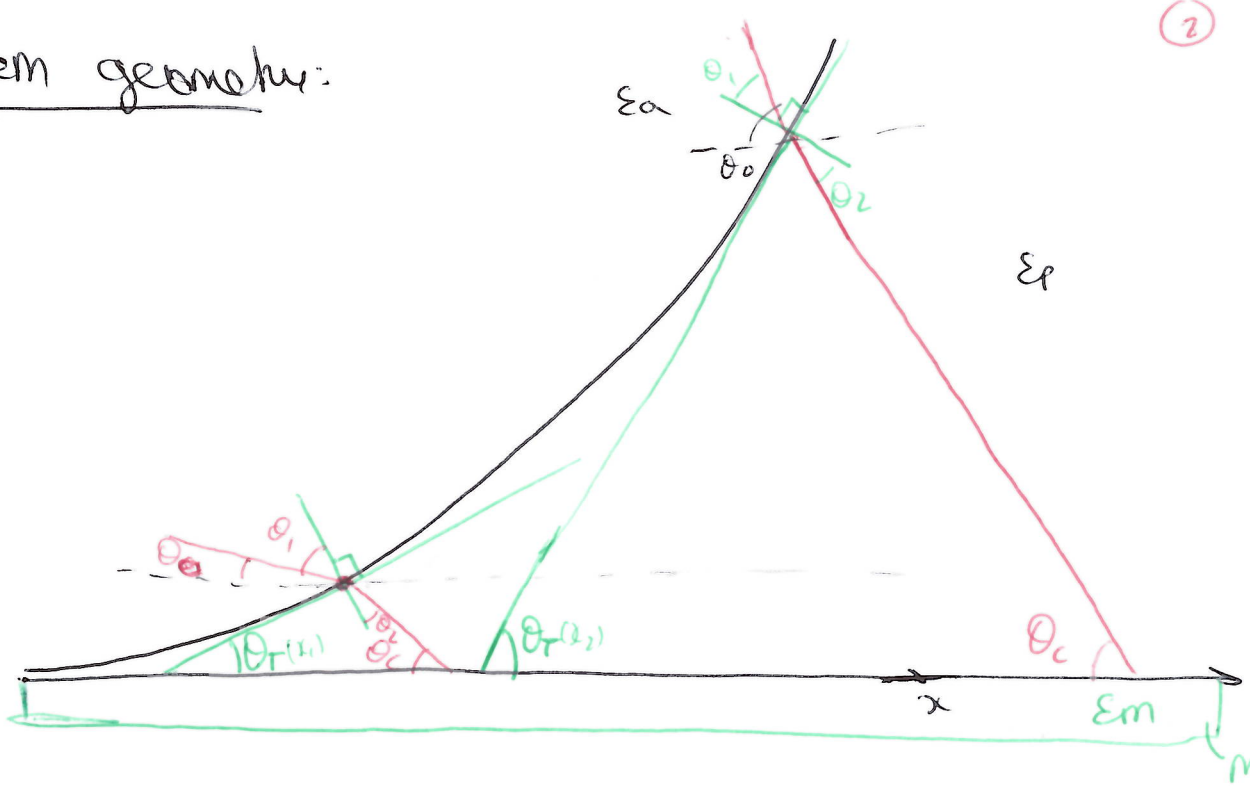
System geometry:



θ_0 : angle of incidence.

θ_1 : from snell's law : angle between incident line and normal to the tangent at the point.

θ_c : coupling angle : constant at a given frequency

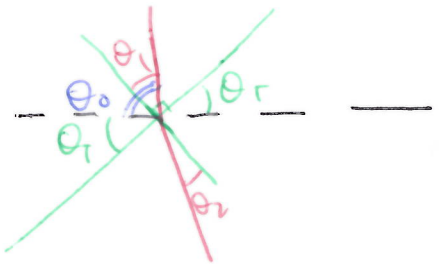
θ_T : Angle between the tangent at a point in the circle and the x-axis.

θ_2 : from snell's law.

Relation from the geometry of the system:

- $90^\circ = \theta_T + \theta_0 - \theta_1$

$$\Rightarrow \boxed{\theta_1 = -\frac{\pi}{2} + \theta_T + \theta_0} \quad (5)$$



- $\frac{\pi}{2} - \theta_2 + \theta_T + \theta_c = \pi$

$$\Rightarrow \boxed{\theta_2 = \theta_T + \theta_c - \frac{\pi}{2}} \quad (6)$$