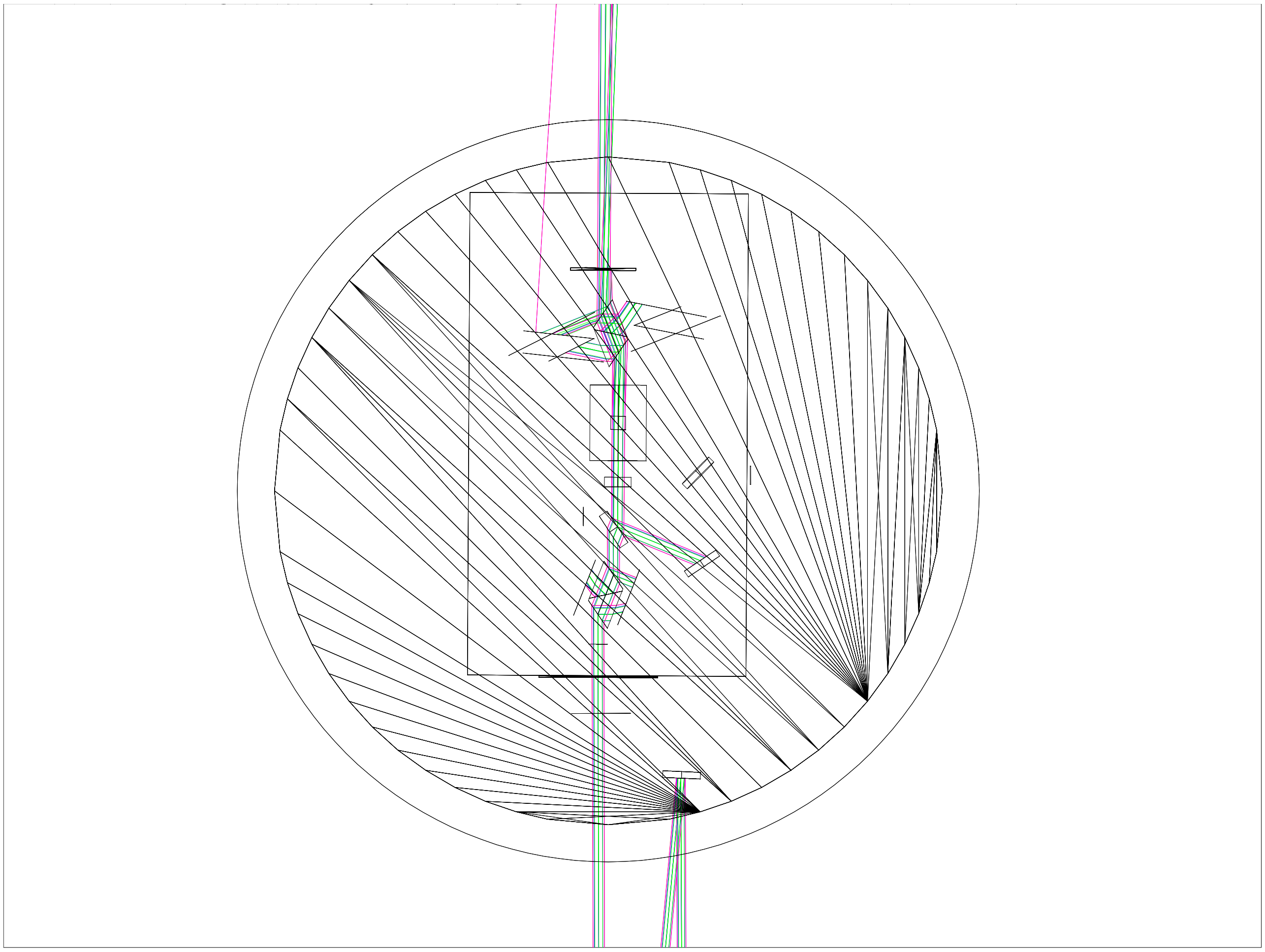

Figure 7: Output Faraday Isolator, MMT2 OMC

3.2.5 Ouput Mode Cleaner

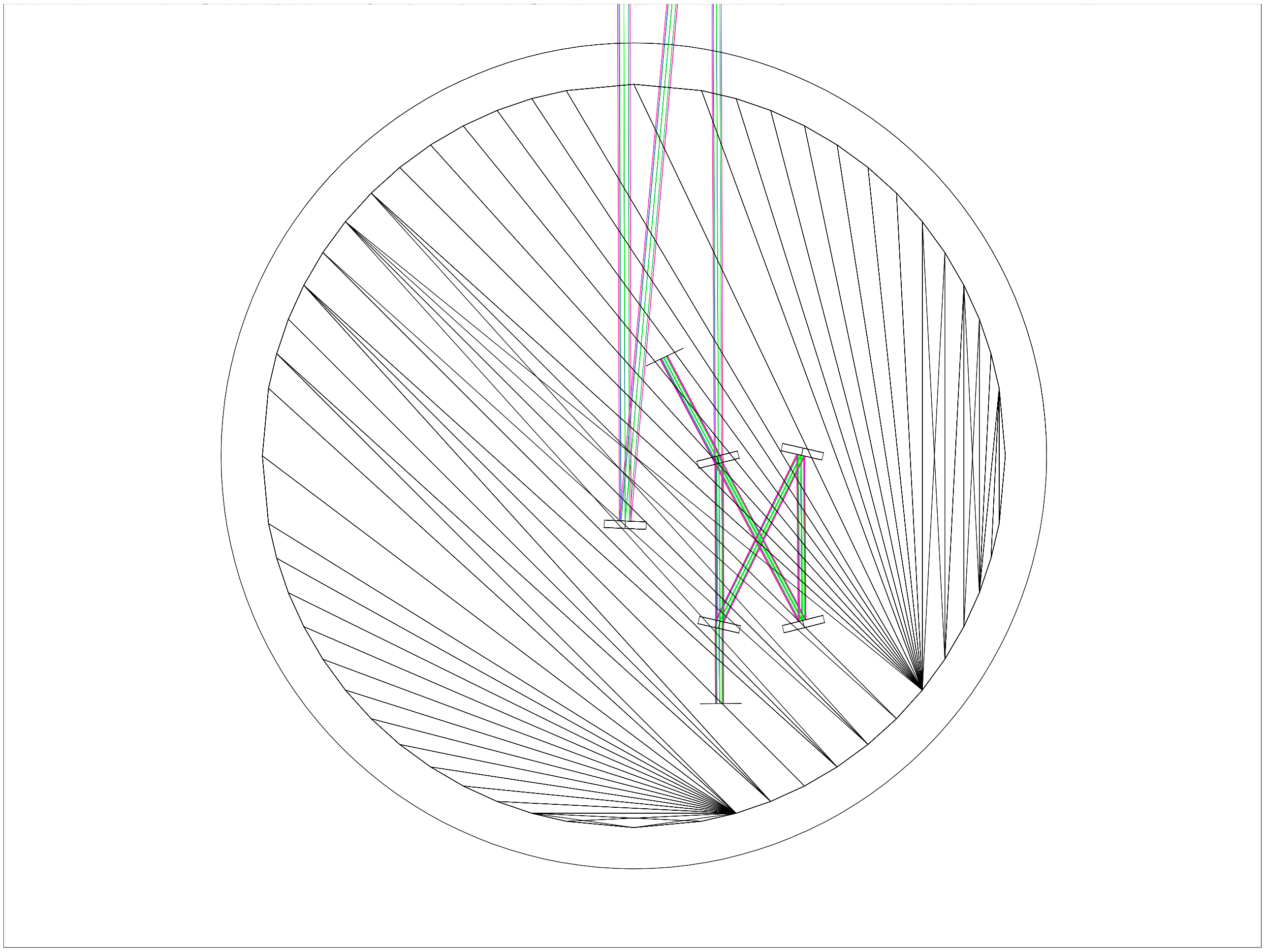

Figure 8: Output Mode Cleaner, MMT1 OMC

3.3 Baffle Characteristics

Table 1: ? Baffle Characteristics

Parameter	**Value**
Location	
Suspension	
Inside aperture diameter	

Parameter	**Value**
Outer diameter	
Material	
BRDF	
Weight	

3.4 Stray Light Noise

3.4.1 Seismic Motion

The ground motion is taken from the Kamioka mine data.

The cryoshield seismic motion is measured data.

The seismic motion of the suspended table, which was modeled as 1/10 the seismic ground motion, can be taken as a minimum requirement.

All of the recycling cavity baffles are mounted to a suspended table in the chamber.

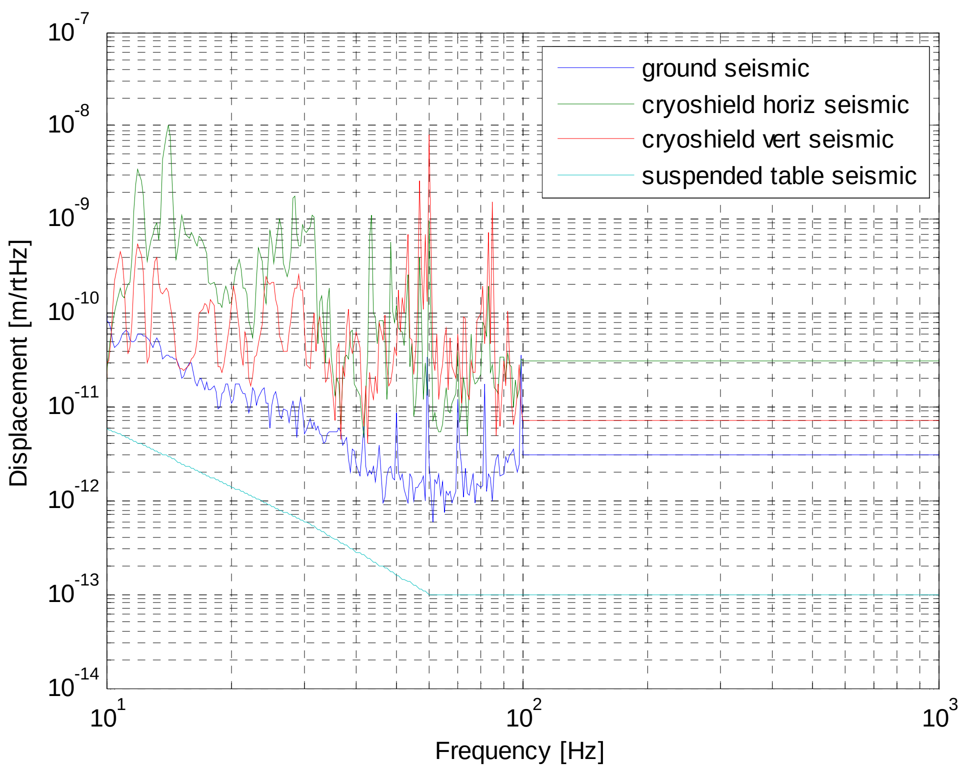

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Figure 9: Seismic Ground Noise, m/rtHz

3.4.2 OFI and OMC Suspension Transmissibility

The Output Faraday Isolator (OFI) and the output mode cleaner (OMC) are mounted to the suspended table, but must be suspended by an additional suspension structure. The aLIGO OFI suspension transmissibility was used as a SUS model for these calculations.

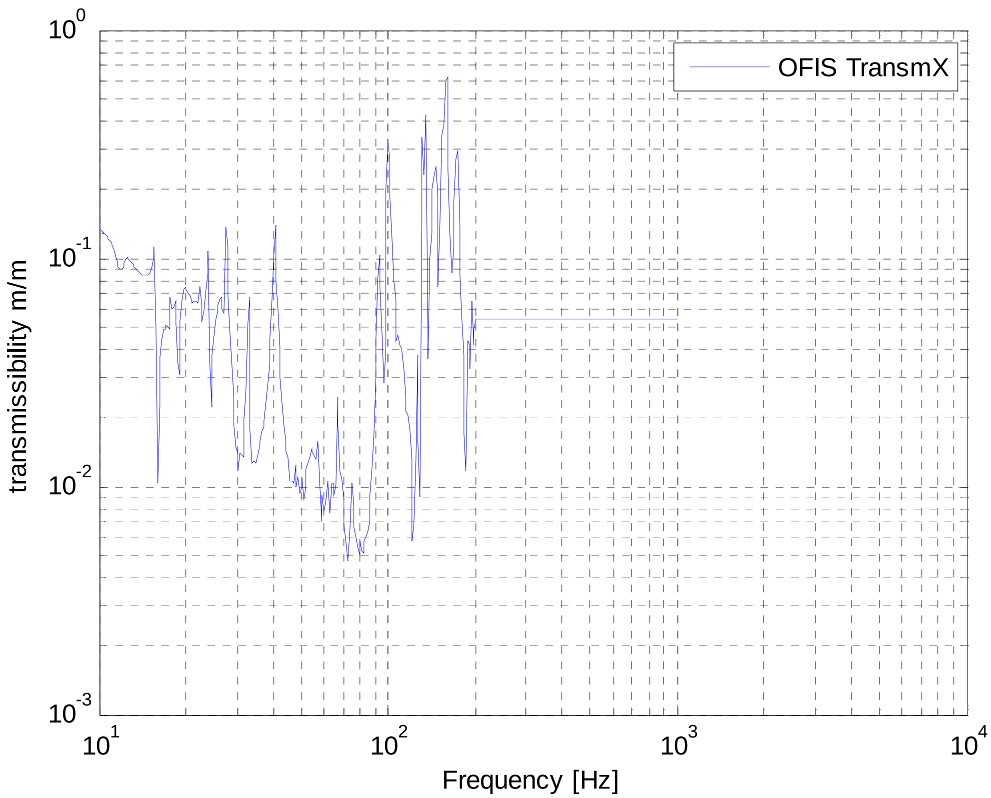

Figure 10: OFI Transmissibility along beam axis

3.4.3 Beam Dump Surface BRDF

Most of the baffles are constructed of polished oxidized steel with the first surface inclined at an incidence angle 57 deg. The measured BRDF is < 0.03 sr^{-1}.

The PRM AR & HR baffle is composed of polished silicon carbide, because it also serves as an errant beam baffle and must absorb the 50 W PSL beam without being damaged. Likewise, the PRM HR baffle is composed of polished silicon carbide, because it also serves as an errant beam baffle and must absorb the reflected beam from PR2 without being damaged.

The output mode cleaner (OMC) Refl beam dump must be made of black glass, with BRDF = 1E-6 sr^-1, in order to reduce the scattering to an acceptable level.

3.4.4 Recycling Cavity Baffles Scatter

3.4.4.1 DARM Motion Transfer Functions

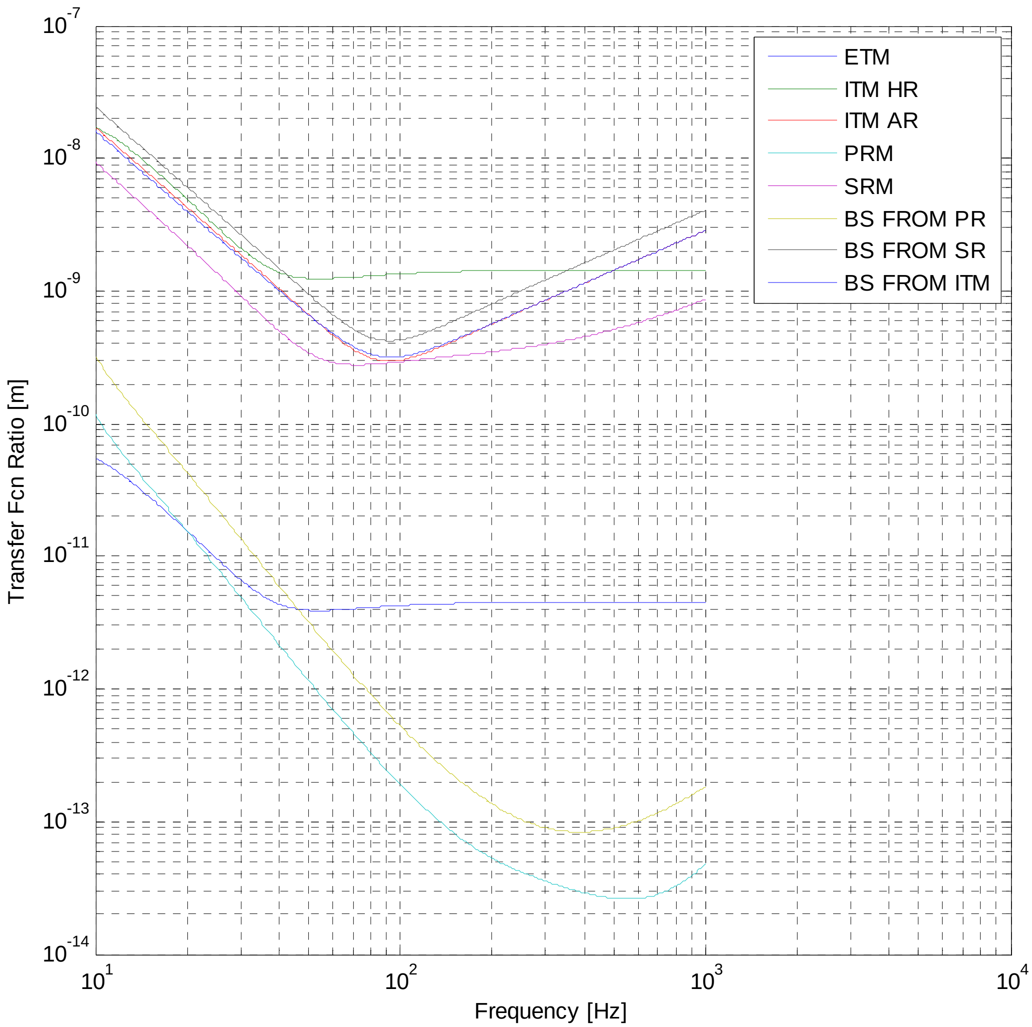

Figure 11: DARM motion transfer functions

3.4.4.2 PRM Scatter

PRM GBHR3

power incident on PRM HR beam dump from
PRM GBHR3
(forward and backward beams), W

$$P_{prmgbhr3} := 2 \cdot P_{rc} \cdot T_{prmhr1064}^{2} \cdot R_{prmar}$$

$$P_{prmgbhr3} = 8 \times 10^{-4}$$

power scattered from PRM HR3 baffle, W

$$P_{prmgbhr3s} := P_{prmgbhr3} \cdot BRDF_{bd} \cdot \frac{w_{ifo}^{2}}{w_{pr20}^{2}} \cdot \Delta_{ifo} \cdot T_{prmhr1064}^{2} \cdot R_{prmar}$$

$$P_{prmgbhr3s} = 7.634 \times 10^{-17}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{prmgbhr3} := TF_{prbs} \cdot \left(\frac{P_{prmgbhr3s}}{P_{psl}} \right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{prmgbhr3} = 2.189 \times 10^{-27}$$

PRM GBAR3

power incident on PRM AR Baffle (forward and backward beams), W

$$P_{prmgbar3} := P_{refl} \cdot R_{prmar} \cdot R_{prmhr1064} \cdot T_{prmar1064}$$

$$P_{prmgbar3} = 4.5 \times 10^{-6}$$

power scattered from PRM AR Baffle, W

$$P_{prmgbar3s} := P_{prmgbar3} \cdot BRDF_{sic} \cdot \frac{w_{ifo}^{2}}{w_{prm0}^{2}} \cdot \Delta_{ifo}$$

$$P_{prmgbar3s} = 1.184 \times 10^{-10}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{prmgbar3} := TF_{prm} \cdot \left(\frac{P_{prmgbar3s}}{P_{psl}} \right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{prmgbar3} = 1.091 \times 10^{-24}$$

Scatter of IO Reflected beam from input Faraday isolator

Reflected power from PRM, W

$$P_{refl} = 0.1$$

power scattered from input Faraday isolator surface, W

$$P_{refls} := P_{refl} \cdot BRDF_{fi} \cdot \frac{w_{ifo}^{2}}{w_{prmmm0}^{2}} \cdot \Delta_{ifo} \cdot T_{prmhr1064}$$

$$P_{refls} = 3.604 \times 10^{-11}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{refls} := TF_{prm} \cdot \left(\frac{P_{refls}}{P_{psl}} \right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{refls} = 6.016 \times 10^{-25}$$

Scatter from dumped IO Reflected beam

Need SiC surface for beam dump, water cooled

power scattered from Refl Beam Dump, W

$$P_{reflbds} := P_{refl} \cdot BRDF_{sic} \cdot \frac{w_{ifo}^{2}}{w_{prmmm0}^{2}} \cdot \Delta_{ifo}$$

$$P_{reflbds} = 3.604 \times 10^{-7}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{reflbds} := TF_{prm} \cdot \left(\frac{P_{reflbds}}{P_{psl}}\right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{reflbds} = 6.016 \times 10^{-23}$$

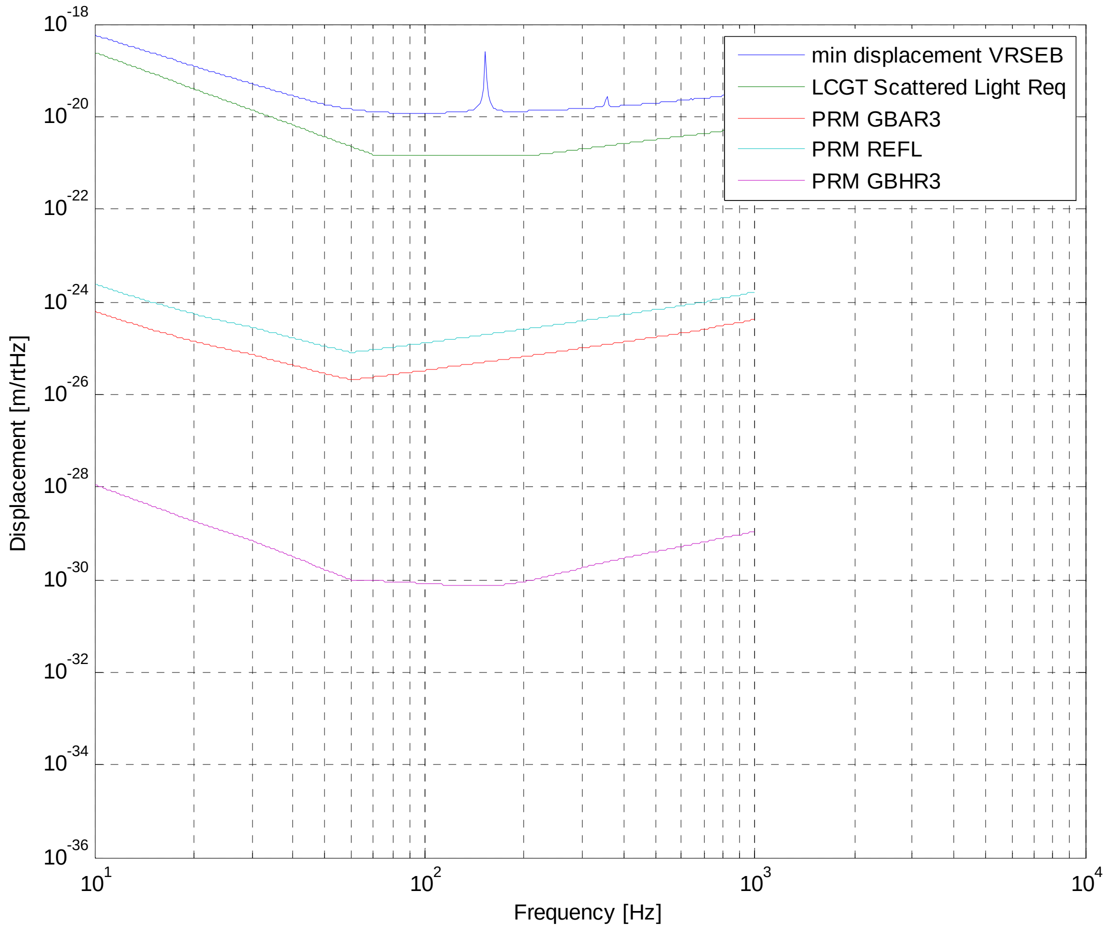

Figure 12: PRM Ghost Beam Scatter

3.4.4.3 PR2 Scatter

PR2 GBHR3

power incident on PR2 scraper baffle from
PR2 GBHR3
(forward and backward beams), W

$$P_{pr2gbhr3} := 2 \cdot P_{rc} \cdot T_{pr2hr1064}{}^{2} \cdot R_{pr2ar1064}$$

$$P_{pr2gbhr3} = 4 \times 10^{-7}$$

$$BRDF_{bd} = 0.03$$

power scattered from PR2 GBHR3 toward PR3, W

$$P_{pr2gbhr3pr3s} := \frac{P_{pr2gbhr3}}{2} \cdot BRDF_{wall} \cdot \frac{w_{ifo}{}^{2}}{w_{pr30}{}^{2}} \cdot \Delta_{ifo} \cdot T_{pr2hr1064}{}^{2} \cdot R_{pr2ar1064}$$

$$P_{pr2gbhr3pr3s} = 1.339 \times 10^{-22}$$

power scattered from PR2 GBHR3 toward PRM, W

$$P_{pr2gbhr3prms} := \frac{P_{pr2gbhr3}}{2} \cdot BRDF_{wall} \cdot \frac{w_{ifo}{}^{2}}{w_{pr20}{}^{2}} \cdot \Delta_{ifo} \cdot T_{pr2hr1064}{}^{2} \cdot R_{pr2ar1064}$$

$$P_{pr2gbhr3prms} = 3.181 \times 10^{-23}$$

total power scattered from PR2 GBHR3

$$P_{pr2gbhr3s} := P_{pr2gbhr3pr3s} + P_{pr2gbhr3prms}$$

$$P_{pr2gbhr3s} = 1.657 \times 10^{-22}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{pr2gbhr3} := TF_{prbs} \cdot \left(\frac{P_{pr2gbhr3s}}{P_{psl}}\right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{pr2gbhr3} = 3.225 \times 10^{-30}$$

PR2 GBAR1 (POB)

power incident on PR2 AR Baffle (forward beam), W

$$P_{pr2gbar1} := P_{rc} \cdot T_{pr2hr1064} \cdot T_{pr2ar1064}$$

$$P_{pr2gbar1} = 0.4$$

PR2 GBAR3

power incident on PR2 AR Baffle (forward and backward beams), W

$$P_{pr2gbar3} := 2 \cdot P_{rc} \cdot T_{pr2hr1064} \cdot R_{pr2ar1064} \cdot R_{pr2hr1064} \cdot T_{pr2ar1064}$$

$$P_{pr2gbar3} = 7.988 \times 10^{-4}$$

power scattered from PR2 GBAR3 toward PR3, W

$$P_{pr2gbar3pr3s} := \frac{P_{pr2gbar3}}{2} \cdot BRDF_{bd} \cdot \frac{{w_{ifo}}^2}{{w_{pr30}}^2} \cdot \Delta_{ifo} \cdot T_{pr2hr1064} \cdot R_{pr2ar1064} \cdot R_{pr2hr1064} \cdot T_{pr2ar1064}$$

$$P_{pr2gbar3pr3s} = 1.602 \times 10^{-16}$$

power scattered from PR2 GBAR3 toward PRM, W

$$P_{pr2gbar3prms} := \frac{P_{pr2gbar3}}{2} \cdot BRDF_{bd} \cdot \frac{{w_{ifo}}^2}{{w_{pr20}}^2} \cdot \Delta_{ifo} \cdot T_{pr2hr1064} \cdot R_{pr2ar1064} \cdot R_{pr2hr1064} \cdot T_{pr2ar1064}$$

$$P_{pr2gbar3prms} = 3.806 \times 10^{-17}$$

total power scattered from PR2 GBAR3

$$P_{pr2gbar3s} := P_{pr2gbar3pr3s} + P_{pr2gbar3prms}$$

$$P_{pr2gbar3s} = 1.983 \times 10^{-16}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{pr2gbar3} := TF_{prbs} \cdot \left(\frac{P_{pr2gbar3s}}{P_{psl}} \right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{pr2gbar3} = 3.528 \times 10^{-27}$$

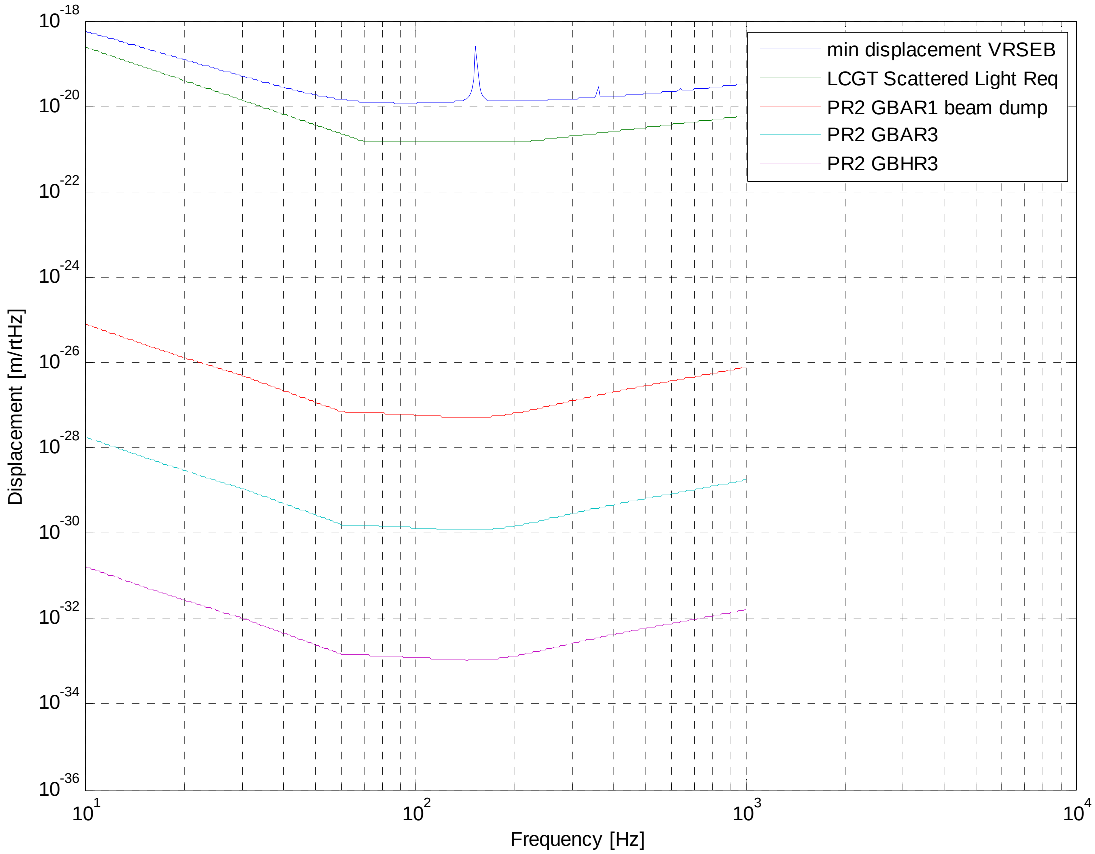

Figure 13: PR2 Ghost Beam Scatter

3.4.4.4 PR3 Scatter

PR3 GBHR3

power incident on chamber wall from PR3 GBHR3
(forward and backward beams), W

$$P_{pr3gbhr3} := 2 \cdot P_{rc} \cdot T_{pr3hr1064}^{2} \cdot R_{pr3ar1064}$$

$$P_{pr3gbhr3} = 4 \times 10^{-9}$$

$$BRDF_{wall} = 0.1$$

power scattered from chamber wall by
PR3 GBHR3 toward BS, W

$$P_{pr3gbhr3bss} := \frac{P_{pr3gbhr3}}{2} \cdot BRDF_{wall} \cdot \Delta_{ifo} \cdot T_{pr3hr1064}^{2} \cdot R_{pr3ar1064}$$

$$P_{pr3gbhr3bss} = 8.338 \times 10^{-31}$$

power scattered from chamber wall
by
PR3 GBHR3 toward PR2, W

$$P_{pr3gbhr3pr2s} := \frac{P_{pr3gbhr3}}{2} \cdot BRDF_{wall} \cdot \Delta_{ifo} \cdot \frac{w_{ifo}^{2}}{w_{pr30}^{2}} \cdot T_{pr3hr1064}^{2} \cdot R_{pr3ar1064}$$

$$P_{pr3gbhr3pr2s} = 1.339 \times 10^{-26}$$

total power scattered from chamber wall by
PR3 GBHR3

$$P_{pr3gbhr3s} := P_{pr3gbhr3bss} + P_{pr3gbhr3pr2s}$$

$$P_{pr3gbhr3s} = 1.339 \times 10^{-26}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{pr3gbhr3} := TF_{prbs} \cdot \left(\frac{P_{pr3gbhr3s}}{P_{psl}} \right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{pr3gbhr3} = 2.899 \times 10^{-32}$$

PR3 GBAR1

power incident on PR3 AR Baffle
(forward and backward beams), W

$$P_{pr3argbar1} := 2 \cdot P_{rc} \cdot T_{pr3hr1064} \cdot T_{pr3ar1064}$$

$$P_{pr3argbar1} = 0.0799$$

power scattered from PR3 AR Baffle toward BS, W

$$P_{pr3argbar1bss} := \frac{P_{pr3argbar1}}{2} \cdot BRDF_{bd} \cdot \Delta_{ifo} \cdot T_{pr3hr1064} \cdot T_{pr3ar1064}$$

$$P_{pr3argbar1bss} = 9.986 \times 10^{-17}$$

power scattered from PR3 AR Baffle toward PR3 W

$$P_{pr3argbar1pr2s} := \frac{P_{pr3argbar1}}{2} \cdot BRDF_{bd} \cdot \Delta_{ifo} \cdot \frac{w_{ifo}^{2}}{w_{pr30}^{2}} \cdot T_{pr3hr1064} \cdot T_{pr3ar1064}$$

$$P_{pr3argbar1pr2s} = 1.604 \times 10^{-12}$$

total power scattered from PR3 AR Baffle, W

$$P_{pr3argbar1s} := P_{pr3argbar1bss} + P_{pr3argbar1pr2s}$$

$$P_{pr3argbar1s} = 1.604 \times 10^{-12}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{pr3gbar1} := TF_{prbs} \cdot \left(\frac{P_{pr3argbar1s}}{P_{psl}}\right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{pr3gbar1} = 3.173 \times 10^{-25}$$

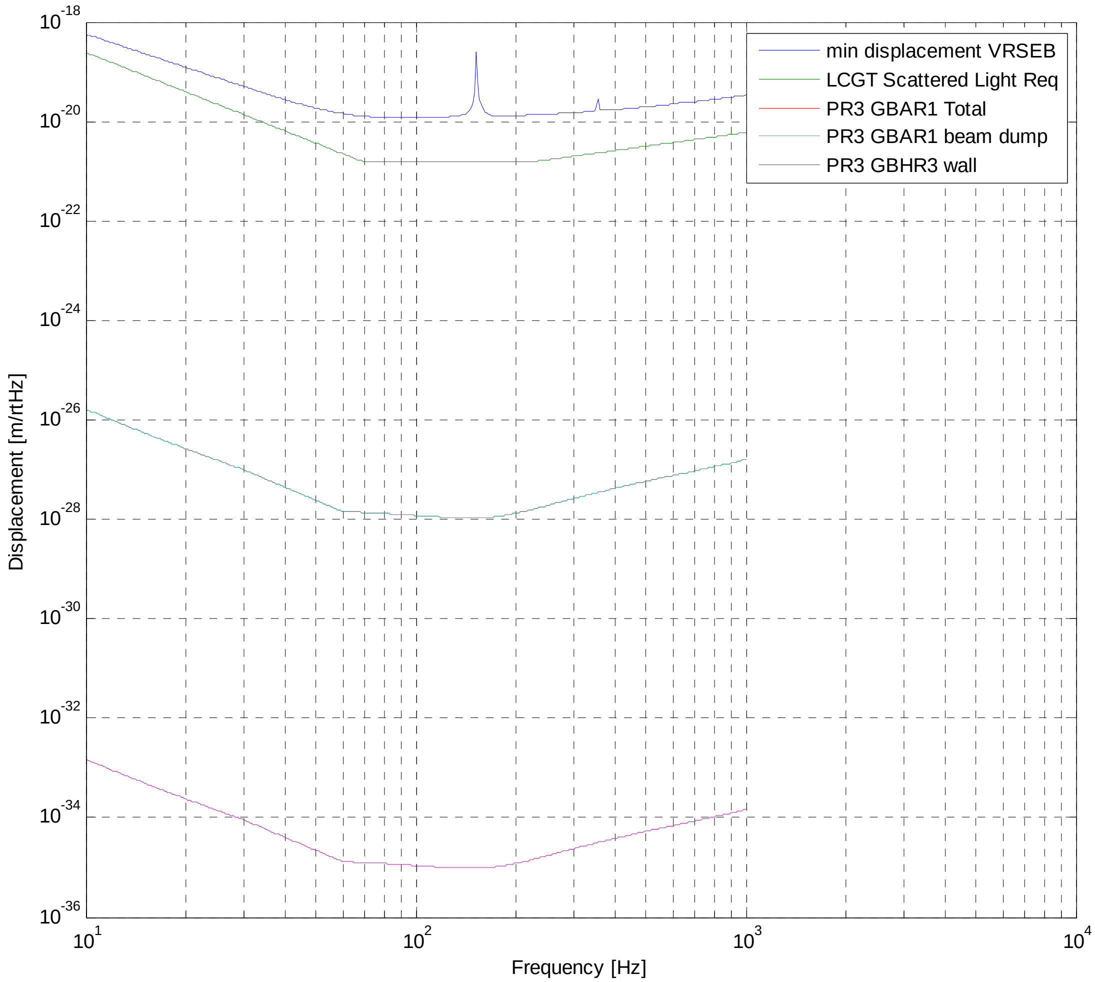

Figure 14: PR3 Ghost Beam Scatter

3.4.4.5 BS Ghost Beams and SR2 HR Scatter

BS_GBAR1 (POX)

power incident on SR2 Scraper Baffle from X arm, W

$$P_{bsar1sr2baf} := \frac{P_{rc}}{2} \cdot R_{bsar}$$

$$P_{bsar1sr2baf} = 0.02$$

power scattered from SR2 Scraper Baffle, W

$$P_{bsar1sr2bafs} := P_{bsar1sr2baf} \cdot BRDF_{bd} \cdot \frac{w_{ifo}^{2}}{w_{sr30}^{2}} \cdot \Delta_{ifo} \cdot R_{bsar}$$

$$P_{bsar1sr2bafs} = 8.318 \times 10^{-13}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{bsar1sr2bafs} := TF_{itmar} \cdot \left(\frac{P_{bsar1sr2bafs}}{P_{psl}}\right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{bsar1sr2bafs} = 1.371 \times 10^{-22}$$

BS_GBAR3P

The stray light from both arms are almost anti-resonant, and the wavefronts overlap; their coherent sum is reduced by the square of the asymmetry coefficient for common mode field rejection

power incident on SR2 Scraper Baffle from both arms, W

$$P_{bsar3sr2baf} := \frac{P_{rc}}{2} \cdot \left[\left(1 - R_{bsar}\right) \cdot R_{bshr} \cdot R_{bsar} + \left(1 - R_{bshr}\right) \cdot R_{bsar}\right] \cdot \left(1 - R_{bsar}\right) \cdot C_{assy}^{2}$$

$$P_{bsar3sr2baf} = 8.249 \times 10^{-6}$$

power scattered from SR2 Scraper Baffle, W

$$P_{bsar3sr2bafs} := P_{bsar3sr2baf} \cdot BRDF_{bd} \cdot \frac{w_{ifo}^{2}}{w_{sr30}^{2}} \cdot \Delta_{ifo} \cdot \left[\left(1 - R_{bsar}\right) \cdot R_{bshr} \cdot R_{bsar} + \left(1 - R_{bshr}\right) \cdot R_{bsar} \right] \cdot \left(1 - R_{bsar}\right) \cdot C_{assy}^{2}$$

$$P_{bsar3sr2bafs} = 1.415 \times 10^{-19}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{bsar3sr2baf} := TF_{itmar} \cdot \left(\frac{P_{bsar3sr2bafs}}{P_{psl}} \right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{bsar3sr2baf} = 5.655 \times 10^{-26}$$

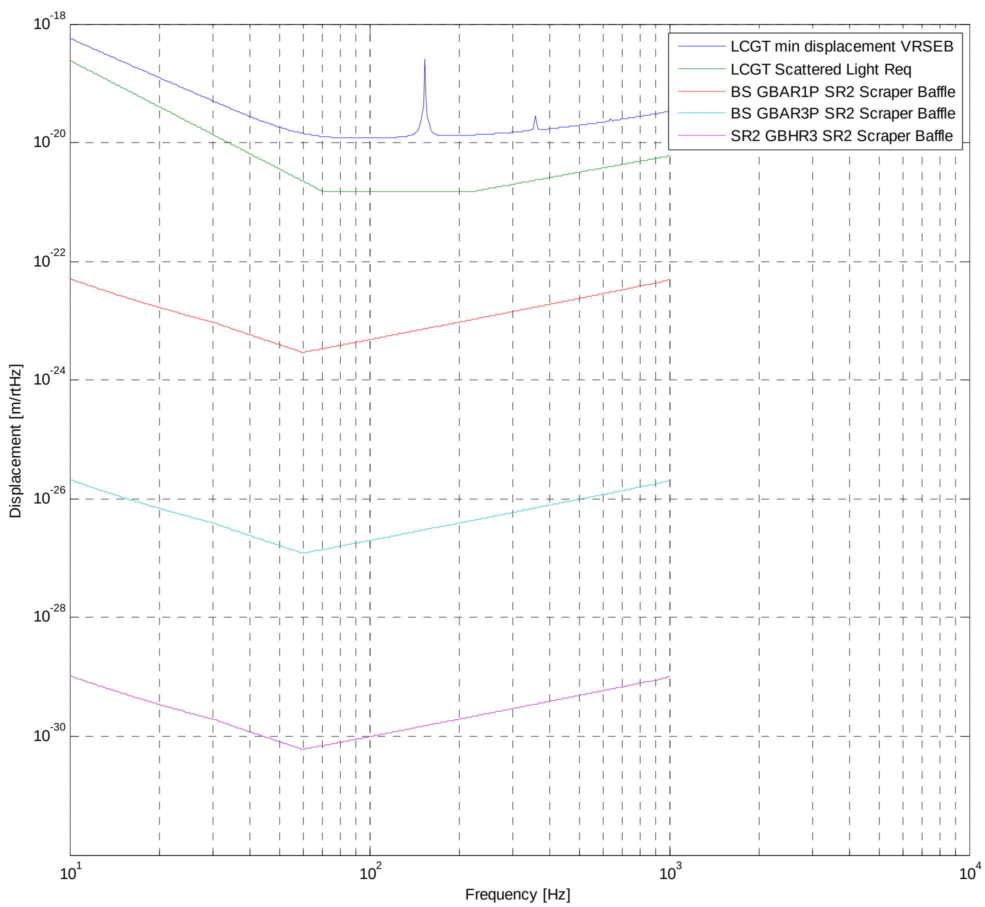

Figure 15: BS and SR2 Ghost beams Scatter

3.4.4.6 ITM Ghost Beams Scatter

ITMX_GBAR1_BD

Part of the ITMX_GBAR1 is caught by the ITMX elliptical baffle,
part reflects from SR2 back through BS and is caught by ITMY ACB.

Power of ITMX GBAR1, W

$$P_{itmar1} := P_{rc} \cdot R_{itmar}$$

$$P_{itmar1} = 0.04$$

ITMY_GBAR1_BD

Part of the ITMY_GBAR1 merges with the POX beam and POY beam at PR2,
part of it is caught by the PR3 HR baffle

ITMY_GBAR3 POY

Power incident on POY PO mirror, W

$$P_{itmar3PO} := \frac{P_{rc}}{2} \cdot R_{bshr} \cdot R_{itmhr}^{2} \cdot R_{itmar} \cdot \left(1 - R_{itmar}\right)^{2}$$

$$P_{itmar3PO} = 9.919 \times 10^{-3}$$

ITMY_GBAR4

2nd order beam can be ignored. Part of the GBAR4 beam is caught on the ITMY Elliptical baf,
part is caught on PR2 scraper baffle

ITMX_GBAR3_BD

power incident on PR2 Scraper Baffle, W

$$P_{itmxar3bd} := \frac{P_{rc}}{2} \cdot \left(1 - R_{bshr}\right) \cdot R_{itmhr}^{2} \cdot R_{itmar} \cdot \left(1 - R_{itmar}\right)^{2}$$

$$P_{itmxar3bd} = 9.9192 \times 10^{-3}$$

power scattered from PR2 Scraper Baffle, W

$$P_{itmxar3bds} := P_{itmxar3bd} \cdot BRDF_{bd} \cdot \frac{w_{ifo}^{2}}{w_{pr30}^{2}} \cdot \Delta_{ifo} \cdot \left(1 - R_{bshr}\right) \cdot R_{itmhr}^{2} \cdot R_{itmar} \cdot \left(1 - R_{itmar}\right)^{2}$$

$$P_{itmxar3bds} = 1.976 \times 10^{-13}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{itmxar3bd} := TF_{prbs} \cdot \left(\frac{P_{itmxar3bds}}{P_{psl}} \right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{itmxar3bd} = 1.114 \times 10^{-25}$$

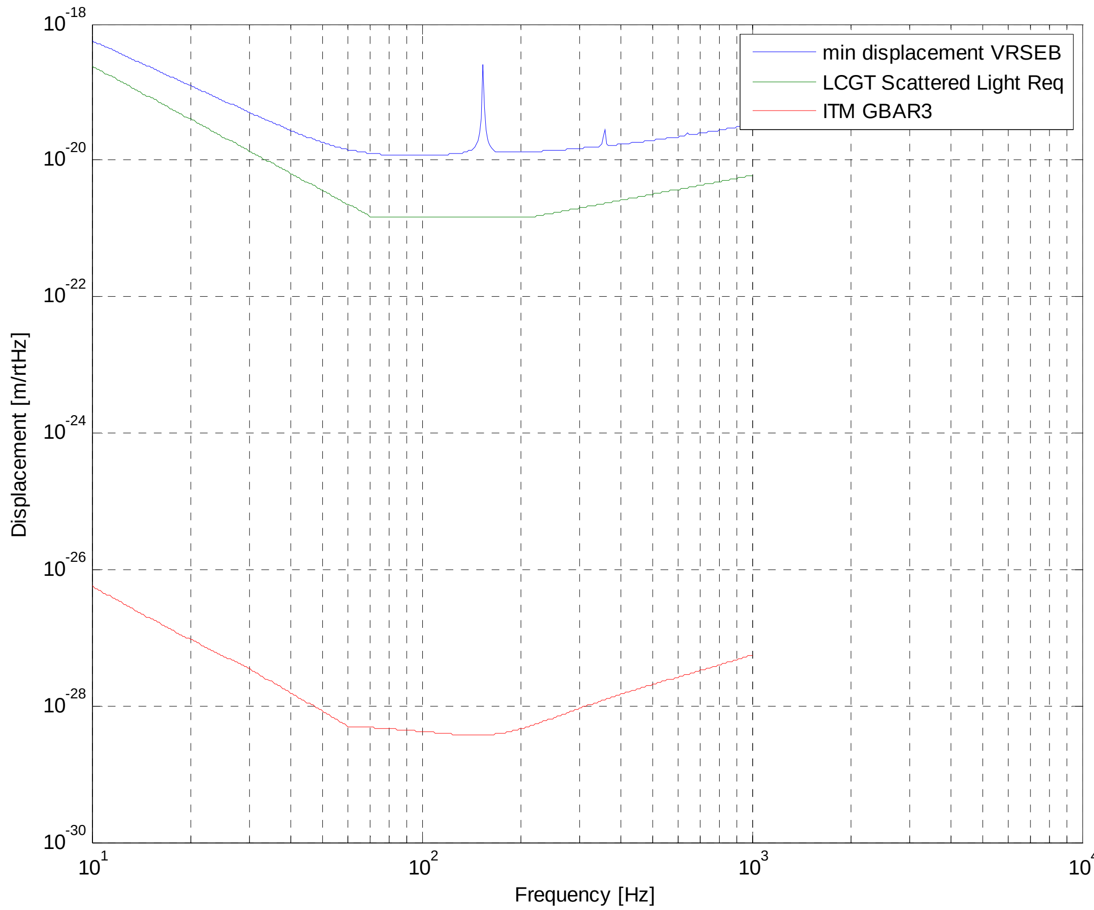

Figure 16: ITM Ghost Beam Scatter

3.4.4.7 SRM Scatter

SRM_GBHR3

power incident on SRM HR baffle, W

$$P_{srmhrbaf} := P_{srm} \cdot R_{srmar1064} T_{srmhr1064}$$

$$P_{srmhrbaf} = 3.893 \times 10^{-7}$$

power scattered from SRM HR baffle, W

$$P_{srmhrbafs} := P_{srmhrbaf} \cdot BRDF_{bd} \cdot \frac{w_{ifo}^{2}}{w_{sr20}^{2}} \cdot \Delta_{ifo} \cdot R_{srmar1064} T_{srmhr1064}$$

$$P_{srmhrbafs} = 3.658 \times 10^{-18}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{srmhrbafs} := TF_{srm} \cdot \left(\frac{P_{srmhrbafs}}{P_{psl}} \right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{srmhrbafs} = 2.875 \times 10^{-25}$$

SRM_GBAR3

power incident on SRM AR Baffle, W

$$P_{srmarbaf} := P_{srm} \cdot R_{srmar1064} \cdot R_{srmhr1064} \cdot T_{srmar106\text{4}}$$

$$P_{srmarbaf} = 2.145 \times 10^{-6}$$

power scattered from SRM AR Baffle, W

$$P_{srmarbafs} := P_{srmarbaf} \cdot BRDF_{bd} \cdot \frac{w_{ifo}^{2}}{w_{srm0}^{2}} \cdot \Delta_{ifo} \cdot R_{srmar1064} \cdot R_{srmhr1064} \cdot T_{srmar106\text{4}}$$

$$P_{srmarbafs} = 1.387 \times 10^{-18}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{srmarbafs} := TF_{srm} \cdot \left(\frac{P_{srmarbafs}}{P_{psl}}\right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{srmarbafs} = 1.771 \times 10^{-25}$$

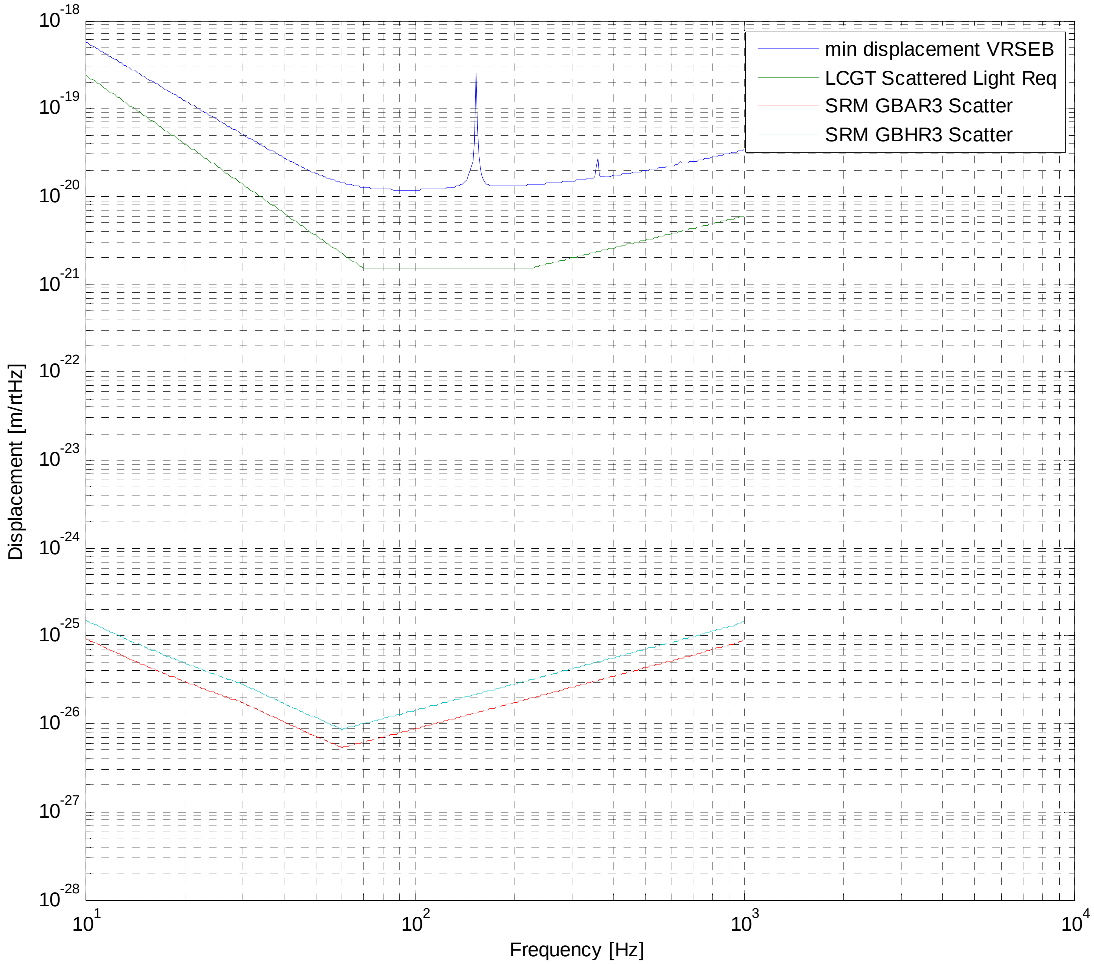

Figure 17: SRM Ghost Beam Scatter

3.4.4.8 SR2 Scatter

SR2 GBHR3

power incident on SR2 scraper baffle from
SR2 GBHR3
(forward and backward beams), W

$$P_{sr2gbhr3} := 2 \cdot P_{src} \cdot T_{sr2hr1064} \cdot R_{sr2ar1064} \cdot T_{sr2hr1064}$$

$$P_{sr2gbhr3} = 1.65 \times 10^{-10}$$

power scattered from SR2 GBHR3 toward SR3, W

$$P_{sr2gbhr3sr3s} := \frac{P_{sr2gbhr3}}{2} \cdot BRDF_{bd} \cdot \frac{w_{ifo}^{2}}{w_{sr30}^{2}} \cdot \Delta_{ifo} \cdot T_{sr2hr1064} \cdot R_{sr2ar1064} \cdot T_{sr2hr1064}$$

$$P_{sr2gbhr3sr3s} = 1.716 \times 10^{-26}$$

power scattered from SR2 GBHR3 toward SRM, W

$$P_{sr2gbhr3srms} := \frac{P_{sr2gbhr3}}{2} \cdot BRDF_{bd} \cdot \frac{w_{ifo}^{2}}{w_{srm0}^{2}} \cdot \Delta_{ifo} \cdot T_{sr2hr1064} \cdot R_{sr2ar1064} \cdot T_{sr2hr1064}$$

$$P_{sr2gbhr3srms} = 3.153 \times 10^{-28}$$

total power scattered from SR2 GBHR3

$$P_{sr2gbhr3s} := P_{sr2gbhr3sr3s} + P_{sr2gbhr3srms}$$

$$P_{sr2gbhr3s} = 1.747 \times 10^{-26}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{sr2gbhr3} := TF_{srbs} \cdot \left(\frac{P_{sr2gbhr3s}}{P_{psl}}\right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{sr2gbhr3} = 2.649 \times 10^{-29}$$

SR2 GBAR1

SR2 GBAR1 power incident on SR2 AR Baffle
(backward beam), W

$$P_{sr2gbar1baf} := P_{src} \cdot T_{sr2hr1064} \cdot T_{sr2ar1064}$$

$$P_{sr2gbar1baf} = 1.648 \times 10^{-4}$$

power scattered from SR3 AR Baffle, W

$$P_{sr2gbar1bafs} := P_{sr2gbar1baf} \cdot BRDF_{bd} \cdot \frac{w_{ifo}^{2}}{w_{sr20}^{2}} \cdot \Delta_{ifo} \cdot T_{sr2hr1064} \cdot T_{sr2ar1064}$$

$$P_{sr2gbar1bafs} = 1.007 \times 10^{-13}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{sr2gbar1baf} := TF_{srbs} \cdot \left(\frac{P_{sr2gbar1bafs}}{P_{psl}}\right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{sr2gbar1baf} = 6.361 \times 10^{-23}$$

SR2 GBAR3

SR2 GBAR3 power incident on SR2 AR Baffle
(forward and backward beams), W

$$P_{sr2gbar3baf} := 2 \cdot P_{src} \cdot T_{sr2hr1064} \cdot R_{sr2ar1064} \cdot R_{sr2hr1064} \cdot T_{sr2ar1064}$$

$$P_{sr2gbar3baf} = 3.295 \times 10^{-7}$$

power scattered from SR3 AR Baffle, W

$$P_{sr2gbar3bafs} := P_{sr2gbar3baf} \cdot BRDF_{bd} \cdot \frac{w_{ifo}^{2}}{w_{sr20}^{2}} \cdot \Delta_{ifo} \cdot \left(T_{sr2hr1064} \cdot R_{sr2ar1064} \cdot R_{sr2hr1064} \cdot T_{sr2ar1064}\right)$$

$$P_{sr2gbar3bafs} = 2.013 \times 10^{-19}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{sr2gbar3baf} := TF_{srbs} \cdot \left(\frac{P_{sr2gbar3bafs}}{P_{psl}} \right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{sr2gbar3baf} = 8.992 \times 10^{-26}$$

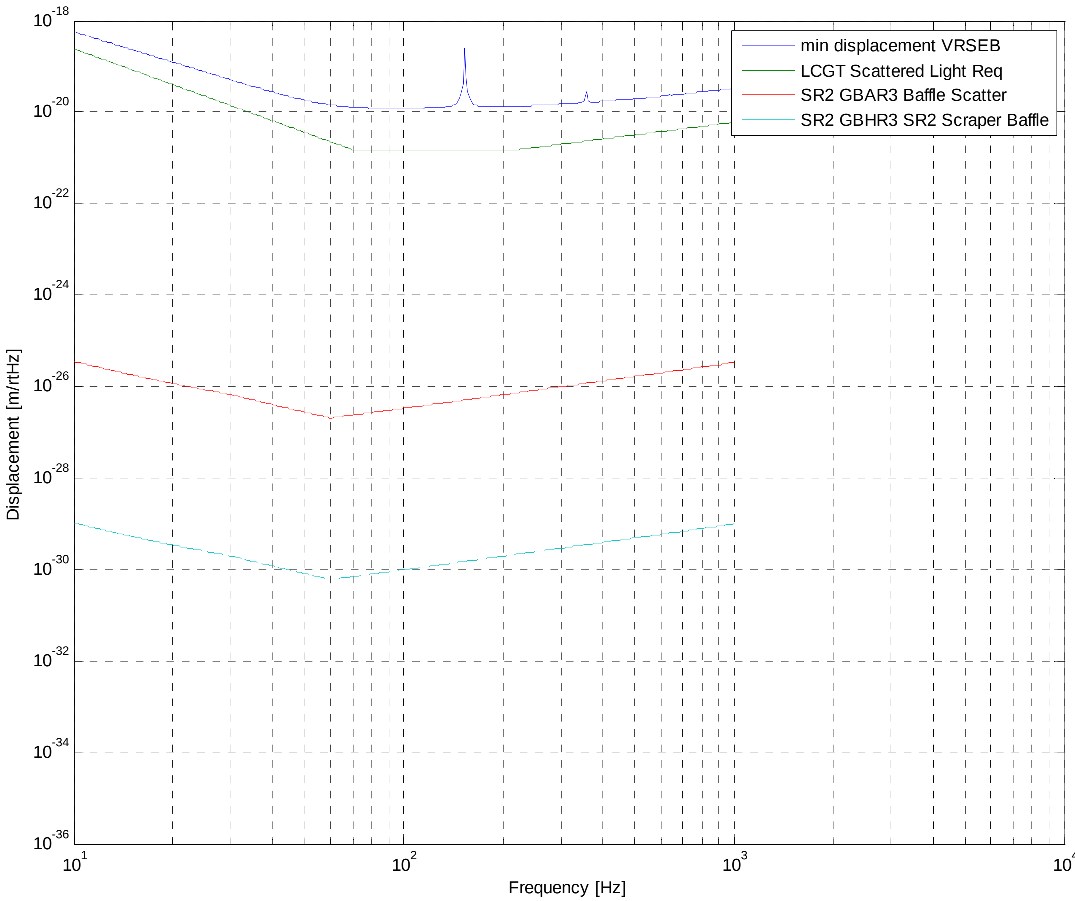

Figure 18: SR2 Ghost Beam Scatter

3.4.4.9 SR3 Scatter

SR3 GBHR3

power incident on wall from SR3 GBHR3 (forward and backward beams), W

$$P_{sr3gbhr3} := 2 \cdot P_{src} \cdot T_{sr3hr1064}{}^{2} \cdot R_{sr3ar1064}$$

$$P_{sr3gbhr3} = 1.65 \times 10^{-12}$$

power scattered from wall by SR3 GBHR3 toward BS, W

$$P_{sr3gbhr3bss} := \frac{P_{sr3gbhr3}}{2} \cdot BRDF_{wall} \cdot \Delta_{ifo} \cdot T_{sr3hr1064}{}^{2} \cdot R_{sr3ar1064}$$

$$P_{sr3gbhr3bss} = 3.439 \times 10^{-34}$$

power scattered from wall by SR3 GBHR3 toward SR2 W

$$P_{sr3gbhr3sr2s} := \frac{P_{sr3gbhr3}}{2} \cdot BRDF_{wall} \cdot \Delta_{ifo} \cdot \frac{w_{ifo}{}^{2}}{w_{sr30}{}^{2}} \cdot \left(T_{sr3hr1064}{}^{2} \cdot R_{sr3ar1064}\right)$$

$$P_{sr3gbhr3sr2s} = 5.719 \times 10^{-30}$$

total power scattered from SR2 scraper baffle by from SR3 GBHR3

$$P_{sr3gbhr3s} := P_{sr3gbhr3bss} + P_{sr3gbhr3sr2s}$$

$$P_{sr3gbhr3s} = 5.719 \times 10^{-30}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{sr3gbhr3} := TF_{srbs} \cdot \left(\frac{P_{sr3gbhr3s}}{P_{psl}}\right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{sr3gbhr3} = 4.793 \times 10^{-31}$$

SR3 AR Baffle

power incident on SR3 AR Baffle
(forward and backward beams), W

$$P_{sr3arbaf} := 2 \cdot P_{src} \cdot T_{sr3hr1064} \cdot T_{sr3ar1064}$$

$$P_{sr3arbaf} = 3.297 \times 10^{-5}$$

power scattered from SR3 AR Baffle toward BS, W

$$P_{sr3arbafbss} := \frac{P_{sr3arbaf}}{2} \cdot BRDF_{bd} \cdot \Delta_{ifo} \cdot T_{sr3hr1064} \cdot T_{sr3ar1064}$$

$$P_{sr3arbafbss} = 4.119 \times 10^{-20}$$

power scattered from SR3 AR Baffle toward SR2, W

$$P_{sr3arbafsr2s} := \frac{P_{sr3arbaf}}{2} \cdot BRDF_{bd} \cdot \Delta_{ifo} \cdot \frac{w_{ifo}^{2}}{w_{sr30}^{2}} \cdot \left(T_{sr3hr1064} \cdot T_{sr3ar1064}\right)$$

$$P_{sr3arbafsr2s} = 6.849 \times 10^{-16}$$

total power scattered from SR3 AR Baffle, W

$$P_{sr3arbafs} := P_{sr3arbafbss} + P_{sr3arbafsr2s}$$

$$P_{sr3arbafs} = 6.849 \times 10^{-16}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{sr3arbaf} := TF_{srbs} \cdot \left(\frac{P_{sr3arbafs}}{P_{psl}}\right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{sr3arbaf} = 5.246 \times 10^{-24}$$

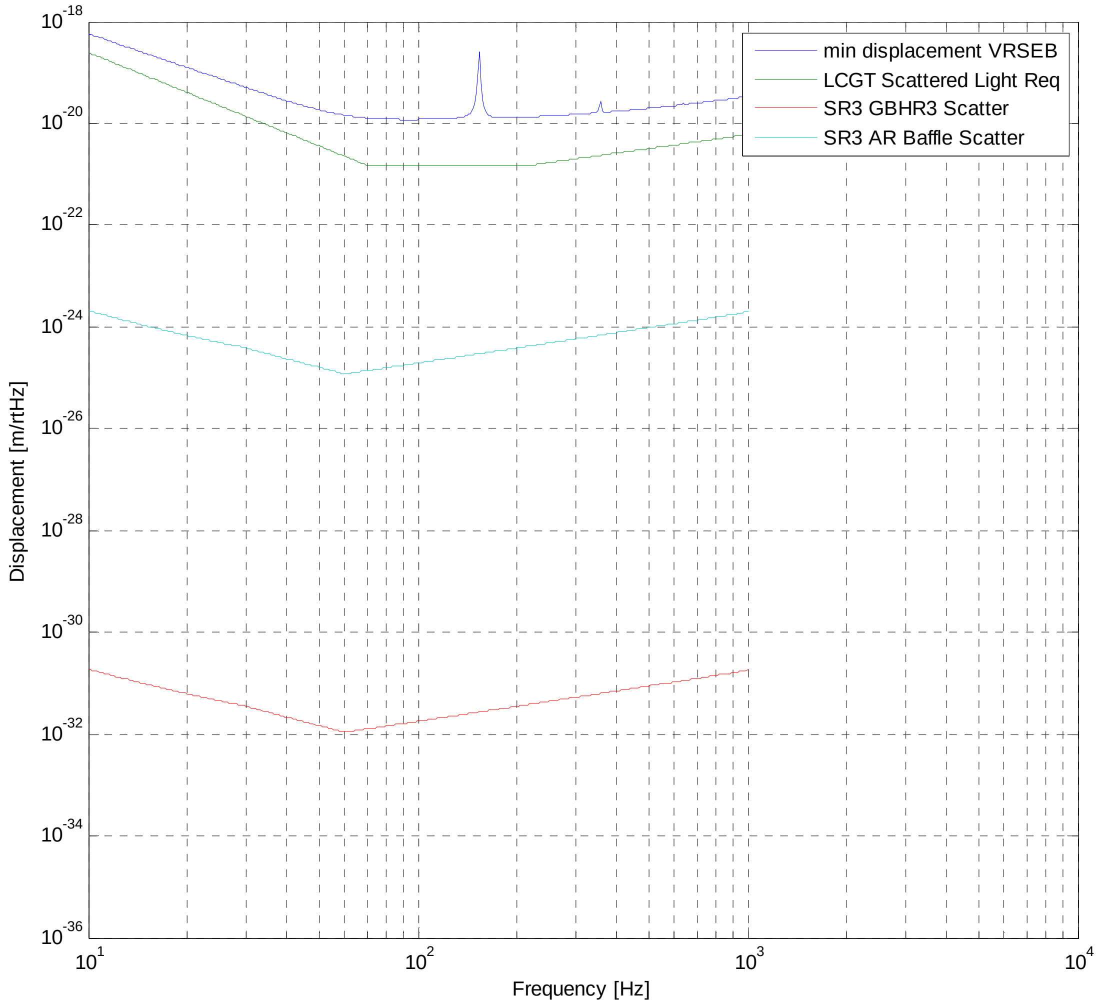

Figure 19: SR3 Ghost Beam Scatter

3.4.4.10 Output Faraday Isolator (OFI) Scatter

Output Faraday Isolator

power incident on Output Faraday Isolator, W

$P_{ofi} := P_{src} \cdot T_{srmhr1064}$ $\qquad$ $BRDF_{fi} = 1 \times 10^{-4}$

$P_{ofi} = 0.051$ $\qquad$ $\Delta_{ifo} = 1.668 \times 10^{-9}$

power scattered from OFI, W

$$P_{ofis} := N_{fi} \cdot P_{ofi} \cdot BRDF_{fi} \cdot \frac{w_{ifo}^2}{w_{srm0}^2} \cdot \Delta_{ifo} \cdot T_{srmar1064}$$

$$P_{ofis} = 1.808 \times 10^{-11}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{ofis} := TF_{srm} \cdot \left(\frac{P_{ofis}}{P_{psl}}\right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{ofis} = 6.391 \times 10^{-22}$$

Output Mode Cleaner

TEM00power incident on Output mode cleaner, W

$$P_{omc} := P_{srctem00} \cdot T_{srmhr1064}$$

$$P_{omc} = 0.015$$

power scattered from OMC W

$$P_{omcs} := P_{omc} \cdot \alpha_{omc} \cdot G_{omc} \cdot \frac{w_{ifo}^2}{w_{omcmm0}^2} \cdot \Delta_{ifo} \cdot T_{srmar1064}$$

$$P_{omcs} = 2.767 \times 10^{-8}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{omcs} := TF_{srm} \cdot \left(\frac{P_{omcs}}{P_{psl}}\right)^{0.5} \cdot A_{ofi} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{omcs} = 2.501 \times 10^{-23}$$

Output Mode Cleaner Refl

power reflected from Output mode cleaner, W

$$R_{omc} := 0.99$$

$$P_{omcrefl} := P_{srctemxx} \cdot T_{srmhr1064}$$

$$P_{omcrefl} = 0.035$$

$$BRDF_{blackglass} := 1 \cdot 10^{-6}$$

power scattered from OMC Refl BD, W

$$P_{omcrefls} := P_{omcrefl} \cdot BRDF_{blackglass} \cdot \frac{w_{ifo}^2}{w_{omcmm0}^2} \cdot \Delta_{ifo} \cdot R_{omc} \cdot T_{srmar1064}$$

$$P_{omcrefls} = 1.26 \times 10^{-12}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{omcrefls} := TF_{srm} \cdot \left(\frac{P_{omcrefls}}{P_{psl}}\right)^{0.5} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{omcrefls} = 1.688 \times 10^{-22}$$

Output Photodetector

power incident on output photodetector, W

$$P_{opd} := P_{srctem00} \cdot T_{srmhr1064} \cdot T_{omc}$$

$$P_{opd} = 0.015$$

power scattered from PD, W

$$P_{opds} := P_{opd} \cdot BRDF_{pd} \cdot \frac{w_{ifo}^2}{w_{opd0}^2} \cdot \Delta_{ifo} \cdot T_{srmar1064}$$

$$P_{opds} = 5.535 \times 10^{-8}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{opds} := TF_{srm} \cdot \left(\frac{P_{opds}}{P_{psl}} \right)^{0.5} \cdot A_{ofi} \cdot x_{sustable} \cdot 2 \cdot k$$

$$DN_{opds} = 3.537 \times 10^{-23}$$

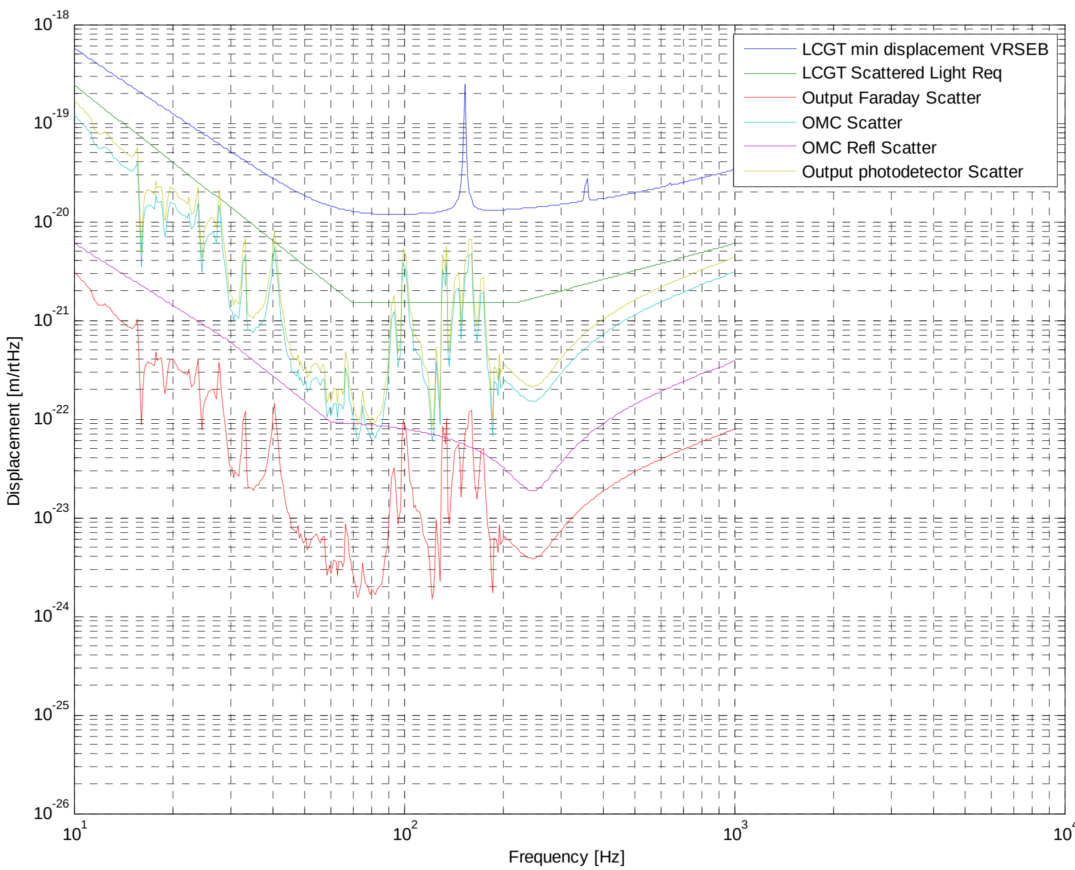

Figure 20: OFI, OMC, OMC Refl, and output PD scatter

3.5 Optical Interfaces

4 INTERFACE CONTROL DOCUMENT

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