ACB scatter
Black Glass panels
7/2/13

SS Center Plate Edge

BG Baffle Plate Hole Edge

BG Baffle Plate Bend Edge
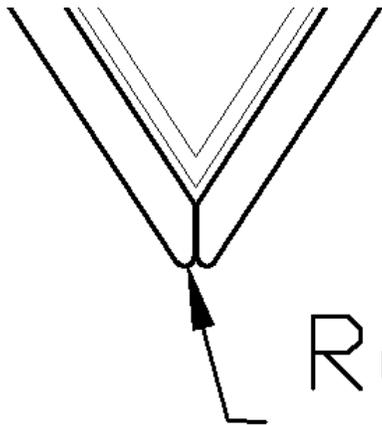
Cryo Baffle Opening
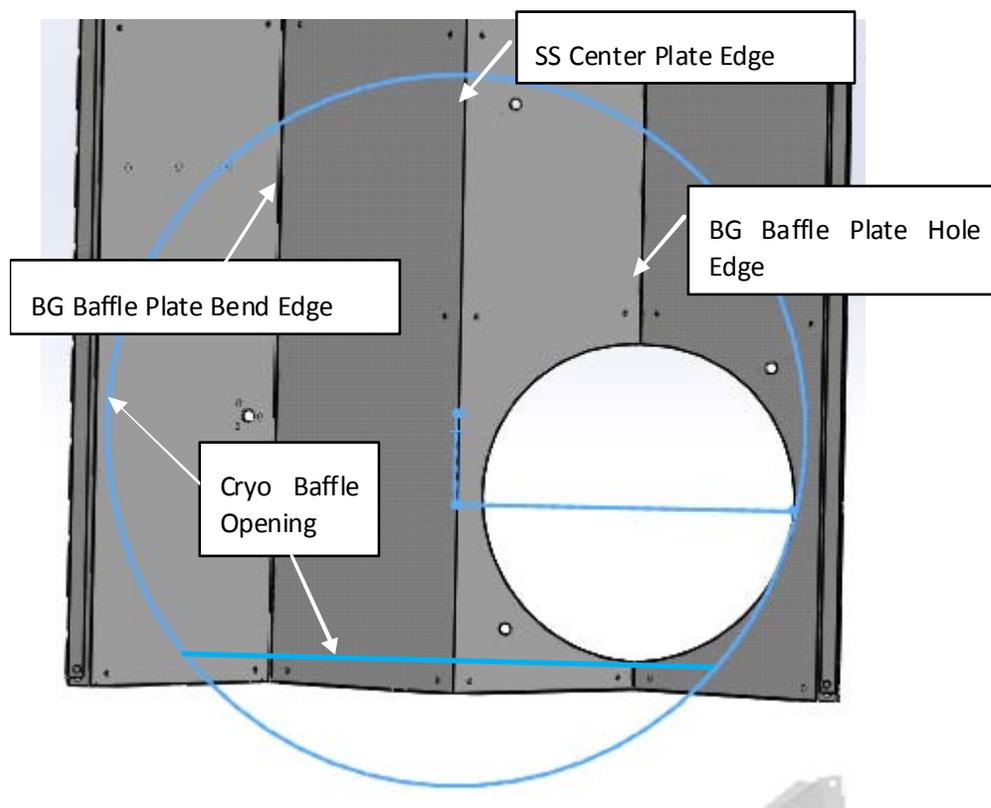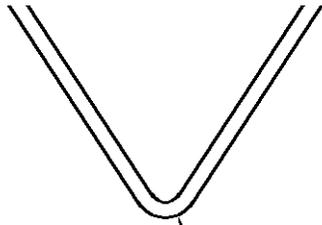
Radius
SS Baffle
Bend

Radius
SS Edge

Radius Black Glass Edge

Arm cavity power, W

$$P_a := 840000$$

optimum radius of SS baffle edge, m

$$r_{edgess} := 1 \times 10^{-5}$$

optimum radius of BG baffle rough-cut edge, m

$$r_{edgebgfp} := 1 \times 10^{-4}$$

radius of SS baffle edge, m

$$r_{edgess} := \frac{0.00004}{5} \qquad r_{edgess} = 8 \times 10^{-6}$$

radius of SS baffle bend, m

$$r_{bendss} := 0.0024$$

radius of BG baffle rough-cut edge, m

$$r_{edgebgr} := 0.01 \cdot 0.0254$$

$$r_{edgebgr} = 2.54 \times 10^{-4}$$

radius of BG baffle fire-polish edge, m

$$r_{edgebgfp} := \frac{0.128}{4} \cdot 0.0254$$

$$r_{edgebgfp} = 8.128 \times 10^{-4}$$

length of baffle plate hole edge (BG cut edge), m	$H_p := 0.678$
length of baffle bend (BG cut edge), m	$H_b := 0.998$
Frontal area of SS center plate cut edge, m^2	$A_{ssbp}(r_{edgess}) := 2 \cdot r_{edgess} \cdot H_p$
	$A_{ssbp}(r_{edgess}) = 1.085 \times 10^{-5}$
Frontal area of SS baffle bend edge, m^2	$A_{ssb}(r_{bendss}) := 2 \cdot r_{bendss} \cdot H_b$
	$A_{ssb}(r_{bendss}) = 4.79 \times 10^{-3}$
Frontal area of BG baffle rough-cut edges, m^2	$A_{bgb}(r_{edgebgr}) := 2 \cdot r_{edgebgr} \cdot (2 \cdot H_b + 2 \cdot H_p)$
	$A_{bgb}(r_{edgebgr}) = 1.703 \times 10^{-3}$
Frontal area of BG baffle fire-polish edges, m^2	$A_{bgb}(r_{edgebgfp}) := 2 \cdot r_{edgebgfp} \cdot (2 \cdot H_b + 2 \cdot H_p)$
	$A_{bgb}(r_{edgebgfp}) = 5.449 \times 10^{-3}$
BRDF of SS cut edge, sr^-1	$BRDF_{edgess} := 0.1$
BRDF of rough-cut black glass edge, sr^-1	$BRDF_{edgebgr} := 0.1$
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	$r_{pd} := \dfrac{0.0114}{2}$

	$r_{pd} = 5.7 \times 10^{-3}$
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	$k := 2 \cdot \dfrac{\pi}{\lambda}$
	$k = 5.905 \times 10^6$
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	$\Delta\Omega_{ifo} := \dfrac{\lambda^2}{\pi \cdot w_{ifo}^2} = 2.502 \times 10^{-9}$
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	$\theta_{cp} := \dfrac{R_{cp}}{L_{arm}}$
half-angle from centerline to Rcp, rad (see ACB_PD_scatter_8-29-12)	$\theta_{pd} := \dfrac{r_{pdbc}}{L_{arm}}$
BRDF, sr^-1; CSIRO, surface 2, S/N 2	$BRDF_1(\theta) := \dfrac{2755.12}{\left(1 + 8.50787 \cdot 10^8 \cdot \theta^2\right)^{1.23597}}$
radius of manifold/cryo baffle, m	$R_{cryo} := \dfrac{0.769}{2} = 0.385$
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	$A_h := \pi \cdot r_{acbhole}^2 = 0.093$
	$A_h = 0.093$
area of manifold/cryo baffle ledge, m^2	$A_L := \displaystyle\int_{H_1}^{R_{cryo}} 2 \cdot \sqrt{R_{cryo}^2 - H^2}\, dH$
	$A_L = 0.043$
area of exposed ACB, m^2	$A_{ACB} := \pi \cdot R_{cryo}^2 - 2 \cdot A_h - A_L = 0.236$
power through the cryopump baffle aperture (hits the arm cavity baffle), W	$P_{acb} := P_a \cdot \displaystyle\int_0^{\theta_{cp}} 2 \cdot \pi \cdot \theta \cdot BRDF_1(\theta)\, d\theta$
	$P_{acb} = 14.573$

Area of cryopump baf aperture, m^2

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

incident intensity, W/m^2

$$I_i := \frac{P_{acb}}{A_{cp}} = 31.376$$

tilt angle of baffle edge, rad

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

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

incident angle, rad

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

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

$$C_{mr} := \frac{2^{\frac{1}{(\beta)}} - 1}{\theta_1{}^2}$$
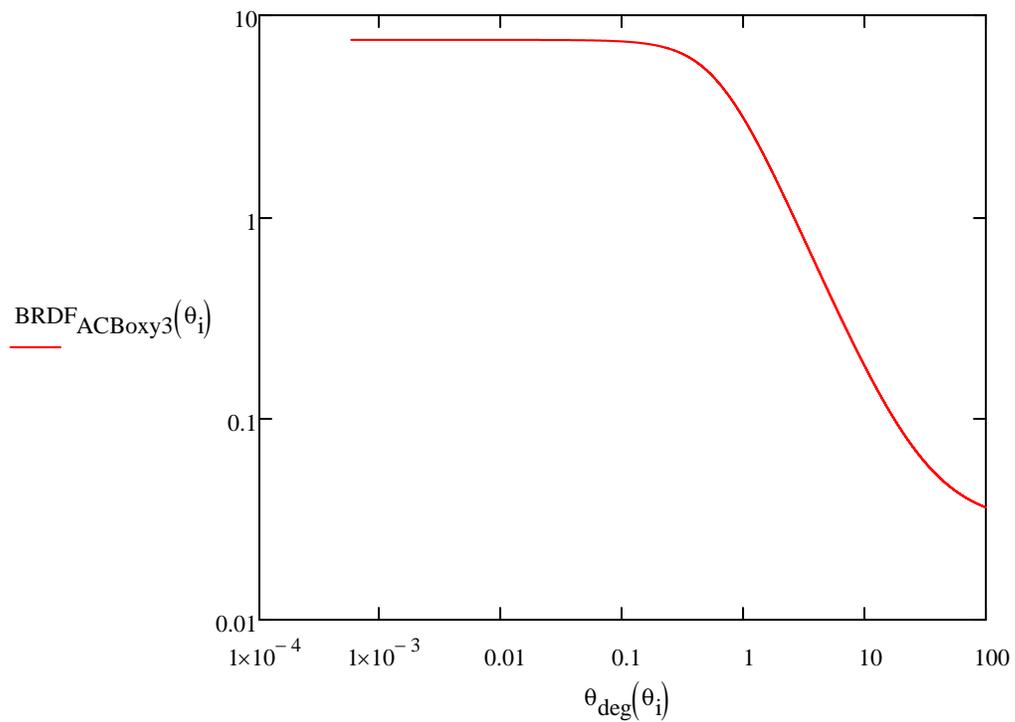
$$C_{mr} = 8.678 \times 10^3$$

large angle BRDF, sr^-1

$$BRDF_{\theta2} := 0.03$$

BRDF function, sr^-1

$$BRDF_{ACBoxy3}(\theta_i) := \frac{BRDF_0}{\left(1 + C_{mr} \cdot \theta_i^2\right)^{\beta}} + BRDF_{\theta2}$$

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

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

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

$$C_{mr} := \frac{2^{\frac{1}{(\beta)}} - 1}{\theta_1^{\,2}}$$
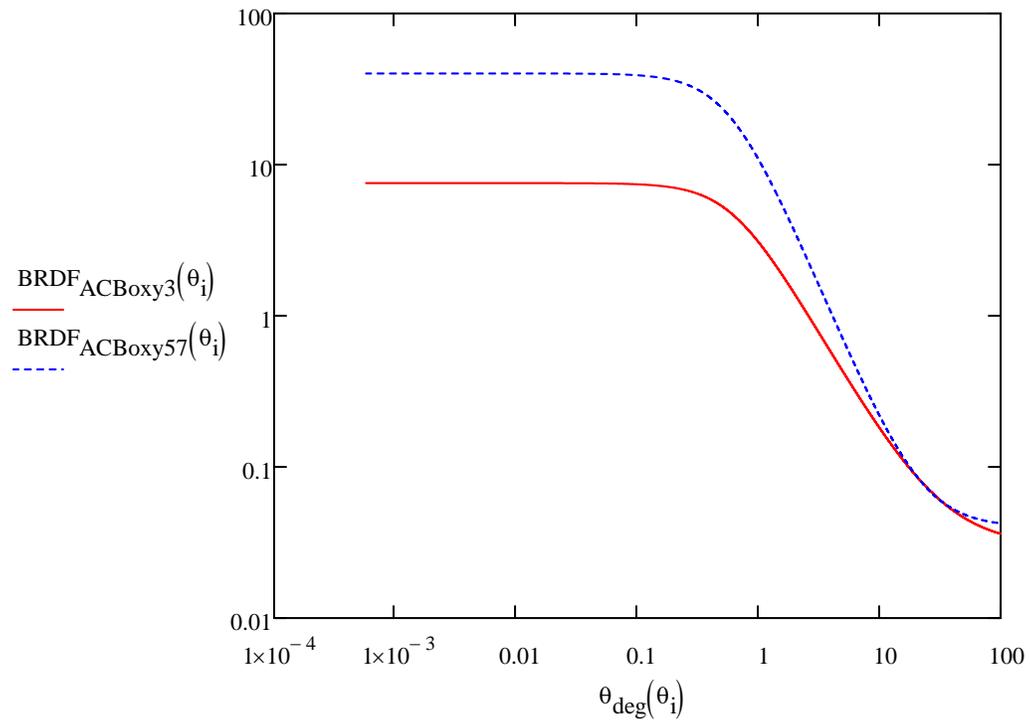
$$C_{mr} = 9.797 \times 10^3$$

large angle BRDF, sr^-1

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

BRDF function, sr^-1

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

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

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

$$BRDF_{ACBoxy3}(\theta_i)$$
———

$$BRDF_{ACBoxy57}(\theta_i)$$
- - - -

BRDF Black Glass 57 deg inc.

specular reflectivity

$$R_{57} := 1.5 \cdot 10^{-3}$$

break-over angle, rad

$$\theta_1 := 1 \cdot \frac{\pi}{180} = 0.017$$

micro-roughness angle, rad

$$\theta_2 := 5 \cdot \frac{\pi}{180} = 0.087$$

max BRDF, sr^-1

$$BRDF_0 := 0.02$$

final slope modifier

$$\beta := 1.4$$

micro-roughness constant

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

$$C_{mr} = 2.103 \times 10^3$$

large angle BRDF, sr^-1

$$BRDF_{\theta 2} := 4 \cdot 10^{-5}$$

BRDF function, sr^-1

$$BRDF_{bg57}(\theta_i) := \frac{BRDF_0}{\left(1 + C_{mr} \cdot \theta_i^{\,2}\right)^{\beta}} + BRDF_{\theta 2}$$

back-reflection angle, rad

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

back-reflection BRDF, sr^-1

$$BRDF_{bg57}(\theta_{57}) = 4.045 \times 10^{-5}$$

BRDF Black Glass 15eg inc.

specular reflectivity

$$R_{15} := 0.042$$

break-over angle, rad	$\theta_1 := 0.5 \cdot \dfrac{\pi}{180} = 8.727 \times 10^{-3}$
micro-roughness angle, rad	$\theta_2 := 5 \cdot \dfrac{\pi}{180} = 0.087$
max BRDF, sr^-1	$BRDF_0 := 0.12$
final slope modifier	$\beta := .75$
micro-roughness constant	$C_{mr} := \dfrac{2^{\frac{1}{(\beta)}} - 1}{\theta_1{}^2}$
	$C_{mr} = 1.996 \times 10^4$
large angle BRDF, sr^-1	$BRDF_{\theta2} := 1.5 \cdot 10^{-5}$
BRDF function, sr^-1	$BRDF_{bg15}(\theta_i) := \dfrac{BRDF_0}{\left(1 + C_{mr} \cdot \theta_i{}^2\right)^\beta} + BRDF_{\theta2}$
back-reflection angle, rad	$\theta_{15} := 15 \cdot \dfrac{\pi}{180} = 0.262$
back-reflection BRDF, sr^-1	$BRDF_{bg15}(\theta_{15}) = 5.482 \times 10^{-4}$

BRDF Black Glass 5 deg inc.

specular reflectivity	$R_5 := 0.05$
break-over angle, rad	$\theta_1 := 0.5 \cdot \dfrac{\pi}{180} = 8.727 \times 10^{-3}$
micro-roughness angle, rad	$\theta_2 := 5 \cdot \dfrac{\pi}{180} = 0.087$
max BRDF, sr^-1	$BRDF_0 := 0.15$

final slope modifier	$\beta := .85$

micro-roughness constant

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

$$C_{mr} = 1.655 \times 10^4$$

large angle BRDF, sr^-1

$$BRDF_{\theta 2} := 1 \cdot 10^{-5}$$

BRDF function, sr^-1

$$BRDF_{bg5}(\theta_i) := \frac{BRDF_0}{\left(1 + C_{mr} \cdot \theta_i{}^2\right)^{\beta}} + BRDF_{\theta 2}$$

back-reflection angle, rad

$$\theta_5 := 5 \cdot \frac{\pi}{180} = 0.087$$

back-reflection BRDF, sr^-1

$$BRDF_{bg5}(\theta_5) = 2.452 \times 10^{-3}$$

BRDF Black Glass fire polish (empirical estimate)

break-over angle, rad

$$\theta_1 := 0.5 \cdot \frac{\pi}{180} = 8.727 \times 10^{-3}$$

micro-roughness angle, rad

$$\theta_2 := 5 \cdot \frac{\pi}{180} = 0.087$$

max BRDF, sr^-1

$$BRDF_0 := 0.1$$

final slope modifier

$$\beta := 0.85$$

micro-roughness constant

$$C_{mr} := \frac{2^{\frac{1}{(\beta)}} - 1}{\theta_1{}^2}$$
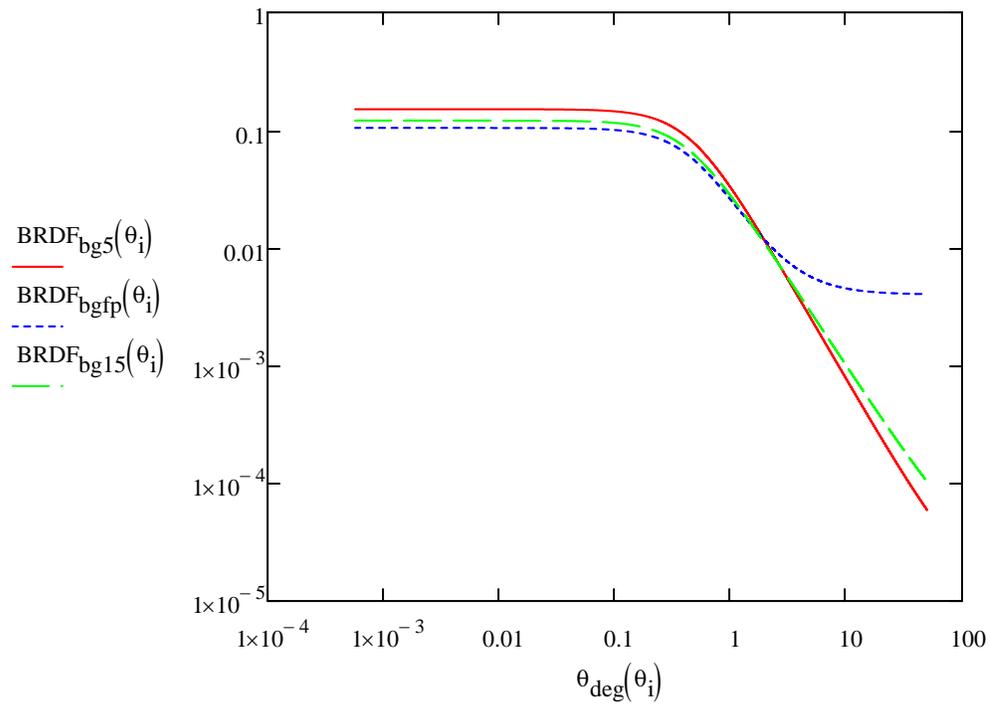
$$C_{mr} = 1.655 \times 10^4$$

large angle BRDF, fire polish, sr^-1 $BRDF_{bgfp} := 4 \cdot 10^{-3}$

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

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

$BRDF_{bg5}(\theta_i)$ ——
$BRDF_{bgfp}(\theta_i)$ - - - -
$BRDF_{bg15}(\theta_i)$ — —

$$BRDF := \begin{pmatrix} 2.452 \times 10^{-3} \\ 5.482 \times 10^{-4} \\ 4.045 \times 10^{-5} \end{pmatrix} \qquad R := \begin{pmatrix} 0.05 \\ 0.042 \\ 1.5 \times 10^{-3} \end{pmatrix}$$

$$\theta := \begin{pmatrix} 5 \\ 15 \\ 57 \end{pmatrix}$$

BRDF

θ

R

θ
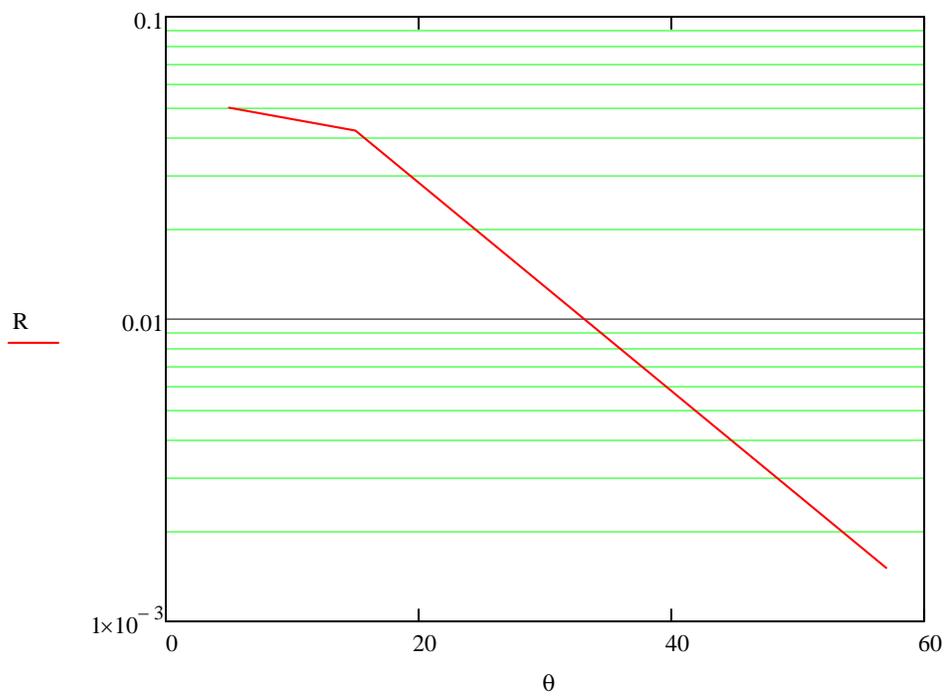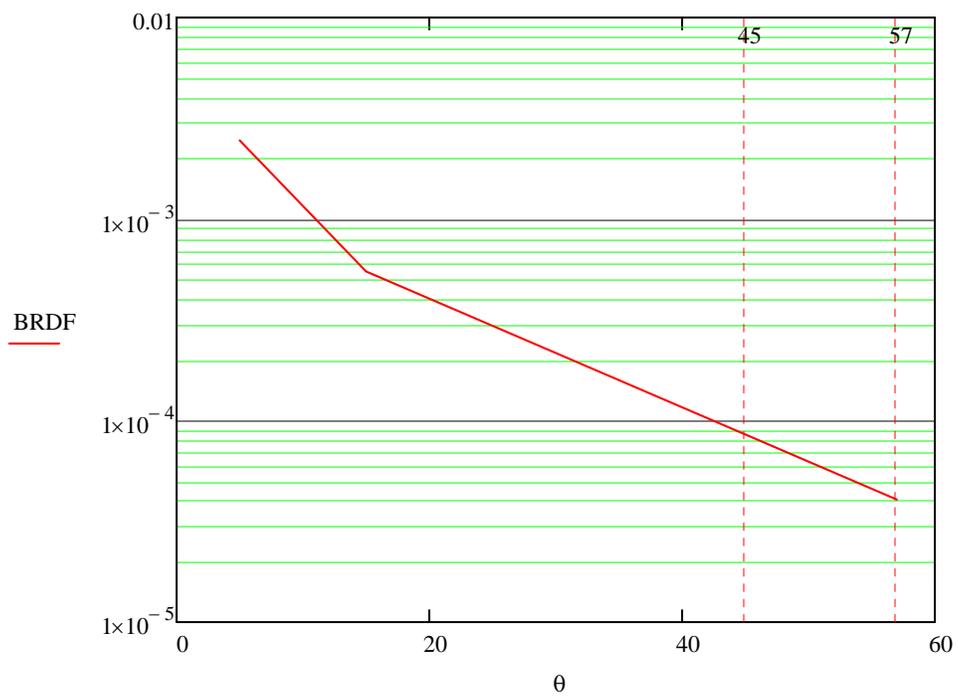
MIXED BAFFLE SCATTER: OXIDIZE SS CENTER PLATE EDGE, BLACK GLASS LOUVER--ROUGH-CUT EDGE

ACB displacement @ 100 HZ, m/rt HZ
$$x_{ACB} = 1 \times 10^{-12}$$

Scatter from SS center plate edge

power incident on SS center plate edge, W

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

$$P_{itmbafpedgess} = 3.404 \times 10^{-4}$$

Scattered power into IFO from SS center plate edge

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

displacement noise @ 100 Hz, m/rtHz

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

$$DN_{acboxyedgeb}(\theta_t, r_{edgess}) = 4.71 \times 10^{-26}$$

Scattered power into IFO from the louver portion of BG baffle

$$P_{acbbglouvsifo}(\theta_t) := I_i \cdot A_{ACB} \cdot BRDF_{bg57}\left(2 \cdot 57 \cdot \frac{\pi}{180}\right) \cdot \frac{\pi \cdot w_{ifo}^2}{L_{arm}^2} \cdot BRDF_1(30 \cdot 10^{-6}) \cdot \Delta\Omega_{ifo}$$

$$P_{acbbglouvsifo}(\theta_t) = 2.86 \times 10^{-20}$$

displacement noise @ 100 Hz, m/rtHz

$$BRDF_{bg57}\left(2 \cdot 57 \cdot \frac{\pi}{180}\right) = 4.006 \times 10^{-5}$$

$$\theta_t := 3 \cdot \frac{\pi}{180}$$

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

$$DN_{acbbglouv}(\theta_t) = 1.389 \times 10^{-25}$$

Scattered power into IFO from BG baffle rough-cut edges

power incident on BG baffle rough-cut edges, W

$$P_{acbedgebgr}(r_{edgebgr}) := I_i \cdot A_{bgb}(r_{edgebgr})$$

$$P_{acbedgebgr}(r_{edgebgr}) = 0.053$$

power scattered into IFO from BG baffle rough-cut edges, W

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

$$P_{acbedgebgrifo}(\theta_t, r_{edgebgr}) = 5.158 \times 10^{-19}$$

displacement noise @ 100 Hz,
m/rtHz

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

$$DN_{acboxyedgeb}(\theta_t, r_{edgebgr}) = 2.654 \times 10^{-25}$$

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

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

power scattered by photodetector,
into IFO mode, W

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

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

displacement noise @ 100 Hz,
m/rtHz

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

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

**Total Power Scattered from the SS center plate, BG rough-cut
edge, BG louver, and PD**

$$P_{acboxybgrtsifo}\left(\theta_t, r_{edgess}, r_{edgebgr}\right) := P_{acboxyedgebsifo}\left(\theta_t, r_{edgess}\right) + P_{acbedgebgrifo}\left(\theta_t, r_{edgebgr}\right) \cdot$$

$$P_{acboxybgrtsifo}\left(\theta_t, r_{edgess}, r_{edgebgr}\right) = 5.484 \times 10^{-19}$$

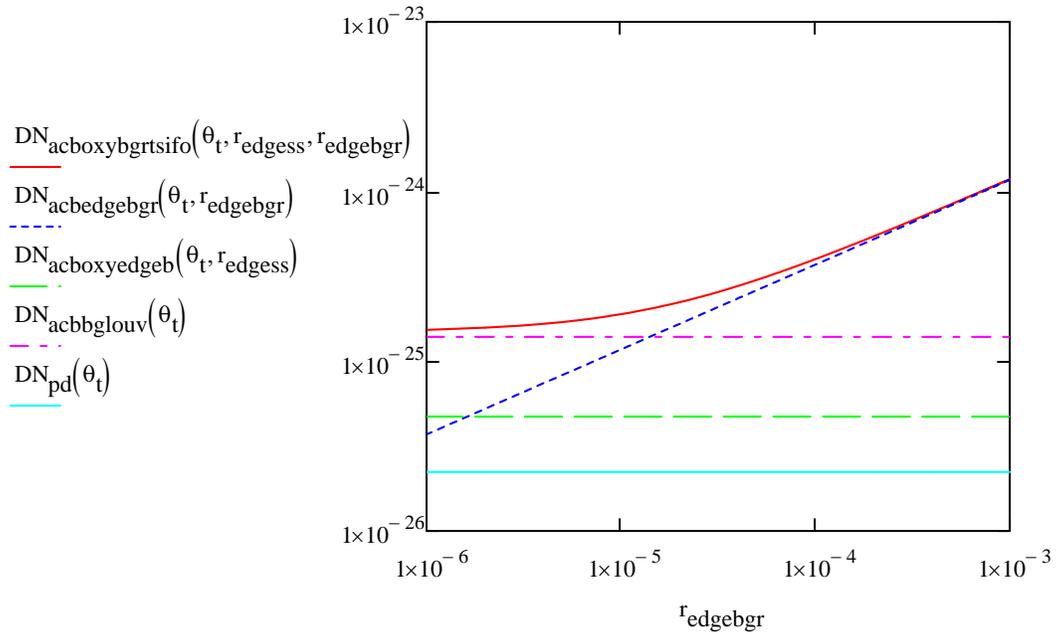total displacement noise @ 100 Hz,
m/rtHz

$$DN_{acboxybgrtsifo}\left(\theta_t, r_{edgess}, r_{edgebgr}\right) := TF_{itmhr} \cdot \left(\frac{P_{acboxybgrtsifo}\left(\theta_t, r_{edgess}, r_{edgebgr}\right)}{P_{psl}}\right)^{0.5} \cdot x_{ACB} \cdot$$

$$DN_{acboxybgrtsifo}\left(\theta_t, r_{edgess}, r_{edgebgr}\right) = 6.085 \times 10^{-25}$$

$r_{edgebgr} = 2.54 \times 10^{-4}$

$r_{edgebgr} := 0, 0.000001 .. 0.001$ $\qquad \theta_t := 3 \cdot \dfrac{\pi}{180}$

$DN_{acboxybgrtsifo}\left(\theta_t, r_{edgess}, r_{edgebgr}\right)$

$DN_{acbedgebgr}\left(\theta_t, r_{edgebgr}\right)$

$DN_{acboxyedgeb}\left(\theta_t, r_{edgess}\right)$

$DN_{acbbglouv}\left(\theta_t\right)$

$DN_{pd}\left(\theta_t\right)$

choose value to match scattering from BG louver

$$r_{edgebgr} := 2 \cdot 10^{-5}$$

MIXED BAFFLE SCATTER: OXIDIZE SS CENTER PLATE EDGE, BLACK GLASS LOUVER--FIRE-POLISH EDGE

Scattered power into IFO from SS center plate edge

$$P_{acboxyedgebsifo}\left(\theta_t, r_{edgess}\right) = 3.286 \times 10^{-21}$$

displacement noise @ 100 Hz,
m/rtHz

$$DN_{acboxyedgeb}\left(\theta_t, r_{edgess}\right) = 4.71 \times 10^{-26}$$

Scattered power into IFO from the louver portion of BG baffle

$$P_{acbbglouvsifo}\left(\theta_t\right) = 2.86 \times 10^{-20}$$

displacement noise @ 100 Hz,
m/rtHz

$$DN_{acbbglouv}\left(\theta_t\right) = 1.389 \times 10^{-25}$$

Scatter from photodetectors

power scattered by photodetector,
into IFO mode, W

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

displacement noise @ 100 Hz,
m/rtHz

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

Scattered power into IFO from fire-polished BG baffle plate edge

incident angle, rad

$$\theta_t := 3 \cdot \frac{\pi}{180} = 0.052$$

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

$$S_{edgebgfp}(\theta_t) := \int_0^{\theta_{xymaxedge}} \left[\int_{2\cdot\theta_i(\theta_t,\theta_{xy})-\frac{w_{ifo}}{L_{arm}}}^{2\cdot\theta_i(\theta_t,\theta_{xy})+\frac{w_{ifo}}{L_{arm}}} BRDF_{bgfp}\left(\theta_s + 2\cdot\theta_i(\theta_t,\theta_{xy})\right)\cdot\sqrt{w_{ifo}^2 - \left[L_{arm}\cdot(\theta_s \right.} \right.$$
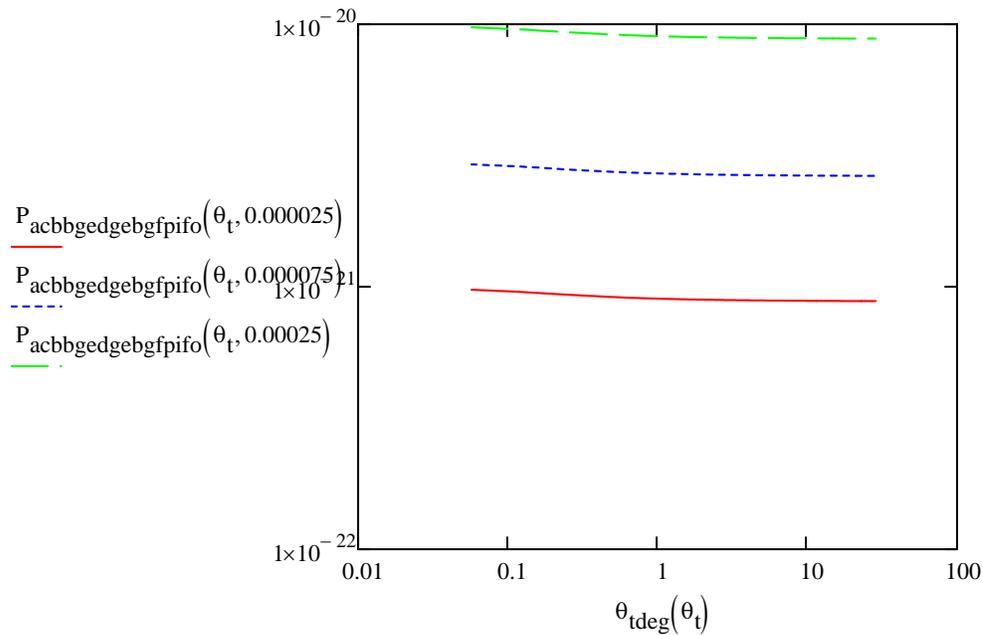
$$S_{edgebgfp}(\theta_t) = 4.947 \times 10^{-14}$$

$$r_{edgebg} := 2.54 \times 10^{-4}$$

$$P_{acbbgedgebgfpifo}(\theta_t, r_{edgebgfp}) := I_i \cdot A_{bgb}(r_{edgebgfp}) \cdot BRDF_1\left(30 \cdot 10^{-6}\right) \cdot \Delta\Omega_{ifo} \cdot \left(S_{edgebgfp}(\theta_t)\right)$$

$$P_{acbbgedgebgfpifo}(\theta_t, r_{edgebg}) = 9.024 \times 10^{-21}$$

$$\theta_t := 0, 0.001 .. 0.5 \qquad\qquad \theta_{tdeg}(\theta_t) := \theta_t \cdot \frac{180}{\pi}$$

$P_{acbbgedgebgfpifo}(\theta_t, 0.000025)$
———

$P_{acbbgedgebgfpifo}(\theta_t, 0.000075)$
- - - -

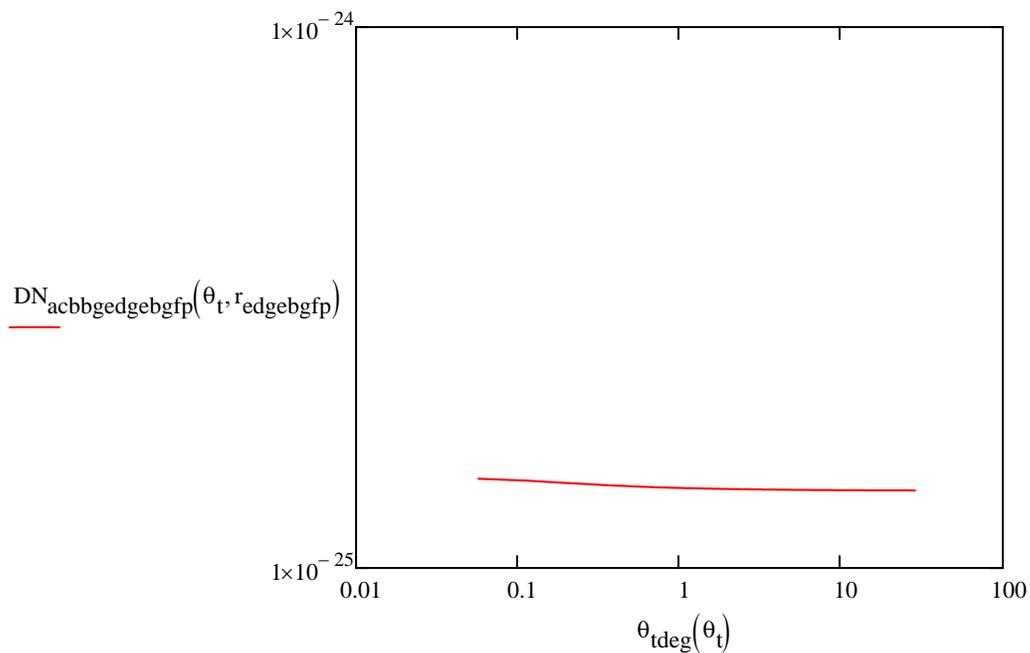$P_{acbbgedgebgfpifo}(\theta_t, 0.00025)$
— —

displacement noise @ 100 Hz,
m/rtHz

$$\theta_t := 3 \cdot \frac{\pi}{180}$$

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

$$DN_{acbbgedgebgfp}\left(\theta_t, r_{edgebgfp}\right) = 1.396 \times 10^{-25}$$

$$\theta_t := 0, 0.001 .. 0.5$$

$$\theta_{tdeg}\left(\theta_t\right)$$

**Total Power Scattered from the SS center plate, black glass
fire-polish edge, BG louver, and PD**

$$\theta_t := 3 \cdot \frac{\pi}{180} = 0.052$$

$$P_{acboxybgfptsifo}\left(\theta_t, r_{edgess}, r_{edgebgfp}\right) := P_{acboxyedgebsifo}\left(\theta_t, r_{edgess}\right) + P_{acbbgedgebgfpifo}\left(\theta_t, r_{edgebg}\right)$$

$$P_{acboxybgfptsifo}\left(\theta_t, r_{edgess}, r_{edgebgfp}\right) = 6.149 \times 10^{-20}$$

total displacement noise @ 100 Hz,
m/rtHz

$$DN_{acboxybgfptsifo}\left(\theta_t, r_{edgess}, r_{edgebgfp}\right) := TF_{itmhr} \cdot \left(\frac{P_{acboxybgfptsifo}\left(\theta_t, r_{edgess}, r_{edgebgfp}\right)}{P_{psl}}\right)^{0.5} \cdot x_{ACl}$$

$$DN_{acboxybgfptsifo}\left(\theta_t, r_{edgess}, r_{edgebgfp}\right) = 2.037 \times 10^{-25}$$

$$DN_{acboxyedgeb}\left(\theta_t, r_{edgess}\right) = 4.71 \times 10^{-26}$$

$$DN_{acbbglouv}\left(\theta_t\right) = 1.389 \times 10^{-25}$$

$$DN_{acbbgedgebgfp}\left(\theta_t, r_{edgebgfp}\right) = 1.396 \times 10^{-25}$$

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

$$\theta_t := 0, 0.001 \ .. \ 0.5$$

$DN_{acboxybgfptsifo}\left(\theta_t, r_{edgess}, r_{edgebgfp}\right)$

$DN_{acbbgedgebgfp}\left(\theta_t, r_{edgebgfp}\right)$

$DN_{acboxyedgeb}\left(\theta_t, r_{edgess}\right)$

$DN_{acbbglouv}\left(\theta_t\right)$
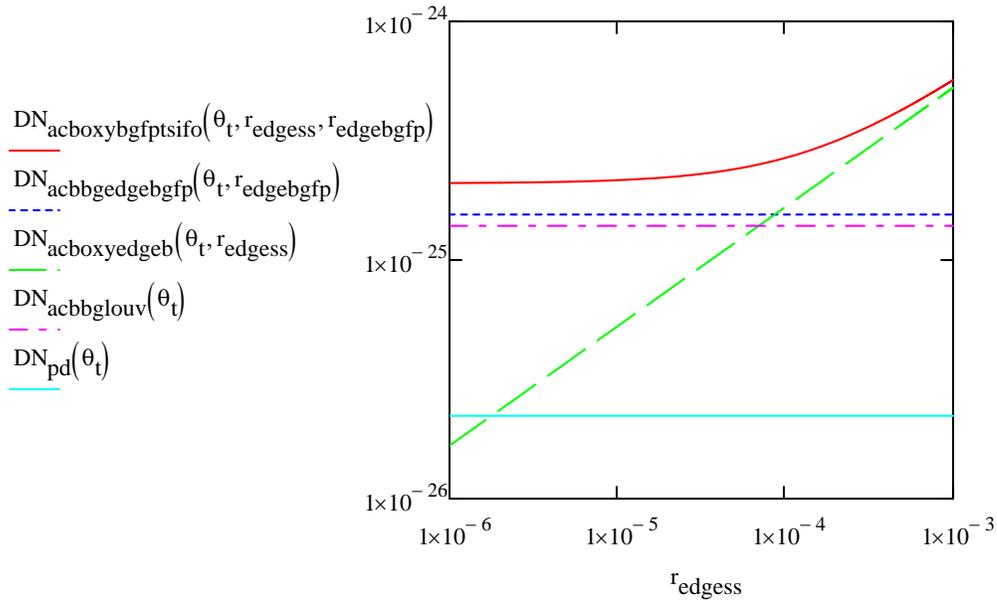
$DN_{pd}\left(\theta_t\right)$

$\theta_{tdeg}\left(\theta_t\right)$
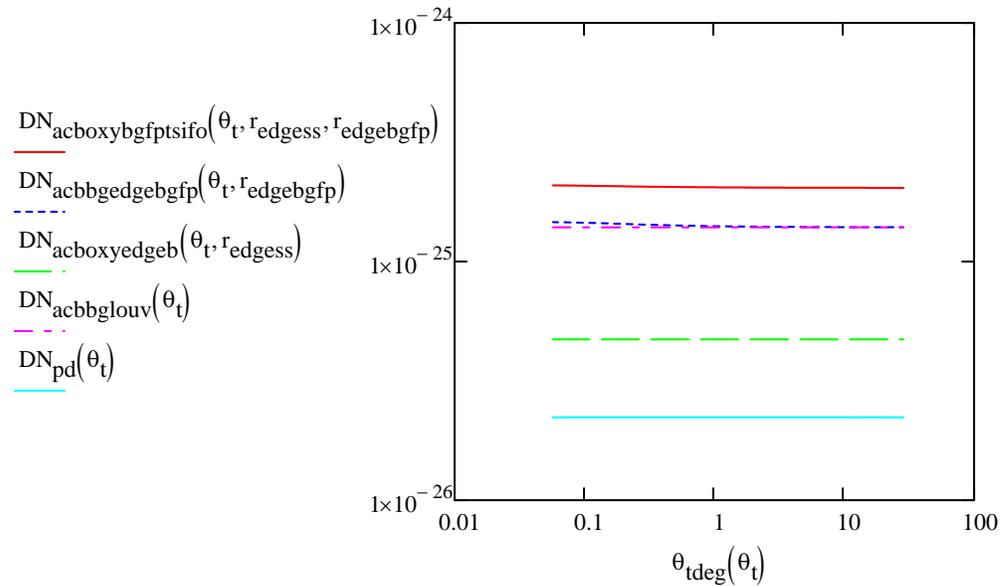
Choose value to match to louver scatter

$r_{edgebgfp} := 1 \cdot 10^{-3}$

$r_{edgess} := 0, 0.000001 .. 0.001$

$\theta_t := 3 \cdot \dfrac{\pi}{180}$

$DN_{acboxybgfptsifo}\left(\theta_t, r_{edgess}, r_{edgebgfp}\right)$

$DN_{acbbgedgebgfp}\left(\theta_t, r_{edgebgfp}\right)$

$DN_{acboxyedgeb}\left(\theta_t, r_{edgess}\right)$

$DN_{acbbglouv}\left(\theta_t\right)$

$DN_{pd}\left(\theta_t\right)$

Choose value to match to louver scatter

$r_{edgess} := 1 \times 10^{-4}$

$r_{edgebgfp} := 0, 0.000001 .. 0.001$

$$\mathrm{DN_{acboxybgfptsifo}}\left(\theta_t, r_{edgess}, r_{edgebgfp}\right)$$
———

$$\mathrm{DN_{acbbgedgebgfp}}\left(\theta_t, r_{edgebgfp}\right)$$
- - - -

$$\mathrm{DN_{acboxyedgeb}}\left(\theta_t, r_{edgess}\right)$$
— · —

$$\mathrm{DN_{acbbglouv}}\left(\theta_t\right)$$
— · · —

$$\mathrm{DN_{pd}}\left(\theta_t\right)$$
———
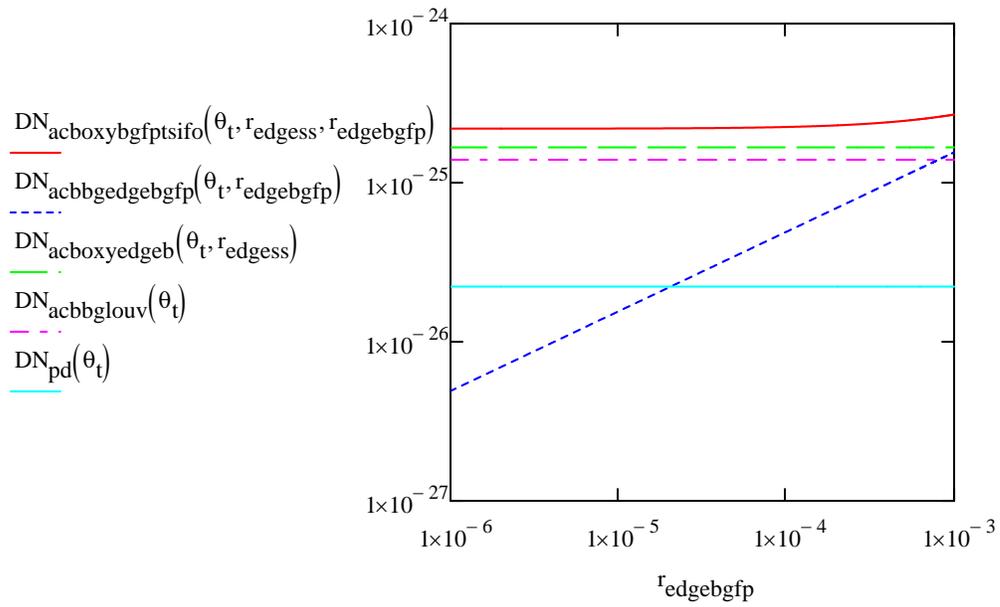
$$r_{edgebgfp} := 1 \cdot 10^{-3}$$

OXIDIZED SS BAFFLE

BRDF geometric scatter function from baffle bend

$$\theta_t := 0$$

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

$$S_{boxy}\left(\theta_t, \mathrm{BRDF_{ACBoxy3}}\right) = 1.176 \times 10^{-12}$$

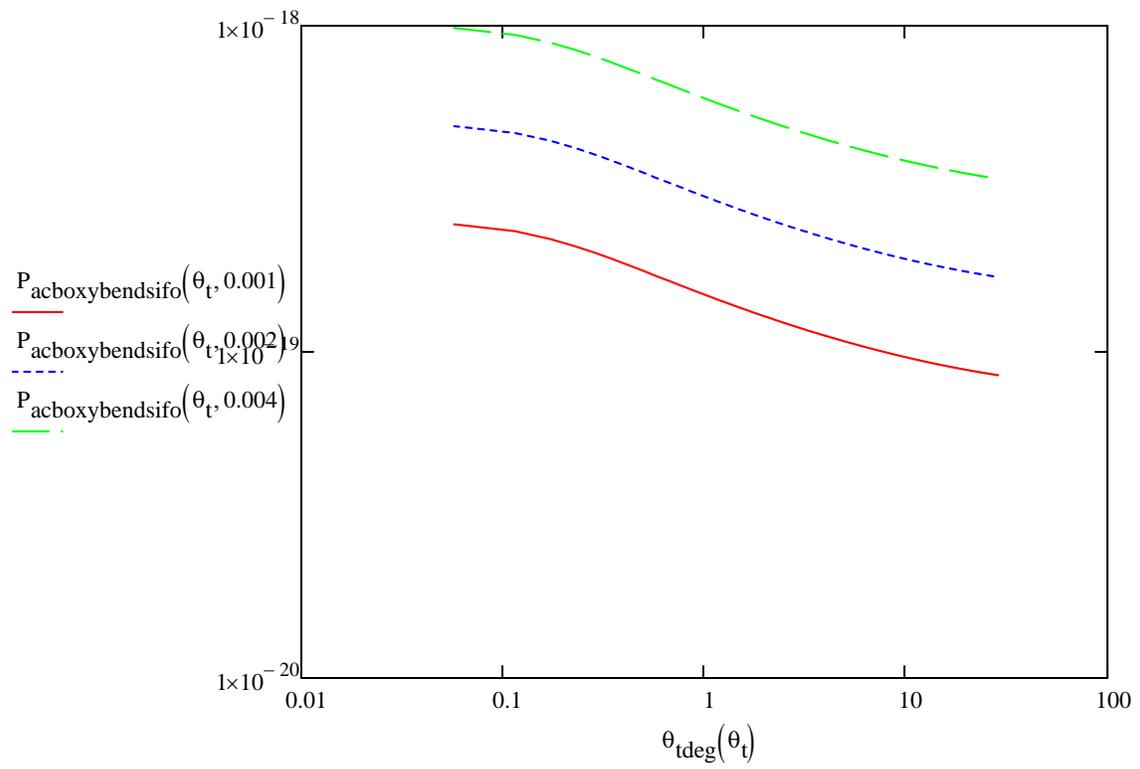**Scattered power into IFO from baffle bend**

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

$$P_{acboxybendsifo}(\theta_t, 0.001) = 2.514 \times 10^{-19}$$

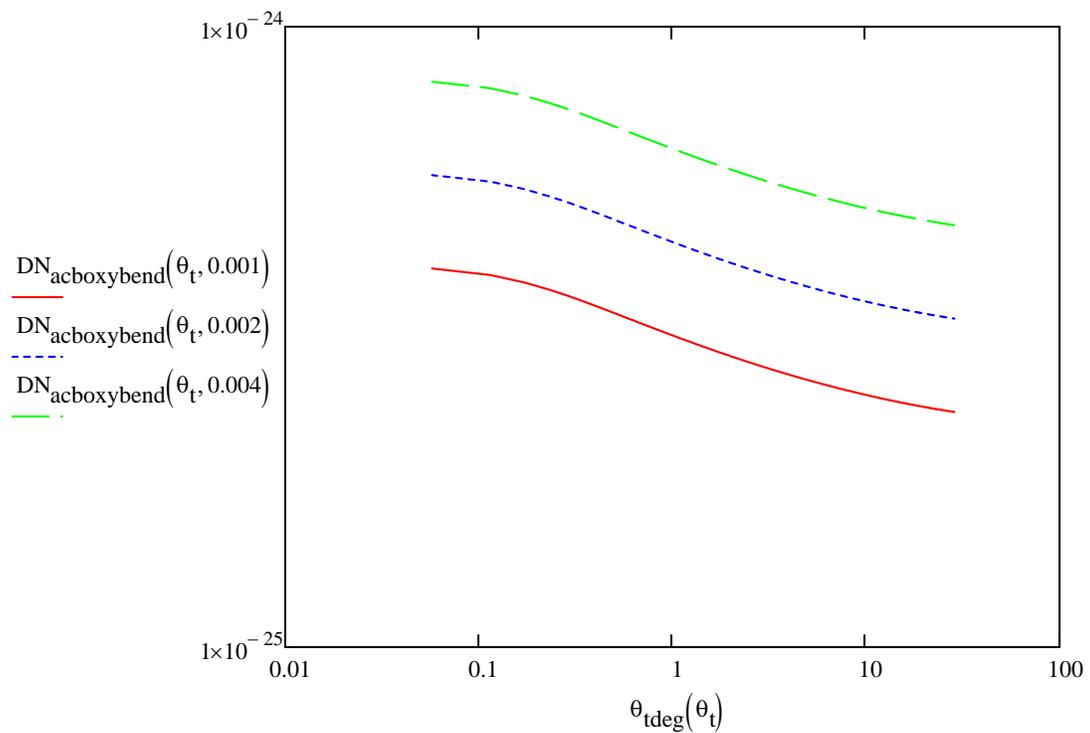$$\theta_t := 0, 0.001 .. 0.5 \qquad \theta_{tdeg}(\theta_t) := \theta_t \cdot \frac{180}{\pi}$$

$P_{acboxybendsifo}(\theta_t, 0.001)$

$P_{acboxybendsifo}(\theta_t, 0.002)$

$P_{acboxybendsifo}(\theta_t, 0.004)$

$\theta_{tdeg}(\theta_t)$

displacement noise @ 100 Hz,
m/rtHz

$$\theta_t := 3 \cdot \frac{\pi}{180}$$

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

$$DN_{acboxybend}(\theta_t, 0.001) = 2.825 \times 10^{-25}$$

$$\theta_t := 0, 0.001 .. 0.5$$

Power Scattered from the louver portion of baffle

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

$$P_{\mathrm{acboxylouvsifo}} := I_i \cdot A_{\mathrm{ACB}} \cdot \mathrm{BRDF}_{\mathrm{ACBoxy57}}\left(2 \cdot 57 \cdot \frac{\pi}{180}\right) \cdot \frac{\pi \cdot w_{\mathrm{ifo}}^2}{L_{\mathrm{arm}}^2} \cdot \mathrm{BRDF}_1\left(30 \cdot 10^{-6}\right) \cdot \Delta\Omega_{\mathrm{ifo}}$$

$$P_{\mathrm{acboxylouvsifo}} = 2.98 \times 10^{-17}$$

displacement noise @ 100 Hz,
m/rtHz

$$\theta_t := 3 \cdot \frac{\pi}{180}$$

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

$$\mathrm{DN}_{\mathrm{acboxylouv}}\left(\theta_t\right) = 4.485 \times 10^{-24}$$

Scatter from screw heads

number of screw heads $\qquad N_{\mathrm{sh}} = 48$

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

Power hitting the screw head, W

$$P_{\mathrm{sh}} := P_0 \cdot \mathrm{BRDF}_1\left(\theta_{\mathrm{pd}}\right) \cdot \frac{A_{\mathrm{sh}}}{L_{\mathrm{arm}}^2} = 1.825 \times 10^{-3}$$

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

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

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

Total scattered power into IFO from SS ACB

$$r_{edgess} := 2.54 \times 10^{-5}$$

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

$$P_{acboxytsifo}(\theta_t, r_{edgess}, r_{bendss}, N_{sh}) = 3.012 \times 10^{-17}$$

total displacement noise @ 100 Hz,
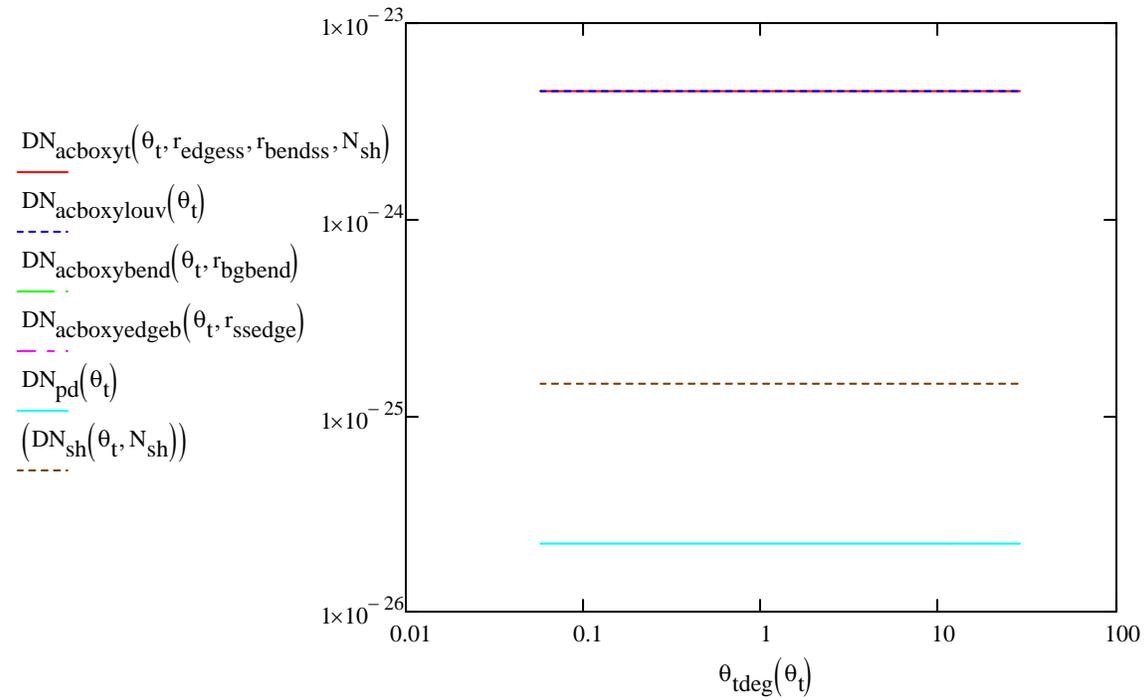m/rtHz

$$\theta_t := 3 \cdot \frac{\pi}{180}$$

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

$$DN_{acboxyt}(\theta_t, r_{edgess}, r_{bendss}, N_{sh}) = 4.489 \times 10^{-24}$$

$$r_{edgess} = 2.54 \times 10^{-5}$$

$$r_{bendss} = 2.4 \times 10^{-3}$$

$\theta_t := 0, 0.001 .. 0.5$

$DN_{acboxyt}\left(\theta_t, r_{edgess}, r_{bendss}, N_{sh}\right)$
— (red)

$DN_{acboxylouv}\left(\theta_t\right)$
- - - - (blue)

$DN_{acboxybend}\left(\theta_t, r_{bgbend}\right)$
— · (green)

$DN_{acboxyedgeb}\left(\theta_t, r_{ssedge}\right)$
— · · (magenta)

$DN_{pd}\left(\theta_t\right)$
—— (cyan)

$\left(DN_{sh}\left(\theta_t, N_{sh}\right)\right)$
- - - - (brown)

$\theta_t := 3 \cdot \dfrac{\pi}{180}$

Comparison of oxidized SS bafle to mixed baffle with rough-cut BG edge

$r_{edgess} = 2.54 \times 10^{-5}$

$r_{bendss} = 2.4 \times 10^{-3}$

$r_{edgebgr} := 1 \cdot 10^{-4}$

$r_{edgebgfp} := 1 \cdot 10^{-4}$

$\dfrac{DN_{acboxyt}\left(\theta_t, r_{edgess}, r_{bendss}, N_{sh}\right)}{DN_{acboxybgrtsifo}\left(\theta_t, r_{edgess}, r_{edgebgr}\right)} = 11.086$

Comparison of oxidized SS bafle to mixed baffle with fire-polish BG edge

$$\frac{DN_{acboxyt}\left(\theta_t, r_{edgess}, r_{bendss}, N_{sh}\right)}{DN_{acboxybgfptsifo}\left(\theta_t, r_{edgess}, r_{edgebgfp}\right)} = 26.249$$

Comparison of mixed baffle with fire-polish BG edge to rough-cut BG edge

$$\frac{DN_{acboxybgrtsifo}\left(\theta_t, r_{edgess}, r_{edgebgr}\right)}{DN_{acboxybgfptsifo}\left(\theta_t, r_{edgess}, r_{edgebgfp}\right)} = \blacksquare$$

Hole

$+ P_{acbbglouvsifo}(\theta_t) + P_{pdsifo}(\theta_t)$

$\dfrac{2}{\sqrt{2}} \cdot k$

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

$$_{;\text{fp}}\big) + P_{\text{acbbglouvsifo}}\big(\theta_t\big) + P_{\text{pdsifo}}\big(\theta_t\big)$$

$$B \cdot \frac{2}{\sqrt{2}} \cdot k$$

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

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