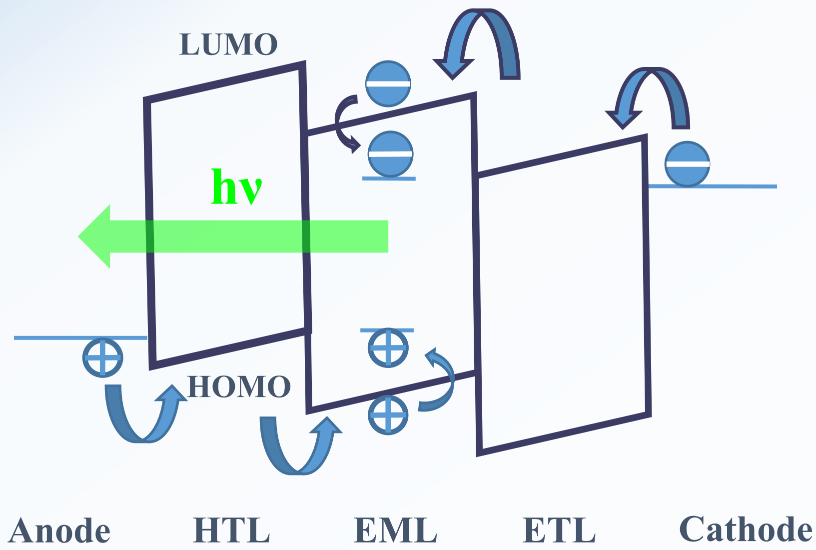
GoodLab Simulation

Optics

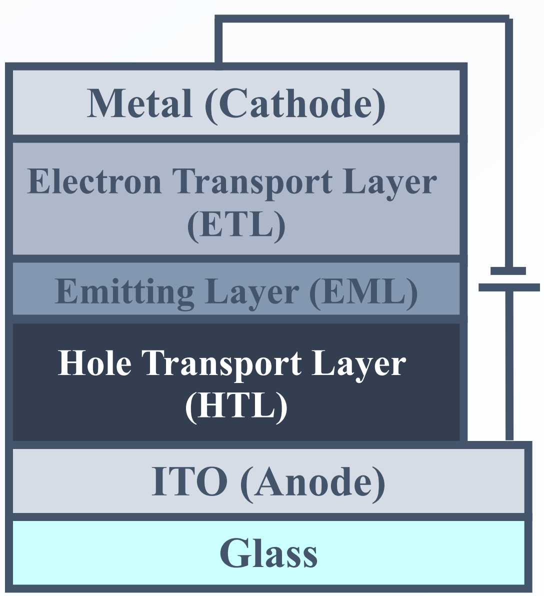
20181025 - 李偉愷

Organic Light-Emitting Devices (OLEDs)



Under forward bias

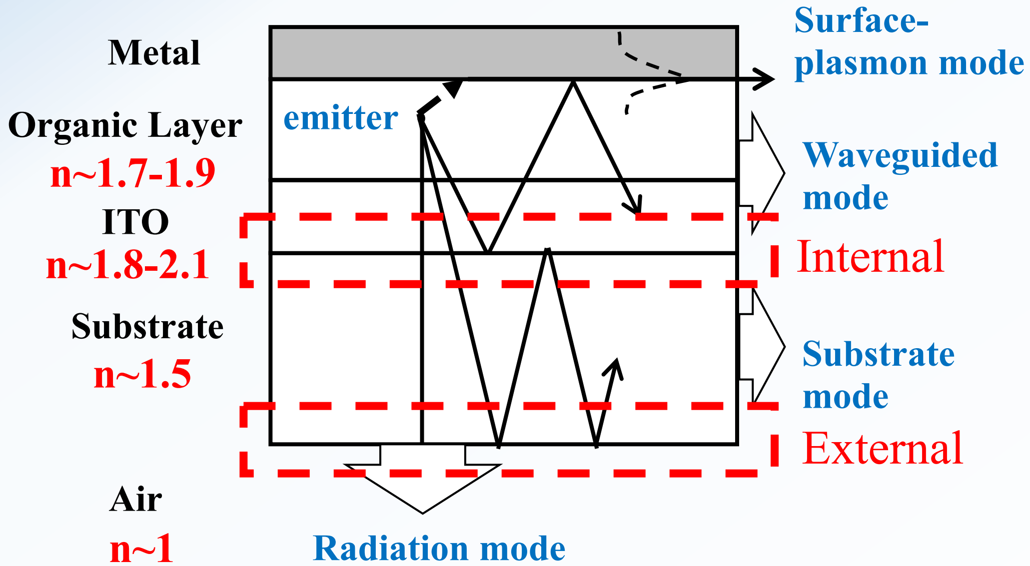
- Charge injection
- Charge transport
- Exciton formation
- Light emission

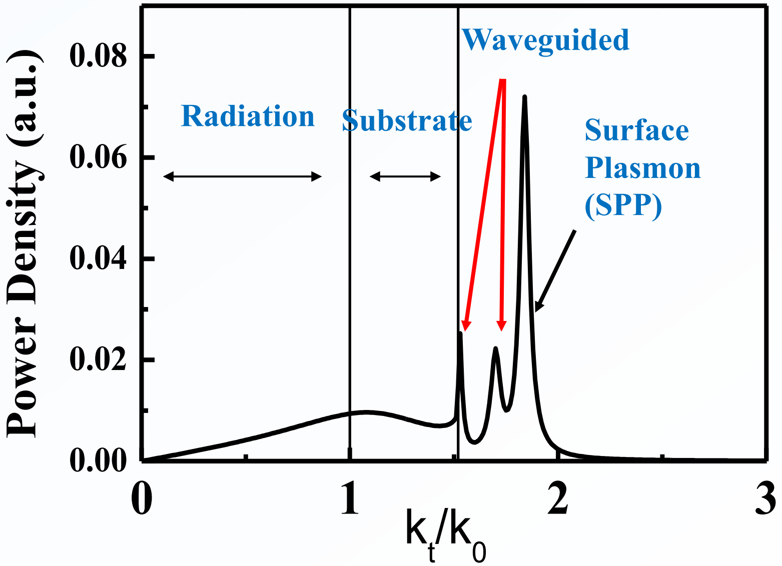


The advantage of OLEDs

- R,G,B available
- High brightness, low voltage, high efficiency
- Fast response, wide viewing angle
- High Contrast
- Lightweight
- Display, lighting, other applications

Optical Out-coupling Issues





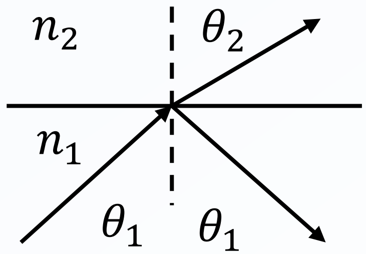
$$\eta_{\mathrm{EQE}} = \gamma \times \eta_{exc} \times \eta_{out}(\Theta,\Gamma) = \eta_{\mathrm{int}} \times \eta_{out}(\Theta,\Gamma)$$

- Due to index mismatches of OLED layers, out-coupling efficiency is **20%~30%** for a typical bottom-emitting OLED.
- Nearly **100%** internal quantum efficiency nowadays.
- Making use of **not out-coupled internal radiation** is a current issue.

Optics-Propagation

Optics

- Ray Optics
  - Snell's law $n_1 sin\theta_1 = n_2 sin\theta_2$
  - Reflection law $\theta_i = \theta_r$

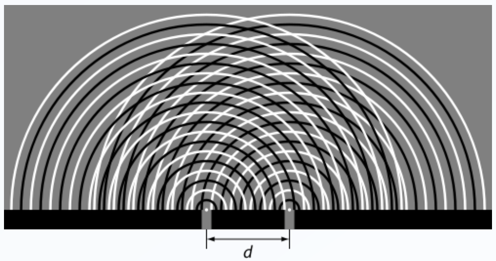


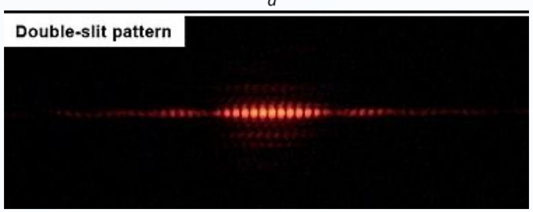
- 基本上假設的是光線而非是波動，因此是討論路徑的問題，並不牽扯到每條光線的強度，若需要考慮到強度則必須另外做討論，在向量上掛上一個強度以及偏振的資訊

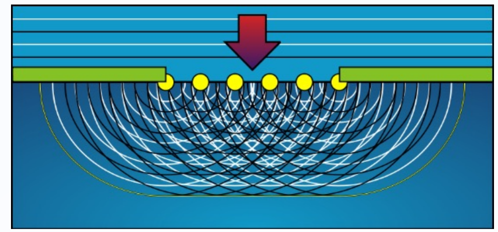
相關課程：光電導論，幾何光學

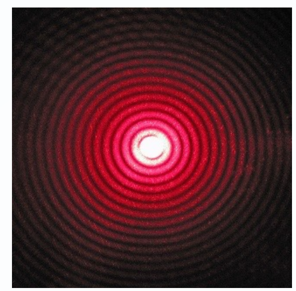
Optics

- Wave Optics
  - Wave Equation $\nabla^2\phi(\boldsymbol{r},t)-\frac{1}{v^2}\frac{\partial^2}{\partial x^2}\phi(\boldsymbol{r},t)=0$
  - $\phi(\boldsymbol{r},t)=f(\boldsymbol{r}-vt)+f(\boldsymbol{r}+vt)$







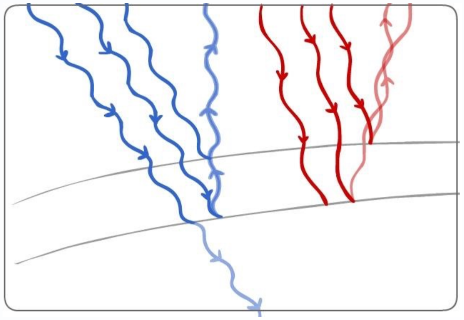


  - 在幾何光學的討論之中，任兩條光線在相加的時候都直接是強度相加，但在波動光學裡面，必須討論相位的相加
  - $\tilde{\phi}(\boldsymbol{r})=|\tilde{\phi}(\boldsymbol{r})|exp\left(i\angle\tilde{\phi}(\boldsymbol{r})\right)=\widetilde{\phi_1}(\boldsymbol{r})+\widetilde{\phi_2}(\boldsymbol{r})$ ex: $\sqrt{2}exp(i\angle 45^o)$
  - $I_{wave}(\boldsymbol{r})=|\tilde{\phi}(\boldsymbol{r})|^2=|\widetilde{\phi_1}(\boldsymbol{r})|^2+|\widetilde{\phi_2}(\boldsymbol{r})|^2+\boxed{\boldsymbol{2Re}(\widetilde{\phi_1^*}(\boldsymbol{r})\widetilde{\phi_2}(\boldsymbol{r}))}$
  - $I_{ray}(\boldsymbol{r})=|\widetilde{\phi_1}(\boldsymbol{r})|^2+|\widetilde{\phi_2}(\boldsymbol{r})|^2$

相關課程：光電導論，波動光學

- $I_{wave}(\boldsymbol{r}) = |\tilde{\phi}(\boldsymbol{r})|^2 = |\widetilde{\phi_1}(\boldsymbol{r})|^2 + |\widetilde{\phi_2}(\boldsymbol{r})|^2 + \boldsymbol{2Re}(\widetilde{\phi_1^*}(\boldsymbol{r})\widetilde{\phi_2}(\boldsymbol{r}))$
- $I_{ray}(\boldsymbol{r}) = |\widetilde{\phi_1}(\boldsymbol{r})|^2 + |\widetilde{\phi_2}(\boldsymbol{r})|^2$
- 所以Ray Optics和Wave Optics最不一樣的地方在於$\widetilde{\phi_1^*}(\boldsymbol{r})\widetilde{\phi_2}(\boldsymbol{r}) = |\widetilde{\phi_1^*}(\boldsymbol{r})|\times|\widetilde{\phi_2}(\boldsymbol{r})|\times exp\left(i\ (\angle\widetilde{\phi_2}(\boldsymbol{r}) - \angle\widetilde{\phi_1}(\boldsymbol{r}))\right) \rightarrow Coherence$

- Coherence and Incoherence是用來區分何時該用Ray Optics和Wave Optics的時候
- Ex: 在薄膜的時候需要考慮各層介面和路徑所造成的相位差，但是在玻璃的時候卻看不到干涉條紋發生，原因是兩個介面之間差距太大，可能因為玻璃本身不夠平整（波長等級）或是材料本身是random的，使得phase消失



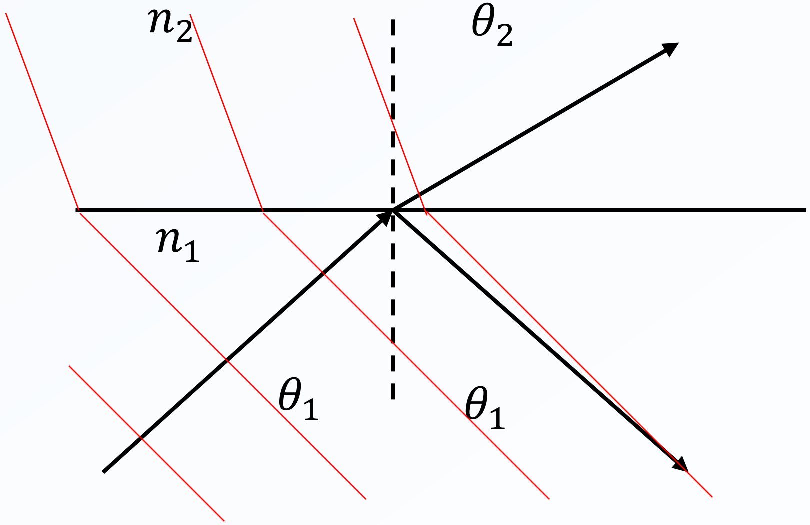
相關課程：光電導論，波動光學，統計光學

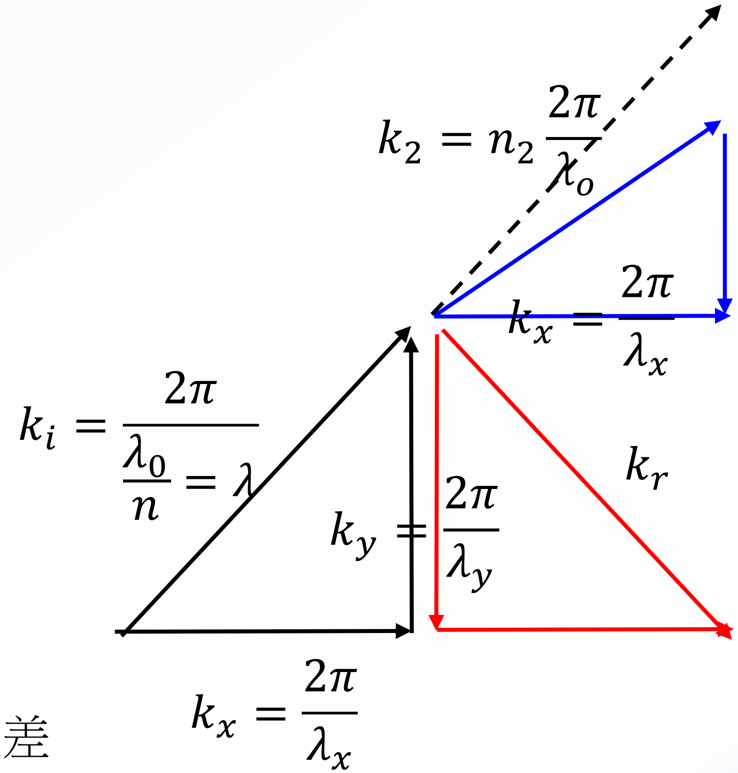
Optics

- Wave Optics
  - 考慮光遇到介面穿透反射的問題。 $f(\boldsymbol{k}\cdot\boldsymbol{r}-\omega t)$

$$k_x^2+k_y^2+k_z^2=k^2$$

λ_x 連續→ k_x連續　　但不同材料的$k=n\dfrac{2\pi}{\lambda_0}$





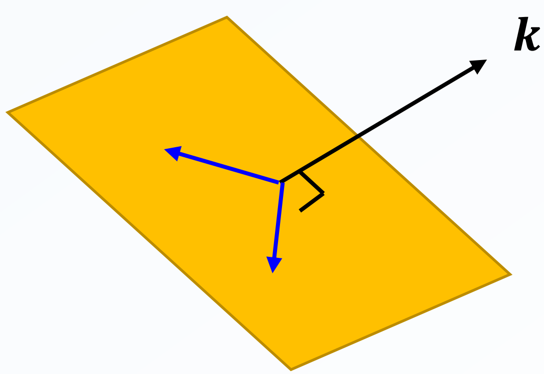
k_x →用來描述在x方向上所對應到任兩的相位差

$k_x\mathrm{d}=2\pi\dfrac{d}{\lambda_x}$ → 假設沿x方向上的波長是λ_x則在x軸上長度d的線段所對應到的相位差

相關課程：光電導論，波動光學

Optics

- Linear EM wave Optics (Vacuum)
  - $\nabla \cdot \boldsymbol{E} = \frac{\rho}{\epsilon_o}$
  - $\nabla \cdot \boldsymbol{B} = 0$
  - $\nabla \times \boldsymbol{E} = -\frac{\partial}{\partial t}\boldsymbol{B}$
  - $\nabla \times \boldsymbol{B} = \mu_o \boldsymbol{J} + \mu_o \epsilon_o \frac{\partial}{\partial t}\boldsymbol{E}$
- Linear EM wave Optics (in Matter)
  - $\nabla \cdot \boldsymbol{D} = \rho_f$
  - $\nabla \cdot \boldsymbol{B} = 0$
  - $\nabla \times \boldsymbol{E} = -\frac{\partial}{\partial t}\boldsymbol{B}$
  - $\nabla \times \boldsymbol{H} = \boldsymbol{J_f} + \frac{\partial}{\partial t}\boldsymbol{D}$
  - $\boldsymbol{D} = \epsilon \boldsymbol{E}$
  - $\boldsymbol{B} = \mu \boldsymbol{H}$



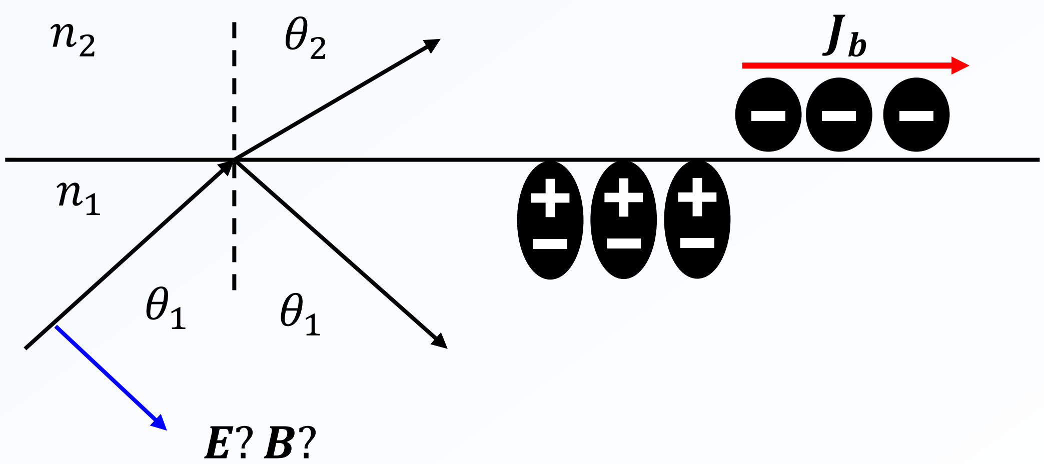
在沒有source的地方

- $\boldsymbol{E} \perp \boldsymbol{k}, \boldsymbol{B} \perp \boldsymbol{k}, \boldsymbol{E} \perp \boldsymbol{B}$
- $\because \boldsymbol{E} = \boldsymbol{E_o} \exp\left(j\left(k_x x + k_y y + k_z z - \omega t\right)\right)$
- $\boldsymbol{B} = \boldsymbol{B_o} \exp(j(k_x x + k_y y + k_z z - \omega t))$
- 所以當一個波的前進方向決定之後，電場的方向一定落在和k垂直的平面上，但卻有兩個方向可以決定E，因此會出現所謂的偏振產生
- ex, linear polarization and circular polarization

相關課程：光電導論，波動光學

Optics

- Linear EM wave Optics (Vacuum)
  - 再回來考慮光遇到介面穿透反射的問題，對於同樣一個介面　同樣的入射方向，從幾何光學的角度來看反射和穿透只有一種，但是從物理光學來看，由於電場的方向有兩種可能，會造成在表面形成電荷或是電流(B.C.不一樣)而造成不同的結果，因此會有所謂的TE(s)和TM(p)產生。



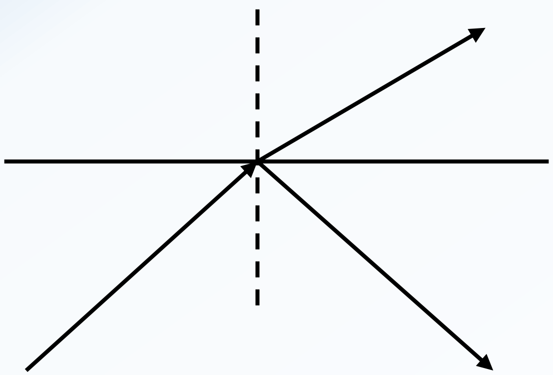
TE(s)：E的方向平行界面
TM(s)：H的方向平行界面

- TE 和TM是由波前的方向和面的方向來決定

$\boldsymbol{s} = \boldsymbol{k} \times \boldsymbol{z}$	TE時E的方向	TM時H的方向
$\boldsymbol{p} = \boldsymbol{k} \times \boldsymbol{s}$	TM時E的方向	TE時H的方向

Wave propagation in multi-layered structure

Fresnel Equation



TE(s)

$$r_{\perp} = \frac{n_i \cos(\theta_i) - n_t \cos(\theta_t)}{n_i \cos(\theta_i) + n_t \cos(\theta_t)}$$

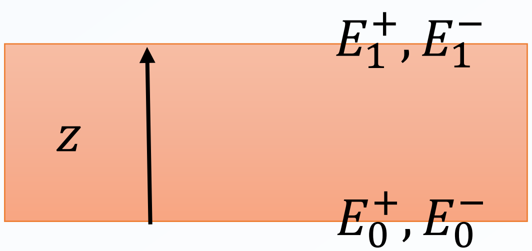
$$t_{\perp} = \frac{2 n_i \cos(\theta_i)}{n_i \cos(\theta_i) + n_t \cos(\theta_t)}$$

TM(p)

$$r_{\parallel} = \frac{n_i \cos(\theta_t) - n_t \cos(\theta_i)}{n_i \cos(\theta_t) + n_t \cos(\theta_i)}$$

$$t_{\parallel} = \frac{2 n_i \cos(\theta_i)}{n_i \cos(\theta_t) + n_t \cos(\theta_i)}$$

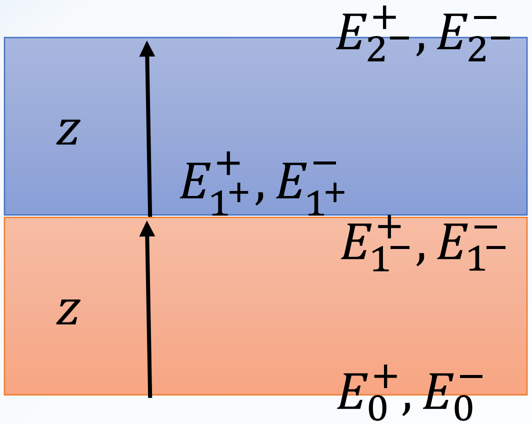
Propagation in a single layer



$$\begin{bmatrix} E_1^+ \\ E_1^- \end{bmatrix} = \begin{bmatrix} e^{ikz} & \\ & e^{-ikz} \end{bmatrix} \begin{bmatrix} E_1^+ \\ E_1^- \end{bmatrix}$$

Wave propagation in multi-layered structure

Fresnel Equation+ Propagation in a single layer = Transfer Matrix Method



Propagation

Fresnel Equation

Propagation

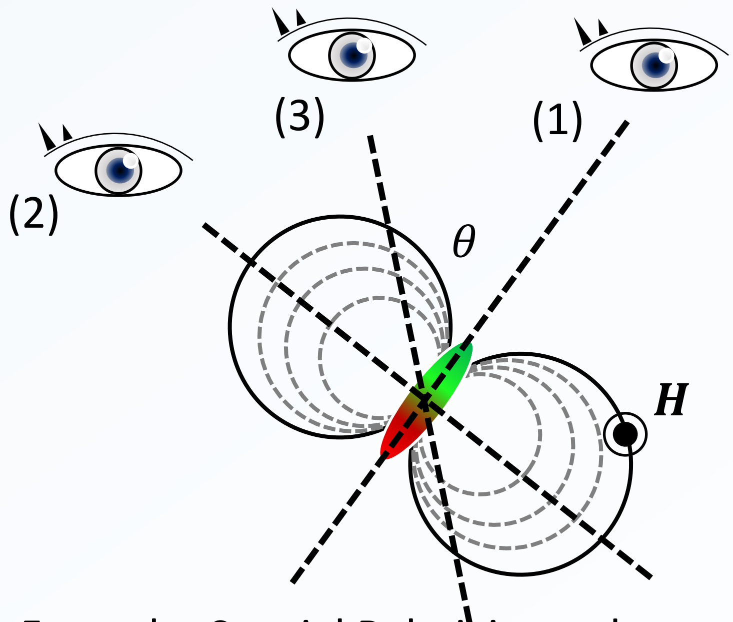
$$\begin{bmatrix} E_j^+ \\ E_j^- \end{bmatrix} = M \begin{bmatrix} E_1^+ \\ E_1^- \end{bmatrix}$$

$$\begin{bmatrix} E_j^+ \\ 0 \end{bmatrix} = M \begin{bmatrix} E_1^+ \\ E_1^- \end{bmatrix} \qquad \tau = \frac{E_j^+}{E_1^+} \qquad r = \frac{E_1^-}{E_1^+}$$

$$R = r^* r \qquad T = \frac{v_j}{v_i} \tau^* \tau$$

Optics-Dipole Source

- *Transition Dipole Moment*
  ↔Classical Electromagnetic Oscillating Dipole
- *Classical Radiation Pattern in Homogeneous Material*



From the Special Relativity and classical electrodynamics, we can know the radiation pattern rapidly without any calculation.
-> $|\mathrm{H}| \sim sin\theta$

1. According to **the Special Relativity theorem**, the laws of physics are invariant (i.e. identical) in all inertial systems (non-accelerating frames of reference). (from Wiki)
2. According to **classical electrodynamics**, the oscillating charge will radiate EM wave.

-> By 1 and 2 we can conclude that the observer along the dipole oscillating direction would see nothing oscillating. In contrast, the observer which is normal to the oscillating direction will observe the most violent oscillation comparing to the observer with different angle. Easily, we can get the formula of the radiation pattern of the dipole oscillation.

- ***Hertzian Dipole Radiation***

$$\boldsymbol{H_\phi} = \frac{sin\theta}{4\pi\epsilon}\sqrt{\frac{\epsilon}{\mu}}\left(\frac{n}{c}\frac{1}{r^2}\frac{d}{dt} + \frac{n^2}{c^2}\frac{1}{r}\frac{d^2}{dt^2}\right)\left|\boldsymbol{\mu}\left(t - \frac{nr}{c}\right)\right|$$

$$\boldsymbol{E_r} = \frac{cos\theta}{4\pi\epsilon}\left(\frac{2}{r^3} + \frac{n}{c}\frac{2}{r^2}\frac{d^2}{dt^2}\right)|\boldsymbol{\mu}(t - \frac{nr}{c})|$$

$$\boldsymbol{E_\theta} = \frac{sin\theta}{4\pi\epsilon}\left(\frac{2}{r^3} + \frac{n}{c}\frac{1}{r^2}\frac{d}{dt} + \frac{n^2}{c^2}\frac{1}{r}\frac{d^2}{dt^2}\right)|\boldsymbol{\mu}\left(t - \frac{nr}{c}\right)|$$

- ***Hertzian Dipole Radiation Far-Field***

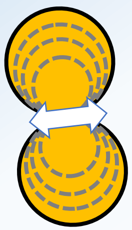
$$\boldsymbol{H_\phi} = \frac{sin\theta}{4\pi\epsilon}\sqrt{\frac{\epsilon}{\mu}}\frac{n^2}{c^2}\frac{1}{r}\frac{d^2}{dt^2}\left|\boldsymbol{\mu}\left(t - \frac{nr}{c}\right)\right|$$

$$\boldsymbol{E_\theta} = \frac{sin\theta}{4\pi\epsilon}\frac{n^2}{c^2}\frac{1}{r}\frac{d^2}{dt^2}|\boldsymbol{\mu}\left(t - \frac{nr}{c}\right)|$$

$$\boldsymbol{S} = \boldsymbol{E}\times\boldsymbol{H} = \frac{1}{16\pi^2\epsilon}\frac{\sin^2\theta}{r^2}\frac{n^3}{c^3}\left(\frac{d^2}{dt^2}\left|\boldsymbol{\mu}\left(t - \frac{nr}{c}\right)\right|\right)^2\boldsymbol{r}$$

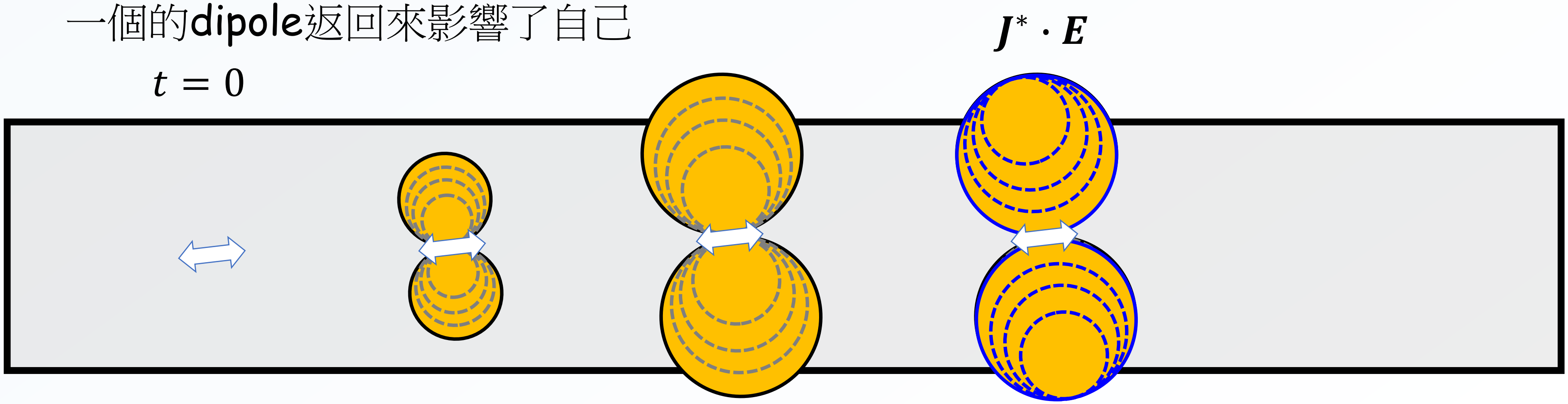
$$P = \frac{1}{4\pi\epsilon}\frac{2n^3}{3c^3}\left(\frac{d^2}{dt^2}\left|\boldsymbol{\mu}\left(t - \frac{nr}{c}\right)\right|\right)^2 \rightarrow \frac{\bar{P}(\theta,\phi)}{P} = \frac{3}{8\pi}\sin^2\theta$$

Purcell Effect



EM wave theory可以告訴我們說，在單位時間內可以從一個dipole 透過電磁波的方式output的功率(P)是多少

但也告訴了我們說在不同的結構底下，dipole的輻射能力是不相同的，是因為前一個的dipole返回來影響了自己



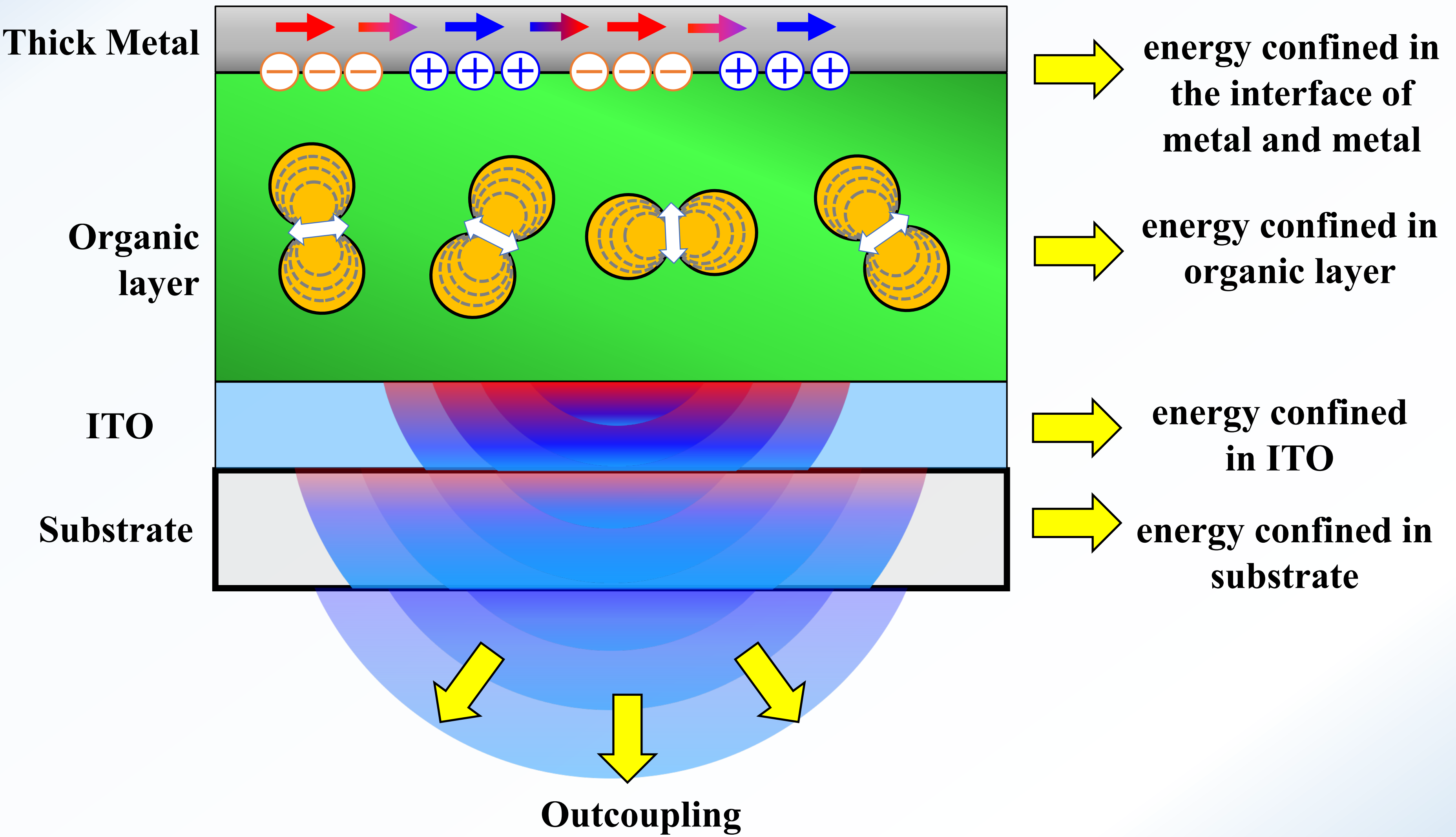
- 不同結構的輻射功率是不同的，因此假設相對某一結構的輻射功率比是F
- 分子每秒以光的方式輻射的功率 P = Q.Y. ×分子從excited state落回ground state 的速率

$$\Gamma(rate\ constant) = \mathrm{F}\Gamma_o$$

$$\eta(Q.Y.) = \frac{\mathrm{F}\eta_o}{(1-\eta_o) + \mathrm{F}\eta_o}$$

GoodLab Simulator

Optics in OLED

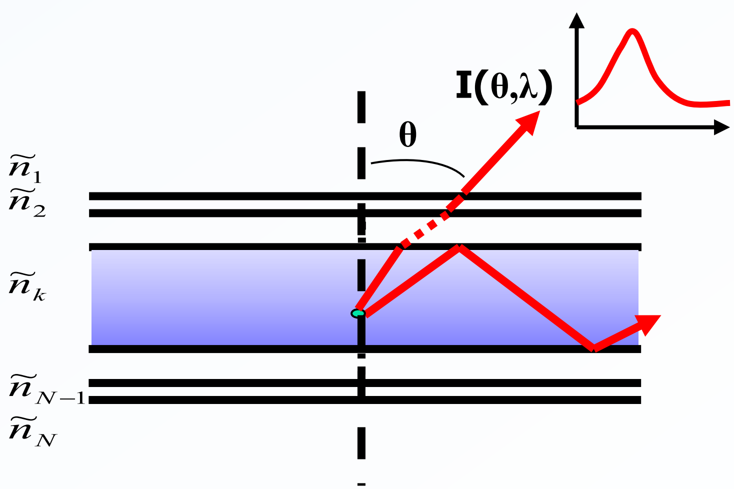


Optical Modeling of OLEDs

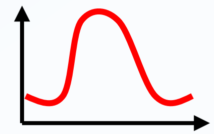
Electromagnetic Modeling

Exciton ⟷ Dipoles

1. Different mode expansion
2. transfer matrix method
3. Field distributions
4. Power distribution into different plane-wave modes
5. Far-field radiation

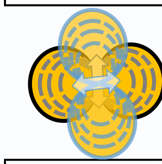


Single-wavelength point dipole



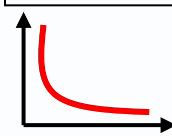
Spectral distribution

Single exciton (excited molecule)



Orientational distribution (isotropic or anisotropic)

Excitons location (single position)



Spatial distribution

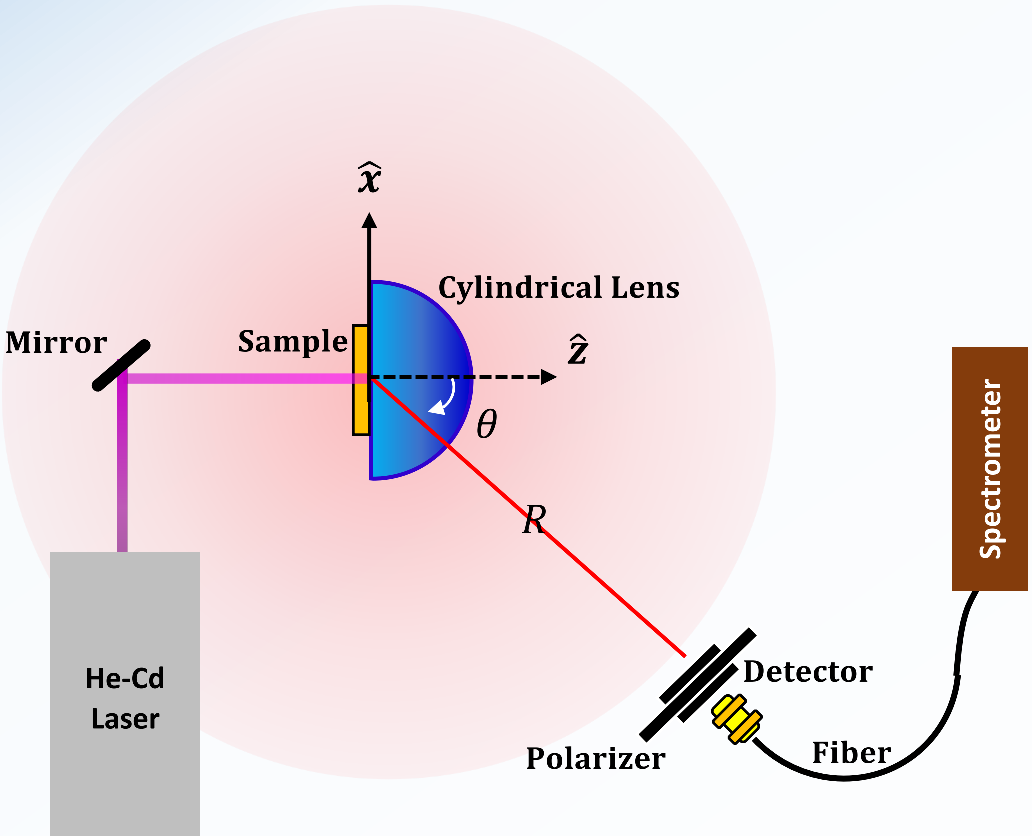
Overall OLED emission properties

- **$\mathbf{I}(\theta,\lambda)$**
- **field/mode distribution**

(Full vectorial, polarization, angle, spectrum, efficiency)

Determine distribution of dipole orientation for thin films

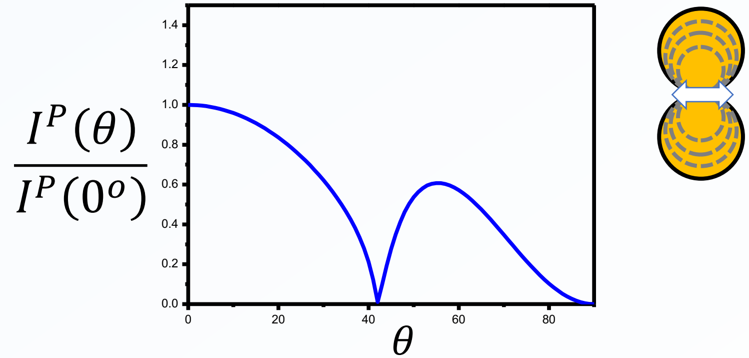
Experimental Setup



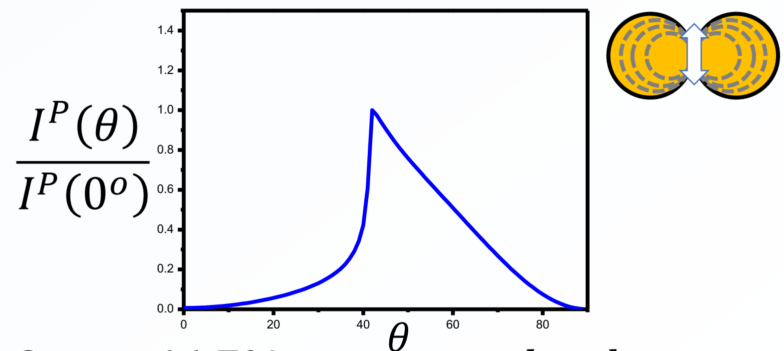
$$TM: \frac{I^P(\theta)}{I^P(0^o)} = \frac{\langle \left\| (\widehat{\mathbf{p}_\pm} \cdot \widehat{\boldsymbol{d}_f}) + \gamma_\mp^{\boldsymbol{p}}(k_t)(\widehat{\mathbf{p}_\mp} \cdot \widehat{\boldsymbol{d}_f}) \right\|^2 \rangle}{\langle \left\| (\widehat{\mathbf{p}_\pm} \cdot \widehat{\boldsymbol{d}_f}) + \gamma_\mp^{\boldsymbol{p}}(0)(\widehat{\mathbf{p}_\mp} \cdot \widehat{\boldsymbol{d}_f}) \right\|^2 \rangle}$$

$$= \frac{\eta_1 \|k_z^e\|^2 \left\|1 - \gamma_\mp^{\boldsymbol{p}}(k_t)\right\|^2 + (1 - 2\eta_1)\|k_t\|^2 \left\|1 + \gamma_\mp^{\boldsymbol{p}}(k_t)\right\|^2}{\eta_1 \|k^e\|^2 \left\|1 - \gamma_\mp^{\boldsymbol{p}}(0)\right\|^2}$$

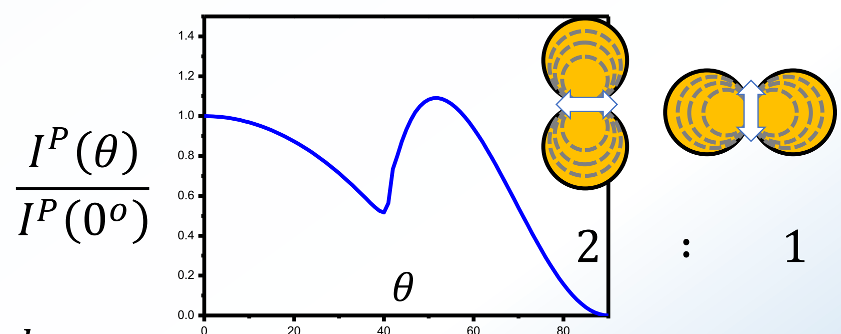
$2\eta_1 = 100\%, \textit{pure horizontal dipole}$



$2\eta_1 = 0\%, \textit{pure vertical dipole}$



$2\eta_1 = 66.7\%, \textit{isotropic dipole}$



$$\frac{k_t}{k_o} = n\sin\theta$$

GoodLab Simulator Usage

Installation

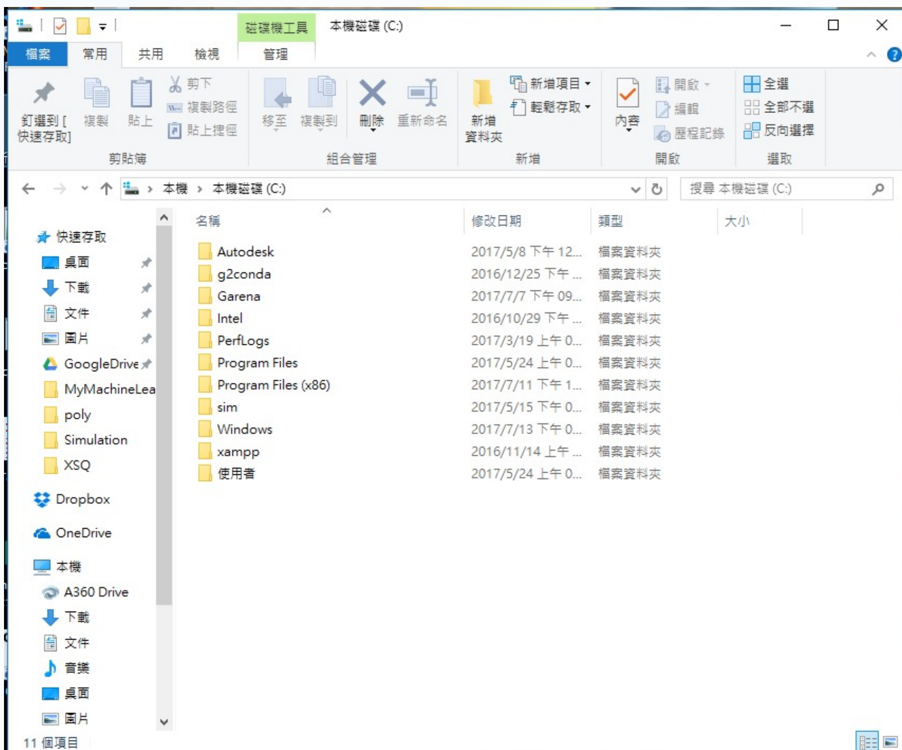
- MATLAB-2009以上
- 材料檔案

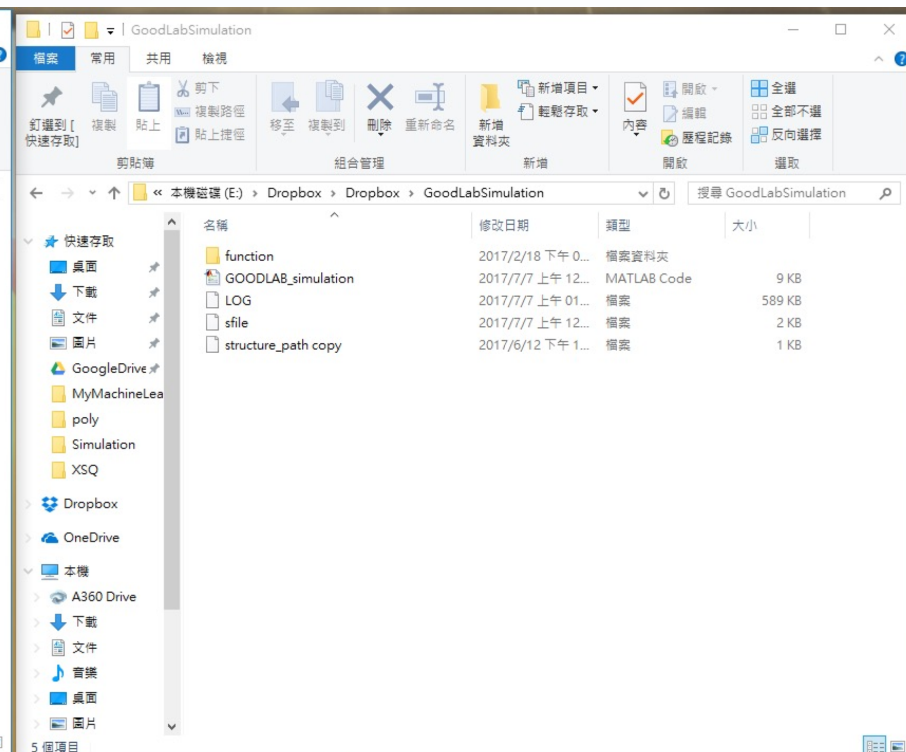
  C://sim/material n k

  C://sim/material PL

  C://sim/material eta

- 程式碼





主程式碼 - GOODLAB_simulation

Editor - E:\Dropbox\Dropbox\GoodLabSimulation\GOODLAB_simulation.m

```matlab
%% GOODLAB Simulation Program
%
% This program is to simulate electromagnetic wave in planar structure and
% all the sturcture parameters are indenpent of time. Thus, all the results
% are in phasor form.
%
% Source Assumption
% Assume that the EM source is a delta current (due to Quantumn mechanics,
% transition dipole moment) and the source? is ensemble with a ditribution
% function with theta and phi.
%
% n k Assumption
% Assume materials are isotropic (i.e. n and k arenot tensors)
%
% 2015/01/08    Construct file.
% 2015/01/09    readnkdata,readPLdata,readcolfile,
%               TR_S_incoherent,TR_P_incoherent,TR_S_coherent,TR_P_coherent,
%               tau_r_S_E,tau_r_P_H,transfermatrix_kt_S,transfermatrix_kt_P
% 2015/01/10    Pointing_S_normalized,Pointing_P_normalized
%
% Last modified by Wei-Kai, Lee, 2015/02/22
%
% Copyright(c) 2015 Wei-Kai, Lee All right reserved.
%
% see also
%
%

function GOODLAB_simulation
clc; clear all; close all;
    addpath(genpath(fileparts(mfilename('fullpath'))));
    VersionInfo();
```

Default path

```
function [DEFAULT,PSD_SETUP,Far_Field_SETUP,MD_SETUP,TRA_SETUP,TEST_SETUP] = SETUPfun()
    %% DEFAULT SETTING
    DEFAULT.MATERIAL_NKPATH  = 'C:/sim/material n k/';
    DEFAULT.MATERIAL_PLPATH  = 'C:/sim/material PL/';
    DEFAULT.MATERIAL_ETAPATH = 'C:/sim/material eta/';
```

Setup function

```
%% Power spectrum setup
PSD_SETUP.kt_ko = 0:0.01:15;
PSD_SETUP.savepath = '../ITO_PPY2acac_PSD_Sim/';
PSD_SETUP.savename = 'ITO_PPY2acac';

PSD_SETUP.saveplot.EML         = true; %true; %false;
PSD_SETUP.saveplot.total       = false; %true; %false;
PSD_SETUP.saveplot.thickness_s = false; %true; %false;
PSD_SETUP.saveplot.thickness_p = false; %true; %false;
PSD_SETUP.saveplot.substrate   = true; %true; %false;
PSD_SETUP.saveplot.outcoupling = false; %true; %false;

PSD_SETUP.plot.EML         = true; %true; %false;
PSD_SETUP.plot.total       = false; %true; %false;
PSD_SETUP.plot.thickness_s = false; %true; %false;
PSD_SETUP.plot.thickness_p = false; %true; %false;
PSD_SETUP.plot.substrate   = false; %true; %false;
PSD_SETUP.plot.outcoupling = false; %true; %false;
```

Command

```
function GOODLAB_simulation
clc; clear all; close all;
    addpath(genpath(fileparts(mfilename('fullpath'))));
    VersionInfo();
    [DEFAULT,PSD_SETUP,Far_Field_SETUP,MD_SETUP,TRA_SETUP,TEST_SETUP] = SETUPfun();
    command  = {@ModeDistribution_Command,      @PSD_command,     @FarField_Command, @TRA_command};
    SETUP    = {                 MD_SETUP,          PSD_SETUP,        Far_Field_SETUP,     TRA_SETUP};
    defaultC = 3;
```

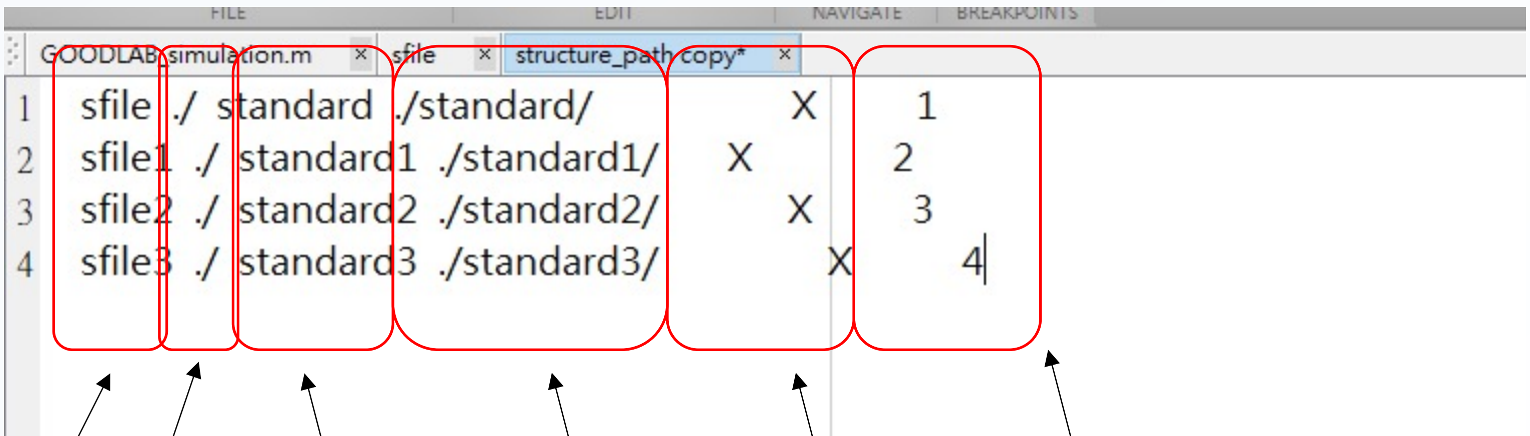
執行指令的種類

Key 數字執行指令

MD: mode distribution (算效率的)
PSD : power density
FarField : far field intensity (遠場)
TRA : 計算穿透反射吸收

```
function commandExecute(DEFAULT,SETUP,command,defaultC,logfid)
    [Rfilename,Rpath,Sfilename,Spath,mark] = readmultipleDevicepath('Structure_path copy',logfid);
```

結構的List檔案,要含副檔名(這邊是無副檔名的檔案)



讀檔檔名

讀檔路徑

存檔檔名

存檔路徑

是否已執行
X:未執行
V:已執行過

要執行的command
可以不打，不打是根
據前面設的檔案執行

所有路徑不允許有空白!!!!!!/ 中文路徑不給讀寫不負責
存檔路徑不存在也沒關係，會自動加入

結構檔

材料名稱　　厚度　　Nk路徑（可以不打，不打以default為主）

FILE　EDIT　NAVIGATE　BREAKPOINTS

GOODLAB_simulation.m ×　sfile* ×　structure_path copy ×

```
MATERIAL          THICKNESS(nm)                 Path
air               X                             C:/sim/material n k/
AL                120.000000                    C:/sim/material n k/
lif               1.000000                      C:/sim/material n k/
b3pympm           5.000000:5.000000:120.000000  C:/sim/material n k/
cbp_irppy2acac    20.000000                     C:/sim/material n k/
tapc_shb          5.000000:5.000000:120.000000  C:/sim/material n k/
c-ito             80.000000                     C:/sim/material n k/
ito_glass         X                             C:/sim/material n k/




wavelength(nm) : 460.000000:5.000000:600.000000
EML :
   Layerno        : 5
   Interface      : 5
   Position(nm)   : 10.000000
   ratio          : 1.000000
   QY             : 1.000000
```

模擬波長

發光層特性

PL_path : XXXXXXXXXXX　-> PL 路徑（可以不打，不打以default為主）

結構檔

材料名稱

MATERIAL	THICKNESS(nm)	Path
air	X	C:/sim/material n k/
AL	120.000000	C:/sim/material n k/
lif	1.000000	C:/sim/material n k/
b3pympm	5.000000:5.000000:120.000000	C:/sim/material n k/
cbp_irppy2acac	20.000000	C:/sim/material n k/
tapc_shb	5.000000:5.000000:120.000000	C:/sim/material n k/
c-ito	80.000000	C:/sim/material n k/
ito_glass	X	C:/sim/material n k/

必須和**nk**以及**PL**的檔案名稱相同，但不需要附檔名，大小寫不對不保證能不能讀

結構檔

厚度

FILE EDIT NAVIGATE BREAKPOINTS

GOODLAB_simulation.m × sfile* × structure_path copy ×

MATERIAL	THICKNESS(nm)	Path
air	X	C:/sim/material n k/
AL	120.000000	C:/sim/material n k/
lif	1.000000	C:/sim/material n k/
b3pympm	5.000000:5.000000:120.000000	C:/sim/material n k/
cbp_irppy2acac	20.000000	C:/sim/material n k/
tapc_shb	5.000000:5.000000:120.000000	C:/sim/material n k/
c-ito	80.000000	C:/sim/material n k/
ito_glass	X	C:/sim/material n k/

第一層跟最後一層的厚度都是X，代表semi-infinite，最下面的代表基板，光會從基板再穿出到第一層介質，假設基板是不會干涉的

除了第一層跟最後一層的厚度是X以外，其他都不需輸入厚度（單位nm），只有一個數字代表不會去scan參數，如果需要scan厚度的話，則可以使用：隔開，開始厚度：厚度間距：結束厚度

結構檔

```
wavelength(nm) : 460.000000:5.000000:600.000000
EML :
    Layerno              : 5
    Interface            : 5
    Position(nm)         : 10.000000
    ratio                : 1.000000
    QY                   : 1.000000
```

模擬波長

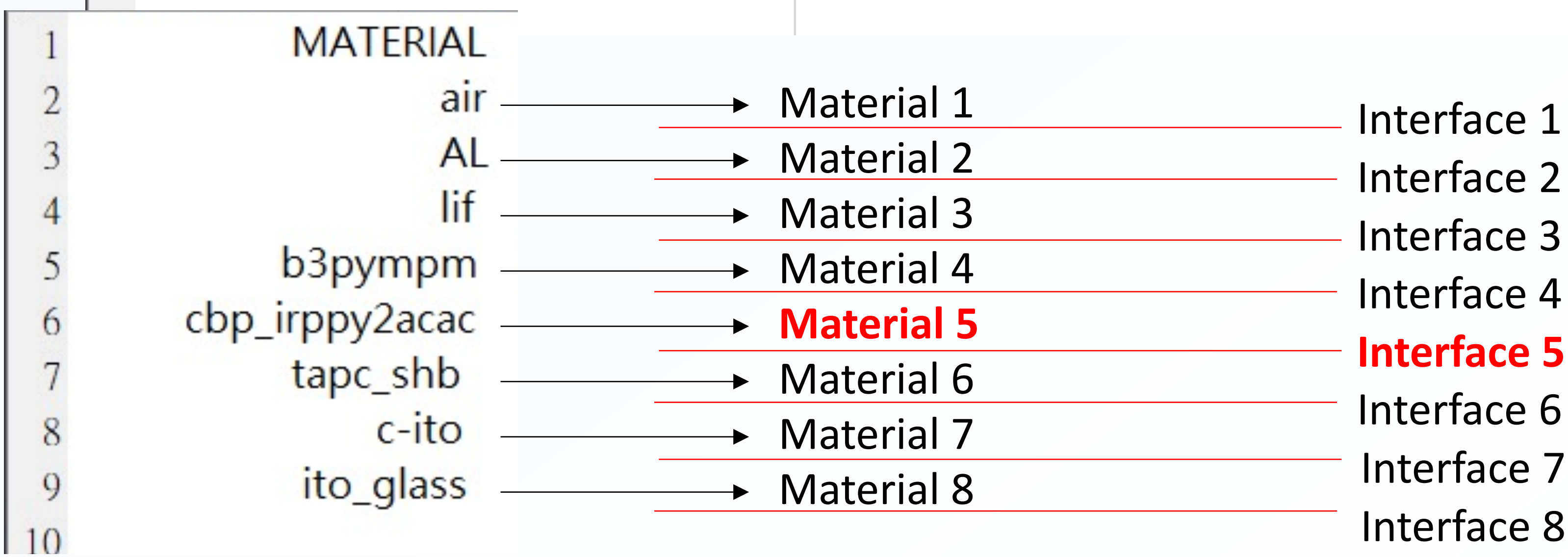
和厚度的設法一樣　開始波長：波長間距：結束波長

在MD中會對波長做積分
在PSD中則是會跑出不同波長的結果

結構檔

```
wavelength(nm) : 460.000000:5.000000:600.000000
EML :
   Layerno          : 5
   Interface        : 5
   Position(nm)     : 10.000000
   ratio            : 1.000000
   QY               : 1.000000
```

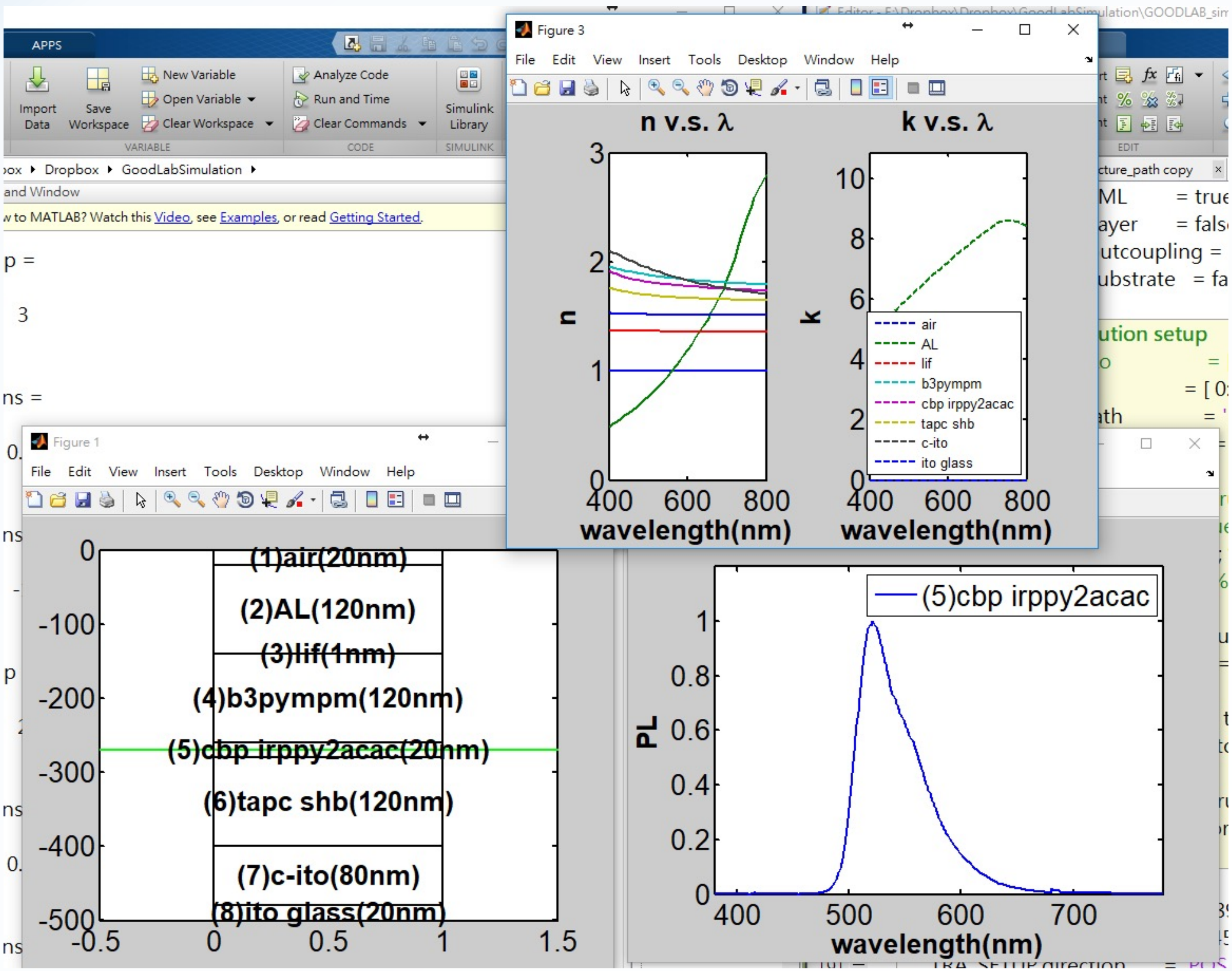
發光層特性

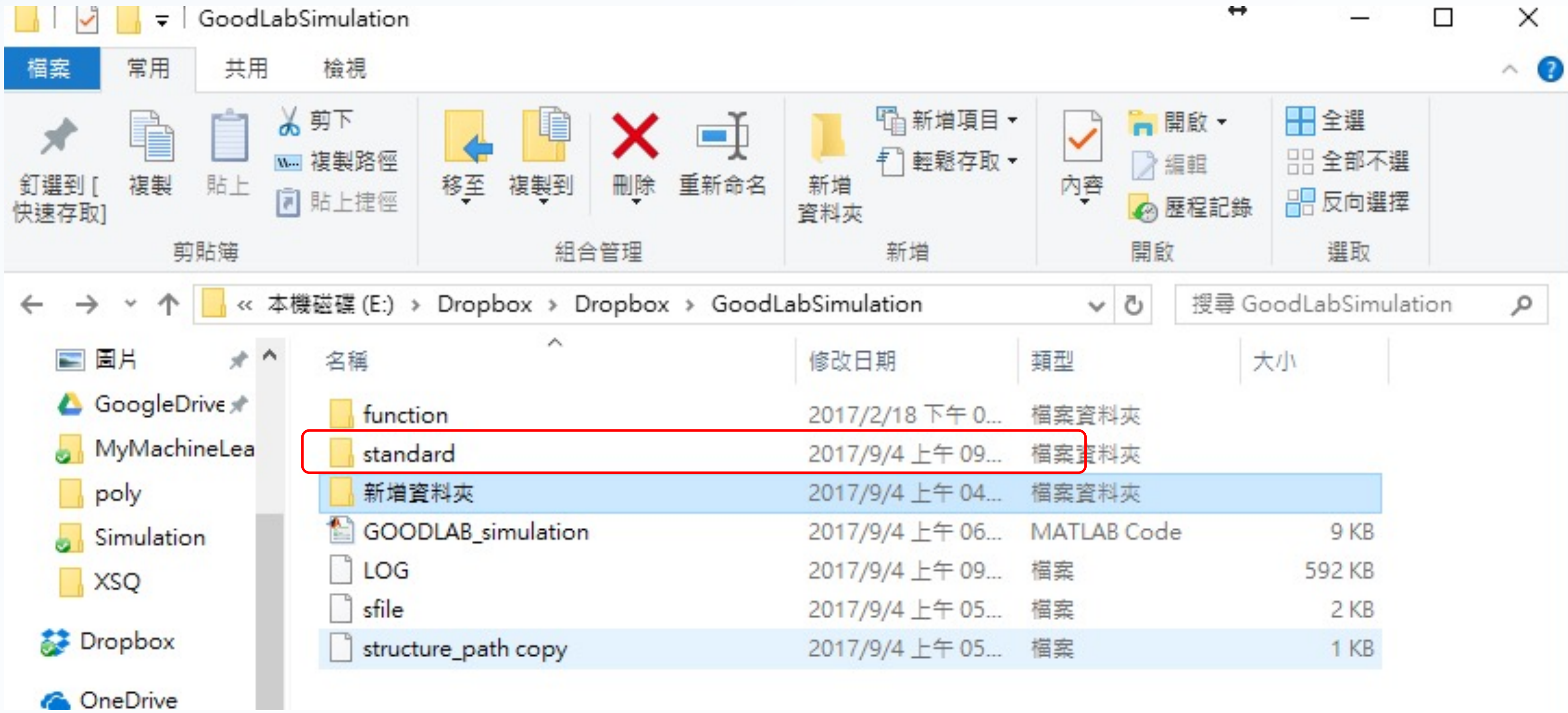


如果現在有很多發光層用逗號隔開，如果要scan參數用:隔開

Mode Distribution

按F5執行




GoodLabSimulation
檔案
常用
共用
檢視
釘選到[快速存取]
複製
貼上
剪下
複製路徑
貼上捷徑
剪貼簿
移至
複製到
刪除
重新命名
組合管理
新增資料夾
新增項目
輕鬆存取
新增
內容
開啟
編輯
歷程記錄
開啟
全選
全部不選
反向選擇
選取
本機磁碟 (E:) › Dropbox › Dropbox › GoodLabSimulation
搜尋 GoodLabSimulation
圖片
GoogleDrive
MyMachineLea
poly
Simulation
XSQ
Dropbox
OneDrive
名稱
修改日期
類型
大小
function
2017/2/18 下午 0...
檔案資料夾
standard
2017/9/4 上午 09...
檔案資料夾
新增資料夾
2017/9/4 上午 04...
檔案資料夾
GOODLAB_simulation
2017/9/4 上午 06...
MATLAB Code
9 KB
LOG
2017/9/4 上午 09...
檔案
592 KB
sfile
2017/9/4 上午 05...
檔案
2 KB
structure_path copy
2017/9/4 上午 05...
檔案
1 KB

Dropbox › Dropbox › GoodLabSimulation › standard

搜尋 standard

名稱	修改日期	類型
standard_Number1_ModeDistribution_EML_cbp_irppy2acac_pos_1...	2017/9/4 上午 06...	JPG 檔案
standard_Number1_ModeDistribution_R	2017/9/4 上午 06...	JPG 檔案
standard_Number2_ModeDistribution_EML_cbp_irppy2acac_pos_1...	2017/9/4 上午 06...	JPG 檔案
standard_Number2_ModeDistribution_R	2017/9/4 上午 06...	JPG 檔案
standard_Number3_ModeDistribution_EML_cbp_irppy2acac_pos_1...	2017/9/4 上午 06...	JPG 檔案
standard_Number3_ModeDistribution_R	2017/9/4 上午 06...	JPG 檔案
standard_Number4_ModeDistribution_EML_cbp_irppy2acac_pos_1...	2017/9/4 上午 06...	JPG 檔案
standard_Number4_ModeDistribution_R	2017/9/4 上午 06...	JPG 檔案

standard_Number567_ModeDistribution_Ratio	2017/9/4 上午 09...	文字文件
standard_Number568_ModeDistribution_EML_cbp_irppy2acac_pos...	2017/9/4 上午 09...	文字文件
standard_Number568_ModeDistribution_Ratio	2017/9/4 上午 09...	
standard_Number569_ModeDistribution_EML_cbp_irppy2acac_pos...	2017/9/4 上午 09...	
standard_Number569_ModeDistribution_Ratio	2017/9/4 上午 09...	
standard_Number570_ModeDistribution_EML_cbp_irppy2acac_pos...	2017/9/4 上午 09...	
standard_Number570_ModeDistribution_Ratio	2017/9/4 上午 09...	
standard_Number571_ModeDistribution_EML_cbp_irppy2acac_pos...	2017/9/4 上午 09...	
standard_Number571_ModeDistribution_Ratio	2017/9/4 上午 09...	
standard_Number572_ModeDistribution_EML_cbp_irppy2acac_pos...	2017/9/4 上午 09...	
standard_Number572_ModeDistribution_Ratio	2017/9/4 上午 09...	
standard_Number573_ModeDistribution_EML_cbp_irppy2acac_pos...	2017/9/4 上午 09...	
standard_Number573_ModeDistribution_Ratio	2017/9/4 上午 09...	
standard_Number574_ModeDistribution_EML_cbp_irppy2acac_pos...	2017/9/4 上午 09...	
standard_Number574_ModeDistribution_Ratio	2017/9/4 上午 09...	
standard_Number575_ModeDistribution_EML_cbp_irppy2acac_pos...	2017/9/4 上午 09...	
standard_Number575_ModeDistribution_Ratio	2017/9/4 上午 09...	
standard_Number576_ModeDistribution_EML_cbp_irppy2acac_pos...	2017/9/4 上午 09...	
standard_Number576_ModeDistribution_Ratio	2017/9/4 上午 09...	
standard_structure_file_OLED_structure_file	2017/9/4 上午 09...	檔案

standard_Number574_ModeDistribution_EML_cbp_irppy2acac_pos...	2017/9/4 上午 09...	JPG 檔案
standard_Number574_ModeDistribution_R	2017/9/4 上午 09...	JPG 檔案
standard_Number575_ModeDistribution_EML_cbp_irppy2acac_pos...	2017/9/4 上午 09...	JPG 檔案
standard_Number575_ModeDistribution_R	2017/9/4 上午 09...	JPG 檔案
standard_Number576_ModeDistribution_EML_cbp_irppy2acac_pos...	2017/9/4 上午 09...	JPG 檔案
standard_Number576_ModeDistribution_R	2017/9/4 上午 09...	JPG 檔案
standard_SETUP	2017/9/4 上午 06...	MATLAB Data
standard_MDsetupmemo	2017/9/4 上午 06...	文字文件
standard_ModeDistribution_Loop_memo	2017/9/4 上午 09...	文字文件
standard_Number1_ModeDistribution_EML_cbp_irppy2acac_pos_1...	2017/9/4 上午 06...	文字文件
standard_Number1_ModeDistribution_Ratio	2017/9/4 上午 06...	文字文件
standard_Number2_ModeDistribution_EML_cbp_irppy2acac_pos_1...	2017/9/4 上午 06...	文字文件
standard_Number2_ModeDistribution_Ratio	2017/9/4 上午 06...	文字文件
standard_Number3_ModeDistribution_EML_cbp_irppy2acac_pos_1...	2017/9/4 上午 06...	文字文件

standard_SETUP

standard_MDsetupmemo

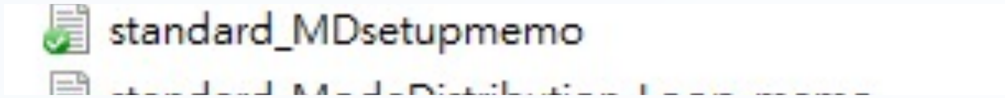
standard_structure_file_OLED_structure_file | standard_ModeDistribution_Loop_memo.txt | standard_MDsetupmemo.txt

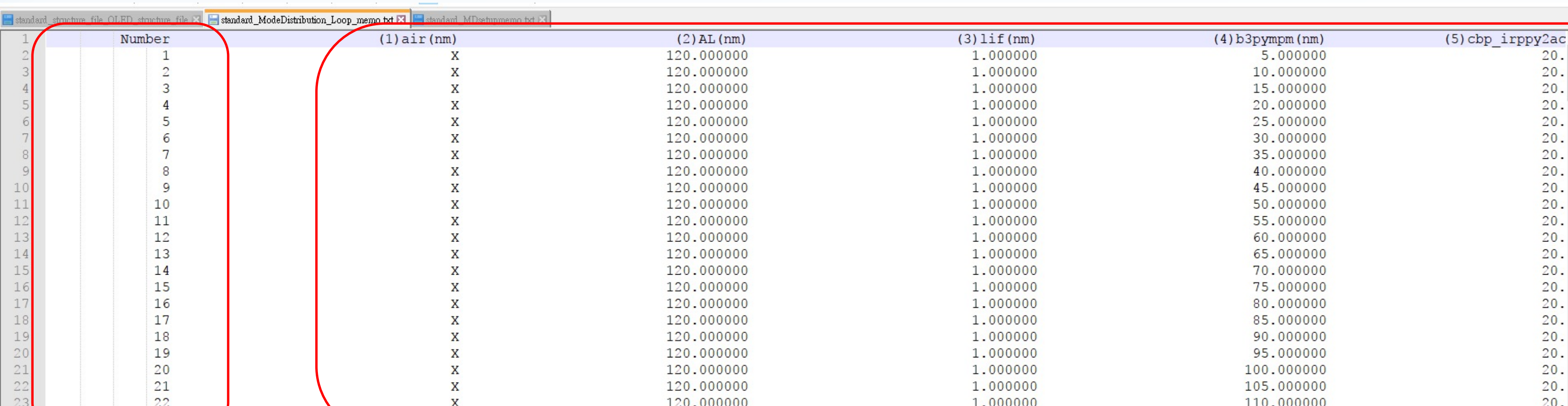
```
04-Sep-2017 06:15:26
Now running Mode Distribution (MD) command
savepath : ./standard/
savename : standard
Calculate EML : 1
Calculate Layer : 1
Calculate outcoupling : 1
Calculate substrate : 1
Plot R : 1
Plot PurcellFactor : 1
Save Plot R : 1
Save Plot PurcellFactor : 1
Save txt R : 1
Save txt PurcellFactor : 1

```

執行的command以及執行參數

最常用的檔案





Number	(1)air(nm)	(2)AL(nm)	(3)lif(nm)	(4)b3pympm(nm)	(5)cbp_irppy2ac
1	X	120.000000	1.000000	5.000000	20.
2	X	120.000000	1.000000	10.000000	20.
3	X	120.000000	1.000000	15.000000	20.
4	X	120.000000	1.000000	20.000000	20.
5	X	120.000000	1.000000	25.000000	20.
6	X	120.000000	1.000000	30.000000	20.
7	X	120.000000	1.000000	35.000000	20.
8	X	120.000000	1.000000	40.000000	20.
9	X	120.000000	1.000000	45.000000	20.
10	X	120.000000	1.000000	50.000000	20.
11	X	120.000000	1.000000	55.000000	20.
12	X	120.000000	1.000000	60.000000	20.
13	X	120.000000	1.000000	65.000000	20.
14	X	120.000000	1.000000	70.000000	20.
15	X	120.000000	1.000000	75.000000	20.
16	X	120.000000	1.000000	80.000000	20.
17	X	120.000000	1.000000	85.000000	20.
18	X	120.000000	1.000000	90.000000	20.
19	X	120.000000	1.000000	95.000000	20.
20	X	120.000000	1.000000	100.000000	20.
21	X	120.000000	1.000000	105.000000	20.
22	X	120.000000	1.000000	110.000000	20.

檔案編碼

結構參數

常用結果

OCpQY	OCnQY	In_Substrate	In_SubstrateQY	PFactor	QYFactor	radiationQY	sub
0.000000	0.058663	0.166399	0.166457	1.493432	1.475483	0.065843	
0.000000	0.079243	0.213909	0.214142	1.339170	1.322758	0.087309	
0.000000	0.098320	0.254434	0.254832	1.269447	1.253756	0.106925	
0.000000	0.115852	0.289007	0.289519	1.236519	1.221196	0.124818	
0.000000	0.131862	0.318598	0.319153	1.221664	1.206519	0.141105	
0.000000	0.146322	0.343960	0.344492	1.216606	1.201534	0.155807	
0.000000	0.159206	0.365795	0.366265	1.216869	1.201801	0.168930	
0.000000	0.170470	0.384591	0.384982	1.219816	1.204711	0.180448	
0.000000	0.180033	0.400620	0.400927	1.223687	1.208532	0.190294	
0.000000	0.187785	0.414042	0.414267	1.227105	1.211914	0.198369	
[illegible]	0.193568	0.424922	0.425076	1.228901	1.213710	0.204523	

OCpQY : outcoupling positive quantum yield

OCnQY : outcoupling negative quantum yield

InSubstrate : the power ratio in substrate

InSubstrateQY : the quantum yield in substrate

PFactor : Wavelength-Intensity average Purcell Factor (Power)

QYFactor : Wavelength-Intensity average Purcell Factor (Quantum Yield)

radiationQY : quantum yield of radiation mode in EML

substrateQY : quantum yield of substrate mode in EML

WaveguideQY : quantum yield of waveguide mode in EML

SPPQY : quantum yield of surface plasma mode in EML

```
%% Mode Distribution setup
%     MD_SETUP.kt_ko              = [ 0:0.001:1.5, 1.5:0.0001:2.1,  2.1:0.001:5,   5.1:0.1:15];
MD_SETUP.kt_ko              = [ 0:0.01:1.5, 1.501:0.0005:2.1,  2.1:0.01:5,   5.1:0.1:15];
MD_SETUP.savepath           = './MD/';
MD_SETUP.savename           = 'H100';

MD_SETUP.EML        = true; %true; %false;
MD_SETUP.Layer      = true; %true; %false;
MD_SETUP.outcoupling = true; %true; %false;
MD_SETUP.substrate   = true; %true; %false;

MD_SETUP.plot.R             = true;
MD_SETUP.plot.PurcellFactor  = true;
```

積分間距，當發現積分不夠平滑時，將間距變小，注意在結構檔的波長也需要改

是否要計算發光層的數據

是否要計算各層的數據

是否要計算outcoupling

是否要計算in substrate

standard_Number1_ModeDistribution_Ratio - 記事本

No. 1的詳細數據檔

檔案(F) 編輯(E) 格式(O) 檢視(V) 說明(H)

	EML_P	EML_QY	OCp	OCpQY	OCn	OCnQY	LayerP1	LayerQY
total_SP	1.000000	1.000000	0.000000	0.000000	0.058683	0.058663	.000000	0.00000
radiation_SP	0.065843	0.065843	0.000000	0.000000	0.058683	0.058663	.000000	0.00000
substrate_SP	0.117077	0.117217	0.000000	0.000000	0.000000	0.000000	.000000	0.00000
waveguide_SP	[illegible]	[illegible]	-0.000000	-0.000000	0.000000	0.000000	.000000	0.00000
SPP_SP	[illegible]	[illegible]	-0.000000	[illegible]	[illegible]	0.000000	[illegible]	[illegible]
total_S	[illegible]	[illegible]	0.000000	[illegible]	[illegible]	0.025538	[illegible]	[illegible]
radiation_S	[illegible]	[illegible]	0.000000	[illegible]	[illegible]	0.025538	[illegible]	[illegible]
substrate_S	[illegible]	[illegible]	-0.000000	[illegible]	[illegible]	0.000000	[illegible]	[illegible]
waveguide_S	[illegible]	[illegible]	-0.000000	[illegible]	[illegible]	0.000000	[illegible]	[illegible]
SPP_S	[illegible]	[illegible]	-0.000000	[illegible]	[illegible]	0.000000	[illegible]	[illegible]
total_P	0.888561	0.888838	0.000000	0.000000	0.033128	0.033125	.000000	0.00000
radiation_P	0.037003	0.037009	0.000000	0.000000	0.033128	0.033125	.000000	0.00000
substrate_P	0.067725	0.067707	0.000000	0.000000	0.000000	0.000000	.000000	0.00000
waveguide_P	0.079729	0.082264	-0.000000	-0.000000	0.000000	0.000000	0.000000	0.00000
SPP_P	0.704105	0.701858	-0.000000	-0.000000	0.000000	0.000000	0.000000	0.00000

EML: S/P power/QY的數據比例

Outcoupling power/QY的數據比例

各層 power/QY的數據比例

```
ormalized Factor : * of structure/* of a single dipole in homogeneous material
ower  Normalized Factor : 1.493432
hoton Normalized Factor : 1.475483
```

PFactor : Wavelength-Intensity average Purcell Factor (Power)

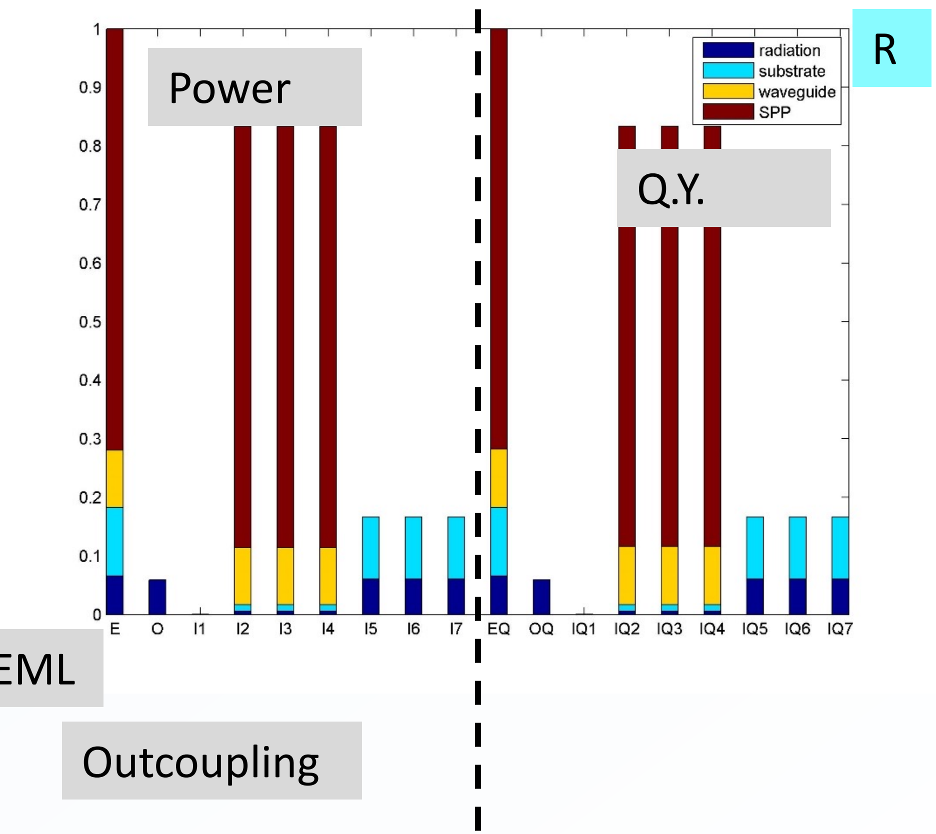
QYFactor : Wavelength-Intensity average Purcell Factor (Quantum Yield)

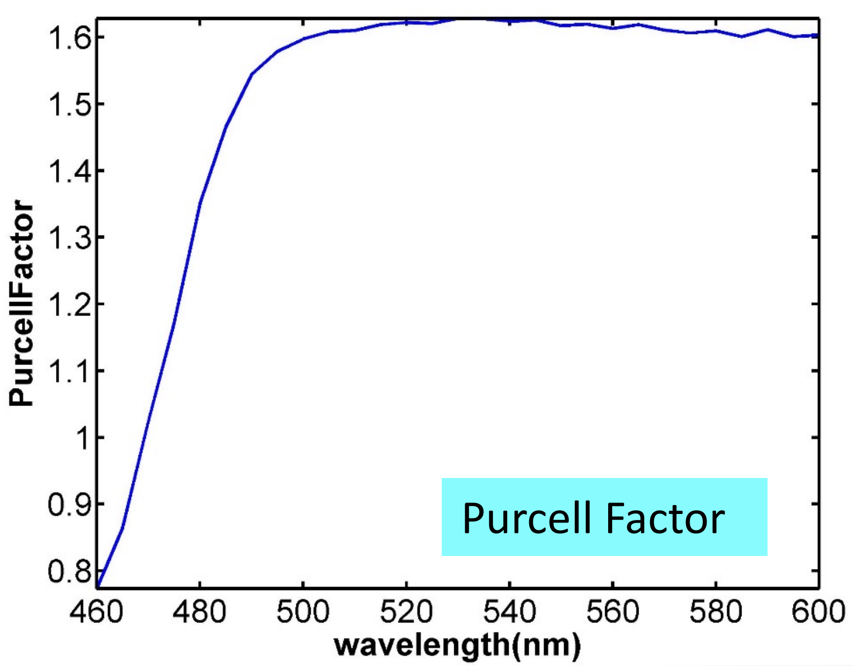
在memo檔裡面的數據在這邊都得的到，在個別file裡面的檔案比較細，不一定會用的到，請自行決定是否要存檔

```
%% Mode Distribution setup
%    MD_SETUP.kt_ko              = [ 0:0.001:1.5, 1.5:0.0001:2.1,  2.1:0.001:5,   5.1:0.1:15];
  MD_SETUP.kt_ko             = [ 0:0.01:1.5, 1.501:0.0005:2.1,  2.1:0.01:5,   5.1:0.1:15];
  MD_SETUP.savepath            = './MD/';
  MD_SETUP.savename             = 'H100';

  MD_SETUP.EML        = true; %true; %false;
  MD_SETUP.Layer     = true; %true; %false;
  MD_SETUP.outcoupling = true; %true; %false;
  MD_SETUP.substrate   = true; %true; %false;

  MD_SETUP.plot.R              = true;
  MD_SETUP.plot.PurcellFactor   = true;
```





List 2 Matrix

名稱	修改日期	類型	大小
function	2017/3/16 上午 1...	檔案資料夾	
Data2MatrixScript	2017/9/4 下午 10...	MATLAB Code	

```
clc; clear all; close all;
addpath(genpath(fileparts(mfilename('fullpath'))));

% file's position
path        = {'E:\Dropbox\Dropbox\GoodLabSimulation\standard\'
              };
fname         = {'standard'...
                };

%% Expanded Module
Module.RatioReadingBool = true;
% memo module
Module.MemoModule{1}.Execute   = @(Data,tag,Parameter) TransparentOLEDModule(Data,tag,Parameter);
Module.MemoModule{1}.Parameter = [];
Module.MemoModule = [];
% ratio module
Module.RatioModule{1}.Execute   = @(Data,tag,Parameter) Metal_Organic_Loss_Module(Data,tag,Parameter);
Module.RatioModule{1}.Parameter = [];
```

Memo檔和R檔(非必較)的路徑

當初的存檔檔名

可選擇是否需要讀R檔

處理memo檔的Module可以自行打開資料夾加入function

處理R檔的Module可以自行打開資料夾加入function

List 2 Matrix

```
%% Expanded Module
Module.RatioReadingBool = true;
% memo module
Module.MemoModule{1}.Execute   = @(Data,tag,Parameter) TransparentOLEDModule(Data,tag,Parameter);
Module.MemoModule{1}.Parameter = [];
Module.MemoModule = [];
% ratio module
Module.RatioModule{1}.Execute   = @(Data,tag,Parameter) Metal_Organic_Loss_Module(Data,tag,Parameter);
Module.RatioModule{1}.Parameter = [];
```

這邊加入的memo module是計算透明元件下上發光效率比的部分

這邊加入的R module是實際trapped energy能量比例

ng

LayerQY7	2017,
metalloss	2017,
metallossQY	2017,
organicloss	2017,
organiclossQY	2017,
summary	2017,
LayerP6	2017,
LayerP7	2017,
LayerQY5	2017,
LayerQY6	2017,
LayerP4	2017,
LayerP5	2017,
LayerQY3	2017,
LayerQY4	2017,
LayerP1	
LayerP2	
LayerP3	
LayerQY1	
LayerQY2	
EML_QY	
OCn	
OCnQY	
OCp	
OCpQY	
EML_P	
In_Substrate	
In_SubstrateQY	
PFactor	
QYFactor	
radiationQY	
SPPQY	
substrateQY	
tag	
WaveguideQY	

OCnQY - 記事本

檔案(F) 編輯(E) 格式(O) 檢視(V) 說明(H)

total_SP

M_tapc_shb_6/M_b3pympm_4	5.000000	10.000000	15.000000	20.000000	25.000000	30.000000	35.000000	40.000000	45.000000	50.000000
5.000000	0.058663	0.079243	0.098320	0.115852	0.131862	0.146322	0.159206	0.170470	0.180033	0.187785
10.000000	0.057828	0.078498	0.097866	0.115936	0.132717	0.148174	0.162238	0.174797	0.185705	0.194774
15.000000	0.057079	0.077933	0.097715	0.116432	0.134099	0.150661	0.165990	0.179915	0.192215	0.202605
20.000000	0.056474	0.077616	0.097917	0.117395	0.136063	0.153825	0.170504	0.185856	0.199567	0.211239
25.000000	0.056060	0.077588	0.098521	0.118878	0.138652	0.157709	0.175813	0.192631	0.207734	0.220589
30.000000	0.055867	0.077889	0.099570	0.120918	0.141904	0.162347	0.181933	0.200220	0.216637	0.230496
35.000000	0.055923	0.078551	0.101097	0.123551	0.145853	0.167760	0.188855	0.208561	0.226138	0.240728
40.000000	0.056250	0.079602	0.103134	0.126811	0.150524	0.173946	0.196532	0.217532	0.236021	0.250970
45.000000	0.056867	0.081069	0.105712	0.130723	0.155924	0.180872	0.204861	0.226942	0.245993	0.260845
50.000000	0.057792	0.082975	0.108855	0.135298	0.162030	0.188459	0.213677	0.236521	0.255695	0.269933
55.000000	0.059043	0.085342	0.112576	0.140525	0.168782	0.196564	0.222738	0.245934	0.264715	0.277819
60.000000	0.060635	0.088183	0.116873	0.146361	0.176066	0.204980	0.231736	0.254786	0.272647	0.284128
65.000000	0.062581	0.091502	0.121716	0.152717	0.183705	0.213425	0.240301	0.262679	0.279104	0.288574
70.000000	0.064883	0.095279	0.127041	0.159448	0.191452	0.221563	0.248044	0.269225	0.283794	0.290977
75.000000	0.067533	0.099471	0.132733	0.166346	0.199008	0.229023	0.254588	0.274119	0.286510	0.291277
80.000000	0.070503	0.103993	0.138625	0.173149	0.206028	0.235443	0.259614	0.277135	0.287175	0.289528
85.000000	0.073739	0.108720	0.144498	0.179553	0.212172	0.240497	0.262887	0.278177	0.285816	0.285887
90.000000	0.077154	0.113480	0.150094	0.185243	0.217119	0.243947	0.264283	0.277243	0.282567	0.280596
95.000000	0.080629	0.118067	0.155136	0.189924	0.220631	0.245642	0.263780	0.274445	0.277649	0.273965
100.000000	0.084016	0.122255	0.159363	0.193354	0.222543	0.245548	0.261465	0.269978	0.271353	0.266338
105.000000	0.087149	0.125825	0.162545	0.195370	0.222803	0.243719	0.257507	0.264113	0.264010	0.258066
110.000000	0.089861	0.128579	0.164531	0.195903	0.221441	0.240304	0.252151	0.257163	0.255965	0.249488
115.000000	0.092005	0.130380	0.165236	0.194966	0.218582	0.235521	0.245693	0.249464	0.247554	0.240923
120.000000	0.093465	0.131147	0.164664	0.192658	0.214417	0.229642	0.238452	0.241344	0.239099	0.232637

Max	0.291277
M_b3pympm_4	50.000000
M_tapc_shb_6	75.000000
Min	0.036370
M_b3pympm_4	120.000000
M_tapc_shb_6	100.000000

Power Spectrum Density

```
function GOODLAB_simulation
clc; clear all; close all;
  addpath(genpath(fileparts(mfilename('fullpath'))));
  VersionInfo();
  [DEFAULT,PSD_SETUP,Far_Field_SETUP,MD_SETUP,TRA_SETUP,TEST_SETUP] = SETUPfun();
  command  = {@ModeDistribution_Command,    @PSD_command,   @FarField_command, @
  SETUP    = {          MD_SETUP,       PSD_SETUP,      Far_Field_SETUP,   TRA_SETUP,    TEST_SE
  defaultC = 2;
```

```
          MATERIAL          THICKNESS(nm)     Path
               air                      X     C:/sim/material n k/
                AL             120.000000     C:/sim/material n k/
               lif               1.000000     C:/sim/material n k/
           b3pympm     5:5:100.000000         C:/sim/material n k/
    cbp_irppy2acac              20.000000     C:/sim/material n k/
          tapc_shb              60.000000     C:/sim/material n k/
             c-ito              80.000000     C:/sim/material n k/
         ito_glass                      X     C:/sim/material n k/




wavelength(nm) : 520
EML :
   Layerno            : 5
   Interface          : 5
   Position(nm)       : 10.000000
   ratio              : 1.000000
   QY                 : 1.000000
```

SETUP

```
%% Power spectrum setup
PSD_SETUP.kt_ko = 0:0.01:15;
PSD_SETUP.savepath = '../ITO_PPY2acac_PSD_Sim/';
PSD_SETUP.savename = 'ITO_PPY2acac';

PSD_SETUP.saveplot.EML        = true; %true; %false;
PSD_SETUP.saveplot.total      = false; %true; %false;
PSD_SETUP.saveplot.thickness_s = false; %true; %false;
PSD_SETUP.saveplot.thickness_p = false; %true; %false;
PSD_SETUP.saveplot.substrate   = true; %true; %false;
PSD_SETUP.saveplot.outcoupling = false; %true; %false;

PSD_SETUP.plot.EML        = true; %true; %false;
PSD_SETUP.plot.total      = false; %true; %false;
PSD_SETUP.plot.thickness_s = false; %true; %false;
PSD_SETUP.plot.thickness_p = false; %true; %false;
PSD_SETUP.plot.substrate   = false; %true; %false;
PSD_SETUP.plot.outcoupling = false; %true; %false;

PSD_SETUP.savetxt.EML        = true; %true; %false;
PSD_SETUP.savetxt.LayerPSD    = true; %true; %false;
PSD_SETUP.savetxt.outcoupling = true; %true; %false;
PSD_SETUP.savetxt.substrate   = true; %true; %false;
PSD_SETUP.savetxt.rtau        = true; %true; %false;

PSD_SETUP.EML        = true; %true; %false;
PSD_SETUP.LayerPSD    = true; %true; %false;
PSD_SETUP.outcoupling = true; %true; %false;
PSD_SETUP.substrate   = true; %true; %false;
PSD_SETUP.rtau        = true; %true; %false;
%% Far Field
```

要跑的範圍

要畫存檔的圖

要畫的圖

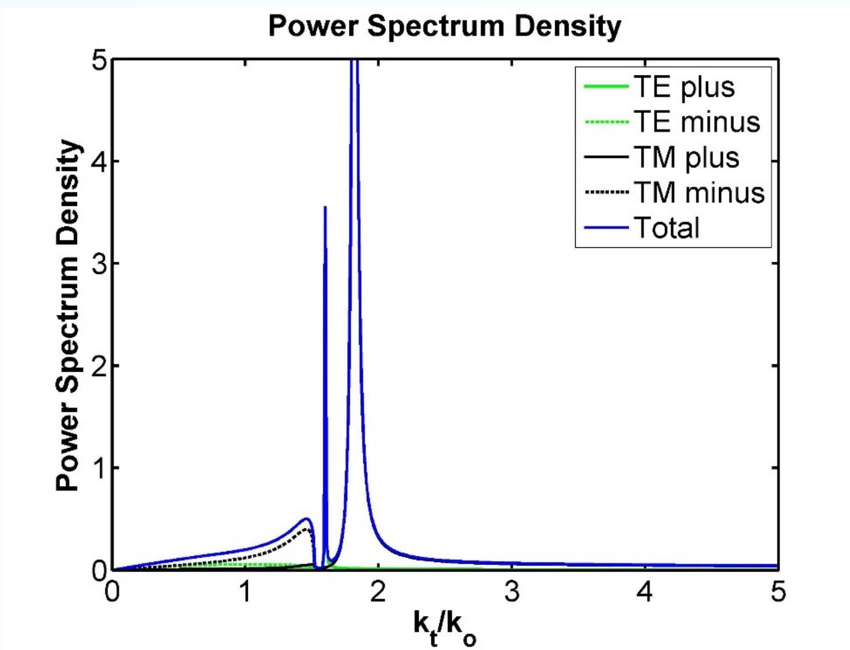
要畫存檔的數據

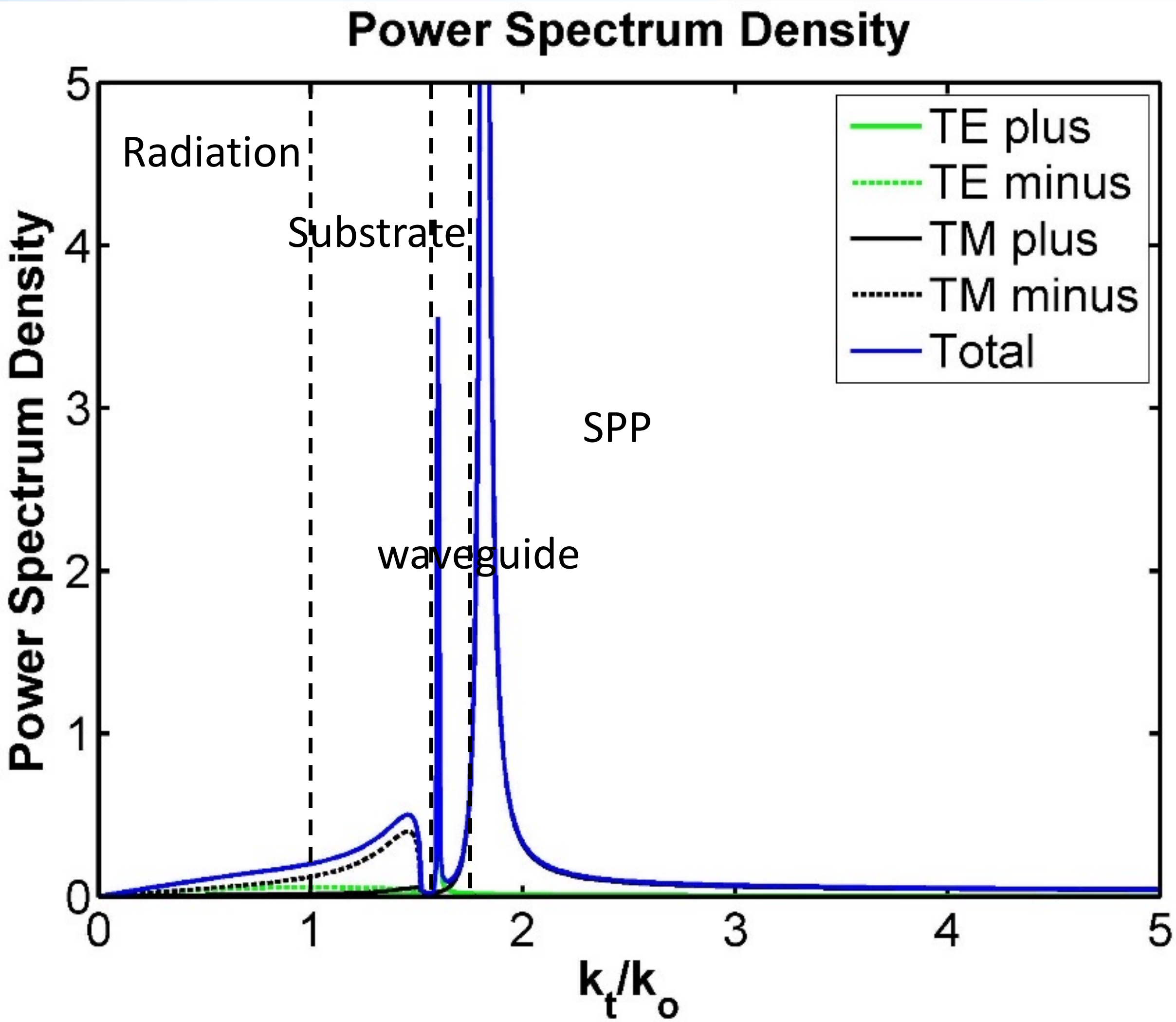
要畫存檔的數據(EML)

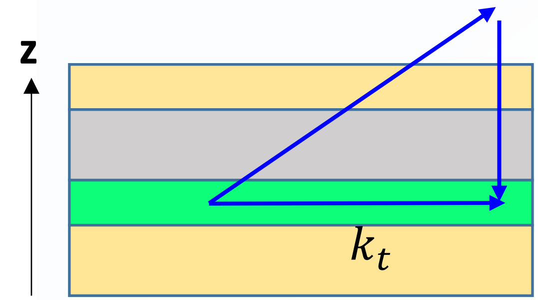
Memo檔 (No.和參數的對應關list)

standard_PowerSpectrum_Loop_memo
standard_PSDSETUP
standard_PSDsetupmemo
standard_structure_file_OLED_structure_file

standard_Number1_EML_All	201
standard_Number1_PowerSpectrumData	201
standard_Number1_PowerSpectrumData_P_Interface	201
standard_Number1_PowerSpectrumData_S_Interface	201
standard_Number1_PowerSpectrumData_TOTAL_Interface	201







$$k_z = \pm\sqrt{k^2 - k_t^2}$$

standard_Number1_PowerSpectrumData 201
standard_Number1_PowerSpectrumData_P_Interface 201

kt_ko	Total	Sp	Sn	Pp	Pn
0.00000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
0.01000	0.00219700	0.00014492	0.00095356	0.00014492	0.00095361
0.02000	0.00439371	0.00028982	0.00190684	0.00028982	0.00190722
0.03000	0.00658981	0.00043469	0.00285957	0.00043469	0.00286086
0.04000	0.00878503	0.00057950	0.00381147	0.00057951	0.00381454
0.05000	0.01097905	0.00072424	0.00476227	0.00072427	0.00476827
0.06000	0.01317159	0.00086890	0.00571168	0.00086895	0.00572205
0.07000	0.01536234	0.00101345	0.00665944	0.00101353	0.00667592
0.08000	0.01755102	0.00115788	0.00760527	0.00115799	0.00762987
0.09000	0.01973733	0.00130217	0.00854889	0.00130233	0.00858394
0.10000	0.02192099	0.00144629	0.00949003	0.00144652	0.00953814
0.11000	0.02410169	0.00159024	0.01042842	0.00159055	0.01049248
0.12000	0.02627917	0.00173400	0.01136376	0.00173441	0.01144700
0.13000	0.02845313	0.00187754	0.01229581	0.00187807	0.01240172
0.14000	0.03062329	0.00202085	0.01322427	0.00202152	0.01335666
0.15000	0.03278938	0.00216390	0.01414887	0.00216474	0.01431185
0.16000	0.03495112	0.00230669	0.01506935	0.00230773	0.01526734
0.17000	0.03710823	0.00244919	0.01598543	0.00245046	0.01622315
0.18000	0.03926046	0.00259138	0.01689684	0.00259292	0.01717933
0.19000	0.04140753	0.00273324	0.01780330	0.00273509	0.01813591
0.20000	0.04354920	0.00287475	0.01870454	0.00287696	0.01909295
0.21000	0.04568520	0.00301589	0.01960030	0.00301852	0.02005049
0.22000	0.04781528	0.00315664	0.02049031	0.00315974	0.02100860

S代表TE, P代表TM
p代表positive
n代表negative

從EML看到的PSD

standard_Number1_PowerSpectrumData 201
standard_Number1_PowerSpectrumData_P_Interface 201

OC_Sp	OC_Sn	OC_Pp	OC_Pn	SubS	SubP
0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
0.00000000	0.00094882	0.00000000	0.00094887	0.00095356	0.00095361
0.00000000	0.00189736	0.00000000	0.00189775	0.00190684	0.00190722
0.00000000	0.00284535	0.00000000	0.00284666	0.00285957	0.00286086
0.00000000	0.00379250	0.00000000	0.00379562	0.00381147	0.00381454
0.00000000	0.00473855	0.00000000	0.00474465	0.00476227	0.00476827
0.00000000	0.00568321	0.00000000	0.00569376	0.00571168	0.00572205
0.00000000	0.00662621	0.00000000	0.00664297	0.00665944	0.00667592
0.00000000	0.00756727	0.00000000	0.00759229	0.00760527	0.00762987
0.00000000	0.00850611	0.00000000	0.00854176	0.00854889	0.00858394
0.00000000	0.00944247	0.00000000	0.00949140	0.00949003	0.00953814
0.00000000	0.01037605	0.00000000	0.01044122	0.01042842	0.01049248
0.00000000	0.01130659	0.00000000	0.01139126	0.01136376	0.01144700
0.00000000	0.01223381	0.00000000	0.01234154	0.01229581	0.01240172
0.00000000	0.01315744	0.00000000	0.01329211	0.01322427	0.01335666
0.00000000	0.01407720	0.00000000	0.01424298	0.01414887	0.01431185
0.00000000	0.01499281	0.00000000	0.01519420	0.01506935	0.01526734
0.00000000	0.01590400	0.00000000	0.01614581	0.01598543	0.01622315
0.00000000	0.01681050	0.00000000	0.01709785	0.01689684	0.01717933
0.00000000	0.01771204	0.00000000	0.01805037	0.01780330	0.01813591
0.00000000	0.01860834	0.00000000	0.01900342	0.01870454	0.01909295
0.00000000	0.01949913	0.00000000	0.01995706	0.01960030	0.02005049
0.00000000	0.02038414	0.00000000	0.02091135	0.02049031	0.02100860

S代表TE, P代表TM
p代表positive
n代表negative
OC : outcoupling
Sub : in substrate

standard_Number1_PowerSpectrumData 201

standard_Number1_PowerSpectrumData_P_Interface 201

P	Abs(tauEp)	Angle(tauEp)	Abs(rEp)	Angle
0	0.00010653	31.10016433	0.93321540	-108.478
1	0.00010652	31.09910075	0.93321647	-108.480
2	0.00010652	31.09590607	0.93321966	-108.483
6	0.00010650	31.09057786	0.93322497	-108.488
4	0.00010648	31.08311948	0.93323242	-108.496
7	0.00010646	31.07353108	0.93324199	-108.506
5	0.00010643	31.06180494	0.93325369	-108.518
2	0.00010640	31.04794520	0.93326752	-108.533
7	0.00010636	31.03194481	0.93328348	-108.549
4	0.00010632	31.01380202	0.93330157	-108.568
4	0.00010627	30.99351799	0.93332180	-108.589
8	0.00010622	30.97108220	0.93334416	-108.612
0	0.00010616	30.94649930	0.93336866	-108.638
2	0.00010610	30.91975613	0.93339529	-108.665
6	0.00010603	30.89085375	0.93342407	-108.695
5	0.00010596	30.85978667	0.93345499	-108.728
4	0.00010588	30.82654715	0.93348805	-108.762
5	0.00010579	30.79113407	0.93352327	-108.799
3	0.00010571	30.75353231	0.93356063	-108.837
1	0.00010561	30.71374225	0.93360015	-108.878
5	0.00010551	30.67175724	0.93364182	-108.922
9	0.00010541	30.62756744	0.93368565	-108.967
0	0.00010530	30.58116579	0.93373165	-109.015

從發光位置看到往上即往下的反射透設係數的大小及相角

TRA

```
versioninfo();
[DEFAULT,PSD_SETUP,Far_Field_SETUP,MD_SETUP,TRA_SETUP,TEST_SETUP] = SETUPfun();
command  = {@ModeDistribution_Command,    @PSD_command,   @FarField_command, @TRA_command, @
SETUP    = {           MD_SETUP,       PSD_SETUP,     Far_Field_SETUP,   TRA_SETUP,      TEST_SETUP, TEST_SETUP
defaultC = 4;
```

GOODLAB_simulation.m × | smie × | structure_path copy × | TRA.m ×

```
MATERIAL                  THICKNESS(nm)    Path
        air                          X     C:/sim/material n k/
        AL                    5.000000     C:/sim/material n k/
        lif                   1.000000     C:/sim/material n k/
    b3pympm           5:5:100.000000     C:/sim/material n k/
cbp_irppy2acac               20.000000     C:/sim/material n k/
   tapc_shb                  60.000000     C:/sim/material n k/
      c-ito                  80.000000     C:/sim/material n k/
  ito_glass                          X     C:/sim/material n k/




wavelength(nm) : 520
EML :
   Layerno            : 5
   Interface          : 5
   Position(nm)          : 10.000000
   ratio              : 1.000000
   QY                 : 1.000000
```

沒用但還是要打

```
%% TRA Distribution setup
TRA_SETUP.Angle          = (0:1:89)/180*pi;
TRA_SETUP.wavelength     = (450:10:750);
TRA_SETUP.direction      = 'POSITIVE';
TRA_SETUP.WriteTRAMatrix  = true;
TRA_SETUP.WriteTRAcoa     = true;
TRA_SETUP.InSubstrateBool = true;
TRA_SETUP.WriteTRAMatrix  = true;
TRA_SETUP.Statistics      = true;
```

從哪裡入設'POSITIVE', 'NEGATIVE'

給lightool的檔案格式

True: 考慮到基板的TRA,
false, 考慮出道基板外面的TRA i.e.考慮incoherent

Angle/wavelength	450.0000	460.0000	470.0000	480.0000	490.0000	500.0000	510.0000	520.00
0.0000	5.5400e-01	5.4300e-01	5.2400e-01	5.0100e-01	4.7600e-01	4.5100e-01	4.2600e-01	4.0300e
1.0000	5.5400e-01	5.4300e-01	5.2400e-01	5.0100e-01	4.7600e-01	4.5100e-01	4.2600e-01	4.0200e
2.0000	5.5400e-01	5.4200e-01	5.2400e-01	5.0100e-01	4.7600e-01	4.5100e-01	4.2600e-01	4.0200e
3.0000	5.5400e-01	5.4200e-01	5.2400e-01	5.0100e-01	4.7600e-01	4.5000e-01	4.2600e-01	4.0200e
4.0000	5.5400e-01	5.4200e-01	5.2300e-01	5.0000e-01	4.7500e-01	4.5000e-01	4.2500e-01	4.0100e
5.0000	5.5400e-01	5.4200e-01	5.2300e-01	5.0000e-01	4.7500e-01	4.4900e-01	4.2500e-01	4.0100e
6.0000	5.5300e-01	5.4100e-01	5.2200e-01	4.9900e-01	4.7400e-01	4.4800e-01	4.2400e-01	4.0000e
7.0000	5.5300e-01	5.4000e-01	5.2100e-01	4.9800e-01	4.7300e-01	4.4800e-01	4.2300e-01	3.9900e
8.0000	5.5200e-01	5.4000e-01	5.2100e-01	4.9700e-01	4.7200e-01	4.4600e-01	4.2200e-01	3.9800e
9.0000	5.5200e-01	5.3900e-01	5.2000e-01	4.9600e-01	4.7100e-01	4.4500e-01	4.2100e-01	3.9700e
10.0000	5.5100e-01	5.3800e-01	5.1900e-01	4.9500e-01	4.7000e-01	4.4400e-01	4.1900e-01	3.9600
11.0000	5.5000e-01	5.3700e-01	5.1700e-01	4.9400e-01	4.6800e-01	4.4200e-01	4.1800e-01	3.9400
12.0000	5.4900e-01	5.3600e-01	5.1600e-01	4.9200e-01	4.6700e-01	4.4100e-01	4.1600e-01	3.9300
13.0000	5.4900e-01	5.3500e-01	5.1500e-01	4.9100e-01	4.6500e-01	4.3900e-01	4.1500e-01	3.9100
14.0000	5.4800e-01	5.3400e-01	5.1300e-01	4.8900e-01	4.6300e-01	4.3700e-01	4.1300e-01	3.8900
15.0000	5.4700e-01	5.3200e-01	5.1200e-01	4.8700e-01	4.6100e-01	4.3500e-01	4.1100e-01	3.8700
16.0000	5.4500e-01	5.3100e-01	5.1000e-01	4.8500e-01	4.5900e-01	4.3300e-01	4.0800e-01	3.8500