實驗10: 光電元件模擬實驗

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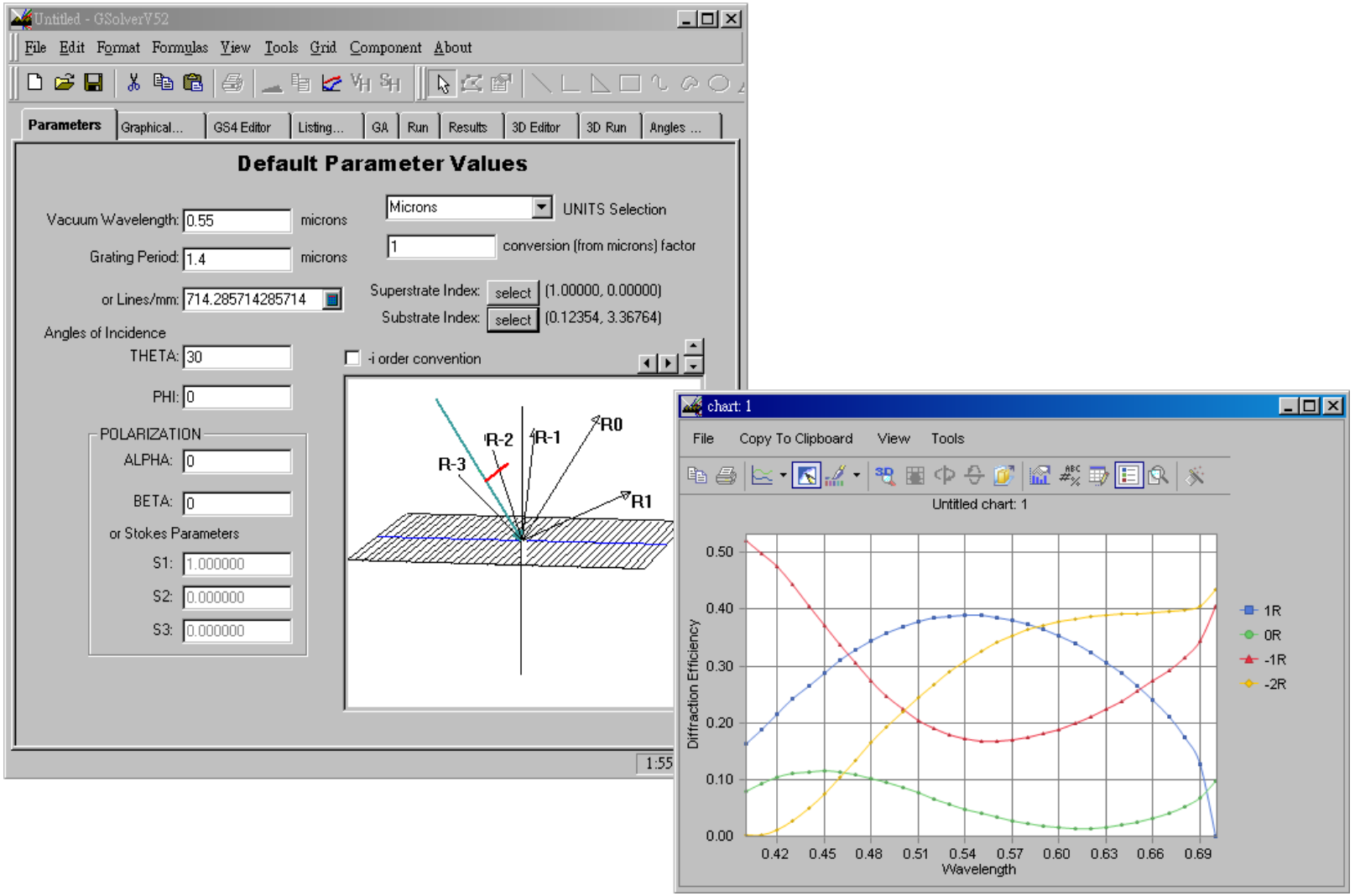
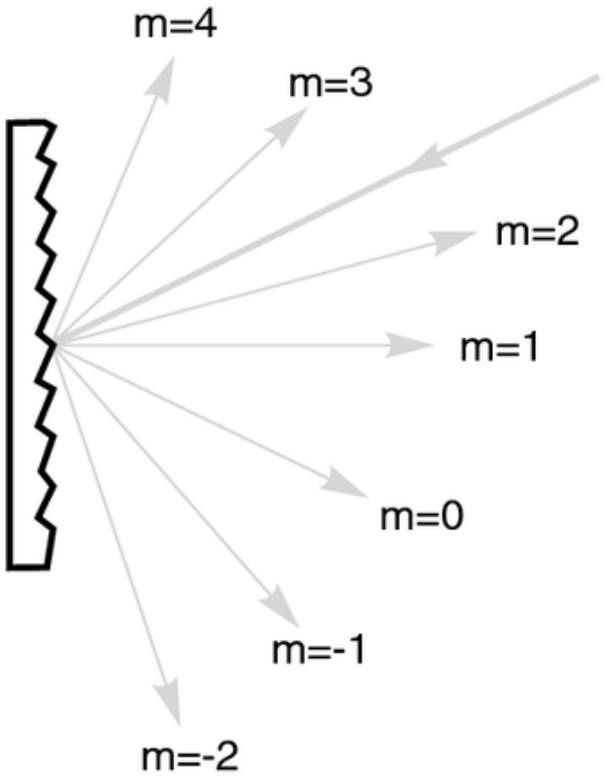
Objectives

- Reflection Gratings [GSolver]
  - 觀察光柵造成的反射角變化
- Gaussian Beam [Matlab]
  - 了解高斯光束的基本特性
- Waveguide Coupler [RSoft]
  - 模擬光波導元件

1.Reflection Grating [GSolver]





反射角　　入射角　　光波長

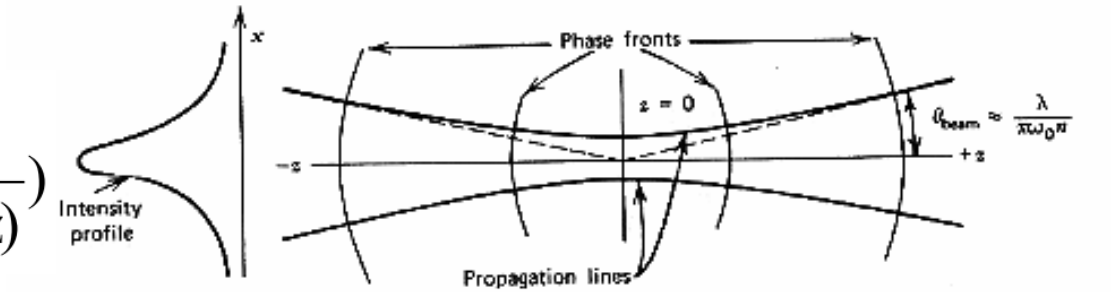
$$\sin\theta_R^{(m)} = \sin\theta_i + \frac{m\lambda}{\Lambda}$$

繞射階數　　結構週期

2.Gaussian Beam [Matlab]

- Intensity

$$I(\rho, z) = I_0 \left[\frac{W_0}{W(z)} \right]^2 \exp\left(-\frac{2\rho^2}{W^2(z)}\right)$$

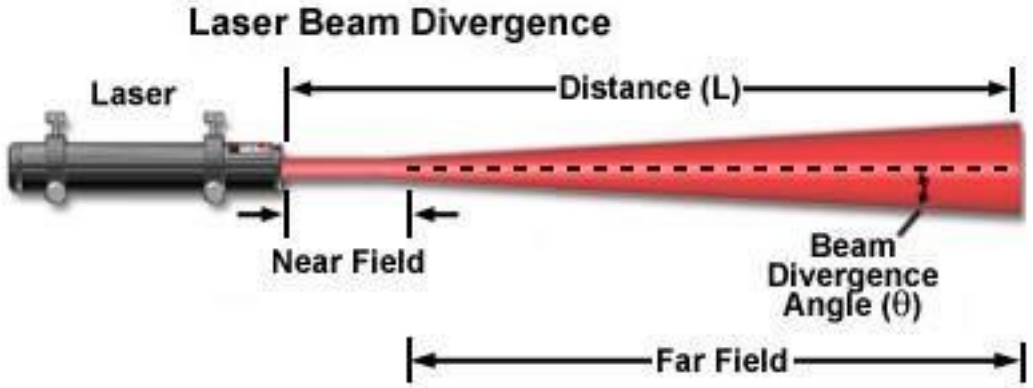


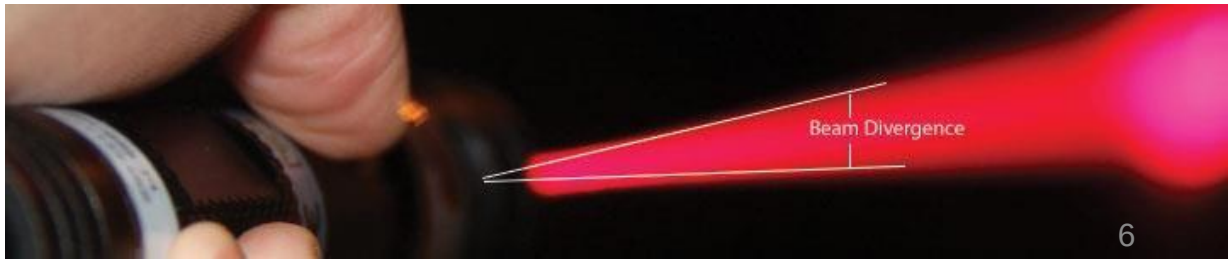
- Beam parameter

$$W(z) = W_0 \sqrt{1 + \left(\frac{z}{z_0}\right)^2}$$

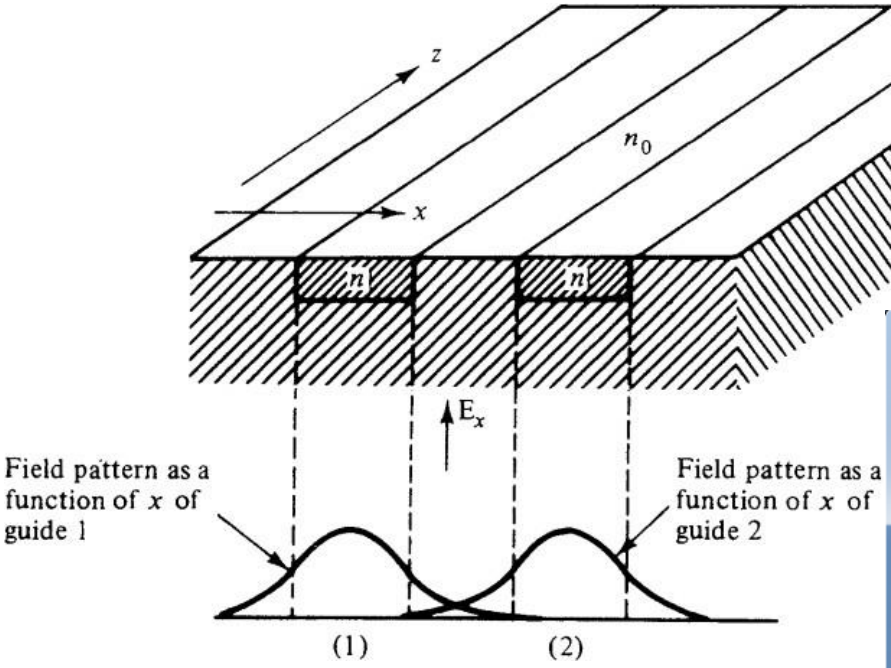
$$R(z) = z \left[1 + \left(\frac{z_0}{z}\right)^2\right]$$

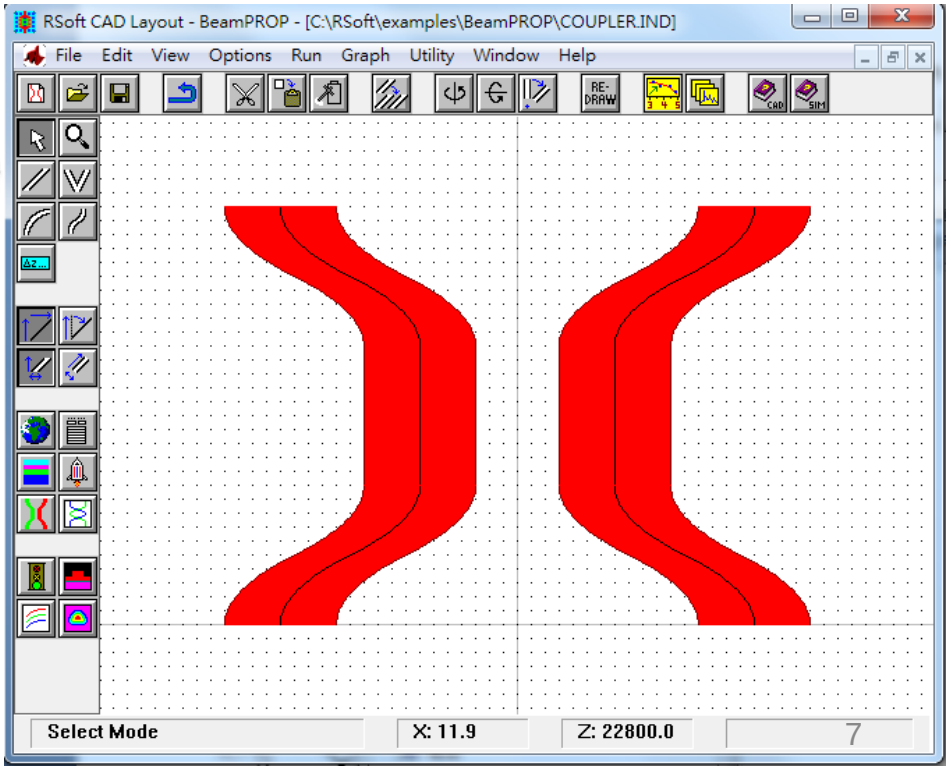
$$W_0 = \sqrt{\frac{\lambda z_0}{\pi}}$$



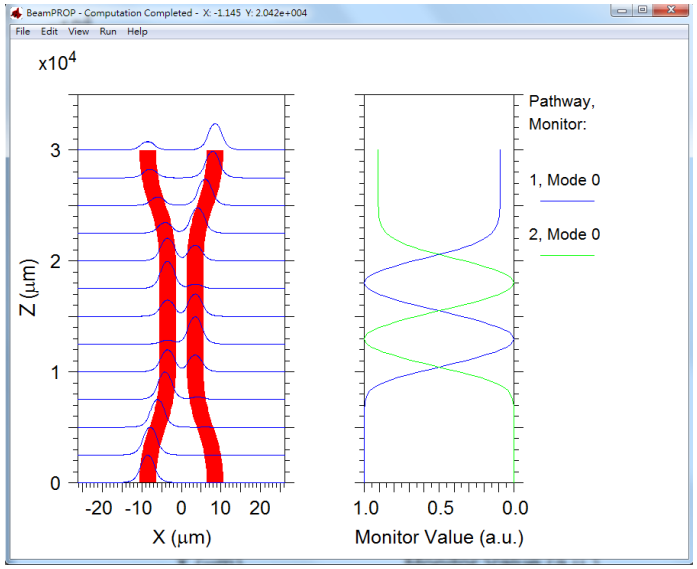


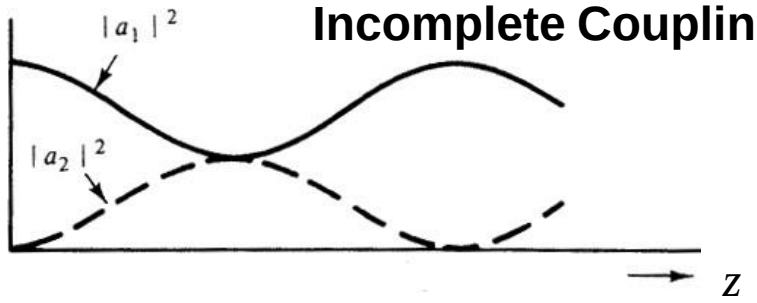
3.Waveguide Coupler [RSoft]

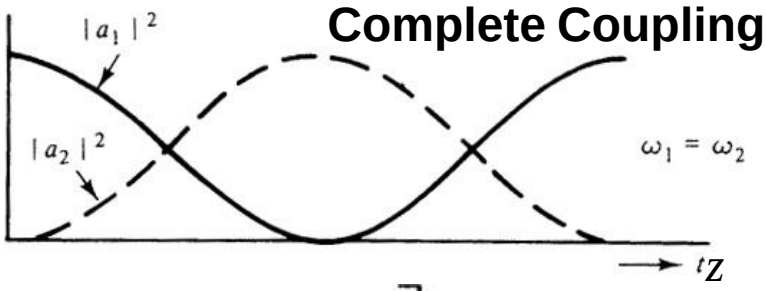




Waveguide Coupler [RSoft]







$$a_1(z) = \left[a_1(0)\left(\cos \beta_0 z + j \frac{\beta_2 - \beta_1}{2\beta_0} \sin \beta_0 z \right) + \frac{\kappa_{12}}{\beta_0} a_2(0) \sin \beta_0 z \right] e^{-j[(\beta_1+\beta_2)/2]z} \quad (7.79)$$

$$a_2(z) = \left[\frac{\kappa_{21}}{\beta_0} a_1(0) \sin \beta_0 z + a_2(0)\left(\cos \beta_0 z + j \frac{\beta_1 - \beta_2}{2\beta_0} \sin \beta_0 z \right) \right] e^{-j[(\beta_1+\beta_2)/2]z} \quad (7.80)$$

$$\beta_0 = \sqrt{\left(\frac{\beta_1 - \beta_2}{2} \right)^2 + |\kappa_{12}|^2}$$

波導1與波導2
內部的傳播係數

傳播距離為“z”時
波導1內的電場

從波導1到波導2的
耦合係數

$$a_1(z) = \left[a_1(0)\left(\cos \beta_0 z + j \frac{\beta_2 - \beta_1}{2\beta_0} \sin \beta_0 z \right) + \frac{\kappa_{12}}{\beta_0} a_2(0) \sin \beta_0 z \right]$$

傳播距離為零時
波導1內的電場
(波導1的起始值)

包含著波導1及
波導2的空間的
傳播係數

傳播距離為零時
波導2內的電場
(波導2的起始值)

Preview Questions

- Diffraction Grating光柵
  - 某入射角的光有兩個不同波長(WL1, WL2)的成分。請問這兩個波長下的第一階反射的繞射角度的差距是多少?
- Gaussian Beam
  - 有一雷射，波長為1064 nm。在10 km 的遠方，此雷射光點大小的擴散不得超過120%。請解出此雷射原本的腰寬大小。
- Waveguide Coupler 光導偶合器
  - 假設波導1與波導2的起始值分別為1與0。找出最佳偶合的條件。
  - 此前提下，找出50-50偶合的條件。

參考資料

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4. J. W. Goodman, *Introduction To Fourier Optics (Roberts & Co, 2005).*
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