T1300412 Manifold-Cryopump scatter
4/30/11

Arm cavity power, W $P_a := 840000$

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

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

$k = 5.905 \times 10^{6}$

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 $TF_{itmhr} := 1.1 \cdot 10^{-9}$

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 $R_{cp} := 0.3845$ $.3845 2 = 0.769$

half-angle from centerline to Rcp, rad $\theta_{cp} := \frac{R_{cp}}{L_{arm}}$

BRDF, sr^-1; CSIRO, surface 2, S/N 2 $BRDF_1(\theta) := \frac{2755.12}{\left(1 + 8.50787 \cdot 10^{8} \cdot \theta^2\right)^{1.23597}}$

BRDF #4 Oxidized stainless steel, 57 deg inc.

large angle BRDF, sr^-1 $BRDF_{\theta 2} := 0.03$

number of manifold/cryopump baffles $N_{cp} := 4$

radius of beam tube aperture, m $R_{bt} := 0.531$

half-angle from centerline to Rbt, rad $\theta_{bt} := \frac{R_{bt}}{L_{arm}} = 1.327 \times 10^{-4}$

power incident on cryopump baffle, W $P_{cp} := P_a \cdot \int_{\theta_{cp}}^{\theta_{bt}} 2 \cdot \pi \cdot \theta \cdot BRDF_1(\theta)\, d\theta = 2.815$

power loss fraction from COC to cryopump $\eta_{lcp} := \frac{P_{cp}}{P_a}$ $\eta_{lcp} = 3.351 \times 10^{-6}$

Power Scattered into IFO

$$P_{cpsifo} := \sqrt{N_{cp}} \cdot P_{cp} \cdot BRDF_{\theta 2} \cdot \frac{\pi \cdot w_{ifo}^{\,2}}{L_{arm}^{\,2}} \cdot BRDF_1\left(30 \cdot 10^{-6}\right) \cdot \Delta\Omega_{ifo} = 1.631 \times 10^{-17}$$

manifold/cryopump displacement @ 100 HZ, m/rt HZ $x_{cp} := 1 \cdot 10^{-12}$

displacement noise @ 100 Hz, m/rtHz

$$DN_{cp} := TF_{itmhr} \cdot \left(\frac{P_{cpsifo}}{P_{psl}}\right)^{0.5} \cdot x_{cp} \cdot 2 \cdot k = 4.692 \times 10^{-24}$$