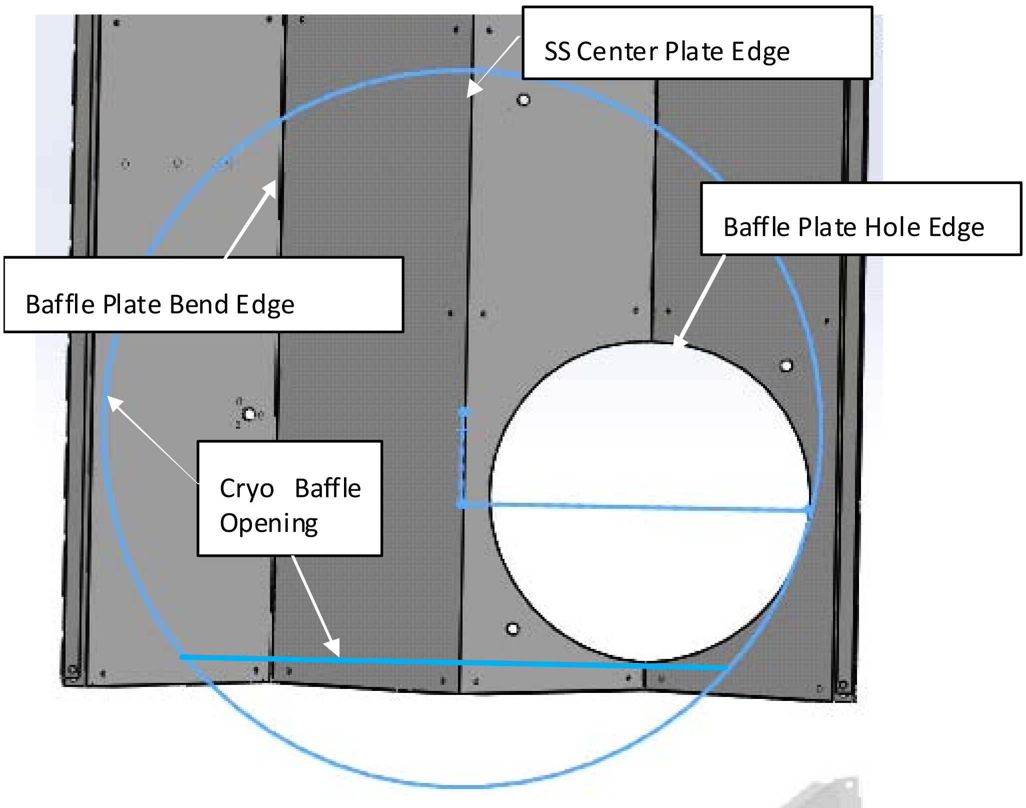
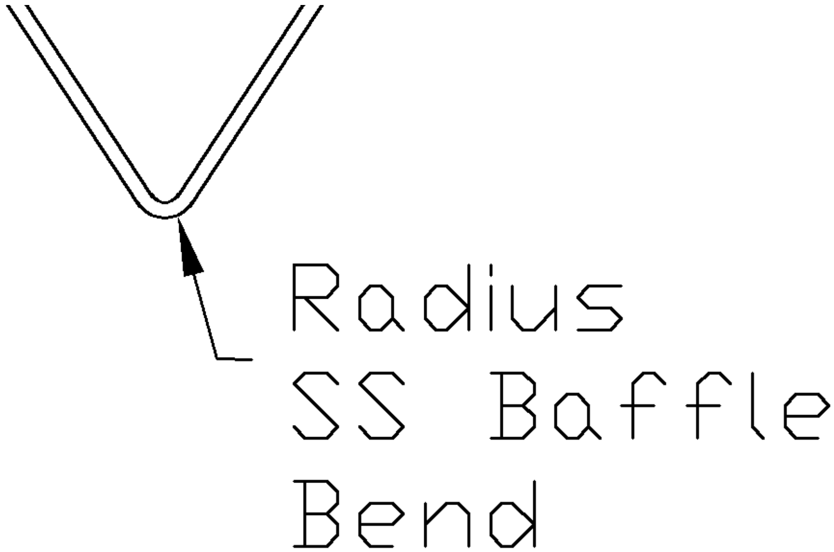
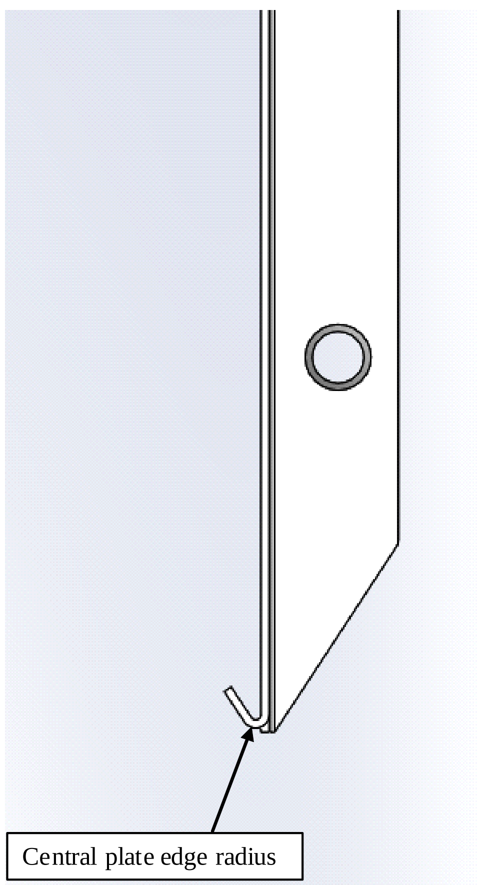
ACB DLC coating on SS
7/19/13




Radius
SS Baffle
Bend


Central plate edge radius

Arm cavity power, W $P_a := 834174$

radius of SS baffle plate edge, m $r_{edgess} := 0.002$

radius of SS baffle bend, m $r_{bendss} := 0.0024$

length of baffle plate edge, m $H_p := 0.655$

length of baffle bend, m $H_b := 2 \cdot 0.239 = 0.478$

Frontal area of SS center plate cut edge, m^2 $A_{ssbp}(r_{edgess}) := 2 \cdot r_{edgess} \cdot H_p$

$A_{ssbp}(r_{edgess}) = 2.62 \times 10^{-3}$

Frontal area of SS baffle bend edge, m^2 $A_{ssb}(r_{bendss}) := 2 \cdot r_{bendss} \cdot H_b$

$A_{ssb}(r_{bendss}) = 2.294 \times 10^{-3}$

BRDF of SS cut edge, sr^-1 $BRDF_{edgess} := 0.1$

BRDF of photodetector, sr^-1 $BRDF_{pd} := 1 \cdot 10^{-3}$

BRDF of screw head sr^-1 $BRDF_{sh} := 5 \cdot 10^{-2}$

number of photodetector $N_{pd} := 16$

number of screw heads $N_{sh} := 3 \cdot N_{pd}$

radius of photodetector ring, m $r_{pdbc} := 0.196$

Photoconductor radius, m $r_{pd} := \frac{0.0114}{2}$

$r_{pd} = 5.7 \times 10^{-3}$

photoconductor area, m^2 $A_{pd} := \pi \cdot r_{pd}^{2}$

$A_{pd} = 1.021 \times 10^{-4}$

Screw head radius (#10), m	$r_{sh} := .004$
Screw head area, m^2	$A_{sh} := \pi \cdot r_{sh}^{2}$
	$A_{sh} = 5.027 \times 10^{-5}$
laser wavelength, m	$\lambda := 1.064 \cdot 10^{-6}$
wave number, m^-1	$k := 2 \cdot \frac{\pi}{\lambda}$
	$k = 5.905 \times 10^{6}$
ACB displacement @ 100 HZ, m/rt HZ	$x_{ACB} := 1 \cdot 10^{-12}$
IFO waist size, m	$w_{ifo} := 0.012$
solid angle of IFO mode, sr	$\Delta\Omega_{ifo} := \frac{\lambda^2}{\pi \cdot w_{ifo}^{2}} = 2.502 \times 10^{-9}$
Transfer function @ 100 Hz, ITM HR	$TF_{itmhr} := 1.1 \cdot 10^{-9}$
Gaussian beam radius at ITM, m	$w := 0.055$
IFO arm length, m	$L_{arm} := 4000$
PSL laser power, W	$P_{psl} := 125$
Arm Power, W	$P_0 := 834174$
radius of Cryopump aperture, m	$R_{cp} := 0.3845$
half-angle from centerline to Rcp, rad	$\theta_{cp} := \frac{R_{cp}}{L_{arm}}$
half-angle from centerline to Rcp, rad (see ACB_PD_scatter_8-29-12)	$\theta_{pd} := \frac{r_{pdbc}}{L_{arm}}$

BRDF, sr^-1; CSIRO, surface 2, S/N 2

$$BRDF_1(\theta) := \frac{2755.12}{\left(1 + 8.50787\cdot 10^8\cdot\theta^2\right)^{1.23597}}$$

radius of manifold/cryo baffle, m

$$R_{cryo} := \frac{0.769}{2} = 0.385$$

height of ledge, m

$$H_L := 0.769 - 0.655 = 0.114$$

$$H_1 := R_{cryo} - H_L = 0.271$$

radius of ACB hole, m

$$r_{acbhole} := 0.172$$

area of ACB hole, m^2

$$A_h := \pi\cdot r_{acbhole}^{\;2} = 0.093$$

$$A_h = 0.093$$

thickness of baffle plate, m

$$t := 0.047\cdot .0254$$

maximum width of exposed hole edge, m

$$w_e := \frac{t}{\cos\left(33\cdot\frac{\pi}{180}\right)}$$

$$w_e = 1.423\times 10^{-3}$$

exposed area of baffle plate hole edge, m^2

$$A_{bpe} := \int_{-r_{acbhole}}^{0} 2\cdot\sqrt{r_{acbhole}^{\;2} - x^2}\,dx - \int_{-r_{acbhole}+w_e}^{0} 2\cdot\sqrt{r_{acbhole}^{\;2} - \left(x - w_e\right)^2}\,dx$$

$$A_{bpe} = 4.897\times 10^{-4}$$

area of manifold/cryo baffle ledge, m^2

$$A_L := \int_{H_1}^{R_{cryo}} 2\cdot\sqrt{R_{cryo}^{\;2} - H^2}\,dH$$

$$A_L = 0.043$$

area of exposed ACB, m^2

$$A_{ACB} := \pi\cdot R_{cryo}^{\;2} - 2.A_h - A_L = 0.236$$

power through the cryopump baffle aperture (hits the arm cavity baffle), W

$$P_{acb} := P_a \cdot \int_0^{\theta_{cp}} 2 \cdot \pi \cdot \theta \cdot BRDF_1(\theta)\, d\theta$$

$$P_{acb} = 14.472$$

Area of cryopump baf aperture, m^2

$$A_{cp} := \pi \cdot R_{cp}^{\;2} = 0.464$$

incident intensity, W/m^2

$$I_i := \frac{P_{acb}}{A_{cp}} = 31.158$$

tilt angle of baffle edge, rad

$$\theta_t := 1 \cdot \frac{\pi}{180} = 0.017$$

$$\theta_{xy} := 0$$

incident angle, rad

$$\theta_i(\theta_t, \theta_{xy}) := \mathrm{acos}(\cos(\theta_{xy}) \cdot \cos(\theta_t))$$

input angle range, bend, rad

$$\theta_{xymaxbend} := 57 \cdot \frac{\pi}{180} = 0.995$$

input angle range, bend, deg

$$\theta_{xymaxbdeg} := \theta_{xymaxbend} \cdot \frac{180}{\pi} = 57$$

input angle range, edge rad

$$\theta_{xymaxedge} := 60 \cdot \frac{\pi}{180}$$

BRDF #4 Oxidized stainless steel, 3 deg inc.

Reflectivity of baffle surface

$$R := 0.02$$

break-over angle, rad

$$\theta_1 := .8 \cdot \frac{\pi}{180} = 0.014$$

micro-roughness angle, rad

$$\theta_2 := 10 \cdot \frac{\pi}{180} = 0.175$$

max BRDF, sr^-1

$$BRDF_0 := 7.5$$

final slope modifier

$$\beta := 0.7$$

micro-roughness constant

$$C_{mr} := \frac{2^{\frac{1}{(\beta)}} - 1}{\theta_1^{\,2}}$$

$$C_{mr} = 8.678 \times 10^{3}$$

large angle BRDF, sr^-1

$$BRDF_{\theta 2} := 0.03$$

BRDF function, sr^-1

$$BRDF_{ACBoxy3}(\theta_i) := \frac{BRDF_0}{\left(1 + C_{mr} \cdot \theta_i^{\,2}\right)^{\beta}} + BRDF_{\theta 2}$$

BRDF #4 Oxidized stainless steel, 57 deg inc.

Reflectivity of baffle surface

$$R := .04$$

break-over angle, rad

$$\theta_1 := 0.6 \cdot \frac{\pi}{180} = 0.01$$

micro-roughness angle, rad

$$\theta_2 := 10 \cdot \frac{\pi}{180} = 0.175$$

max BRDF, sr^-1

$$BRDF_0 := 40$$

final slope modifier

$$\beta := 0.95$$

micro-roughness constant

$$C_{mr} := \frac{2^{\frac{1}{(\beta)}} - 1}{\theta_1^{\,2}}$$

$$C_{mr} = 9.797 \times 10^{3}$$

large angle BRDF, sr^-1

$$BRDF_{\theta 2} := 0.04$$

BRDF function, sr^-1

$$BRDF_{ACBoxy57}(\theta_i) := \frac{BRDF_0}{\left(1 + C_{mr} \cdot \theta_i^{\,2}\right)^{\beta}} + BRDF_{\theta 2}$$

back-scatter angle, rad

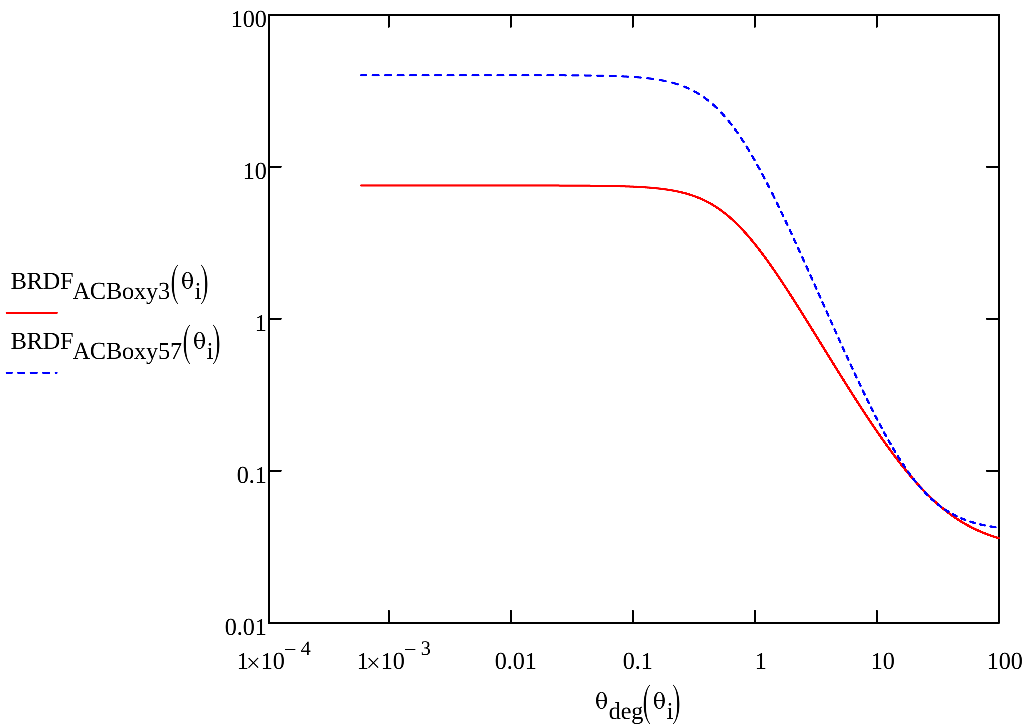
$\theta_{57} := 2 \cdot 57 \cdot \frac{\pi}{180} = 1.99$

back-scatter BRDF, sr^-1

$BRDF_{ACBoxy57}(\theta_{57}) = 0.042$

$\theta_{deg}(\theta_i) := \theta_i \cdot \frac{180}{\pi}$

$\theta_i := 0, 0.00001 .. 10 \cdot \theta_2$



BRDF DLC @ 57 deg inc.

specular reflectivity $R_{dlc57} := 0.11$

break-over angle, rad $\theta_1 := 4 \cdot \frac{\pi}{180} = 0.07$

micro-roughness angle, rad $\theta_2 := 60 \cdot \frac{\pi}{180} = 1.047$

max BRDF, sr^-1 $BRDF_0 := 0.02$

final slope modifier $\beta := 1.1$

micro-roughness constant $C_{mr} := \frac{2^{\frac{1}{(\beta)}} - 1}{\theta_1^{\,2}}$

$C_{mr} = 180.116$

large angle BRDF, sr^-1 $BRDF_{\theta 2} := 6.5 \cdot 10^{-5}$

BRDF function, sr^-1 $BRDF_{dlc57}(\theta_i) := \frac{BRDF_0}{\left(1 + C_{mr} \cdot \theta_i^{\,2}\right)^{\beta}} + BRDF_{\theta 2}$

back-scatter angle, rad $\theta_{57} := 2 \cdot 57 \cdot \frac{\pi}{180} = 1.99$

back-scatter BRDF, sr^-1 $BRDF_{dlc57}(\theta_{57}) = 7.952 \times 10^{-5}$

BRDF DLC 15 deg inc.

specular reflectivity $R_{dlc15} := 0.0076$

break-over angle, rad $\theta_1 := 1.5 \cdot \frac{\pi}{180} = 0.026$

micro-roughness angle, rad $\theta_2 := 60 \cdot \frac{\pi}{180} = 1.047$

max BRDF, sr^-1 $BRDF_0 := 0.015$

final slope modifier $\beta := 0.7$

micro-roughness constant $C_{mr} := \frac{2^{\frac{1}{(\beta)}} - 1}{\theta_1^{\,2}}$

$C_{mr} = 2.468 \times 10^{3}$

large angle BRDF, sr^-1 $BRDF_{\theta 2} := 1.0 \cdot 10^{-6}$

BRDF function, sr^-1 $BRDF_{dlc15}(\theta_i) := \frac{BRDF_0}{\left(1 + C_{mr} \cdot \theta_i^{2}\right)^{\beta}} + BRDF_{\theta 2}$

back-scatter angle, rad $\theta_{15} := 2 \cdot 15 \cdot \frac{\pi}{180} = 0.524$

back-scatter BRDF, sr^-1 $BRDF_{dlc15}(\theta_{15}) = 1.574 \times 10^{-4}$

BRDF DLC 5 deg inc.

specular reflectivity $R_{dlc5} := 0.0048$

break-over angle, rad $\theta_1 := 0.5 \cdot \frac{\pi}{180} = 8.727 \times 10^{-3}$

micro-roughness angle, rad $\theta_2 := 10 \cdot \frac{\pi}{180} = 0.175$

max BRDF, sr^-1 $BRDF_0 := 0.3$

final slope modifier $\beta := 0.9$

micro-roughness constant $C_{mr} := \frac{2^{\frac{1}{(\beta)}} - 1}{\theta_1^{2}}$

$C_{mr} = 1.523 \times 10^{4}$

large angle BRDF, sr^-1 $BRDF_{\theta 2} := 5 \cdot 10^{-6}$

BRDF function, sr^-1

$$BRDF_{dlc5}(\theta_i) := \frac{BRDF_0}{\left(1 + C_{mr}\cdot\theta_i^{\,2}\right)^{\beta}} + BRDF_{\theta 2}$$

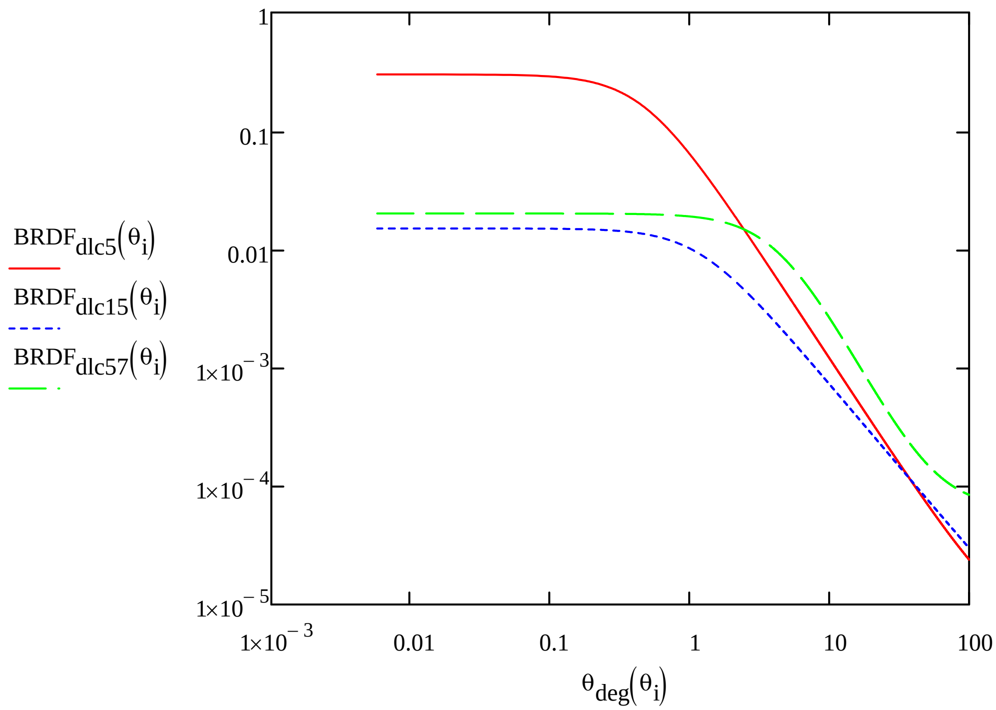
back-scatter angle, rad

$$\theta_5 := 2\cdot 5\cdot\frac{\pi}{180} = 0.175$$

back-scatter BRDF, sr^-1

$$BRDF_{dlc5}(\theta_5) = 1.197\times 10^{-3}$$

$\theta_i := 0, 0.0001 .. 10\cdot\theta_2$ $\theta_2 = 0.175$



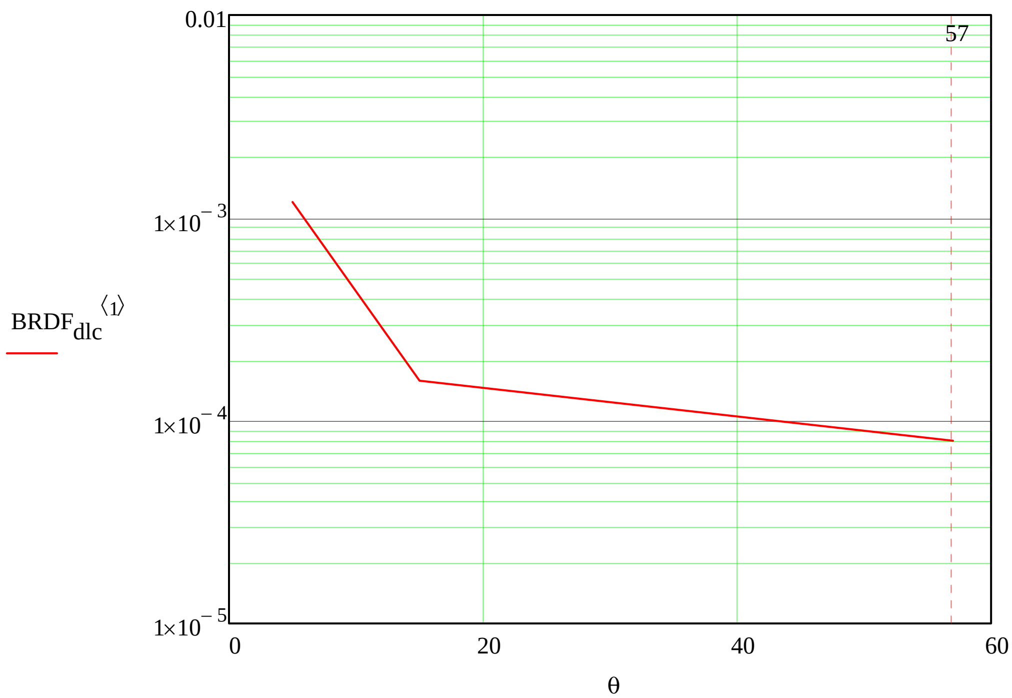
$$BRDF_{dlc} := \begin{pmatrix} 5 & BRDF_{dlc5}(\theta_5) \\ 15 & BRDF_{dlc15}(\theta_{15}) \\ 57 & BRDF_{dlc57}(\theta_{57}) \end{pmatrix}$$

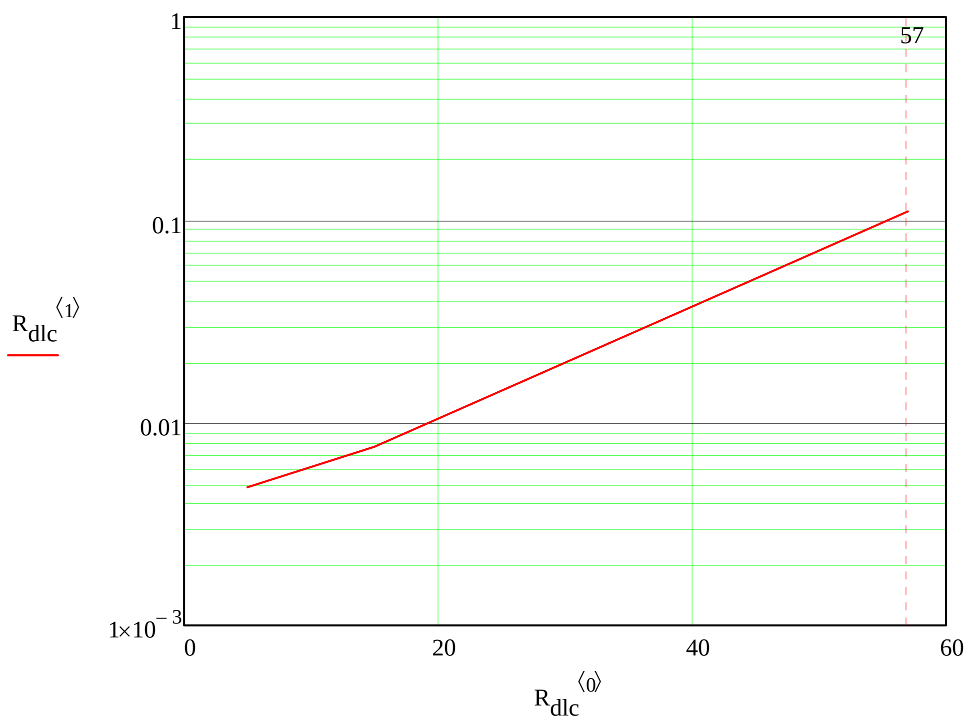
$$R_{dlc} := \begin{pmatrix} 5 & R_{dlc5} \\ 15 & R_{dlc15} \\ 57 & R_{dlc57} \end{pmatrix} \qquad \theta := BRDF_{dlc}^{\langle 0 \rangle}$$

$R_{dlc5} = 4.8 \times 10^{-3}$ $\qquad R_{dlc5} := 4.8 \times 10^{-3}$

$R_{dlc15} = 7.6 \times 10^{-3}$ $\qquad R_{dlc15} := 7.6 \times 10^{-3}$

$R_{dlc57} = 0.11$ $\qquad R_{dlc57} := 0.11$





Scatter from photodetectors

number of photodetector $N_{pd} = 16$

photoconductor area, m^2 $A_{pd} = 1.021 \times 10^{-4}$

Power hitting the PD, W

$$P_{pd} := P_0 \cdot BRDF_1(\theta_{pd}) \cdot \frac{A_{pd}}{L_{arm}^2} = 3.706 \times 10^{-3}$$

power scattered by photodetector, into IFO mode, W

$$P_{pdsifo}(\theta_t) := \sqrt{N_{pd}} \cdot P_{pd} \cdot BRDF_{pd} \cdot \frac{\pi \cdot w_{ifo}^2}{L_{arm}^2} \cdot BRDF_1(\theta_{pd}) \cdot \Delta\Omega_{ifo}$$

$$P_{pdsifo}(\theta_t) = 7.304 \times 10^{-22}$$

displacement noise @ 100 Hz, m/rtHz

$$DN_{pd}(\theta_t) := TF_{itmhr} \cdot \left(\frac{P_{pdsifo}(\theta_t)}{P_{psl}} \right)^{0.5} \cdot x_{ACB} \cdot \frac{2}{\sqrt{2}} \cdot k$$

$$DN_{pd}(\theta_t) = 2.221 \times 10^{-26}$$

Scatter from screw heads

number of screw heads $N_{sh} = 48$

Screw head area, m^2 $A_{sh} = 5.027 \times 10^{-5}$

Power hitting the screw head, W

$$P_{sh} := P_0 \cdot BRDF_1(\theta_{pd}) \cdot \frac{A_{sh}}{L_{arm}^2} = 1.825 \times 10^{-3}$$

power scattered by screw head into IFO

mode, W

$$P_{shifo}(\theta_t, N_{sh}) := \sqrt{N_{sh}} \cdot P_{sh} \cdot BRDF_{sh} \cdot \frac{\pi \cdot w_{ifo}^2}{L_{arm}^2} \cdot BRDF_1(\theta_{pd}) \cdot \Delta\Omega_{ifo}$$

$$P_{shifo}(\theta_t, N_{sh}) = 3.115 \times 10^{-20}$$

displacement noise @ 100 Hz,
m/rtHz

$$DN_{sh}(\theta_t, N_{sh}) := TF_{itmhr} \cdot \left(\frac{P_{shifo}(\theta_t, N_{sh})}{P_{psl}} \right)^{0.5} \cdot x_{ACB} \cdot \frac{2}{\sqrt{2}} \cdot k$$

$$DN_{sh}(\theta_t, N_{sh}) = 1.45 \times 10^{-25}$$

OXIDIZED SS BAFFLE

Scatter from oxy SS baffle hole edge

BRDF geometric scatter function from baffle hole edge

$$\theta_i(\theta_t, \theta_{xy}) := acos(cos(\theta_{xy}) \cdot cos(\theta_t))$$

$$S_{boxy}(\theta_t, BRDF_{ACBoxy3}) := \int_0^{\theta_{xymaxbend}} \left[\int_{2 \cdot \theta_i(\theta_t, \theta_{xy}) - \frac{w_{ifo}}{L_{arm}}}^{2 \cdot \theta_i(\theta_t, \theta_{xy}) + \frac{w_{ifo}}{L_{arm}}} BRDF_{ACBoxy3}(\theta_s + 2 \cdot \theta_i(\theta_t, \theta_{xy})) \cdot \sqrt{w}\right.$$

$$S_{boxy}(\theta_t, BRDF_{ACBoxy3}) = 7.008 \times 10^{-13}$$

Scattered power into IFO from baffle hole edge

$$P_{acboxyholesifo}(\theta_t) := I_i \cdot A_{bpe} \cdot BRDF_1\left(30 \cdot 10^{-6}\right) \cdot \Delta\Omega_{ifo} \cdot \left(S_{boxy}(\theta_t, BRDF_{ACBoxy3})\right)$$

$P_{acboxyholesifo}(\theta_t) = 3.651 \times 10^{-20}$

displacement noise @ 100 Hz,
m/rtHz

$$DN_{acboxyhole}(\theta_t) := TF_{itmhr} \cdot \left(\frac{P_{acboxyholesifo}(\theta_t)}{P_{psl}} \right)^{0.5} \cdot x_{ACB} \cdot \frac{2}{\sqrt{2}} \cdot k$$

$$DN_{acboxyhole}(\theta_t) = 1.57 \times 10^{-25}$$

Scatter from SS center plate edge

power incident on SS center plate edge, W

$$P_{itmbafpedgess} := I_i \cdot A_{ssbp}(r_{edgess})$$

$$P_{itmbafpedgess} = 0.082$$

Scattered power into IFO from oxy SS center plate edge

$$P_{acboxyedgebsifo}(\theta_t, r_{edgess}) := I_i \cdot A_{ssbp}(r_{edgess}) \cdot BRDF_{edgess} \cdot \frac{\pi \cdot w_{ifo}^2}{L_{arm}^2} \cdot BRDF_1(30 \cdot 10^{-6}) \cdot \Delta\Omega_{ifo}$$

$$P_{acboxyedgebsifo}(\theta_t, r_{edgess}) = 7.881 \times 10^{-19}$$

displacement noise @ 100 Hz,
m/rtHz

$$DN_{acboxyedgeb}(\theta_t, r_{edgess}) := TF_{itmhr} \cdot \left(\frac{P_{acboxyedgebsifo}(\theta_t, r_{edgess})}{P_{psl}} \right)^{0.5} \cdot x_{ACB} \cdot \frac{2}{\sqrt{2}} \cdot k$$

$$DN_{acboxyedgeb}(\theta_t, r_{edgess}) = 7.294 \times 10^{-25}$$

Scatter from oxy SS center baffle bend

BRDF geometric scatter function from oxy SS baffle bend

$$\theta_i(\theta_t, \theta_{xy}) := \mathrm{acos}(\cos(\theta_{xy}) \cdot \cos(\theta_t))$$

$$S_{boxy}(\theta_t, BRDF_{ACBoxy3}) := \int_0^{\theta_{xymaxbend}} \left[\int_{2 \cdot \theta_i(\theta_t, \theta_{xy}) - \frac{w_{ifo}}{L_{arm}}}^{2 \cdot \theta_i(\theta_t, \theta_{xy}) + \frac{w_{ifo}}{L_{arm}}} BRDF_{ACBoxy3}(\theta_s + 2 \cdot \theta_i(\theta_t, \theta_{xy})) \cdot \sqrt{v}\right.$$

$$S_{boxy}(\theta_t, BRDF_{ACBoxy3}) = 7.008 \times 10^{-13}$$

Scattered power into IFO from oxy SS baffle bend

$$P_{acboxybendsifo}(\theta_t, r_{bendss}) := I_i \cdot A_{ssb}(r_{bendss}) \cdot BRDF_1(30 \cdot 10^{-6}) \cdot \Delta\Omega_{ifo} \cdot (S_{boxy}(\theta_t, BRDF_{ACBoxy3}))$$

$$P_{acboxybendsifo}(\theta_t, 0.001) = 7.128 \times 10^{-20}$$

displacement noise @ 100 Hz,
m/rtHz

$$DN_{acboxybend}(\theta_t, r_{bendss}) := TF_{itmhr} \cdot \left(\frac{P_{acboxybendsifo}(\theta_t, r_{bendss})}{P_{psl}} \right)^{0.5} \cdot x_{ACB} \cdot \frac{2}{\sqrt{2}} \cdot k$$

$$DN_{acboxybend}(\theta_t, 0.001) = 2.194 \times 10^{-25}$$

Power Scattered from the oxy SS louver portion of baffle

$$BRDF_{ACBoxy57}\left(2 \cdot 57 \cdot \frac{\pi}{180}\right) = 0.042$$

$$P_{acboxylouvsifo} := I_i \cdot A_{ACB} \cdot BRDF_{ACBoxy57}\left(2 \cdot 57 \cdot \frac{\pi}{180}\right) \cdot \frac{\pi \cdot w_{ifo}^2}{L_{arm}^2} \cdot BRDF_1(30 \cdot 10^{-6}) \cdot \Delta\Omega_{ifo}$$

$$P_{acboxylouvsifo} = 2.959 \times 10^{-17}$$

displacement noise @ 100 Hz,
m/rtHz

$$DN_{acboxylouv}(\theta_t) := TF_{itmhr} \cdot \left(\frac{P_{acboxylouvsifo}}{P_{psl}} \right)^{0.5} \cdot x_{ACB} \cdot \frac{2}{\sqrt{2}} \cdot k$$

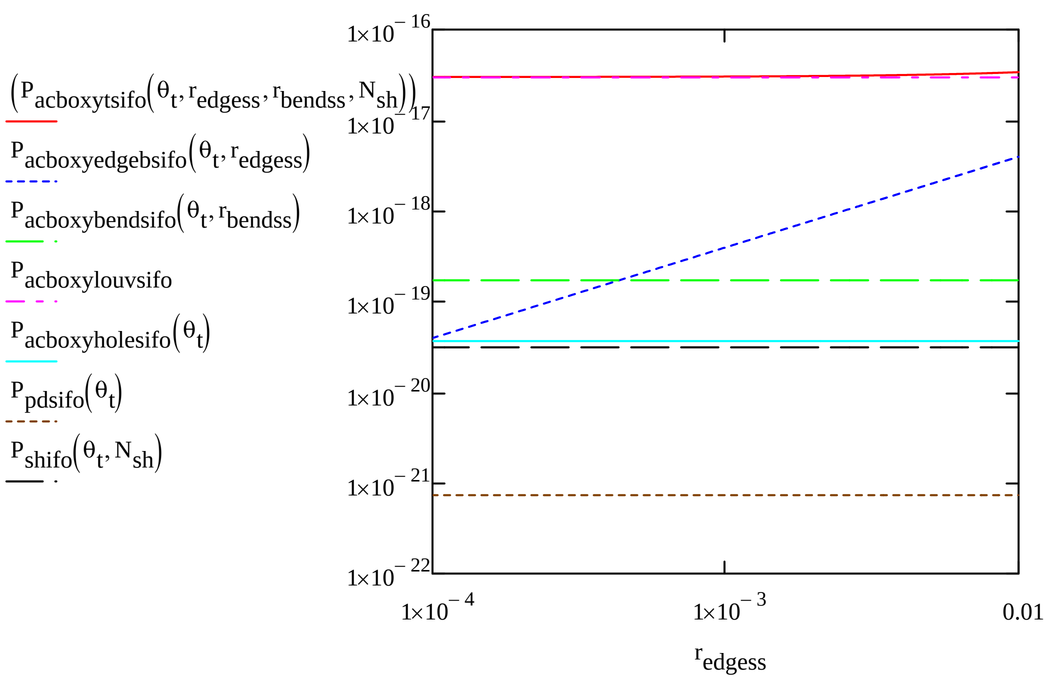
$$DN_{acboxylouv}(\theta_t) = 4.47 \times 10^{-24}$$

Total scattered power into IFO from oxy SS ACB

$$P_{acboxytsifo}(\theta_t, r_{edgess}, r_{bendss}, N_{sh}) := P_{acboxyedgebsifo}(\theta_t, r_{edgess}) + P_{acboxybendsifo}(\theta_t, r_{bendss}) +$$

$$P_{acboxytsifo}(\theta_t, r_{edgess}, r_{bendss}, N_{sh}) = 3.062 \times 10^{-17}$$

$$r_{edgess} := 0.0001, 0.00011 .. 0.01$$



$r_{edgess} := 0.002$

Note: the SS edge scatter does not dominate for edge radius < 0.003 m

total displacement noise @ 100 Hz,
m/rtHz

$$DN_{acboxyt}(\theta_t, r_{edgess}, r_{bendss}, N_{sh}) := TF_{itmhr} \cdot \left(\frac{P_{acboxytsifo}(\theta_t, r_{edgess}, r_{edgess}, N_{sh})}{P_{psl}} \right)^{0.5} \cdot x_{ACB} \cdot \frac{2}{\sqrt{2}} \cdot k$$

$$DN_{acboxyt}(\theta_t, r_{edgess}, r_{bendss}, N_{sh}) = 4.544 \times 10^{-24}$$

DLC_SS BAFFLE

Scatter from DLC SS baffle hole edge

BRDF geometric scatter function from baffle hole edge

$$\theta_i(\theta_t, \theta_{xy}) := acos(cos(\theta_{xy}) \cdot cos(\theta_t))$$

$$S_{bdlc}(\theta_t, BRDF_{dlc5}) := \int_0^{\theta_{xymaxbend}} \left[\int_{2\cdot\theta_i(\theta_t,\theta_{xy}) - \frac{w_{ifo}}{L_{arm}}}^{2\cdot\theta_i(\theta_t,\theta_{xy}) + \frac{w_{ifo}}{L_{arm}}} BRDF_{dlc5}(\theta_s + 2\cdot\theta_i(\theta_t, \theta_{xy})) \cdot \sqrt{w_{ifo}^2 - [L_{arr}$$

$$S_{bdlc}(\theta_t, BRDF_{dlc5}) = 2.766 \times 10^{-15}$$

Scattered power into IFO from baffle hole edge

$$P_{acbdlcholesifo}(\theta_t) := I_i \cdot A_{bpe} \cdot BRDF_1(30 \cdot 10^{-6}) \cdot \Delta\Omega_{ifo} \cdot (S_{bdlc}(\theta_t, BRDF_{dlc5}))$$

$$P_{acbdlcholesifo}(\theta_t) = 1.441 \times 10^{-22}$$

displacement noise @ 100 Hz,
m/rtHz

$$DN_{acbdlchole}(\theta_t) := TF_{itmhr} \cdot \left(\frac{P_{acbdlcholesifo}(\theta_t)}{P_{psl}}\right)^{0.5} \cdot x_{ACB} \cdot \frac{2}{\sqrt{2}} \cdot k$$

$$DN_{acbdlchole}(\theta_t) = 9.864 \times 10^{-27}$$

Scatter from DLC-SS center plate edge

BRDF geometric scatter function from DLC-SS center plate edge

$$S_{edlc}(\theta_t, BRDF_{dlc5}) := \int_0^{\theta_{xymaxbend}} \left[\int_{2\cdot\theta_i(\theta_t,\theta_{xy})-\frac{w_{ifo}}{L_{arm}}}^{2\cdot\theta_i(\theta_t,\theta_{xy})+\frac{w_{ifo}}{L_{arm}}} BRDF_{dlc5}(\theta_s + 2\cdot\theta_i(\theta_t,\theta_{xy}))\cdot\sqrt{w_{ifo}^2 - [L_{arr}} \right.$$

$$S_{edlc}(\theta_t, BRDF_{dlc5}) = 2.766 \times 10^{-15}$$

Scattered power into IFO from DLC-SSbaffle center plate edge

$$r_{edgess} = 2 \times 10^{-3}$$

$$P_{acbdlcedgebsifo}(\theta_t, r_{edgess}) := I_i \cdot A_{ssbp}(r_{edgess}) \cdot BRDF_1(30\cdot 10^{-6}) \cdot \Delta\Omega_{ifo} \cdot (S_{edlc}(\theta_t, BRDF_{dlc5}))$$

$$P_{acbdlcedgebsifo}(\theta_t, r_{edgess}) = 7.711 \times 10^{-22}$$

displacement noise @ 100 Hz,
m/rtHz

$$DN_{acbdlcedge}[\theta_t, (r_{edgess})] := TF_{itmhr} \cdot \left[\frac{P_{acbdlcedgebsifo}[\theta_t, (r_{edgess})]}{P_{psl}}\right]^{0.5} \cdot x_{ACB} \cdot \frac{2}{\sqrt{2}} \cdot k$$

$$DN_{acbdlcedge}\left[\theta_t,\left(r_{edgess}\right)\right] = 2.282 \times 10^{-26}$$

Scatter from DLC-SS baffle bend

BRDF geometric scatter function from DLC-SS baffle bend

$$S_{bdlc}\left(\theta_t, BRDF_{dlc5}\right) := \int_0^{\theta_{xymaxbend}} \left[\int_{2\cdot\theta_i(\theta_t,\theta_{xy})-\frac{w_{ifo}}{L_{arm}}}^{2\cdot\theta_i(\theta_t,\theta_{xy})+\frac{w_{ifo}}{L_{arm}}} BRDF_{dlc5}\left(\theta_s + 2\cdot\theta_i\left(\theta_t,\theta_{xy}\right)\right)\cdot\sqrt{w_{ifo}^2 - \left[L_{arr}\right.}\right.$$

$$S_{bdlc}\left(\theta_t, BRDF_{dlc5}\right) = 2.766 \times 10^{-15}$$

Scattered power into IFO from DLC-SS baffle bend

$$P_{acbdlcbendsifo}\left(\theta_t, r_{bendss}\right) := I_i\cdot A_{ssb}\left(r_{bendss}\right)\cdot BRDF_1\left(30\cdot 10^{-6}\right)\cdot\Delta\Omega_{ifo}\cdot\left(S_{bdlc}\left(\theta_t, BRDF_{dlc5}\right)\right)$$

$$P_{acbdlcbendsifo}\left(\theta_t, 0.001\right) = 2.814 \times 10^{-22}$$

displacement noise @ 100 Hz,
m/rtHz

$$DN_{acbdlcbend}\left(\theta_t, r_{bendss}\right) := TF_{itmhr}\cdot\left(\frac{P_{acbdlcbendsifo}\left(\theta_t, r_{bendss}\right)}{P_{psl}}\right)^{0.5}\cdot x_{ACB}\cdot\frac{2}{\sqrt{2}}\cdot k$$

$$DN_{acbdlcbend}\left(\theta_t, 0.001\right) = 1.378 \times 10^{-26}$$

Power Scattered from the DLC-SS louver portion of baffle

$$BRDF_{dlc57}\left(2\cdot 57\cdot\frac{\pi}{180}\right) = 7.952 \times 10^{-5}$$

$$P_{acbdlclouvsifo}(\theta_t) := I_i \cdot A_{ACB} \cdot BRDF_{dlc57}\left(2 \cdot 57 \cdot \frac{\pi}{180}\right) \cdot \frac{\pi \cdot w_{ifo}^{2}}{L_{arm}^{2}} \cdot BRDF_1\left(30 \cdot 10^{-6}\right) \cdot \Delta\Omega_{ifo}$$

$$P_{acbdlclouvsifo}(\theta_t) = 5.636 \times 10^{-20}$$

displacement noise @ 100 Hz,
m/rtHz

$$DN_{acbdlclouv}(\theta_t) := TF_{itmhr} \cdot \left(\frac{P_{acbdlclouvsifo}(\theta_t)}{P_{psl}}\right)^{0.5} \cdot x_{ACB} \cdot \frac{2}{\sqrt{2}} \cdot k$$

$$DN_{acbdlclouv}(\theta_t) = 1.951 \times 10^{-25}$$

Total scattered power into IFO from DLC-SS ACB

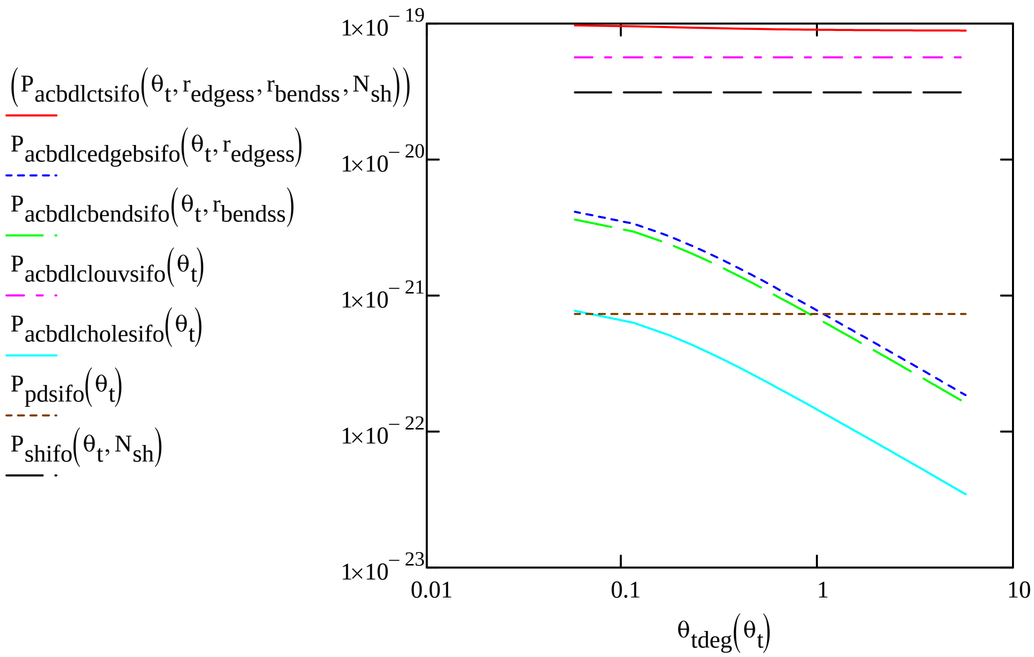
$$P_{acbdlctsifo}(\theta_t, r_{edgess}, r_{bendss}, N_{sh}) := P_{acbdlcedgebsifo}(\theta_t, r_{edgess}) + P_{acbdlcbendsifo}(\theta_t, r_{bendss}) + P_{a}$$

$$P_{acbdlctsifo}(\theta_t, r_{edgess}, r_{bendss}, N_{sh}) = 8.983 \times 10^{-20}$$

Tilt the baffle so that edge scatter does not dominate

$$\theta_{tdeg}(\theta_t) := \theta_t \cdot \frac{180}{\pi}$$

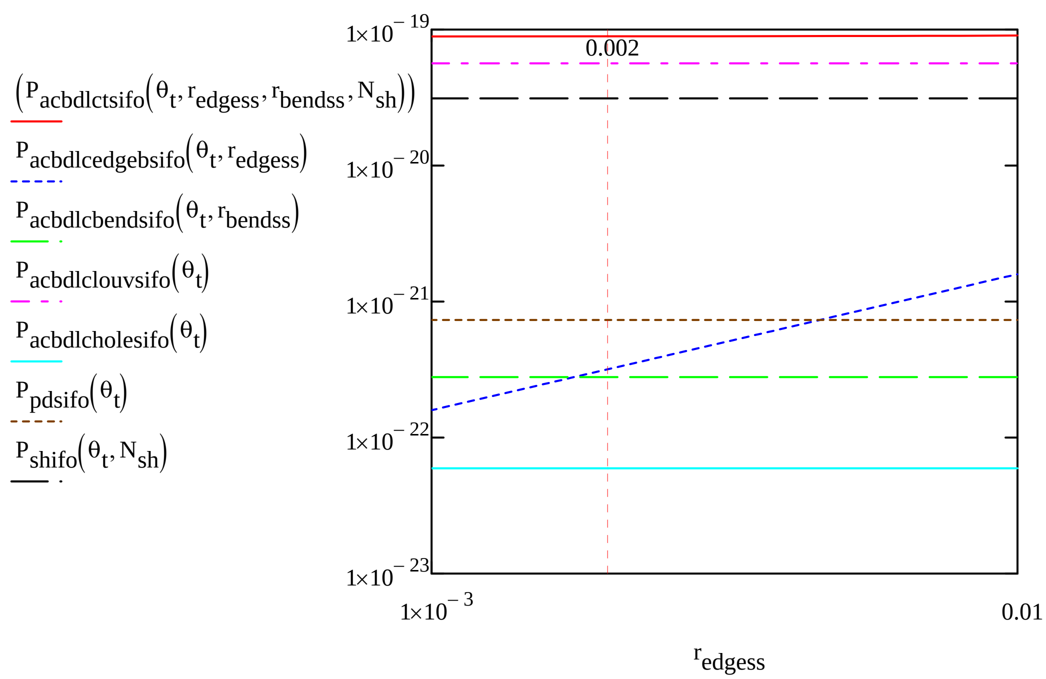
$$\theta_t := 0, 0.001 .. 0.1$$



Note: the edge scatter does not dominate for tilt angles >1 deg

$\theta_t := 0.052$

$r_{edgess} := 0.001, 0.002 .. 0.01$



$r_{edgess} := 0.002$

Note: the DLC edge scatter does not dominate for edge radius < 0.01 m

total displacement noise @ 100 Hz,
m/rtHz

$$\theta_t = 0.052$$

$$r_{edgess} = 2 \times 10^{-3}$$

$$DN_{acbdlct}(\theta_t, r_{edgess}, r_{bendss}, N_{sh}) := TF_{itmhr} \cdot \left(\frac{P_{acbdlctsifo}(\theta_t, r_{edgess}, r_{bendss}, N_{sh})}{P_{psl}} \right)^{0.5} \cdot x_{ACB} \cdot \frac{2}{\sqrt{2}} \cdot k$$

$$DN_{acbdlct}(\theta_t, r_{edgess}, r_{bendss}, N_{sh}) = 2.45 \times 10^{-25}$$

Comparison of DLC coated SS to oxidized SS baffle

$$\frac{DN_{acboxyt}(\theta_t, r_{edgess}, r_{bendss}, N_{sh})}{DN_{acbdlct}(\theta_t, r_{edgess}, r_{bendss}, N_{sh})} = 18.539$$

Edge

$$\overline{{}_{\text{ifo}}{}^{2} - \left[L_{arm}\cdot\left(\theta_s - 2\cdot\theta_i\left(\theta_t,\theta_{xy}\right)\right)\right]^2}\cdot\frac{L_{arm}}{L_{arm}^{2}}\,d\theta_s\right]\cdot\cos\left(\theta_{xy}\right)\,d\theta_{xy}$$

$$\overline{{}_{ifo}^{\;2} - \left[L_{arm}\cdot\left(\theta_s - 2\cdot\theta_i\left(\theta_t,\theta_{xy}\right)\right)\right]^2}\cdot\frac{L_{arm}}{L_{arm}^{\;2}}\,d\theta_s\Bigg]\cdot\cos\left(\theta_{xy}\right)\,d\theta_{xy}$$

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$$P_{acboxylouvsifo} + P_{pdsifo}(\theta_t) + P_{shifo}(\theta_t, N_{sh}) + P_{acboxyholesifo}(\theta_t)$$

$$n\cdot\left(\theta_s - 2\cdot\theta_i\left(\theta_t,\theta_{xy}\right)\right)\Big]^2\cdot\frac{L_{arm}}{L_{arm}^2}\,d\theta_s\Bigg]\cdot\cos\left(\theta_{xy}\right)d\theta_{xy}$$

$$\overline{n\cdot\left(\theta_s - 2\cdot\theta_i\left(\theta_t,\theta_{xy}\right)\right)}\Big]^2\cdot\frac{L_{arm}}{L_{arm}^{\;2}}\,d\theta_s\Bigg]\cdot\cos\left(\theta_{xy}\right)d\theta_{xy}$$

$$\overline{n\cdot\left(\theta_s - 2\cdot\theta_i\left(\theta_t,\theta_{xy}\right)\right)\Big]}^2\cdot\frac{L_{arm}}{L_{arm}^{\;2}}\,d\theta_s\Bigg]\cdot\cos\left(\theta_{xy}\right)d\theta_{xy}$$

$$\text{acbdlclouvsifo}(\theta_t) + P_{pdsifo}(\theta_t) + P_{shifo}(\theta_t, N_{sh}) + P_{acbdlcholesifo}(\theta_t)$$