Scattering from SR2 Scraper Baf
7-8-12

REF: H1 SIGNAL RECYCLING CAVITY beam size_2-27-12.xmcd

wavelength, m	$\lambda := 1.064 \cdot 10^{-6}$
index of refraction of fused silica	$n := 1.458464$
distance from SR3 TO SR2 SCRAPER BAF, m	$l_{SR3\_SR2scrapbaf} := 14.888$
distance from SR3 TO SR2, m	$l_{SR3\_SR2} := 15.4612$
distance from SR2 TO SRM, m	$l_{SR2\_SRM} := 15.7409$
distance from SRM AR TO SRM AR Baff, m	$l_{SRM\_srmarbaf} := 0.14$
distance from SRM AR TO OFI INPUT OPTICSf, m	$l_{SRM\_ofi} := 0.4$
distance from BS Ellip Baf to SR3, m	$l_{BSellipbaf\_SR3} := 19.653$
distance from ITM to BS Ellip Baf, m	$l_{ITM\_bsellip} := 4.890$
radius1 of SR3 m	$R1_{SR3} := -36.000$
thickness of SR3, m	$t_{SR3} := 0.100$
radius2 of SR3, m	$R2_{SR3} := 10^{64}$
radius1 of SR2 m	$R1_{SR2} := 6.430$
radius1 of SRM m	$R1_{SRM} := 5.690$
thickness of SRM m	$t_{SRM} := 0.075$

radius2 of SRM m	$R2_{SRM} := 10^{64}$
Beam curvature radius at SRM AR, m	$RC_{srmar} := -3.841$
Beam curvature radius at ITM HR, m	$R_{itm} := -1.824 \times 10^{4}$
ITM beam radius, m	$w_{itm} := 0.053168$
BS ellip baf beam radius, m	$w_{bsellbaf} := 0.053297$
Beam curvature radius at SR3, m	$R_{sr3} := 1.326 \times 10^{3}$
SR3 beam radius, m	$w_{sr3} := 0.054152$
horizontal aperture in BS ellip baf, m	$r_{bsellipx} := 0.105$
vertical aperture in BS ellip baf, m	$r_{bsellipy} := 0.130$
SRM HR beam radius, m	$w_{srmhr} := 0.002077$
SRM AR beam radius, m	$w_{srmar} := 0.002049$
SRM beam waist m	$w_{srm0} := 0.00035$
X coordinate of SRM AR Baf, mm	$x_s := 0$
Y coordinate of SRM AR Baf,, m	$y_s := 0$
axial coordinate of SRM AR Baf, m	$z_s := -l_{SRM\_srmarbaf}$
X coordinate of SRM surface, m	$x := 0$
Y coordinate of SRM surface, m	$y := 0$
axial coordinate of SRM surface, m	$z := 0$

BRDF of baf, sr^-1 $BRDF_{baf} := 0.030$

Motion of baffle @ 100 Hz, m/rt Hz $x_{hamsei} := 1 \cdot 10^{-12}$

solid angle of IFO mode, sr $\Delta_{ifo} := 2.72 \cdot 10^{-9}$

Solid Angle of SRM beam waist, sr $\Delta_{srm0} := \left[\pi \cdot \left(\frac{\lambda}{\pi \cdot w_{srm0}}\right)^2\right]$

$\Delta_{srm0} = 2.942 \times 10^{-6}$

Solid Angle of SRM AR Baf beam, sr $\Delta_{srmbaf} := \left[\pi \cdot \left(\frac{\lambda}{\pi \cdot w_{srmar}}\right)^2\right]$

$\Delta_{srmbaf} = 8.583 \times 10^{-8}$

laser wavelength, m $\lambda := 1.064 \cdot 10^{-6}$

wave number, m^-1 $k := 2 \cdot \frac{\pi}{\lambda}$ $k = 5.905 \times 10^{6}$

Transfer function @ 100 Hz, SRM $TF_{srm} := 4.22 \cdot 10^{-10}$

ITM beam radius, m $w_{itm} := 0.053168$

SRM HR beam radius $w_{srmhr} := 2.077$

IFO waist size, m $w_{ifo} := 0.0120$

IFO arm length, m $L := 4000.0$

radius of ITM, m $r_{itm} := 0.170$

Transmissivity of ITM HR $T_{itmhr} := 0.0140$

translation BS Ellip Baf to ITM $T_{BSellipbaf\_ITM} := \begin{pmatrix} 1 & l_{ITM\_bsellip} \\ 0 & 1 \end{pmatrix}$

$$T_{BSellipbaf\_ITM} = \begin{pmatrix} 1 & 4.89 \\ 0 & 1 \end{pmatrix}$$

translation SR3 to BS ellip baf

$$T_{BSellipbaf\_SR3} := \begin{pmatrix} 1 & l_{BSellipbaf\_SR3} \\ 0 & 1 \end{pmatrix}$$

$$T_{BSellipbaf\_SR3} = \begin{pmatrix} 1 & 19.653 \\ 0 & 1 \end{pmatrix}$$

SR3 mirror

$$M1_{SR3} := \begin{pmatrix} 1 & 0 \\ \frac{2}{R1_{SR3}} & 1 \end{pmatrix}$$

$$M1_{SR3} = \begin{pmatrix} 1 & 0 \\ -0.056 & 1 \end{pmatrix}$$

translation SR2 to SR3

$$T_{SR3\_SR2} := \begin{pmatrix} 1 & l_{SR3\_SR2} \\ 0 & 1 \end{pmatrix}$$

translation SR3 to SR2scraper baf

$$T_{SR3\_SR2scrap} := \begin{pmatrix} 1 & l_{SR3\_SR2scrapbaf} \\ 0 & 1 \end{pmatrix}$$

translation SR3 to SR2

$$T_{SR3\_SR2} := \begin{pmatrix} 1 & l_{SR3\_SR2} \\ 0 & 1 \end{pmatrix}$$

SR2 mirror

$$M_{SR2} := \begin{pmatrix} 1 & 0 \\ \frac{2}{R1_{SR2}} & 1 \end{pmatrix} \qquad M_{SR2} = \begin{pmatrix} 1 & 0 \\ 0.311 & 1 \end{pmatrix}$$

translation SR2 to SRM

$$T_{SR2\_SRM} := \begin{pmatrix} 1 & l_{SR2\_SRM} \\ 0 & 1 \end{pmatrix} \qquad T_{SR2\_SRM} = \begin{pmatrix} 1 & 15.741 \\ 0 & 1 \end{pmatrix}$$

first surface SRM

$$M1_{SRM} := \begin{pmatrix} 1 & 0 \\ \frac{1-n}{n \cdot R1_{SRM}} & \frac{1}{n} \end{pmatrix} \qquad M1_{SRM} = \begin{pmatrix} 1 & 0 \\ -0.055 & 0.686 \end{pmatrix}$$

thickness of SRM

$$T1_{SRM} := \begin{pmatrix} 1 & t_{SRM} \\ 0 & 1 \end{pmatrix} \qquad T1_{SRM} = \begin{pmatrix} 1 & 0.075 \\ 0 & 1 \end{pmatrix}$$

second surface SRM

$$M2_{SRM} := \begin{pmatrix} 1 & 0 \\ \dfrac{n-1}{R2_{SRM}} & n \end{pmatrix} \qquad M2_{SRM} = \begin{pmatrix} 1 & 0 \\ 0 & 1.458 \end{pmatrix}$$

translation SRM AR to SRM AR Baf

$$T_{SRMar\_SRMarbaf} := \begin{pmatrix} 1 & l_{SRM\_srmarbaf} \\ 0 & 1 \end{pmatrix}$$

$$T_{SRMar\_SRMarbaf} = \begin{pmatrix} 1 & 0.14 \\ 0 & 1 \end{pmatrix}$$

Determine height of BS Ellip Baf ray at SRM AR

ray vertical height at BS Ellip Baf, m $\qquad r_{bsellipx} = 0.105$

ray matrix from BS Ellip Baf to SRM AR baf

$$M_{bsellipbaf\_SRMarbaf} := T_{SRMar\_SRMarbaf} \cdot M2_{SRM} \cdot T1_{SRM} \cdot M1_{SRM} \cdot T_{SR2\_SRM} \cdot T_{SR3\_SR2} \cdot M1_{SR3}$$

determine horizontal ray launch angle at BS ellip baf to hit center of SRM AR Baf

guess: ray horizontal angle at BS Ellip Baf $\qquad \alpha h_{bsellipx} := 0.00471 \qquad r_{bsellipx} = 0.105$

$$\begin{pmatrix} hh_{srmarbaf} \\ \alpha h_{srmarbaf} \end{pmatrix} := T_{SRMar\_SRMarbaf} \cdot M_{bsellipbaf\_SRMarbaf} \cdot \begin{pmatrix} r_{bsellipx} \\ \alpha h_{bsellipx} \end{pmatrix}$$

$$\begin{pmatrix} hh_{srmarbaf} \\ \alpha h_{srmarbaf} \end{pmatrix} = \begin{pmatrix} -7.422 \times 10^{-5} \\ -6.432 \times 10^{-3} \end{pmatrix}$$

ray horizontal angle at SRM AR Baf $\qquad \alpha h_{srmarbaf} = -6.432 \times 10^{-3}$

Calculate horizontal ray height at SRM AR

$$rh_{srmar} := \alpha h_{srmarbaf} \cdot l_{SRM\_srmarbaf}$$

$$rh_{srmar} = -9.004 \times 10^{-4}$$

determine vertical ray launch angle at BS ellip baf to hit SR2 Scraper Baf

guess: ray vertical angle at BS Ellip Baf $\alpha v_{bsellipy} := 0.005770$ $r_{bsellipy} = 0.13$

$$\begin{pmatrix} hv_{srmarbaf} \\ \alpha v_{srmarbaf} \end{pmatrix} := M_{bsellipbaf\_SRMarbaf} \cdot \begin{pmatrix} r_{bsellipy} \\ \alpha v_{bsellipy} \end{pmatrix}$$

$$\begin{pmatrix} hv_{srmarbaf} \\ \alpha v_{srmarbaf} \end{pmatrix} = \begin{pmatrix} 8.673 \times 10^{-6} \\ -7.874 \times 10^{-3} \end{pmatrix}$$

ray vertical angle at SRM AR Baf $\alpha v_{srmarbaf} = -7.874 \times 10^{-3}$

Calculate vertical ray height at SRM AR

$$rv_{srmar} := \alpha v_{srmarbaf} \cdot l_{SRM\_srmarbaf}$$

$$rv_{srmar} = -1.102 \times 10^{-3}$$

solid angle from SRM AR Baf to SRM AR

$$\omega_{srmarbaf\_srmar} := \pi \cdot \left(\frac{rh_{srmar} + rv_{srmar}}{2 \cdot l_{SRM\_srmarbaf}} \right)^2$$

$$\omega_{srmarbaf\_srmar} = 1.607 \times 10^{-4}$$

Ref. T070247

input laser power, W $P_{psl} := 125$

transmissivity of SRM HR $T_{srmhr} := 0.2$

reflectivity of SRM AR $R_{srmar} := 50\cdot 10^{-6}$

transmissivity of SRM AR $T_{srmar} := 1 - R_{srmar}$ $T_{srmar} = 1$

reflectivity of SRM HR $R_{srmhr} := 1 - T_{srmhr}$ $R_{srmhr} = 0.8$

as port signal ratio $G_{as} := 0.00108$

output signal power, W $P_{srm} := P_{psl}\cdot G_{as}$ $P_{srm} = 0.135$

power in signal recycling cavity, W $P_{src} := \dfrac{P_{srm}}{T_{srmhr}}$ $P_{src} = 0.675$

SRM AR Beam Reference Field

IFO field at SRM AR

$$E_{srmar}(x,y) := e^{-i\cdot k\cdot \frac{x^2+y^2}{2\cdot R_{srmar}} - \frac{x^2+y^2}{w_{srmar}{}^2}}$$

normalize arm cavity field

$$E_{srmar0} := \sqrt{\frac{\pi}{2}\cdot w_{srmar}{}^2}$$

Field coupling for arm cavity beam

$$OVI := 4\cdot \int_0^{r_{itm}} \int_0^{r_{itm}\cdot\sqrt{1-\frac{y^2}{r_{itm}{}^2}}} \frac{E_{srmar}(x,y)}{E_{srmar0}} \cdot \frac{\overline{E_{srmar}(x,y)}}{E_{srmar0}}\, dx\, dy$$

$OVI = 1$

Power coupling coupling factor for arm cavity beam

$$PCF := \left|OVI^2\right|$$

$$PCF = 1$$

SRM AR Baf SCATTER

distance from SRM AR Baf to SRM AR surface

distance from SRM AR TO SRM AR Baff, m

$$l_{SRM\_srmarbaf} = 0.14$$

$$z_s := l_{SRM\_srmarbaf}$$

$$z_{srmbaf\_srmar}(x_s, y_s, z_s, x, y, z) := \left[\left(x_s - x\right)^2 + \left(y_s - y\right)^2 + \left(z_s - z\right)^2\right]^{0.5}$$

$$z_{srmbaf\_srmar}(x_s, y_s, z_s, x, y, z) = 0.14$$

SRM_GBAR3 Power incident on SRM AR Baf, W

$$P_{gbar3\_srmbaf} := P_{srm} \cdot R_{srmar} \cdot R_{srmhr} \cdot T_{srmar}$$

$$P_{gbar3\_srmbaf} = 5.4 \times 10^{-6}$$

scattered power from SRM AR Baf surfaces, W

$$P_{srmbaf}(z_s, P_{srm}) := P_{gbar3\_srmbaf} \cdot BRDF_{baf} \cdot \omega_{srmarbaf\_srmar} \cdot R_{srmar} \cdot R_{srmhr} \cdot T_{srmar}$$

$$P_{srmbaf}(z_s, P_{srm}) = 1.041 \times 10^{-15}$$

Point Source Field

constant distance of scatter source from SRM AR

$$z_s = 0.14 \qquad z_c(z_s) := z_s$$

assume that phase factor is unity

$$z_c(z_s) := 0 \qquad z_c(z_s) := z_s$$

constant phase factor for scattered field

$$\Phi_{srmbaf}(z_s) := e^{-i\cdot k\cdot z_c(z_s)}$$

$$\Phi_{srmbaf}(z_s) = 0.946 + 0.325i$$

Normalized Scattered field at SRM AR

$$x_s := 0 \qquad y_s := 0 \qquad z_s = 0.14$$

$$x := 0 \qquad y := 0 \qquad z := 0$$

$$E_{srmarbafsrmar}(x_s, y_s, z_s, x, y, z) := \Phi_{srmbaf}(z_s)\cdot e^{-i\cdot k\cdot \frac{(x-x_s)^2+(y-y_s)^2}{2\cdot z_{srmbaf\_srmar}(x_s, y_s, z_s, x, y, z)}}$$

$$E_{srmarbafsrmar}(x_s, y_s, z_s, x, y, z) = 0.946 + 0.325i$$

normalize arm cavity field

average SRM field radius, m $\qquad r_{srmave} := \sqrt{\frac{4\cdot(7.926\times 10^{-7})}{\pi}}$

$$P_{srmbafifo1ptnormalize}(z_s) := \frac{4}{\pi\cdot r_{srmave}^{2}}\cdot\int_0^{rh_{srmar}}\int_0^{rv_{srmar}\cdot\sqrt{1-\frac{y^2}{rh_{srmar}^{2}}}} E_{srmarbafsrmar}(x_s, y_s, z_s, x,$$

$$P_{srmbafifo1ptnormalize}(z_s) = 0.984$$

Field coupling for point source on-axis

$$E_{srmbafifo1pt}(z_s, P_{srm}) := \frac{4}{\sqrt{\pi \cdot r_{srmave}^2}} \cdot \int_0^{rh_{srmar}} \int_0^{rv_{srmar} \cdot \sqrt{1 - \frac{y^2}{rh_{srmar}^2}}} \sqrt{P_{srmbaf}(z_s, P_{srm})} \cdot E_{srmarbafsr}$$

$$E_{srmbafifo1pt}(z_s, P_{srm}) = -8.519 \times 10^{-10} + 6.109i \times 10^{-10}$$

Coupled power, W

$$P_{srmbafifo1pt}(z_s, P_{srm}) := E_{srmbafifo1pt}(z_s, P_{srm}) \cdot \overline{E_{srmbafifo1pt}(z_s, P_{srm})}$$

$$P_{srmbafifo1pt}(z_s, P_{srm}) = 1.099 \times 10^{-18}$$

Power coupling factor

$$PCF_{srmbafifo1pt}(z_s, P_{srm}) := \frac{P_{srmbafifo1pt}(z_s, P_{srm})}{P_{srmbaf}(z_s, P_{srm})}$$

$$PCF_{srmbafifo1pt}(z_s, P_{srm}) = 1.055 \times 10^{-3}$$

$$z_s = 0.14$$

RMS value

$$z_s = 0.14$$

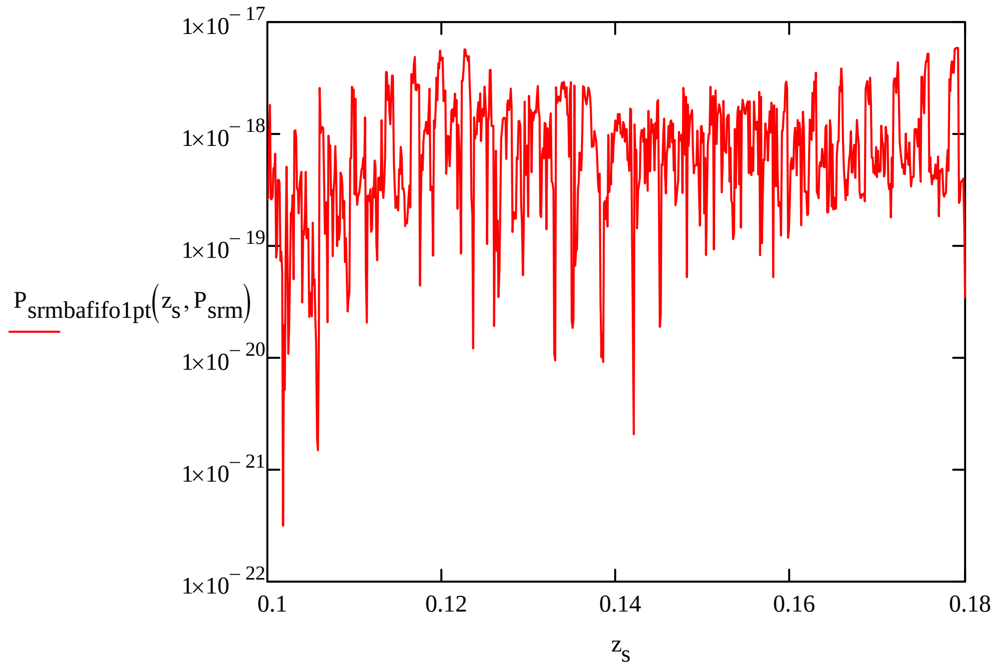
$$\delta z_s := 0.0001$$

$$P_{srmbafifo1ptrms}(z_s, P_{srm}) := \sqrt{\frac{1}{\delta z_s} \cdot \int_{z_s - \delta z_s}^{z_s + \delta z_s} P_{srmbafifo1pt}(z_s, P_{srm})^2 \, dz_s}$$

$$P_{srmbafifo1ptrms}(z_s, P_{srm}) = 1.246 \times 10^{-18}$$

$P_{srmbafifo1pt}(z_s, P_{srm}) = 1.099 \times 10^{-18}$

$z_s := 0.10, 0.1001 .. 0.18$



$z_s := l_{SRM\_srmarbaf}$

effective scattering solid angle

$$\Delta\omega_{effsrmbaf1ptonaxis}(z_s, P_{srm}) := \frac{P_{srmbafifo1pt}(z_s, P_{srm})}{P_{gbar3\_srmbaf} \cdot BRDF_{baf} \cdot R_{srmar} \cdot R_{srmhr} \cdot T_{srmar}}$$

$\Delta\omega_{effsrmbaf1ptonaxis}(z_s, P_{srm}) = 1.696 \times 10^{-7}$

$$\Delta\omega_{effsrmbaf1ptonaxisrms}(z_s, P_{srm}) := \frac{P_{srmbafifo1ptrms}(z_s, P_{srm})}{P_{gbar3\_srmbaf} \cdot BRDF_{baf} \cdot R_{srmar} \cdot R_{srmhr} \cdot T_{srmar}}$$

$\Delta\omega_{effsrmbaf1ptonaxisrms}(z_s, P_{srm}) = 1.923 \times 10^{-7}$

Compare with IFO solid angle

scaled-up IFO arm solid angle, used for previous calculations

$$\frac{w_{ifo}^{2}}{w_{srm0}^{2}} \cdot \Delta_{ifo} = 3.197 \times 10^{-6}$$

Solid Angle of SRM beam waist, sr

$$\Delta_{srm0} = 2.942 \times 10^{-6}$$

solid angle at SRM AR Baf beam radius

$$\Delta_{srmbaf} = 8.583 \times 10^{-8}$$

Scattering of SRM_GBAR3

$$DN_{srmbafifo1ptonaxis}(z_s, P_{srm}) := TF_{srm} \cdot \left(\frac{P_{srmbafifo1ptrms}(z_s, P_{srm})}{P_{psl}} \right)^{0.5} \cdot x_{hamsei} \cdot 2 \cdot k$$

$$DN_{srmbafifo1ptonaxis}(z_s, P_{srm}) = 4.976 \times 10^{-25}$$

**FOUR POINT
ANNULAR SOURCE**

$x_s := w_{srmar}$ $y_s := w_{srmar}$ $z_s = 0.14$ $z_s(z_s) := z_s$

Tilt of baffle surface, deg $\theta_{tbaf} := 5$

baffle distance increment, m $\Delta z_s(y_s) := \dfrac{y_s}{\tan\left(\theta_{tbaf} \cdot \frac{\pi}{180}\right)}$ $\Delta z_s(y_s) = 0.023$

Coupled field, rtW

annular source field

field 1 @ 0, +ys, +Δzs

$$E_{srmarbafsrmar1}(x_s, y_s, z_s, x, y, z) := \Phi_{srmbaf}\left(z_c(z_s) + \Delta z_s(y_s)\right)\cdot e^{-i\cdot k\cdot\frac{(x-0)^2+(y-y_s)^2}{2\cdot z_{srmbaf\_srmar}\left(x_s, y_s, z_s+\Delta z_s(y_s),\right.}}$$

$$E_{srmarbafsrmar1}(x_s, y_s, z_s, x, y, z) = -0.973 - 0.231i$$

field 2 @ 0, -ys, -Δzs

$$E_{srmarbafsrmar2}(x_s, y_s, z_s, x, y, z) := \Phi_{srmbaf}\left(z_c(z_s) - \Delta z_s(y_s)\right)\cdot e^{-i\cdot k\cdot\frac{(x-0)^2+(y+y_s)^2}{2\cdot z_{srmbaf\_srmar}\left(x_s, -y_s, z_s-\Delta z_s(y_s\right.}}$$

$$E_{srmarbafsrmar2}(x_s, y_s, z_s, x, y, z) = -0.879 - 0.477i$$

field 3 @ +xs, 0, Δzs=0

$$E_{srmarbafsrmar3}(x_s, y_s, z_s, x, y, z) := \Phi_{srmbaf}\left(z_c(z_s)\right)\cdot e^{-i\cdot k\cdot\frac{(x-x_s)^2+(y+0)^2}{2\cdot z_{srmbaf\_srmar}(x_s, 0, z_s, x, y, z)}}$$

$$E_{srmarbafsrmar3}(x_s, y_s, z_s, x, y, z) = 0.971 - 0.238i$$

field 4 @ -xs, 0 Δzs=0

$$E_{srmarbafsrmar4}(x_s, y_s, z_s, x, y, z) := \Phi_{srmbaf}\left(z_c(z_s)\right)\cdot e^{-i\cdot k\cdot\frac{(x+x_s)^2+(y+0)^2}{2\cdot z_{srmbaf\_srmar}(x_s, 0, z_s, x, y, z)}}$$

$$E_{srmarbafsrmar4}(x_s, y_s, z_s, x, y, z) = 0.971 - 0.238i$$

$$F_{ann}(x_s, y_s, z_s, x, y, z) := \frac{E_{srmarbafsrmar1}(x_s, y_s, z_s, x, y, z)}{4} + \frac{E_{srmarbafsrmar2}(x_s, y_s, z_s, x, y, z)}{4} + \frac{E_{srm}}{}$$

$$F_{ann}(x_s, y_s, z_s, x, y, z) = 0.023 - 0.296i$$

$$E_{srmbaffifo4pt}(x_s, y_s, z_s, P_{srm}) := \frac{4}{\sqrt{\pi \cdot r_{srmave}^2}} \cdot \int_0^{rh_{srmar}} \int_0^{rv_{srmar} \cdot \sqrt{1 - \frac{y^2}{rh_{srmar}^2}}} \sqrt{P_{srmbaf}(z_s, P_{srm})} \cdot F_{ann}$$

$$E_{srmbaffifo4pt}(x_s, y_s, z_s, P_{srm}) = -1.261 \times 10^{-10} + 3.52i \times 10^{-10}$$

Coupled power, W

$$P_{srmbafifo4pt}(x_s, y_s, z_s, P_{srm}) := E_{srmbaffifo4pt}(x_s, y_s, z_s, P_{srm}) \cdot \overline{E_{srmbaffifo4pt}(x_s, y_s, z_s, P_{srm})}$$

$$P_{srmbafifo4pt}(x_s, y_s, z_s, P_{srm}) = 1.398 \times 10^{-19}$$

Check 1pt on axis with 4pt on axis

$$P_{srmbafifo4pt}(0, 0, z_s, P_{srm}) = 1.099 \times 10^{-18}$$

Power coupling factor

$$PCF_{srmbafifo4pt}(x_s, y_s, z_s, P_{srm}) := \frac{P_{srmbafifo4pt}(x_s, y_s, z_s, P_{srm})}{P_{srmbaf}(z_s, P_{srm})}$$

$$PCF_{srmbafifo4pt}(x_s, y_s, z_s, P_{srm}) = 1.342 \times 10^{-4}$$

$$PCF_{srmbafifo1pt}(z_s, P_{srm}) = 1.055 \times 10^{-3}$$

RMS value

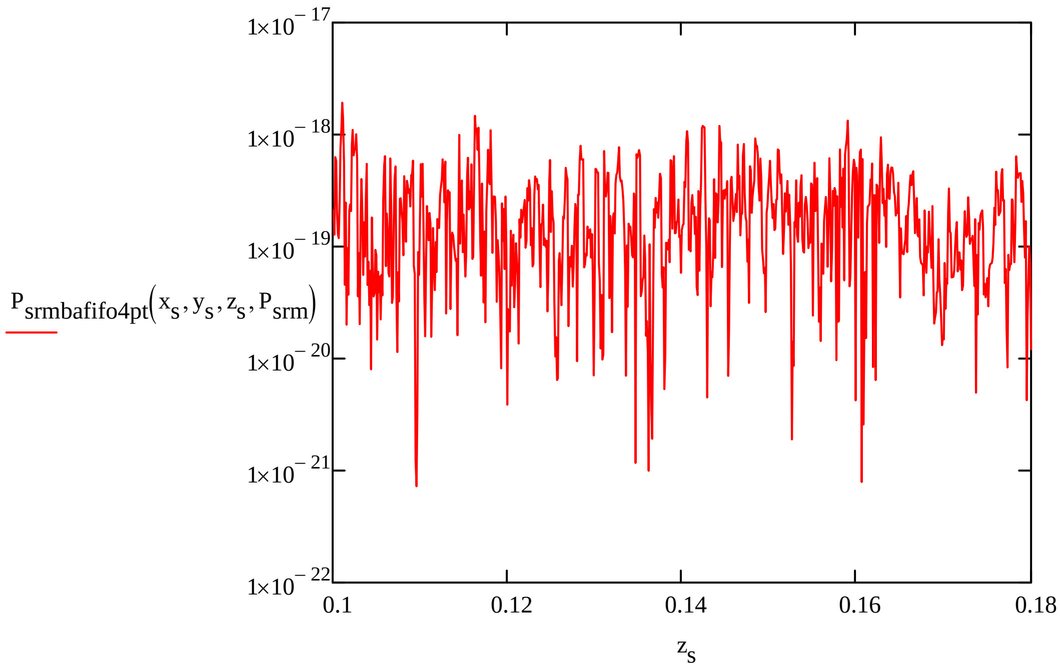
averaging increment, m $\delta z_s := 0.0001$

$$P_{srmbafifo4ptrms}(x_s, y_s, z_s, P_{srm}) := \sqrt{\frac{1}{\delta z_s} \cdot \int_{z_s - \delta z_s}^{z_s + \delta z_s} P_{srmbafifo4pt}(x_s, y_s, z_s, P_{srm})^2 \, dz_s}$$

$$P_{srmbafifo4ptrms}(x_s, y_s, z_s, P_{srm}) = 5.266 \times 10^{-19}$$

$$P_{srmbafifo1ptrms}(z_s, P_{srm}) = 1.246 \times 10^{-18}$$

$$z_s := 0.10, 0.1001 .. 0.18$$



$$z_s := l_{SRM\_srmarbaf}$$

Fresnel Zone number

$$N := \frac{x_s^2}{z_s \cdot \lambda} \qquad N = 28.185$$

$$\delta z_{fr} := \frac{x_s^2}{(N+1)\cdot\lambda} - z_s$$

$$\delta z_{fr} = -4.797 \times 10^{-3}$$

effective scattering solid angle

$$\Delta\omega_{effsrmbaf4pt}(x_s, y_s, z_s, P_{srm}) := \frac{P_{srmbafifo4pt}(x_s, y_s, z_s, P_{srm})}{P_{gbar3\_srmbaf} \cdot BRDF_{baf} \cdot R_{srmar} \cdot R_{srmhr} \cdot T_{srmar}}$$

$$\Delta\omega_{effsrmbaf4pt}(x_s, y_s, z_s, P_{srm}) = 2.157 \times 10^{-8}$$

$$\Delta\omega_{effsrmbaf4ptrms}(x_s, y_s, z_s, P_{srm}) := \frac{P_{srmbafifo4ptrms}(x_s, y_s, z_s, P_{srm})}{P_{gbar3\_srmbaf} \cdot BRDF_{baf} \cdot R_{srmar} \cdot R_{srmhr} \cdot T_{srmar}}$$

$$\Delta\omega_{effsrmbaf4ptrms}(x_s, y_s, z_s, P_{srm}) = 8.128 \times 10^{-8}$$

Compare with various solid angles

scaled-up IFO arm solid angle, used for previous calculations, sr

$$\frac{w_{ifo}^2}{w_{srm0}^2} \cdot \Delta_{ifo} = 3.197 \times 10^{-6}$$

Solid Angle of SRM beam waist, sr $\quad \Delta_{srm0} = 2.942 \times 10^{-6}$

solid angle at SRM AR Baf beam radius, sr $\quad \Delta_{srmbaf} = 8.583 \times 10^{-8}$

$$DN_{srmbafifo4ptrms}(x_s, y_s, z_s, P_{srm}) := TF_{srm} \cdot \left(\frac{P_{srmbafifo4ptrms}(x_s, y_s, z_s, P_{srm})}{P_{psl}} \right)^{0.5} \cdot x_{hamsei} \cdot 2 \cdot k$$

$$DN_{srmbafifo4ptrms}(x_s, y_s, z_s, P_{srm}) = 3.235 \times 10^{-25}$$

OFI SCATTER

distance from SRM AR TO OFI INPUT OPTICSf, m

$$l_{SRM\_ofi} = 0.4$$

$$z_s := l_{SRM\_ofi}$$

distance from OFI optics to SRM AR surface

$$z_{ofi\_srmar}(x_s, y_s, z_s, x, y, z) := \left[(x_s - x)^2 + (y_s - y)^2 + (z_s - z)^2 \right]^{0.5}$$

$$z_{ofi\_srmar}(x_s, y_s, z_s, x, y, z) = 0.4$$

Power incident on OFI optics, W

$$P_{srm} = 0.135$$

scattered power from OFI optical surfaces, W

$$P_{srmbaf}(z_s, P_{srm}) := P_{srm} \cdot BRDF_{baf} \cdot \omega_{srmarbaf\_srmar}$$

$$P_{srmbaf}(z_s, P_{srm}) = 6.51 \times 10^{-7}$$

·TBSellipbaf_SR3

$$y, z) \cdot \overline{E_{srmarbafsrmar}(x_s, y_s, z_s, x, y, z)}\, dx\, dy$$

$$\mathrm{nar}\left(0,0,z_s,x,y,z\right)\cdot\frac{\overline{E_{srmar}(x,y)}}{E_{srmar0}}\,dx\,dy$$

$\overline{\ x, y, z)}$

$\overline{), x, y, z)}$

$$\frac{\text{rmarbafsrmar3}\left(x_s, y_s, z_s, x, y, z\right)}{4} + \frac{E_{\text{srmarbafsrmar4}}\left(x_s, y_s, z_s, x, y, z\right)}{4}$$

$$\left(x_s, y_s, z_s, x, y, z\right) \cdot \frac{\overline{E_{\text{srmar}}(x, y)}}{E_{\text{srmar0}}} \, dx \, dy$$