Polarization loss due to Horizontal Intrinsic resonance with 15%CS + 5.9% WS, 10%CS + 5.9% WS and 12%CS + 5.9% WS

$$\sigma_1 := \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \qquad \sigma_2 := \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix} \qquad \sigma_3 := \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \qquad \sigma_0 := \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$M(nx, ns, ny, \phi) := \sigma_0 \cdot \cos\left(\frac{\phi}{2}\right) - i \cdot \frac{(nx \cdot \sigma_1 + ns \cdot \sigma_2 + ny \cdot \sigma_3) \cdot \sin\left(\frac{\phi}{2}\right)}{\sqrt{nx^2 + ns^2 + ny^2}} \qquad sptune(M) := \frac{1 \cdot \operatorname{acos}\left(\frac{tr(M)}{2}\right)}{\pi}$$

$$preaxis(M) := \left(\frac{i\,tr(\sigma_1 \cdot M)}{2 \cdot \sin(\pi \cdot sptune(M))} \quad \frac{i\,tr(\sigma_2 \cdot M)}{2 \cdot \sin(\pi \cdot sptune(M))} \quad \frac{i\,tr(\sigma_3 \cdot M)}{2 \cdot \sin(\pi \cdot sptune(M))} \right)$$

$$pf(\varepsilon, \alpha) := \left[2 \cdot \exp\left[-\pi \cdot \frac{(|\varepsilon|)^2}{2 \cdot \alpha} \right] - 1 \right] \qquad prms(\varepsilon, \alpha) := \frac{\left[1 - \pi \cdot \frac{(|\varepsilon|)^2}{\alpha} \right]}{\left[1 + \pi \cdot \frac{(|\varepsilon|)^2}{\alpha} \right]} \qquad phc(\varepsilon, \alpha) := \left[2 \cdot \sqrt{\frac{1}{\left[\pi \cdot \frac{(|\varepsilon|)^2}{\alpha} \right] + 1}} - 1 \right]$$

$G := 1.7928$

$emx := 0.0000016$

$emx1 := 0.000001462$

$emx2 := 0.00000179$

$dvh := 8.72$

0.000001462

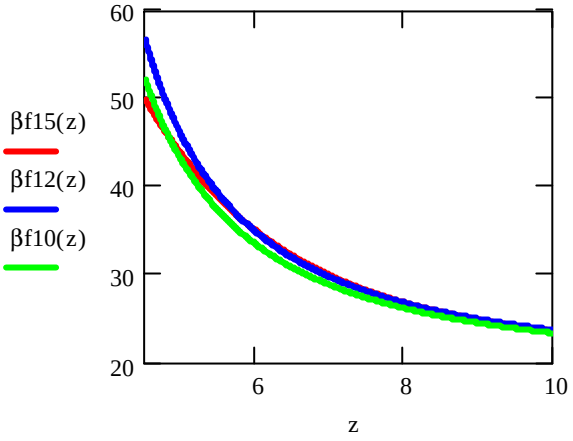
0.00000179

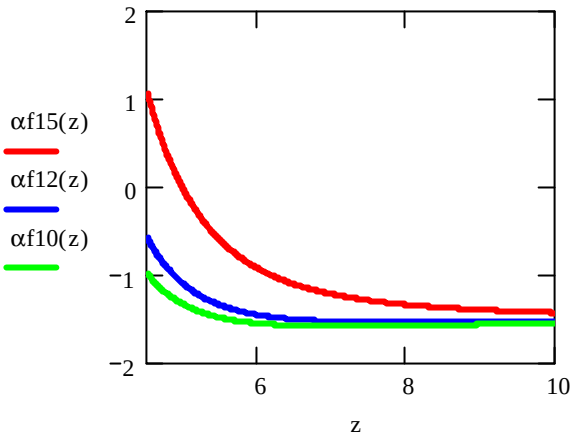
$dc := \frac{1}{3}$

$$\alpha f10(z) := -1.53883 + \frac{51.807}{z^3} - \frac{1299.9}{z^4} + \frac{5808.23}{z^5} \qquad \beta f10(z) := 19.6398 + \frac{6328.28}{z^3} - \frac{35310.1}{z^4} + \frac{90820.9}{z^5}$$

$$\alpha f15(z) := -1.52947 + \frac{246.587}{z^3} - \frac{2704.33}{z^4} + \frac{11953.2}{z^5} \qquad \beta f15(z) := 19.7905 + \frac{4107.19}{z^3} - \frac{1787.49}{z^4} - \frac{19524.4}{z^5}$$

$$\alpha f12(z) := -1.54022 + \frac{114.494}{z^3} - \frac{1962.94}{z^4} + \frac{8271.74}{z^5} \qquad \beta f12(z) := 19.6429 + \frac{7166.25}{z^3} - \frac{42294.1}{z^4} + \frac{113516}{z^5}$$





$$f15(x) := 0.64681 + 2.2079 \cdot \frac{G^2}{x^2}$$

$$f10(x) := 0.64002 + \frac{2.25011 \cdot G^2}{x^2}$$

$$f12(x) := 0.64681 + 2.2079 \cdot \frac{G^2}{x^2}$$

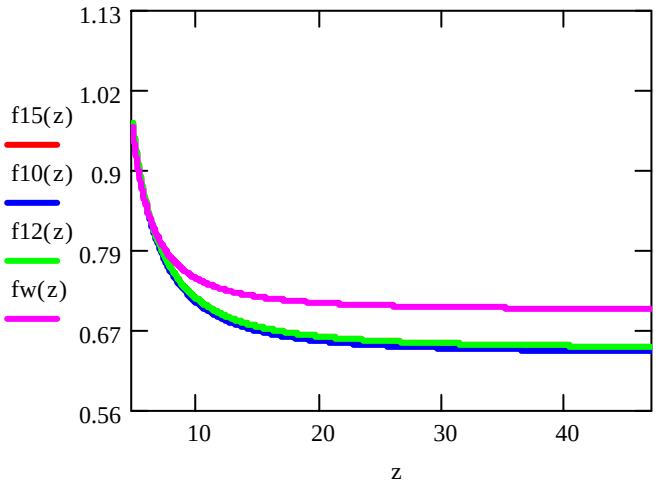
$$fw(x) := 0.70194 + \frac{1.29873 \cdot G^2}{\left(x^2 - 1.89205 \cdot G^2\right)}$$

$$ss15 := \frac{39.11873}{180}$$

$$ss10 := \frac{25.39531}{180}$$

$$ss12 := \frac{35.207}{180}$$

$$ssw := \frac{15.06097}{180}$$



$$Mot15(x) := \left[\left[M\left[0,0,1,2\cdot\pi\cdot(1-dc)\cdot x\right]\cdot M(0,1,0,ssw\cdot fw(x)\cdot\pi)\cdot M(0,0,1,2\cdot\pi\cdot dc\cdot x)\cdot M(0,1,0,ss15\cdot f15(x)\cdot\pi)\right]\right]$$

$$Mot10(x) := \left[\left[M\left[0,0,1,2\cdot\pi\cdot(1-dc)\cdot x\right]\cdot M(0,1,0,ssw\cdot fw(x)\cdot\pi)\cdot M(0,0,1,2\cdot\pi\cdot dc\cdot x)\cdot M(0,1,0,ss10\cdot f10(x)\cdot\pi)\right]\right]$$

$$Mot12(x) := \left[\left[M\left[0,0,1,2\cdot\pi\cdot(1-dc)\cdot x\right]\cdot M(0,1,0,ssw\cdot fw(x)\cdot\pi)\cdot M(0,0,1,2\cdot\pi\cdot dc\cdot x)\cdot M(0,1,0,ss12\cdot f12(x)\cdot\pi)\right]\right]$$

$$vs15(x) := sptune(Mot15(x)) \qquad Ph15(x) := \sqrt{\left[\left(preaxis(Mot15(x))^{T}\right)_{0}\right]^{2} + \left[\left(preaxis(Mot15(x))^{T}\right)_{1}\right]^{2}}$$

$$Pv15(x) := \left(preaxis(Mot15(x))^{T}\right)_{2} \qquad P15pol(x) := \left(preaxis\left(M(0,1,0,ss15\cdot\pi)\cdot Mot15(x)\cdot M(0,1,0,-ss15\cdot\pi)\right)^{T}\right)_{2}$$

$$dvsdgg15(x) := \frac{vs15(x+0.001) - vs15(x)}{0.001} \qquad dvsdgg15(dvh) = 0.917$$

$$vs10(x) := sptune(Mot10(x)) \qquad Ph10(x) := \sqrt{\left[\left(preaxis(Mot10(x))^{T}\right)_{0}\right]^{2} + \left[\left(preaxis(Mot10(x))^{T}\right)_{1}\right]^{2}}$$

$$Pv10(x) := \left(preaxis(Mot10(x))^{T}\right)_{2} \qquad P10pol(x) := \left(preaxis\left(M(0,1,0,ss10\cdot\pi)\cdot Mot10(x)\cdot M(0,1,0,-ss10\cdot\pi)\right)^{T}\right)_{2}$$

$$dvsdgg10(x) := \frac{vs10(x+0.001) - vs10(x)}{0.001} \qquad dvsdgg10(dvh) = 0.953$$

$$vs12(x) := sptune(Mot12(x)) \qquad Ph12(x) := \sqrt{\left[\left(preaxis(Mot12(x))^{T}\right)_{0}\right]^{2} + \left[\left(preaxis(Mot12(x))^{T}\right)_{1}\right]^{2}}$$

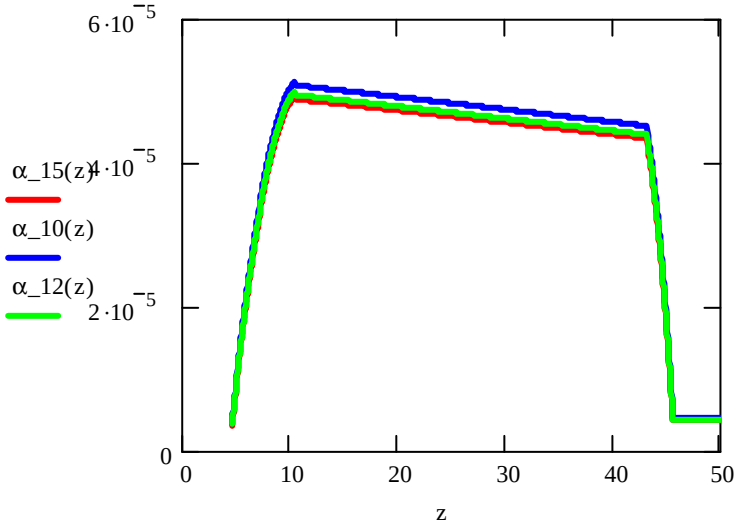
$$Pv12(x) := \left(preaxis(Mot12(x))^{T}\right)_{2} \qquad P12pol(x) := \left(preaxis\left(M(0,1,0,ss12\cdot\pi)\cdot Mot12(x)\cdot M(0,1,0,-ss12\cdot\pi)\right)^{T}\right)_{2}$$

$$dvsdgg12(x) := \frac{vs12(x+0.001) - vs12(x)}{0.001} \qquad dvsdgg12(dvh) = 0.928$$

$$\alpha\_15(z) := \begin{cases} \left(-9.02652\cdot10^{-5} + 2.62147\cdot10^{-5}\cdot z - 1.18953\cdot10^{-6}\cdot z^2\right)\cdot dvsdgg15(dvh) & \text{if } (z > 4.471) \wedge (z < 10.3945) \\ \left(5.51162\cdot10^{-5} - 1.77519\cdot10^{-7}\cdot z - 8.42693\cdot10^{-11}\cdot z^2\right)\cdot dvsdgg15(dvh) & \text{if } (z \geq 10.3945) \wedge (z \leq 43.10429) \\ \left(-0.00678948 + 0.0003254\cdot z - 3.87012\cdot10^{-6}\cdot z^2\right)\cdot dvsdgg15(dvh) & \text{if } (z > 43.10429) \wedge (z \leq 45.46) \\ 4.742\cdot10^{-6}\cdot dvsdgg15(dvh) & \text{if } z > 45.46 \end{cases}$$

$$\alpha\_10(z) := \begin{cases} \left(-9.02652\cdot10^{-5} + 2.62147\cdot10^{-5}\cdot z - 1.18953\cdot10^{-6}\cdot z^2\right)\cdot dvsdgg10(dvh) & \text{if } (z > 4.471) \wedge (z < 10.3945) \\ \left(5.51162\cdot10^{-5} - 1.77519\cdot10^{-7}\cdot z - 8.42693\cdot10^{-11}\cdot z^2\right)\cdot dvsdgg10(dvh) & \text{if } (z \geq 10.3945) \wedge (z \leq 43.10429) \\ \left(-0.00678948 + 0.0003254\cdot z - 3.87012\cdot10^{-6}\cdot z^2\right)\cdot dvsdgg10(dvh) & \text{if } (z > 43.10429) \wedge (z \leq 45.46) \\ 4.742\cdot10^{-6}\cdot dvsdgg10(dvh) & \text{if } z > 45.46 \end{cases}$$

$$\alpha\_12(z) := \begin{cases} \left(-9.02652\cdot10^{-5} + 2.62147\cdot10^{-5}\cdot z - 1.18953\cdot10^{-6}\cdot z^2\right)\cdot dvsdgg12(dvh) & \text{if } (z > 4.471) \wedge (z < 10.3945) \\ \left(5.51162\cdot10^{-5} - 1.77519\cdot10^{-7}\cdot z - 8.42693\cdot10^{-11}\cdot z^2\right)\cdot dvsdgg12(dvh) & \text{if } (z \geq 10.3945) \wedge (z \leq 43.10429) \\ \left(-0.00678948 + 0.0003254\cdot z - 3.87012\cdot10^{-6}\cdot z^2\right)\cdot dvsdgg12(dvh) & \text{if } (z > 43.10429) \wedge (z \leq 45.46) \\ 4.742\cdot10^{-6}\cdot dvsdgg12(dvh) & \text{if } z > 45.46 \end{cases}$$



$$\theta 15(x) := 2\cdot\sin(\pi\cdot dvh)\sqrt{\frac{\left(1+\alpha f15(x)^2\right)\cdot emx\cdot G}{\beta f15(x)\cdot x}} \qquad \phi 15(Gg) := \operatorname{atan}\left[\frac{\left(preaxis(Mot15(Gg))^T\right)_0}{\left(preaxis(Mot15(Gg))^T\right)_1}\right]$$

$$eps15(Gg) := \sqrt{Gg\cdot\frac{emx}{G}}\cdot 2G\cdot Ph15(Gg)\cdot\frac{\sin(\pi\cdot dvh)}{4\cdot\pi}\cdot\sqrt{\frac{\left(1+\alpha f15(Gg)^2\right)}{\beta f15(Gg)}}$$

$$\theta 10(x) := 2\cdot\sin(\pi\cdot dvh)\sqrt{\frac{\left(1+\alpha f10(x)^2\right)\cdot emx\cdot G}{\beta f10(x)\cdot x}} \qquad \phi 10(Gg) := \operatorname{atan}\left[\frac{\left(preaxis(Mot10(Gg))^T\right)_0}{\left(preaxis(Mot10(Gg))^T\right)_1}\right]$$

$$eps10(Gg) := \sqrt{Gg\cdot\frac{emx}{G}}\cdot 2G\cdot Ph10(Gg)\cdot\frac{\sin(\pi\cdot dvh)}{4\cdot\pi}\cdot\sqrt{\frac{\left(1+\alpha f10(Gg)^2\right)}{\beta f10(Gg)}}$$

$$\theta 12(x) := 2\cdot\sin(\pi\cdot dvh)\sqrt{\frac{\left(1+\alpha f12(x)^2\right)\cdot emx\cdot G}{\beta f12(x)\cdot x}} \qquad \phi 12(Gg) := \operatorname{atan}\left[\frac{\left(preaxis(Mot12(Gg))^T\right)_0}{\left(preaxis(Mot12(Gg))^T\right)_1}\right]$$

$$eps12(Gg) := \sqrt{Gg\cdot\frac{emx}{G}}\cdot 2G\cdot Ph12(Gg)\cdot\frac{\sin(\pi\cdot dvh)}{4\cdot\pi}\cdot\sqrt{\frac{\left(1+\alpha f12(Gg)^2\right)}{\beta f12(Gg)}}$$

$$Ggh(z) := \begin{cases} \left(\frac{z}{2}+13-dvh\right) & \text{if } \frac{z}{2} = \operatorname{trunc}\left(\frac{z}{2}\right) \\ \frac{z}{2}-4.5+dvh & \text{otherwise} \end{cases}$$

$n := 1, 2 .. 82$

$PH15_0 := 1$ $PHC15_0 := 1$

$PH15_n := (prms(eps15(Ggh(n)), \alpha\_15(Ggh(n)))) \cdot PH15_{n-1}$

$PHC15_n := (phc(eps15(Ggh(n)), \alpha\_15(Ggh(n)))) \cdot PHC15_{n-1}$

$PH15_{82} = 0.8$

$PH15_{80} = 0.837$

$PH10_0 := 1$ $PHC10_0 := 1$

$PH10_n := (prms(eps10(Ggh(n)), \alpha\_10(Ggh(n)))) \cdot PH10_{n-1}$

$PHC10_n := (phc(eps10(Ggh(n)), \alpha\_10(Ggh(n)))) \cdot PHC10_{n-1}$

$PH10_{82} = 0.889$

$PH10_{80} = 0.912$

$PH12_0 := 1$ $PHC12_0 := 1$

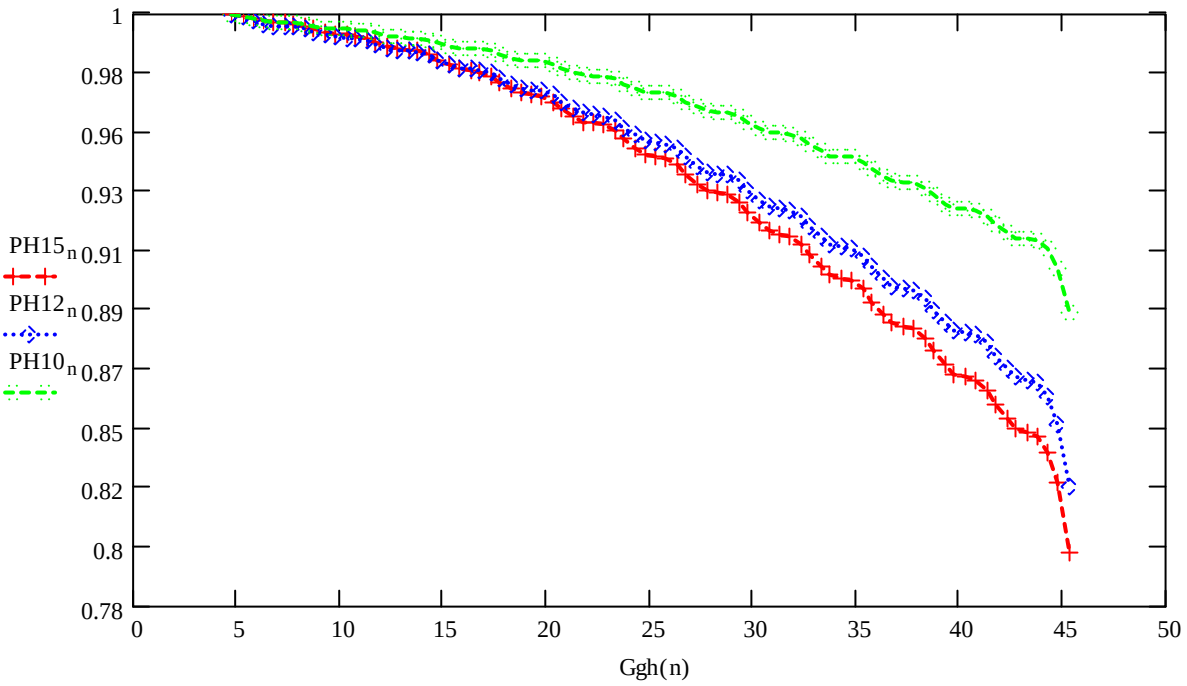
$PH12_n := (prms(eps12(Ggh(n)), \alpha\_12(Ggh(n)))) \cdot PH12_{n-1}$

$PHC12_n := (phc(eps12(Ggh(n)), \alpha\_12(Ggh(n)))) \cdot PHC12_{n-1}$

$PH12_{82} = 0.824$

$PH12_{80} = 0.857$

$Ggh(80) = 44.28$ $Ggh(82) = 45.28$



	$e_{x\_rms}(mm-mrad)$	Total loss	Loss at 36+
14%	1.6	20%	3.7%
12%	1.6	17.6%	3.3%
10%	1.6	11.1%	2.3%

$$\alpha\_15(45) = 1.516 \times 10^{-5}$$

$$\alpha\_12(45) = 1.534 \times 10^{-5}$$

$$\alpha\_10(45) = 1.576 \times 10^{-5}$$