N6PLSPS

Wave traveling with total internal reflection through a planar waveguide.

Resonance condition of s-polarization.

Global definition of n1, n2, n3, d and λ above the graph

$$\theta := 0, 1 .. 90$$

$$y(\theta) := 2\cdot\pi\cdot n1\cdot\frac{d}{\lambda}\cdot\cos\left(2\cdot\pi\cdot\frac{\theta}{360}\right)$$

$$zs1(\theta) := \frac{\left(\sqrt{n1^2\cdot\sin\left(2\cdot\pi\cdot\frac{\theta}{360}\right)^2 - n2^2}\right)}{n1\cdot\cos\left(2\cdot\pi\cdot\frac{\theta}{360}\right)}$$

$$ys1(\theta) := -\operatorname{atan}(zs1(\theta))$$

$$zs3(\theta) := \frac{\left(\sqrt{n1^2\cdot\sin\left(2\cdot\pi\cdot\frac{\theta}{360}\right)^2 - n3^2}\right)}{n1\cdot\cos\left(2\cdot\pi\cdot\frac{\theta}{360}\right)}$$

$$ys3(\theta) := -\operatorname{atan}(zs3(\theta))$$

ys is for m=1, yys for m=2, yyys for m=3

For these parameters the angle θ of the first three possible modes is determined

Global definition

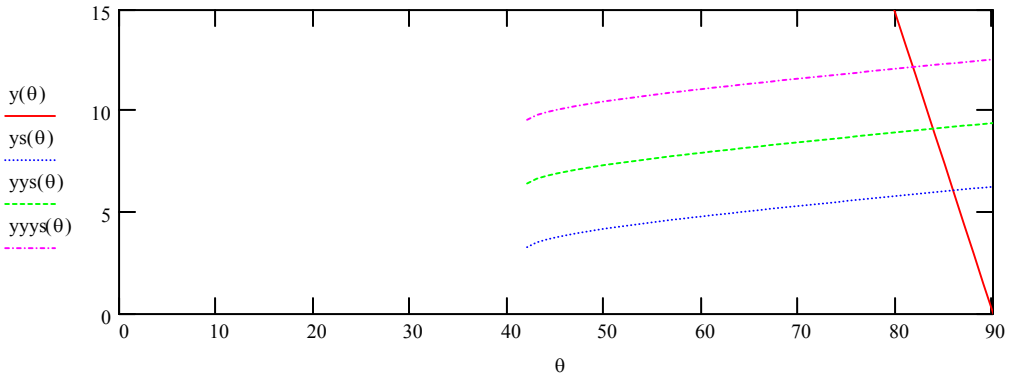
$$\theta c := \operatorname{asin}\left(\frac{n2}{n1}\right)$$

$$\theta\theta c := 360\cdot\frac{\theta c}{2\cdot\pi}$$

$$\theta\theta c = 41.81$$

$$ys(\theta) := -ys1(\theta) - ys3(\theta) + \pi$$
$$yys(\theta) := -ys1(\theta) - ys3(\theta) + \pi\cdot 2$$
$$yyys(\theta) := -ys1(\theta) - ys3(\theta) + \pi\cdot 3$$

$$n1 \equiv 1.5$$
$$n2 \equiv 1$$
$$n3 \equiv 1$$
$$d \equiv 18$$
$$\lambda \equiv 2$$



At the cross-over point of y with ys, yys, or yyys respectively, the resonance condition is fulfilled.
The functions ys, yys and yyys are complex in the region from horizontal appearance to zero. This is shown in the next graph where the argument is plotted. The complex region has to be disregarded for the determination of the cross-over point.