MC Tube Baffle Scatter
8/4/10

chamber motion @ 20 Hz, m/rt Hz $x_m := 10^{-8}$

thermal noise displacement @ 20 Hz, m/rt Hz $X_{srd} := 2 \cdot 10^{-20}$

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

$$BRDF_1(\theta) := \frac{2755.12}{\left(1 + 8.5078 \cdot 10^{8} \cdot \theta^2\right)^{1.23597}}$$

arm power, W $P_{arm} := 8.34 \cdot 10^{5}$

arm length, m $L := 4000$

spot radius of IFO mode, m $w := .0115$

COC radius, m $R_{coc} := 0.170$

Arm Cavity Baffle radius, m $R_{ACB} := \frac{0.346}{2}$

$R_{ACB} = 0.173$

maximum scattering angle, rad $\theta_{max} := \frac{R_{ACB}}{L}$

$\theta_{max} = 4.325 \times 10^{-5}$

minimum scattering angle, rad $\theta_{min} := \frac{R_{coc}}{L}$

$\theta_{min} = 4.25 \times 10^{-5}$

SCATTERED POWER FROM FAR COC THROUGH BEAM TUBE, PAST NEAR COC

total power scattered into annulus between near COC and ACB

$$P_{etmbaf} := P_{arm} \cdot 2 \cdot \pi \cdot \int_{\theta_{min}}^{\theta_{max}} BRDF_1(\theta) \cdot \sin(\theta)\, d\theta$$

$$P_{etmbaf} = 0.145$$

DIFFUSE LIGHT SCATTERED FROM MODECLEANER TUBE BAFFLE

fraction of power reaching modecleaner tube corner

$$\eta_{mct} := 0.01$$

incident power on modecleaner tube corner, W

$$P_{mctbaf} := \eta_{mct} \cdot P_{etmbaf}$$

$$P_{mctbaf} = 1.45 \times 10^{-3}$$

BRDF of Baffle, sr^-1

$$BRDF_{baff} := 0.05$$

BRDF of COC @ 3E-5 rad incidence angle

$$BRDF_1\left(3 \cdot 10^{-5}\right) = 1.364 \times 10^{3}$$

solid angle of IFO, sr

$$\Delta\Omega := 2.72 \cdot 10^{-9}$$

power scattered into IFO, watt

$$P_{mctbs} := P_{mctbaf} \cdot BRDF_{baff} \cdot \frac{\pi \cdot w^2}{L^2} \cdot BRDF_1\left(3 \cdot 10^{-5}\right) \cdot \Delta\Omega$$

$$P_{mctbs} = 6.987 \times 10^{-21}$$

MC baffle scattered power to arm power ratio

$$\eta_{mctbsifo} := \frac{P_{mctbs}}{P_{arm}}$$

$$\eta_{mctbsifo} = 8.377 \times 10^{-27}$$

chamber motion @ 20 Hz, m/rt Hz

$$x_m = 1 \times 10^{-8}$$

SRD displacement @ 20 Hz, m/rt Hz

$$X_{srd} = 2 \times 10^{-20}$$

relative scattered light displacement noise

$$f := \frac{\sqrt{\eta_{mctbsifo}} \cdot x_m}{X_{srd}}$$

$$f = 0.046$$

LIGHT RETRO-REFLECTED FROM MODECLEANER TUBE CORNER

estimated fraction of power retro-reflected from modecleaner tube corner

$$\eta_{mcrefl} := 0.1$$

power retro-reflected into IFO, watt

$$P_{mctr} := P_{mctbaf} \cdot \eta_{mcrefl} \cdot BRDF_{baff} \cdot \frac{\pi \cdot w^2}{L^2} \cdot BRDF_1\left(3 \cdot 10^{-5}\right) \cdot \Delta$$

$$P_{mctr} = 6.987 \times 10^{-22}$$

retro-reflected power to arm power ratio

$$\eta_{mctrifo} := \frac{P_{mctr}}{P_{arm}}$$

$$\eta_{mctrifo} = 8.377 \times 10^{-28}$$

relative scattered light displacement noise

$$f := \frac{\sqrt{\eta_{mctrifo}} \cdot x_m}{X_{srd}}$$

$$f = 0.014$$